

**The Effects of Group Decision Support Systems and Task Structures  
on Group Decision Processes and Outcomes:  
An Experimental Investigation**

**By**

**Simon Sing Kwong Lam**

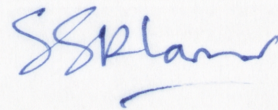
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## DECLARATION

It is declared that this submission represents my own original work, and no part of this thesis has been submitted previously to this University, or to any other institution for a degree, diploma, or any other qualification.

Signed

A handwritten signature in blue ink, appearing to read 'SSK Lam', with a horizontal flourish underneath.

Simon Sing Kwong Lam

To Wendy

A wife of noble character who can find?

She is worth far more than pearl.

Proverbs 31:10

## **ABSTRACT**

This research examines whether structures of decision tasks moderate the effects of group decision support systems (GDSS) on patterns of group communication and decision outcomes of decision making groups. This research also examines the relationship between patterns of group communication and decision outcomes. Although prior research has shown that the effects of GDSS on group decision making are not uniformly positive, conditions under which the use of GDSS is appropriate and beneficial are not well understood. The characteristics of the group task are emerging as important variables that are believed to moderate the effects of GDSS on group decision making. Failure to explicitly study the role of group communication in group decision making is another reason why prior research on GDSS has yielded much conflicting evidence. This research seeks to show that the effects of GDSS on decision making processes and outcomes are task structure dependent and the effects of GDSS cannot be evaluated on the basis of outcomes alone; decision processes must also be evaluated in order to understand how decisions are made and why GDSS can improve group outcomes in some situations but provide negative effects in others.

A controlled laboratory experiment was conducted with a 2x3 factorial between-subjects design, manipulating two independent variables: levels of support (GDSS support and no support) and task structures (additive, disjunctive and conjunctive). Practising managers were chosen as subjects. Using a personnel recruitment exercise as the experimental task, the structure of the task was manipulated by varying the group members' role and information distribution. Subjects were either provided with GDSS or with no support. The experiment was administered to the subjects who were participating in a management training course. The discussion records of the decision making process were coded using a coding scheme. Other dependent variables were decision quality, decision time and perceived satisfaction with process and outcome.



The research results support the hypothesis that structures of a decision task moderate the effects of GDSS on both the patterns of group communication and decision outcomes of a decision making group. GDSS significantly improve decision quality in disjunctive and conjunctive tasks. GDSS also significantly alter patterns of group communication in disjunctive and conjunctive tasks. However, no significant differences in decision quality and patterns of group communication exist between groups using GDSS and face-to-face groups in additive tasks. The results also show strong relationships between patterns of group communication and decision outcomes. The research provides strong support for the theory that an understanding of how GDSS shape the patterns of group communication is likely to provide an explanation as to why GDSS can improve group outcomes in some situations but fail to perform in others.

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# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 Background to the Research**

Managers and professionals spend much time in group decision meetings (Mintzberg, 1973; Sproull, 1983). A decision group in an organisation may decide what new products should be manufactured and how they are to be designed, advertised, and sold. Another decision group may decide who should be hired for the newly created management post and how much the organisation is prepared to spend on funding a training program. One objective of the gathering of individuals in group decision meetings is to make the participants more effective and productive than they would be if they were working individually on the problem, through an elimination of duplication of effort and the gaining of deeper understanding of the situation from the varying points of view of other people. Group members can share the task of recalling information and each member may bring to the discussion information that others in the group did not have (Stasser, 1992). However, this is not always achieved; many managers have a negative view of group decision meetings and consider them non-productive and a waste of their time (Drucker, 1988; Hymowtis, 1988; Mosvick and Nelson, 1987).

Because a significant amount of decision making in organisations is performed in group meetings, non-productive group meetings can have major consequences for the success of organisations. Several techniques such as the Nominal Group Technique and the Delphi Method (Delbecq and Van de Ven, 1971; Dalkey and Halmer, 1963) have been developed to improve the decision making processes of group meetings (McGrath, 1984). With recent advances in computer, telecommunication and management science techniques, serious efforts have been made to use computer technology to enhance group decision making performance in meetings (Jelassi and Beauclair, 1987; George, et al., 1990; Dennis and Gallupe, 1993 and Benbasat and Lim, 1993).

Group decision support systems (GDSS) are a development in computer technology which have been designed as a tool to improve the effectiveness and efficiency of group meetings involving problem solving and decision making (Huber, 1984). GDSS can be defined as interactive computer-based systems which combine communication, computer and decision technologies to support problem formulation and solution in group meetings (DeSanctis and Gallupe, 1987). GDSS are distinguishable from other computer systems from which they developed by their focus on group rather than individual activities. The goal of GDSS is to improve the process of group decision making by removing common communication barriers, providing techniques for structuring decision analysis, and systematically directing the pattern, timing, or content of discussion (Turoff and Hiltz, 1982; Huber, 1984; DeSanctis and Gallupe, 1987). By reducing this 'process loss' (Steiner, 1972) associated with group meetings, GDSS aim to increase the efficiency, reliability, and quality of group decision making.

Whether GDSS technology can really improve the decision quality of group decision making is an important research issue. Although there has been a substantial amount of research in this area, the effectiveness of GDSS remains an open issue (Dennis and Gallupe, 1993). The literature on GDSS has progressed beyond the early thinking that GDSS have unequivocal effects, regardless of other moderating variables. Instead, what is considered more important and of greater interest is the issue of how GDSS affect group outcomes and under what conditions (Benbasat and Lim, 1993).

In this study, the structure of the decision task is isolated as a potentially important variable which may moderate the effects of GDSS use on decision making groups. This research also recognises the importance of understanding the decision process as key to explaining the relationships between the effects of GDSS technology and group decision making. Hence, this research seeks to provide empirical evidence of how the effects of GDSS vary across different task structures and how these effects can be explained through the study of the decision process in decision making groups.

## **1.2 Statement of the Problem**

### **1.2.1 GDSS Research**

There has been a substantial amount of research activity on GDSS dealing with the effects of GDSS on group decision making (for example, Pinsonneault and Kraemer, 1990; Gray, Vogel, and Beauclair, 1990; Nunamaker, et al., 1991; Dennis and Gallupe, 1993). These studies attempted to establish the effectiveness of groups supported by GDSS in comparison to groups not supported by GDSS. However, generalisations about the effects of GDSS on group decision making have been plagued by inconsistencies between study findings. Some of these studies found strongly positive results (for example, Steeb and Johnston, 1981; Gallupe, 1985; Cass, Heintz, and Kaiser, 1992), while others found mildly positive results (for example, Lewis, 1982; Gallupe, DeSanctis and Dickson, 1988; Applegate, Konsynski and Nunamaker, 1986), and still others found mixed, neutral or negative results (for example, Watson, DeSanctis and Poole, 1988; Turoff and Hiltz, 1982; Beauclair, 1987; Jarvenpaa, Rao, and Huber, 1988; Gallupe and McKeen, 1990). As Dennis and Gallupe put it 'The result of these studies can be summed up in one word: mixed' (Dennis and Gallupe, 1993, p.64). It is clear that the effectiveness of GDSS remains an open issue and the conditions under which the use of GDSS is appropriate and beneficial are still not well understood.

Qualitative and quantitative reviews of GDSS empirical work have attempted to integrate the seemingly inconsistent results by attributing differences to one or more situational factors. Based on an input-process-output scheme, Nunamaker, et al., (1993) proposed a research framework for the analysis of the effects of GDSS. This framework suggested that the effects of GDSS are contingent on a myriad of group, task, context, and GDSS features that differ from situation to situation (Dennis, et al., 1988). Using meta-analysis procedures, Benbasat and Lim (1993) quantitatively integrated the results of 31 experimental studies on the effects of GDSS use. The results showed that GDSS effects were moderated by group, context, and technology variables.

These research efforts suggest that the effects of GDSS are dependent on a variety of factors. GDSS use is not beneficial in some situations and the commonly stated advantages of GDSS have been shown not to hold in the circumstances in which they were studied. The effects of GDSS are contingent on a myriad of situational factors. It is inappropriate to say that the use of GDSS improves group decision performance or reduces member satisfaction, because such statements must be qualified by the situation (Nunamaker, et al., 1993).

### **1.2.2 Task Structures**

Of all of the factors which have been suggested as moderating the effects of GDSS use, the variable 'group task' is emerging as an important variable. Poole, Seibold, and McPhee (1985) point out that 'the general variable group task is emerging as an especially important variable, often accounting for as much as 50% of the variance in group performance' (p.88). Poole and Hirokawa (1986) declare that 'In the pantheon of factors determining decision behaviour and outcomes, task stands in the first position, both in terms of evidence supporting its effect strength and in terms of a theoretical linkage to decision processes' (p.26). Task differences should be expected to affect significantly the communication process as well as the task performance (McGrath, 1984).

Although research on GDSS is starting to provide some empirical evidence of how decision performance across different group tasks is affected by GDSS support, the primary focus has been on the type of task (idea generating task versus decision task). All of these research studies focused primarily on the complexity and the type of task which groups perform. The structure of the task appears to have received no attention. Within the social psychology literature, Steiner (1966, 1972) and others (Littlepage, 1991; Michaelsen, Watson, and Black, 1989; Zaccaro and Lowe, 1988; Zaccaro and McCoy, 1988) have suggested that the performance and success of a decision group basically depend on the structure of the group's task. Task structure can be defined as the overall configuration of the problem space (Newell, 1980) that underlies the task. In every task performed by a group, there exists a set of collective or shared purposes which get transformed into a set of strategies for accomplishing the task (McGrath, et



al., 1993). Some researchers also argue that the task structure is a more fundamental concept than the type of task (Steiner, 1972, Gouran and Hirokawa, 1983; Hirokawa, 1982, 1990).

Although the main objective of GDSS technology is to provide support for the group decision process, we still lack empirical studies of how GDSS technology may affect group decision performance under different task structures.

### **1.2.3 Patterns of Group Communication**

Another possible reason why previous research on GDSS effectiveness has yielded much conflicting evidence is its failure to acknowledge explicitly the important role of group interaction or communication in group decision making. According to Simon (1960, 1976), decision making is a process, and the understanding of this process is just as important as the decision outcome. Steiner (1972) and Shiflett (1979) have identified intra-group processes as one of the key determinants of group effectiveness. Their research explicitly acknowledged the important function of group communication interaction as the moderator of the input-output linkage. The need for controlled, microlevel studies of the process of interaction, as a key to understanding the relationships between decision support and decision quality, has been pointed out by several GDSS scholars (McCartt and Rohrbaugh, 1989; Pinsonneault and Kraemer, 1990).

Although most of the authors in GDSS research acknowledge the importance of studying the patterns of group communication within GDSS environments, few research studies have been conducted which include explicit quantitative assessment of how group interaction or communication patterns differ. GDSS can be characterised as a social technology (Poole and DeSanctis, 1990; Contractor and Seibold, 1993) and understanding the group communication patterns is particularly likely to provide an answer to how GDSS shape the process and the outcome of group decision making and hence explain why GDSS can improve group performance in some situations but fail to perform in another situations (Poole, Holmes and DeSanctis, 1991).

### **1.3 Research Questions**

The primary objective of this study is to examine whether the structure of a decision task moderate the effects of GDSS on the patterns of group communication and decision outcomes in a decision making group. Decision outcomes are to be measured by the objective decision performance and perceived decision satisfaction of the group decision process. The secondary objective is to examine the relationship between the patterns of group communication and decision outcomes in face-to-face and GDSS supported groups working on a decision task. Within the framework of the objectives, this study seeks to answer the following questions:

- 1. Are there any systematic differences in the decision outcomes between GDSS supported and face-to-face decision making groups across different task structures?**
- 2. Are there any systematic differences in the patterns of group communication between GDSS supported and face-to-face decision making groups across different task structures?**
- 3. Is there any systematic relationship between the patterns of group communication and the decision outcomes among the GDSS supported and face-to-face decision making groups across different task structures?**

### **1.4 Justification for the Research**

Although research reviews of the empirical work on GDSS use have attempted to integrate the conflicting results by attributing differences to different types of task the GDSS try to support, a systematic empirical study of the effects of GDSS use on different group tasks, especially on different decision task structures is still lacking. On the basis of an extensive review of the literature, this research appears to be the first empirical study to examine GDSS effects on different task structures.

In theoretical terms, this study makes a contribution to the development of an emerging trend of GDSS research. As Nunamaker, et al., (1991) pointed out, we are at the conclusion of the initial phase of GDSS research, a phase that mainly focused on experimental work comparing GDSS to non-GDSS groups. This indicated that the second phase of GDSS research ought to *isolate* and *explain* why GDSS are of value to certain groups and not others. This research isolates task structure as one of the variables which may mediate the effect of GDSS use among decision making groups. This research also recognises the importance of decision process as a key to explaining the relationships between the effect of GDSS technology and group decision making. This research conducts a more microlevel analysis and provides empirical evidence which indicates how GDSS effects can be different across different task structures and how these effects can be explained through the study of the decision process of the decision making groups. This research makes a contribution not only to the existing GDSS literature but also extends the so far very limited second phase of GDSS research.

In practical terms, this study contributes to the further development of GDSS technology by looking into how GDSS can best be used for different decision task structures. It provides reliable information so that future GDSS can be designed to suit the different requirements of different decision task structures.

Moreover, the results of this study can help organisations in deciding whether to acquire a GDSS and how to effectively use a GDSS. Group decision making can be structured differently in different organisations. For example, in one organisation, the acquisition decision may be structured as an additive task with all group members receiving information about possible acquisition targets and each group member evaluating the information and communicating his or her opinion to the rest of the group so that the group can work together to select the best acquisition possibility. In another organisation, the acquisition decision may resemble a disjunctive task with each group member identifying his or her primary acquisition target and the individual group member needing to convince the other members that his or her suggestion is the best one. In yet a third type of organisation, the acquisition process may resemble a

conjunctive task. One member of the group may examine the financial implications of various alternative acquisition targets, another group member may evaluate the legal ramifications of the acquisition, such that no single group member has all the information needed to make the optimal decision. Only if all members communicate their unique information to the group is it likely to identify effective solutions.

Not only will decision task structures vary across organisations, but the task structure of different types of decisions may vary within an organisation itself. An acquisition may be additive, a strategic human resources decision may be disjunctive, and a decision concerning global expansion could be conjunctive. This research sets out to provide empirical evidence for how GDSS use changes the patterns of group communication in group decision making and under which decision task structures GDSS are most effective. Organisations deciding whether to acquire or use a GDSS will be able to do so with the knowledge that the technology can change some patterns of decision group communication. Organisations can also evaluate the task structure of their decision making group before deciding how or when to use GDSS technology.

## **1.5 The Research Method**

The research method used in this study was a controlled laboratory experiment with a 2x3 factorial between-subjects design, manipulating two independent variables: computer group decision support (computer support and no computer support) and task structure (additive, disjunctive and conjunctive). The purpose of this research is to study the patterns of group communication and the effects of GDSS on group decision making across different task structures, therefore it is essential to control other variables which may have the potential to influence the effects of GDSS support so as to permit strong inferences about the effects of GDSS across different task structures. Experimental methods allow careful control of the extraneous variables while manipulating the independent variables so that their effects on the dependent variables can be directly studied (Jarvenpaa, Dickson and DeSanctis, 1985; Benbasat and Nault, 1990).

Most of the experimental research on GDSS has involved students as participants and researchers have widely discussed the problem of validity of using student subjects for experimental research (Gordon, Slade, and Schmitt, 1986; McFarlan, 1986; Burnett and Dunne, 1986; Greenberg, 1987). In this study, practising managers were chosen as subjects in the experiment. This approach should enhance the ability to generalise the findings for organisations. Using a personnel recruitment exercise as the experimental task, group members worked in a decision room with either a face-to-face or a GDSS environment. Task structures were manipulated by varying the group member roles and the information distribution of the experimental task. The experiment was administered when the subjects were participating in a management training course. All the experimental materials and procedures were carefully pilot-tested before the experiment. To study the group interaction communication, the discussion records of the decision making group were coded using the coding scheme developed by Gettys, et al., (1987). Decision outcomes were measured by objective decision performances and perceived decision satisfaction of the group decision process.

In order to test the questionnaires used to gather perceptual data, factor analysis was used to assess the construct validity of the questionnaires. The reliability of the construct was assessed using the standard Cronbach coefficient alpha. Two-way analysis of variance (ANOVA) was applied to each of the dependent variable across the experimental treatments. Before subjecting the data to testing, the assumptions of this statistical test were also verified.

## **1.6 Organisation of the Chapters**

The remainder of this thesis is organised as follows. Chapter 2 examines the theoretical foundation of the current understanding of the effects of GDSS use in group decision making and reviews the literature of GDSS research. Based on the review of the literature, Chapter 2 also discusses implications for GDSS research.

Chapter 3 presents the two theoretical perspectives that are relevant to the study of GDSS across different task structures. A research framework is then developed together with the hypotheses to be tested in this study.

Chapter 4 describes the controlled laboratory experiment for testing the research hypotheses. The research method is briefly described and justified. The chapter then describes the subjects, the decision task, the experimental manipulations, the procedures and the measurement of dependent variables in the experimental task. The pilot-test of the experimental materials and procedure are also described.

Chapter 5 presents the results of the experiment. The statistical methods for testing the research hypotheses are described. The results of the tests of construct validity and reliability of the dependent variables are presented. The requirements of the statistical tests and the manipulation check of the experimental treatments are described. The results of testing the research hypotheses are then provided.

Chapter 6 concludes this thesis with a summary and discussion of the major findings of the research. The theoretical and practical implications of the findings are presented. The limitations of this research and recommendation for future research are also discussed.

## **1.7 Chapter Summary**

This chapter has laid the foundations for the report. It has provided the background to the research and a statement of the problems being addressed. The research questions have been presented, the importance of the research was justified, the research method briefly described and the report outlined. On these foundations, the report can proceed with a detailed description of the research.

The next chapter examines the roots of GDSS research and the theoretical foundations for understanding the effects of GDSS use in group decision making. The chapter also

reviews and summarises the literature of GDSS research and examines its implications for future research based on these findings.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

The study of GDSS has become an important topic of interest in recent years. The promising use of computers in aiding the manager to cope with the complexity of group decision making has aroused much attention in the development of GDSS technology. The increase in the amount of research into GDSS usage is well documented. The recent bibliographies by DeSanctis (1989) and the 3M Corporation (1991) indicated that by 1991 between 200 and 300 papers were directly related to GDSS. Recent reviews (Kraemer and King, 1988; Kraemer and Pinsonneault, 1990; Seibold and Contractor, 1991; Vogel and Nunamaker, 1990; Wagner, Wynne and Mennecke, 1993) pointed to at least twelve different universities that have GDSS research facilities. Annual international conferences have been held on the subject (Blanning and King, 1989; Galagher, et al., 1989). At least ten major companies including IBM, Marriott, and Dell Computer have invested hundreds of thousands of dollars installing GDSS facilities in their companies (Bulkeley, 1992).

Despite recent research efforts, the conditions under which the use of GDSS is appropriate and beneficial are still not understood (Pinsonneault and Kraemer, 1990). Empirical research findings often appear contradictory and inconsistent. In an effort to bring order to GDSS research, this chapter reviews the literature of GDSS research and examines the theoretical foundation of the current understanding of the effects of GDSS use in group decision making. Based on a review of the literature, this chapter discusses the structure of task as an important variable which can moderate the effects of GDSS on group decision making. This literature review is organised into four sections. Section 2.2 gives a general introduction to GDSS and examines the roots of its research. Section 2.3 covers the theoretical foundations of current understanding of the effects of GDSS use in group meetings. Section 2.4 presents a review of the laboratory and field studies of GDSS effects. Section 2.5 then summarises the results of the literature review and examines the implications for future research and the



importance of task structures as a moderating variable on the effects of GDSS on group decision making. Finally Section 2.6 presents a summary of this chapter.

## **2.2 GDSS and the Roots of its Research**

### **2.2.1 GDSS Technology**

The essence of GDSS technology in group meetings is to provide computer-based information exchange and decision making support for group members. Group decision making is an integral part of organisational life (Fisher and Ellis, 1990). Computer technologies are being configured in an attempt to enhance the efficiency and effectiveness of such activities. GDSS can be defined as computer-based systems that combine communication, computer, and decision technologies to support problem finding, formulating solutions and decision making in group meetings (DeSanctis and Gallupe, 1987). As decision support tools designed to improve group performance, GDSS vary in their capability to support meetings (Huber, 1984, Kraemer and Pinsonneault, 1990). DeSanctis and Gallupe (1987) suggested that GDSS can be classified into three levels. Level 1 GDSS provide technological support such as electronic mail or electronic brainstorming tools to improve the decision process by removing communication barriers between members. Level 2 GDSS provide decision modelling and group decision techniques such as risk analysis models or multiple criteria voting techniques aimed at improving effectiveness and reducing uncertainty that would otherwise occur in the group's decision process. Level 3 GDSS are characterised by machine-induced group communication patterns which involve machine generated advice in the selecting and arranging of rules to be applied during interpersonal communication.

With different levels of sophistication, the basic features of GDSS are to provide an interactive computer-based environment that combines communication and decision technologies to support groups' decision making processes. The most commonly cited benefits when using GDSS in group meetings are:

1. GDSS provide equal opportunities for participation, since they enable all group members to work simultaneously in a computer-mediated communication environment (Huber, 1982; Nunamaker, et al., 1991) and there is no competition for speaking time (Siegel, et al., 1986; Turoff and Hiltz, 1982).
2. GDSS, by incorporating anonymity features, permit ideas to be evaluated on their own merits, rather than on the basis of who contributed them (Nunamaker, et al., 1991; Valacich, Dennis and Nunamaker, 1992).
3. GDSS facilitate group processes by the implementation of a decision model, the application of group process structuring techniques, and the creation of a meeting memory (Nunamaker, et al., 1991; DeSanctis and Gallupe, 1987).

Multiple avenues of research have proliferated to examine these claims. In order to understand these studies, one needs to examine the roots of GDSS research and the theoretical foundation for explaining the effects of GDSS on group decision making.

### **2.2.2 The Roots of GDSS Research**

The idea of 'Group Decision Systems' existed before the advent of computers or electronic communication. Researchers have long been trying to devise ways to improve the effectiveness of group decision making and specifically to help groups avoid what Steiner (1972) called 'process losses' or process deficiency. Most of these systems did not involve the use of electronic or high-tech devices. Computer-based group decision support systems are relatively recent developments. A great deal of GDSS theoretical development and research can be traced back to its roots in the earlier work on individual-based decision support systems (Keen and Scott-Morton, 1978; Sprague, 1980; Sprague and Watson, 1979) that, in turn, is based largely on the theory of decision making put forward by Herbert Simon (Simon, 1960, 1976).

According to Simon, decision makers always fail to achieve maximum potential utility for personal gain in a decision making process because of the inadequacies in human rational capacities. Decision support systems (DSS) are designed with the goal

of enhancing individual rational capacity so that individual utility can be maximised. This is done primarily through the provision of some well structured decision making tools to enhance user ability in decision problem solving. Michael Scott-Morton (1970) was among the first to study the use of computers for supporting individual decision makers. The early empirical works done with individual DSS were focused on computer support for intellectual tasks such as idea generation and problem solving. Although the focus was on individual decision makers using computer support, most of the researchers (Stabell, 1974; Grudnitski, 1975; and Alter, 1975) in DSS speculated about the impact of computer-based DSS on group decision making. Most of their research suggested that individual decision support systems could be extended to support groups of decision makers. Just as DSS were designed to overcome the limitations of the individual decision maker, computer decision support systems can be designed to overcome the limits of rationality experienced by groups (Huber, 1984; Nunamaker, Applegate, and Konsynski, 1988) so that their aggregate utilities are maximised. This perspective has given birth to a new direction of research and development into group decision support systems (GDSS).

The second foundation of GDSS research has its roots in communication theories. Traditionally, communication theories have focused on message exchange between two or more parties and research in communication has been focused on the information channels and the nature of the message between the senders and receivers (Berlo, 1977; Bormann, 1980). Early GDSS research has drawn from a variety of communication theories. Most of the early works studied how computer-mediated communication was different from verbal exchange between group members.

Chapanis (1972) was among the first to study rigorously computer messaging versus face-to-face verbal communication. His research found that groups using computer messaging took longer to solve a problem and exchanged fewer messages than groups engaged in face-to-face meetings. Krueger (1976) also studied the effects of computer-mediated communication and found that participation by group members was more even in a computer-mediated environment than in a face-to-face group. It

has been argued that computerised communication channels reduce individuation (Hiltz, Turoff, and Johnson, 1989) and social presence (Sproull and Kiesler, 1986).

Early experimental work conducted during the late 1960s and 1970s (Williams, 1977; Short, Williams, and Christie, 1976) also found that the use of computer-mediated communication strongly influenced how a group approached a specific task. These researchers suggested that computer-mediated communication could introduce new factors into the normal group processes and alter the communication patterns of a group. Although these early studies, in using computers to support communication between group members, were done using simple computer-messaging systems, these studies provided a foundation for further studying the differences between computer-mediated communication and face-to-face meetings and whether the differences can lead to better group performance.

In short, the origins of GDSS theoretical development and research are found in both the early individual DSS research and computer-mediated communication research. The DSS researchers noted that computer support for individual decision makers was useful but the true power of the computer technology lay in supporting group decision making. The computer messaging research demonstrated that using computers as a medium of information exchange is very different from face-to-face verbal exchange. These two areas of research have facilitated the development of a rich literature on GDSS and have provided a foundation for studying the effects of GDSS on group decision making.

### **2.3 Theoretical Foundations of the Effects of GDSS**

What are the effects of GDSS on group processes and group outcomes? Can computer-based DSS replace face-to-face decision meetings? Can the use of GDSS really yield better decisions? Although a decade of GDSS research, based primarily on the two roots discussed in the previous section, has begun to provide initial answers to these questions, a theoretical foundation for explaining the observed effects of GDSS on group decision making is only beginning to emerge from the literature.

The theoretical foundation for studying the effects of GDSS on group decision making has centred on the group process model proposed by Steiner (Steiner, 1972). The central concept in Steiner's model is the notion of a group's potential productivity in a task. Like machines which can never achieve 100 per cent efficiency, Steiner argued that people working in a group would expect to fall short of their maximum potential. Steiner called this 'process losses'. He suggested that there are two general sources of process loss. Co-ordination losses occur when group members do not organise optimally and motivation losses occur when group members fail to be motivated in a group task. The actual productivity of the group will be reduced as a result of these process losses. Although working in a group can result in process losses, Steiner argued that group productivity can, at the same time, be improved by group learning or stimulation. Steiner called these 'process gains'. Certain aspects of the meeting process improve groups' outcomes (process gains), whereas others impair groups' outcomes (process losses) (Hill, 1982; Steiner, 1972). Steiner (1972) and Huber (1982) have suggested that the actual group effectiveness is equal to the sum of capabilities of the individual group members plus the group process gains minus the group process losses. In other words, the group meeting outcomes are contingent upon the balance of the process gains and process losses (Connolly, Jessup, and Valacich, 1990; Steiner, 1972).

This interaction of process gains and losses in group processes has created a theoretical platform for understanding the effects of GDSS on group decision making (Nunamaker, et al., 1993). GDSS research has pursued the objectives of fostering group process gains, and alleviating group process losses. GDSS have been designed to ease a group decision making process by allowing parallel communication, providing decision making modelling, creating a group memory and providing anonymity. GDSS features are expected to foster better group decision making to the extent that they reduce the process losses due to conformance pressure, evaluation apprehension, relevance apprehension, domination, air time fragmentation, attention blocking, concentration blocking, cognitive inertia, attention blocking, failure to

remember and socialising. Table 2.1 summarises the expected effects of GDSS features on group process gains and losses.

Table 2.1: GDSS Features and Expected Effects on Process Losses

| GDSS Features             | References          | Expected Effects on Process Losses |
|---------------------------|---------------------|------------------------------------|
| Anonymity                 | [13,17]             | Decreased conformance pressure     |
|                           | [5,8,9,11,13,17,18] | Decreased evaluation apprehension  |
|                           | [4,17]              | Decreased relevance apprehension   |
|                           | [12,13,14,16,17]    | Decreased domination               |
|                           | [2,6,14,17]         | Decreased contributor effect       |
|                           | [1,3,5,10,17]       | Increased free riding              |
| Parallel communication    | [7,12,13]           | Decreased air-time fragmentation   |
|                           | [13]                | Decreased attention blocking       |
|                           | [13]                | Decreased concentration blocking   |
|                           | [13]                | Decreased cognitive inertia        |
|                           | [7,12,13,15,16]     | Decreased domination               |
|                           | [13]                | Decreased free riding              |
|                           | [13]                | Increased information overload     |
| Electronic log and memory | [13]                | Decreased attention blocking       |
|                           | [2,13]              | Decreased failure to remember      |
|                           | [13]                | Decreased information overload     |
| Decision Modelling        | [2,13]              | Decreased coordination problems    |

- |                                         |                                     |
|-----------------------------------------|-------------------------------------|
| [1] Albanese and Van Fleet (1985)       | [10] Kerr and Bruun (1983)          |
| [2] DeSanctis and Gallupe (1987)        | [11] Lamm and Trommsdorff (1973)    |
| [3] Diehl and Stroebe (1987)            | [12] Lim, Raman and Wei (1990)      |
| [4] Gallupe (1985)                      | [13] Nunamaker, et al.(1991)        |
| [5] Harkins and Jackson (1985)          | [14] Nunamaker, Applegate and       |
| [6] Hiltz, Turoff and Johnson (1989)    | Konsynski (1988)                    |
| [7] Huber (1982)                        | [15] Siegel, et al. (1986)          |
| [8] Jablin and Seibold (1978)           | [16] Turoff and Hiltz (1982)        |
| [9] Jablin, Seibold and Sorenson (1977) | [17] Valacich, Dennis and           |
|                                         | Nunamaker (1992)                    |
|                                         | [18] Vroom, Grant and Cotton (1969) |

Anonymity of GDSS mediated communication may minimise the process losses generated by conformance pressure and evaluation and relevance apprehension. When group members are reluctant to critique the comments of others due to politeness or fear of negative evaluation from the group, the group productivity will be reduced. Anonymity provides a low-threat environment in which group members can feel free to express criticism without fear of reprisals or embarrassment (Nunamaker, et al., 1991; Valacich, Dennis and Nunamaker, 1992). However, anonymity in GDSS environments may result in more free riding because it is more difficult to find out whether someone is active or not (Albabese and VanFleet, 1985).

Parallel communication, facilitated by an electronic channel, enables everyone to communicate simultaneously (Dennis, et al., 1990). Since no one needs to wait for someone else to finish, process losses from air time fragmentation can be significantly reduced (Diehl and Stroebe, 1987; Hirokawa and Pace, 1983; Nunamaker, et al., 1991). Process losses from attention blocking can also be reduced as group members do not need to suppress their comments as they occur (Nunamaker, et al., 1991). Furthermore, parallel communication also promotes broader input into the meeting process and reduces the chance of free riding and domination (Nunamaker, et al., 1991; Huber, 1982). Free riding may be reduced since no member can excuse their failure to participate since they no longer need to compete for air time (Hackins and

Jackson, 1985; Kerr and Bruun, 1983; Valacich, Dennis and Nunamaker, 1992). Domination may also be reduced since computer supported communication systems prevent dominant members from restraining other members from expressing their ideas (Jablin and Seibold, 1978; Nunamaker, et al., 1991). Parallel communication can reduce attention and concentration blocking as group members do not need to devote their concentration to listening to others (Nunamaker, et al., 1991). Cognitive inertia is also reduced as group members can communicate simultaneously and no longer need to restrain from contributing comments as they occur (Nunamaker, et al., 1991). However, parallel communication may lead to some information overload. This effect may increase the cognitive burden of the group members.

Group memory in GDSS can record all electronic comments so that group members can retrieve information anytime they want. This feature should reduce attention blocking. It also provides a way to reduce the process losses of information overloading resulting from the parallel communication medium (Nunamaker, et al., 1991; DeSanctis and Gallupe, 1987).

Decision Modelling in GDSS can reduce the process losses by increasing the co-ordination of the decision making groups (DeSanctis and Gallupe, 1987). It provides a way to structure the decision making process and reduces the efforts of co-ordination between group members.

In summary, the theory suggests that the effects of GDSS can be analysed by studying the sources of group process gains or losses in GDSS use. The balance of these gains and losses that take place in a particular situation will determine the outcomes of the group decision process. GDSS features like parallel communication, group memory, anonymity and electronic media can lead to significant reduction of these group losses and therefore achieve better decision outcomes. A considerable amount of research has been generated to examine the effects of GDSS on group decision making particularly on how GDSS can reduce the process losses of decision making groups and whether GDSS can improve the decision outcomes. Having laid down the



theoretical foundation for the effects of GDSS, the next section reviews GDSS empirical research.

## **2.4 Review of GDSS Empirical Research**

This section provides a review of the major GDSS empirical research. This review is divided into laboratory studies and field studies. The review is organised in chronological order and it provides a historical perspective of the main findings of GDSS research (Dennis and Gallupe, 1993).

### **2.4.1 Laboratory Studies**

Empirical research on GDSS has grown immensely in the past ten years. Laboratory studies have dominated the literature, and they have been the primary method for investigating the effects of GDSS.

Steeb and Johnson (1981) conducted an experiment to compare the effects of a chauffeured GDSS called Group Decision Aid. The system was tested using ten groups each with three members. The decision task was a specialised, complex crisis scenario derived from an international terrorist simulation case. Five groups had computer support while the other five groups relied on manual tools (they were given pencils, paper, and blackboard). All groups were asked to reach a group consensus as to what decision to make. Results indicated that the GDSS groups were more satisfied with the process and more confident with the decision they had made. The GDSS groups also developed higher-quality decisions according to the experts who evaluated the decision outcomes.

Lewis (1982) viewed GDSS research as an intersection of research in decision support systems, social psychology, microcomputer technology, and systems science. He perceived GDSS largely as a way to make formal decision models available to individuals working in groups. Lewis used a microcomputer-based GDSS called 'Facilitator' to support three person groups. Much of the research was focused on evaluating the system design of 'Facilitator', and the experiment played an important

role in learning more about obstacles in using a GDSS system. A control treatment group had no support, the first experimental treatment group used 'Facilitator', and the second experimental treatment group used a structured paper-and-pencil technique that incorporated the same features as 'Facilitator'. Lewis found that the use of GDSS produced decisions of higher quality generated more alternatives per decision, and reduced domination by single group members when compared to either the control group or the paper-and-pencil group. This study also provided suggestions for future GDSS design such as informing group members of the time they were taking on different stages of a process and maintaining a record of minutes.

Turoff and Hiltz (1982) conducted two experiments to show that 'computers may indeed be used to support group communications as an integral part of decision support systems' (p.83). Their system was built around an automated Delphi technique and provided computer conferencing capabilities. The experiments were conducted to investigate the impact of computed-based support on group decision making. The first experiment was essentially an experiment into the effects of computer conferencing on group decision making. The second experiment, however, manipulated leadership in the group, the use of GDSS and the mode of group interaction (either face-to-face or computer-conference). The results indicated that the use of a GDSS aided the groups in reaching quality decisions more often than groups unaided by a GDSS. The results also revealed that leaders tended to emerge less often in computer-supported groups.

Gallupe (1985) performed an experiment to examine the impact of GDSS on tasks with low and high levels of difficulty. He developed a rudimentary GDSS in BASIC and then used a 2x2 experimental design that compared GDSS and non-GDSS groups performing simple versus complex tasks. Decision outcomes and group processes were measured. Decision outcomes measured included decision quality, decision time, decision confidence, satisfaction with group process, and amount of GDSS usage. the group processes measure consisted of number of issues considered, number of alternatives generated, and participation in decision making. He found that GDSS was particularly appropriate for complex decision tasks. He also found that GDSS groups

made better quality decisions than non-GDSS groups but GDSS groups were less satisfied than non-GDSS groups.

Watson (1987) studied the impact of using a GDSS on consensus formation in small groups. He developed a GDSS in C programming language running under the UNIX operating system. This system became the Software Assisted Meeting Management System (SAMB). In a task requiring resolution of competing personal preferences, 3 or 4 person groups were randomly assigned to one of the three experimental treatments: a computer-based support system; a manual, paper and pencil, support system and no support. He found that GDSS technology appeared to offer some advantage over no support, but little advantage over the paper and pencil method of supporting group discussion. He also found that GDSS groups were less satisfied with the process than non-GDSS groups.

Beauchair (1987) conducted a GDSS study using a small GDSS developed on a small local area network. Groups had to reach a decision regarding a student discipline case. Using a 2x2 factorial design, she compared control groups, groups with computer-aided brainstorming support, groups with computer-aided ranking and voting support, and groups with both computer-aided brainstorming and ranking/voting support. Beauchair found that there were no differences between GDSS groups and non-GDSS groups for decision quality, time to make the decision, amount of participation by group members, and satisfaction with the group outcome.

Jarvenpaa, Rao, and Huber (1988) conducted an experiment in which the same three groups used three different forms of GDSS technology. Groups were given unstructured problems and asked to use either an electronic blackboard, or workstations, or were given no support. They found that GDSS had no effect on participation or satisfaction with the process.

Zigurs, Poole and DeSanctis (1988) reported on a GDSS experiment which focused on group process rather than outcome. Small groups of three people were used. The amount and the pattern of influence behaviour experienced within the group were the

major dependent variables. The major empirical findings of the study showed no significant differences between the overall amount of influence behaviour attempted in computer-supported groups, although significant differences were found in the pattern of influence behaviour, i.e., the different types of influence behaviour used in the computer supported group. They also found that using a GDSS resulted in a more even distribution of influence in the group compared to non-GDSS groups.

Lim, Raman, and Wei (1990) conducted an experiment to look at GDSS effects on the equality of influence and dominance among decision groups. They found no differences in the equality of influence, except for the no-leader GDSS groups, which had a more even distribution of influence. The dominant member in GDSS groups had less influence than the dominant member in non-GDSS groups.

Gallupe (1990) conducted two experiments using two different GDSS but the same type of task to study the effect of use of a GDSS on individual versus group decision making. The study compared the performance of GDSS groups, non-GDSS groups, and the 'best members' of those groups to determine if use of a GDSS improved decisions. The results were consistent in both experiments. The findings indicated that GDSS groups did not do as well as the best members of their group and non-GDSS groups did as well as or better than the best members. One explanation proposed was that GDSS generated more equal participation among group members, making it more difficult for the best member to influence the group.

George, et al. (1990) compared the performance of six-member groups, some using a GDSS called GroupSystems and others without GDSS support. Using a generate-and-choose task, they found no differences and sometimes poorer decision quality in the GDSS supported groups. Non-GDSS groups were also more likely to reach consensus in less time but the GDSS supported groups had more equal participation. They also found no significant effects due to anonymity or the presence of a randomly selected leader.

Jessup, Connolly and Galegher (1990) studied the influence of anonymity on group process in groups using GDSS with an idea-generating task. They found that the anonymous GDSS groups generated more comments, were more critical, and were more likely to embellish ideas proposed by others than the non-anonymous groups.

Gallupe and McKeen (1990) conducted a laboratory experiment to examine the effects of the use of a GDSS in face-to-face versus remote meetings. Use of a GDSS was found to increase the time it took to reach a decision but had no impact on the decision quality of the groups. The study also demonstrated that decision satisfaction was less in GDSS groups.

Winniford (1991) studied the use of the GroupSystem GDSS using five and ten member groups for a chosen task. The results were similar to George, Easton, Nunamaker, and Northcraft (1990). There were no differences in decision quality or member satisfaction.

Sengupta and Te'eni (1991) investigated the effect of computer generated cognitive feedback in GDSS supported group decision processes. In a laboratory experiment with groups of three decision makers, 15 groups received on-line cognitive feedback and 15 groups did not. The results showed that users receiving cognitive feedback maintained a higher level of control over the decision making process as their decision strategies converged.

Jessup and Tansik (1991) conducted an experiment using a GDSS to evaluate effects of anonymity and proximity on group process. Twenty groups of four persons each performed an idea-generating task. The results indicated that group members working anonymously and apart generated more comments. Close proximity groups were more satisfied and the highest levels of perceived system effectiveness were reported under the conditions of anonymity.

Cass, Heintz and Kaiser (1992) conducted an experiment to assess the effect of a GDSS on synchronous face-to-face and dispersed meetings with subjects linked via a

voice connection. Members solved a preference allocation task and reported their satisfaction with the meeting process and its outcome. The results demonstrated that both GDSS and location effects were significant for decision quality, with face-to-face non-GDSS group members reporting the highest level of satisfaction. Dispersed subjects without GDSS technology were more satisfied with both the process and the outcome of their meeting. But when a GDSS was available, face-to-face subjects reported higher satisfaction with the meeting outcome than dispersed subjects.

Valacich, Dennis and Nunamaker (1992) studied the effects of group size (3 and 9 members) and group member anonymity on the performance of groups using a computer-mediated idea-generation system. The results indicated that although group members in all conditions made a similar number of comments, larger groups generated significantly more and higher quality ideas than smaller groups. Anonymity however had no effect on group performance. Members of small identified groups made the fewest critical remarks, were the most satisfied, and rated themselves more effective than group members from the other experimental conditions.

Dickson, Partridge and Robinson (1993) studied the effects of facilitative support of GDSS on group performance. The study explored two facilitative supports: chauffeur-driven and facilitator-driven. The results showed that chauffeur-driven groups had higher levels of post-meeting consensus than the facilitator-driven groups; there were no differences with the performance of the person guided groups.

Wheeler, Mennecke and Scudder (1993) reported a laboratory experiment in which they manipulated the degree of restrictive structure in a GDSS and the preference of the group for procedural order. They found that performance was generally better when the group used the non-restrictive GDSS, although they were more satisfied with the restrictive environment. They concluded that preference for procedural order and restrictiveness moderates the manner in which technology-supported decision processes were used and perceived.

Hwang and Guynes (1994) conducted an experiment to investigate the effects of GDSS in groups of nine persons and the effects of group size (three versus nine persons) in the computer supported environment. A 2x2 completely randomised factorial design was employed. The results indicated that decision quality can be improved in large computer-supported groups and large groups generated more alternatives but took longer to reach a final decision than the smaller ones.

#### **2.4.2 Field Studies**

Dennis, Nunamaker and Vogel (1990) defined GDSS field studies as research to study the use of GDSS technology by specific business groups (public or private sector) addressing problems in their organisation or in another institution. One of the first organised field studies of GDSS was conducted by Nunamaker, Applegate, and Konsynski (1988). After studying 40 groups using GDSS, they concluded that anonymity had an important influence on how a group used GDSS technology. They also concluded that larger groups were more satisfied with GDSS use than smaller groups.

In 1987, a GDSS called GroupSystems was adopted by IBM and this has resulted in a series of research studies over several years. The first of these studies was conducted by Nunamaker, et al. (1989). GroupSystems was used by 441 participants from 29 groups and the results showed that the participants reported GDSS to be very effective and satisfying. Their results also indicated that the planning time of some managerial tasks can be reduced by 55 percent.

Using a case study approach, several field studies have examined the use of GDSS in strategic planning (Dennis, et al., 1990), in the search for competitive advantage (Dennis, Nunamaker and Paranka, 1991), in supporting negotiating groups (Herniter, 1991), and in the system development process (Daniels, 1991; Hayes, 1991). The results of these case studies were very consistent, They found that larger groups using GDSS were more satisfied, more effective and efficient. Tyran, et al. (1991) suggested that these results could be attributed to the ability of members to work in parallel and

anonymity, which led to increased equality of participation and improved communication across the organisational hierarchy.

Dennis, et al. (1990) studied the strategic-planning processes of 17 organisations (later expanded to 30 organisations) and found the use of GDSS could lead to more successful strategic management. They suggested that GDSS use could enhance idea generation, problem identification, innovation, communication between top management, organisational learning and functional and operational integration within an organisation.

Vogel, et al. (1990) examined a study undertaken by IBM. Participants again reported high satisfaction and improvements in meeting efficiency and effectiveness. A study by Grohowski, et al. (1990) attributed this success to increasing the number of participants attending meetings, more participation and an increasing task focus during the meetings.

Dennis (1991), who studied ten operations management groups from five public and private organisations, also found larger GDSS-supported groups to be more satisfied than smaller groups. His other finding suggested that anonymity was less important in hierarchically structured groups which included members with different status and power.

Martz, Vogel, and Nunamaker (1992) in their subsequent studies of GDSS used in IBM found that the groups who used the GDSS changed over time. They found that there was an increase in the use of GDSS across different managerial levels and different departments within an organisation. Groups which used GDSS were more heterogeneous and less cohesive over time, indicating a growing willingness to apply the GDSS across the whole organisation.



## **2.5 Summary of GDSS Empirical Research and Implications**

Table 2.2 presents a summary of the empirical results of GDSS research. As is evident from this summary, generalisations about the effects of GDSS on group decision making have been plagued by inconsistencies between study findings. As Dennis and Gallupe put it 'The result of these studies can be summed up in one word: mixed' (Dennis and Gallupe, 1993, p.64). In GDSS research, some of the studies found GDSS use had improved quality performance, while other found negative or mixed results. Participation has been shown to be more equally distributed among group members supported by GDSS but some studies have shown no effect from GDSS use. GDSS use has been shown to reduce group consensus but the results were not consistent in other studies. Effects on member satisfaction on GDSS use in the laboratory have been positive, negative or mixed.

### **2.5.1 GDSS Research Implications**

Based on this literature review, it is clear that the effects of GDSS use are not uniform across all situations and conditions. The situations under which the use of GDSS are beneficial are still not well understood. The anticipated reduction of group process losses (Steiner, 1972) with GDSS use are not beneficial in all situations and the commonly stated advantages of GDSS have not been shown to hold with all the GDSS research. GDSS use improved group performance in some situations whereas in others its use reduced the group performance. It is inappropriate to say that GDSS use improves group decision performance or reduces member satisfaction, all statements must be qualified by the situation (Nunamaker, et al., 1993).

Qualitative and quantitative reviews of GDSS empirical work have attempted to integrate the seemingly conflicting results by attributing differences to one or more situational factors. Nunamaker, et al., (1991) proposed a research framework for the analysis of GDSS effects. The framework, based on an input-process-output scheme, is present in Figure 2.1.

Table 2.2: Summary of Empirical GDSS results

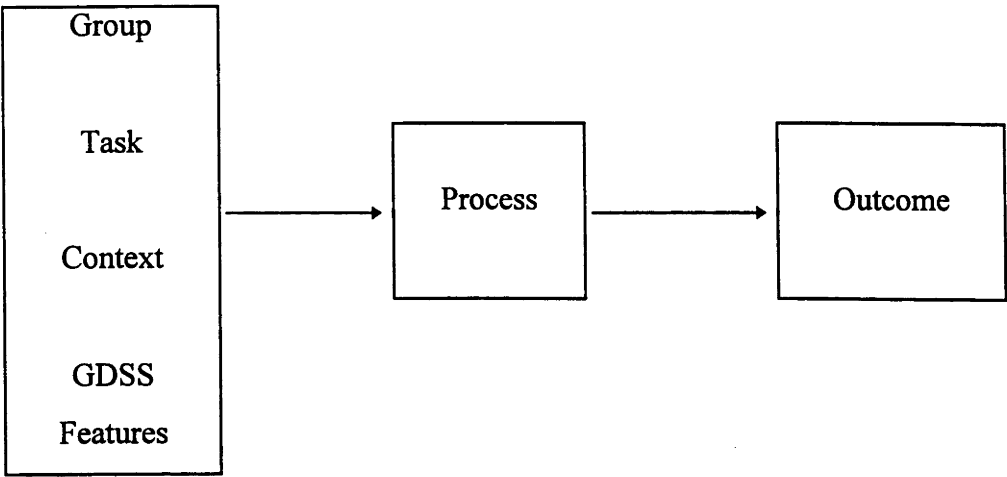
| Dependent Variable  | References                          | Experimental Results |
|---------------------|-------------------------------------|----------------------|
| Decision quality    | Steeb and Johnson (1981)            | GDSS>non-GDSS        |
|                     | Lewis (1982)                        | GDSS>non-GDSS        |
|                     | Turoff and Hiltz (1982)             | GDSS>non-GDSS        |
|                     | Gallupe (1985)                      | GDSS>non-GDSS        |
|                     | Beauclair (1987)                    | GDSS=non-GDSS        |
|                     | Jarvenpaa, Rao, and Huber (1988)    | GDSS>non-GDSS        |
|                     | Watson, et al. (1988)               | Mixed                |
|                     | George, et al. (1990)               | Mixed                |
|                     | Gallupe, et al. (1990)              | Mixed                |
|                     | Dennis, et al. (1990)               | GDSS>non-GDSS        |
|                     | Gallupe and McKeen (1990)           | GDSS=non-GDSS        |
|                     | Winniford (1991)                    | GDSS=non-GDSS        |
|                     | Cass, Heintz, and Kaiser (1992)     | GDSS>non-GDSS        |
|                     | Hwang and Guynes (1994)             | Mixed                |
| Equal Participation | Turoff and Hiltz (1982)             | GDSS>non-GDSS        |
|                     | Lewis (1987)                        | GDSS>non-GDSS        |
|                     | Beauclair (1987)                    | GDSS=non-GDSS        |
|                     | Jarvenpaa, Rao, and Huber (1988)    | GDSS=non-GDSS        |
|                     | Hiltz, Turoff and Johnson (1989)    | Mixed                |
|                     | George, et al. (1990)               | GDSS>non-GDSS        |
|                     | Vogel, et al. (1990)                | GDSS>non-GDSS        |
|                     | Poole, Holmes, and DeSanctis (1991) | Mixed                |

|                       |                                       |               |
|-----------------------|---------------------------------------|---------------|
| Level of<br>consensus | Watson (1987)                         | Mixed         |
|                       | Lim, Raman, and Wei (1990)            | GDSS=non-GDSS |
|                       | George, et al. (1990)                 | GDSS<non-GDSS |
|                       | Tan, et al. (1991)                    | Mixed         |
| Satisfaction          | Steeb and Johnson (1981)              | GDSS>non-GDSS |
|                       | Gallupe (1985)                        | GDSS<non-GDSS |
|                       | Watson (1987)                         | GDSS<non-GDSS |
|                       | Beauchair (1987)                      | GDSS=non-GDSS |
|                       | Jarvenpaa, Rao, and Huber (1988)      | GDSS=non-GDSS |
|                       | Vogel, et al. (1990)                  | GDSS>non-GDSS |
|                       | Dennis, et al. (1991)                 | GDSS>non-GDSS |
|                       | Winniford (1991)                      | GDSS=non-GDSS |
|                       | Cass, Heintz, and Kaiser (1992)       | GDSS>non-GDSS |
|                       | Wheeler, Mennecke, and Scudder (1993) | Mixed         |

|               |                                        |
|---------------|----------------------------------------|
| GDSS>non-GDSS | Effect of GDSS is significantly higher |
| GDSS<non-GDSS | Effect of GDSS is significantly lower  |
| GDSS=non-GDSS | No significant difference              |
| Mixed         | Mixed results                          |

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Fig 2.1: Input-Process-Output GDSS Research Framework



This research seeks to show that the effects of GDSS on decision making processes and outcomes are task structure dependent and the effects of GDSS cannot be evaluated on the basis of outcomes alone; decision processes must also be evaluated in order to understand how decisions are made and why GDSS can improve group outcomes in some situations but provide negative effects in others. The input-process-output scheme, proposed by Nunamaker, et al. (1993), provides a framework to include input, output and the process as the necessary variables for the analysis of GDSS effects. This framework provides a suggested that the effects of GDSS use are contingent on a myriad of group, task, context, and GDSS features that differ from situation to situation (Dennis, et al., 1988). The reduction of process losses generated by the use of GDSS have different effects across different situations. Task characteristics like complexity or the contextual situation like organisational culture can reduce different types of process losses (Steiner, 1972) and influence how GDSS impact the group process. Different GDSS features like the type of support, the type of decision aids, and the type of communication channel can also have an impact on GDSS effects. The effects of GDSS use are therefore not uniformly positive in all situations but actually depend on the situation itself.

### 2.5.2 Task Structures

Although the input-process-output scheme provided a framework for the analysis of GDSS effects, it did not suggest the situations under which the use of GDSS can have a positive impact on group decision making. Of all the factors which have been suggested as moderating the effects of GDSS use in the input-process-output framework, the variable 'group task' is emerging as an important variable. Poole, Seibold, and McPhee (1985) point out that: 'the general variable, group task, is emerging as an especially important variable, often accounting for as much as 50% of the variance in group performance' (p.88). DeSanctis and Gallupe (1987) note the importance of tasks and task differences in GDSS research. Kraemer and Pinsonneault (1989) provide a conceptual framework for analysing the impacts of GDSS on group process and outcome. Task differences are depicted as an important class of contextual variables for GDSS use. Several authors studying group decision making (Hackman and Morris, 1975; Hiltz, Johnson, and Turoff, 1986; McGrath, 1984; Poole and Hirokawa, 1986) also point out the importance of the task in group decision research. Poole and Hirokawa (1986) declare that: 'In the pantheon of factors determining decision behaviour and outcomes, task stands in the first position, both in terms of evidence supporting its effect strength and in terms of a theoretical linkage to decision processes' (p.26). Task differences should be expected to affect significantly the communication process as well as the task performance (McGrath, 1984).

In spite of the importance of the task dimension and the elapsed time since its importance was identified, little effort has been devoted to a systematic analysis of the differences between tasks and how these differences affect group performance. GDSS research has generally been based on empirical evidence gathered in relation to a single task. Nor has the growing volume of research on GDSS focused on a specific class of task. Studies have been lumped together in efforts to understand process and outcome variable effects of small group decisions. Little systematic consideration has been given to the differences in tasks from one study to another (Pinsonneault and Kraemer, 1990). Although reviewers of GDSS literature (for example, Dennis and Gallupe, 1993; Benbasat and Lim, 1993) have pointed out the importance of the moderating effect of task differences, most empirical research on GDSS has still failed

to take into account the ways in which effective work in groups is contingent upon features of the group task (McGrath and Hollingshead, 1993).

Group tasks can refer to the characteristics of the group's substantive work (McGrath, 1984). Group tasks can be classified according to the degree of complexity (Kraemer and Pinsonneault, 1989), for example, simple versus complex tasks; the type of the task (McGrath, 1984), for example, decision task versus idea generation task; and the structure associated with the particular task (Steiner, 1972), for example, additive, disjunctive versus conjunctive tasks. GDSS researchers have studied some aspects of task differences and their effects on GDSS use. Gallupe (1985) compared the effects of GDSS support between a simple and complex task and suggested that GDSS was more suitable for a complex task. Hollingshead, McGrath and O'Conner (1993) studied the effects of GDSS among different task types and found that there were no differences in performance between computer groups and face-to-face groups for idea generation and decision making tasks, but face-to-face groups performed better on negotiation and intellectual tasks than did their computed-mediated counterparts.

These research studies focused primarily on the complexity and the type of task which groups perform. The structure of the task has received no attention. According to McGrath (1984), types of tasks can be categorised according to what the group must accomplish during the course of its meeting. Major group goals include idea-generating tasks, creativity tasks, intellectual tasks, decision-making tasks and cognitive conflict tasks. However, within the social psychology literature, Steiner (1966, 1972) and others (Littlepage, 1991; Michaelsen, Watson and Black, 1989; Zaccaro and Lowe, 1988; Zaccaro and McCoy, 1988) have suggested that the performance and success of a decision group depend basically on the structure of the group's task. Task structure can be defined as the overall configuration of the problem space (Newell, 1980) that underlies the task. In every task performed by a group, there exists a set of collective or shared purposes which get transformed into a set of strategies for accomplishing these tasks (McGrath, et al., 1993). Task structure provides a procedural orientation or the 'rules of the game' for how members in the group make decisions. Task structure affects the group's need for problem analysis

and procedural orientation and planning. That is, with different task structures, the group faces different procedural requirements for accomplishing its objective(s).

Some researchers also argue that task structure is a more fundamental concept than the type of task (Steiner, 1972; Gouran and Hirokawa, 1983; Hirokawa, 1980, 1990). Even within the same task type, there may be different task structures. Within a decision task, each group can make their group decision differently. Steiner (1972) identified three types of task structures typically imposed upon decision groups: additive, disjunctive, and conjunctive.

In an *additive* task, each group member contributes a part to the group decision and the success of the task is determined by the aggregation of individual effort. Group performance is determined by the aggregation of individual effort. Each group member has similar responsibilities and information. According to Zaccaro and Lowe (1988), each group member must maximise his or her own individual performance in order to maximise the overall group effort in an additive task.

In a *disjunctive* task, a group selects one optimal solution from an array of solutions proposed by individual group members (Littlepage, 1991; Steiner, 1972). The success of the decision group depends on whether a member who has the ability to solve the problem exists and whether group members recognise and accept the superior contribution of an individual's solution to the exclusion of all others. The success of a disjunctive task is therefore heavily influenced by the performance of the members who make the greatest contribution.

In a *conjunctive* task, however, the successful decision can only be achieved when all the group members maximise their efforts because all group members have unique information. Conjunctive tasks differ from additive tasks because each group member has different information. Conjunctive tasks also differ from disjunctive tasks because no one group member has enough information to suggest the correct answer or optimal solution. A group achieves a successful outcome only when all of the information held by individual group members is accurately communicated to other

group members. The whole group will fail even if only one member fails to contribute to the decision task. The success of the decision task is heavily influenced by the performance of the member who makes the least contribution.

According to Steiner (1972), even within a decision task, different task structures can exist and these task structures within a decision task will alter how a group approaches the task and eventually affect the behaviour of the group members and the performance of the decision groups. Although research on GDSS is starting to provide some empirical evidence for how decision performance across different group tasks are affected by GDSS support, the primary focus has been on the type of task (idea generating task versus decision task). Although the main objective of GDSS technology is to provide support for the group decision process, we still lack empirical studies of how GDSS technology may affect group decision performance under different task structures. This thesis is an attempt to bridge this gap in current GDSS literature.

### **2.5.3 Patterns of Group Communication**

As discussed in Section 2.2.2, a great deal of GDSS research can be traced back to work on individual decision support systems (Keen and Scott-Morton, 1978; Sprague, 1980; Sprague and Watson, 1979). That, in turn, is based largely on the theory of decision making put forth by Herbert Simon (Simon, 1960, 1976). Simon (1960) investigated the relationships between the irrational and non-logical nature of problem solving and data processing. His findings confirmed that decision making is often far from being rational and objective. Decision makers frequently let feelings overcome logic and these can lead to poor decision paths and outcomes. According to Simon, decision making is a process, and understanding this process is just as important as the decision outcomes. In this regard, Hackman and Morris (1975) specifically state that the key to understanding group decision making is to be found in the interaction process which takes place among group members while they are working on a task. Steiner (1972) and Shiflett (1979) have identified intra-group processes as one of the key determinants of group effectiveness. Their research explicitly acknowledged the



important function of group communication interaction as the moderator of the input-output linkage.

Thus, another possible reason why previous research on GDSS effectiveness has yielded much conflicting evidence is its failure to acknowledge explicitly the important role of the group decision process, especially the communication process, in group decision making. Although there has been a substantial amount of research activity in the area of GDSS, most of this research has focused exclusively on the effects of GDSS on the decision outcome, with very little focusing on understanding the effects of GDSS use on the decision process. The theoretical foundation of GDSS research stated that it was by studying the sources of group process gains or losses, and their balance within the decision making process that the effects of GDSS use could be predicted. It is surprising that so little of GDSS research has looked at the micro-level of how GDSS use can reduce process losses and how the change of decision making processes influences the decision outcomes of the group.

The need for controlled, micro-level studies of the process of interaction, as a key to understanding the relationships between decision support and decision quality, has been pointed out by several GDSS scholars. McCartt and Rohrbaugh (1989) state that GDSS decision processes cannot be evaluated on the basis of outcomes alone, the process must be evaluated in order to understand how decisions are made. Pinsonneault and Kraemer (1990) also point out that GDSS research needs to study dynamic interactions and process activities of the group.

Although most of the authors of GDSS studies acknowledge the importance of studying the patterns of group communication within the GDSS support environment, few research studies have been conducted which include explicit quantitative assessment of how group interaction or communication patterns differ. Rather than analysing the interaction process of GDSS problem solving to understand better how outcomes get shaped as they do, researchers have taken a global approach by focusing on whether GDSS can improve group decision quality. Variables studied globally have included decision quality, decision satisfaction, member participation, task focus

and total decision time. However, global effects do not necessarily indicate why members are not satisfied with the GDSS support process nor do they provide an insight into the manner in which decisions get shaped. GDSS can be characterised as a social technology (Poole and DeSanctis, 1990; Contractor and Seibold, 1993) and understanding the communication patterns is especially likely to provide an answer to how GDSS shape the process and the outcome of group decision making and hence explain why GDSS can improve group performance in some situations but fail to perform in another situation (Poole, Holmes, and DeSanctis (1991).

## **2.6 Research Questions**

Although research reviews of the empirical work on GDSS use have attempted to integrate the conflicting results by attributing differences to different types of task the GDSS try to support, a systematic empirical study of the effects of GDSS use on different group tasks, especially on different decision task structures is still lacking. On the basis of an extensive review of the literature, this research appears to be the first empirical study to examine GDSS effects on different task structures.

The primary objective of this study is to examine whether the structure of a decision task moderates the effects of GDSS on the patterns of group communication and decision outcomes in a decision making group. Decision outcomes are measured by objective decision performance and perceived decision satisfaction with the group decision making process. The second objective is to examine the relationship between the patterns of group communication and decision outcomes in face-to-face and GDSS supported groups working on a decision task. Within the framework of the objectives, this study seeks to answer the following questions:

- 1. Are there any systematic differences in the decision outcomes between GDSS supported and face-to-face decision making groups across different task structures?**

- 2. Are there any systematic differences in the patterns of group communication between GDSS supported and face-to-face decision making groups across different task structures?**
- 3. Is there any systematic relationship between the patterns of group communication and the decision outcomes among the GDSS supported and face-to-face decision making groups across different task structures?**

This study attempts to make a contribution to the development of an emerging trend of GDSS research by isolating task structure as one of the variables which can moderate the effect of GDSS use among decision making groups as well as recognising the importance of the decision process as the key to explaining the relationship between the effects of GDSS technology and group decision making. This research would appear to be the first empirical investigation designed to examine systematically GDSS technology and task structure and their influence on patterns of group communication and the decision performance of decision making groups. It is designed to provide reliable information so that future GDSS can be designed to suit the different requirements of different decision task structures.

## **2.7 Chapter Summary**

This chapter examined the roots of GDSS research and the theoretical foundation for understanding the effects of GDSS use in group decision meetings. This chapter also reviewed both laboratory and field studies on GDSS and suggested further research areas based on the results of prior research. It can be concluded that the effects of GDSS appear to depend on a variety of contingent factors. Understanding how GDSS affect tasks with different structures can help to explain the inconsistent empirical results of GDSS research and provides a better understanding of how GDSS can be used under different task structures. A research question was developed in this study. This question was examined according to a research framework developed in Chapter 3. The research framework is based on the input-process-output scheme proposed by Nunamaker, et al. (1991) and is further developed by drawing from two relevant

theoretical perspectives. The hypotheses were then developed to be tested in the experiment described in Chapter 4.

## **CHAPTER 3**

### **RESEARCH FRAMEWORK AND HYPOTHESES**

#### **3.1 Introduction**

It is clear from the literature review in Chapter 2 that the effectiveness of GDSS remains an open issue and the conditions under which the use of GDSS is appropriate and beneficial are not well understood. The literature review reveals that GDSS are not beneficial in all situations and the commonly stated advantages of GDSS have not been shown to hold in all circumstances. The structure of the decision task is emerging as an important variable which can moderate the effects of GDSS on group decision making, but how task structures are associated with group decision outcomes under computer supported environments like GDSS appears not to have been fully understood in previous studies.

The primary objective of this study is to examine whether the structure of a decision task moderates the effects of GDSS on the patterns of group communication and decision performance in group decision making. The purpose of this chapter is to develop a theoretical framework for analysing this research objective. The theoretical framework is based on the input-process-output scheme proposed by Nunamaker, et al. (1993) and is further developed in this chapter by drawing from two relevant theoretical perspectives: adaptive structuration theory and functional perspective on group decision making. This chapter also develops research hypotheses to be tested in the experiment described in Chapter 4 and is organised into five sections. Section 3.2 discusses two theoretical perspectives and their implications for GDSS research. Section 3.3 describes a research framework for analysing GDSS effects on group decision making across different task structures. Section 3.4 presents the hypotheses to be tested in the experiment described in Chapter 4 and finally Section 3.5 provides a summary of this chapter.

### **3.2 Theoretical Perspectives**

Based on the literature review in Chapter 2, the effects of GDSS use are not uniform across all situations. As discussed in Section 2.5.1., Nunamaker, et al. (1993) proposed a research framework for the analysis of GDSS effects. Based on an input-process-output scheme, their framework suggested that the effects of GDSS use are contingent on a myriad of group, task, context, and GDSS features that differ from situation to situation. The discussion in Sections 2.5.2. and 2.5.3. further suggested that the structure of the decision task can moderate the effect of GDSS use among decision making groups and that understanding the patterns of group communication is key to explaining the relationships between the effect of GDSS technology and group decision making.

Although the input-process-output scheme provides a framework for the analysis of GDSS effects, it does not suggest any theoretical explanation of why the task structure can have an impact on the outcome of GDSS use and why patterns of group communication is the key process variable which can explain the relationships between the effects of GDSS use. Two perspectives are useful in providing the theoretical background for understanding the impacts of task structures and patterns of group communication on the effect of GDSS use. They are (1) adaptive structuration theory, and (2) a functional perspective on group decision making. Each of these perspectives and their implications are discussed.

#### **3.2.1 Adaptive Structuration Theory**

The development of GDSS to support group decision making processes can be seen as an extension of traditional computer systems such as wordprocessor, spreadsheet, and database management programs (Poole and DeSanctis, 1992). These traditional systems are designed around the notion of person-machine interaction. However, communicating between group members for information sharing is an essential part of group decision making. Unlike the traditional computer systems, interpersonal communication is of central importance to the design and operation of GDSS. The interaction between person-to-person in the work group mediated by GDSS

technology is the basis of the context for adoption and application of GDSS and from which the process of GDSS and its impacts on group decision making can be interpreted (Contractor and Seibold, 1993).

Although there has been a substantial amount of research in the area of GDSS, the effectiveness of GDSS remains an open issue (Dannis and Gallupe, 1993) and the situations under which the use of GDSS are beneficial are still not well understood (Benbasat and Lim, 1993). It is clear from the literature review in Chapter 2 that one limitation of current GDSS research is that most of it focuses on the institutional aspects of the technology, which are seen to be independent of and constraining human action, hence portraying social reality as objective. Most research on the impacts of GDSS assigns technology the role of the independent variable and GDSS researchers tend to take a realist position and assume that a single, objective reality exists independently of what individuals perceive. They consider that the social world, like the physical world, exists independently of individuals' perceptions as a real, concrete and unchanging structure and that reality exists as a structure, composed of relationships among its parts, which is divisible and fragmentable and as a result precise, accurate measurements and observations of this world are possible (Burrell and Morgan, 1979; Morgan, 1980). By presuming that GDSS technology is an object capable of having an impact on social systems, such research treats both technology and organisation structures as objects. The objectivist approach thus overstates the importance of technology's material characteristics but ignores the social interpretations and actions that may modify the impact of particular technological configurations (Kling, 1980).

Most GDSS researchers tend also to take the view that decision making is comparatively simple and straightforward and that people attempt to reach their decision through careful specification of the facts and refinement of their understanding of the probable consequences of their available options. But, as experience shows and the other models of decision behaviour attempt to describe (Poole, 1981), this rational viewpoint is limited in light it can cast on 'real-world'

decision making because it specifically excludes the baffling nonrational or complex social behaviours individual often exhibit (O'Conner, 1980).

Giddens' theory of structuration (1976) offers a useful framework for exploring the relationships among information technology, human action, and social structure. As presented by Giddens (1976, 1979, 1984), structuration theory does not explicitly incorporate technology. This theory has, however, been used by organisation theorists to address the question of technology's relationship to organisational changes (Walsham, 1993; Markus and Robey, 1988; Riley, 1983). Giddens (1976) proposes what he calls the duality of structure, which refers to the notion that the structure or institutional characteristics of social systems are created by human action, and then in turn shape future behaviour and the explanations of social phenomena must thus refer to both the role of human action and the effects of existing institutional and technological frameworks. In drawing on structuration theory to understand the relationship between organisations and information technology, it is necessary to acknowledge that information technology is the social product of subjective human action within specific structural and cultural contexts. This model recognises four key influences that operate continuously and simultaneously in the interaction between technology and organisations: (1) information technology is the outcome of human action; (2) information technology is also the means of other human action, serving to facilitate the accomplishment of computer-mediated work or communication; (3) information technology is built and used within particular social contexts and interaction with information technology influences the social contexts within which it is built and used and from which the impacts of information technology can be interpreted.

Adaptive structuration theory (AST) (Poole and DeSanctis, 1992), which is based on the work of Giddens' theory of structuration, provides a theoretical perspective for understanding how group members use or *adapt* GDSS technology in group decision making. AST has been discussed in a number of research articles (for example, Poole and DeSanctis, 1990, 1992; Poole, et al., 1991; Holmes and Poole, 1991; Contractor and Seibold, 1993). As with the theory of structuration, AST proceeds from the



assumption that groups are organised around a variety of practices that are task related and social in character. Understanding how group members use or adapt GDSS technology on a task is just as important as the operations of the software or hardware of the system (Holmes and Poole, 1991).

The theory states that the impact of group technology, like GDSS, on group decision making can be best understood in terms of the structures this technology promotes in the group and how they adapt these structures to a specific decision task. Like all computer technologies, GDSS provide sets of defined procedures or 'rules' like multicriteria decision modelling or voting procedures, and sets of defined facilities or 'resources' like public display screens for groups to use. These sets of rules and resources form a structure which group members can use in structuring their decision making process. Although the features designed into GDSS do not automatically determine how groups use the structures, it is through the group's interaction processes in the 'structuration' of these rules and resources that GDSS can have an impact.

AST argues that while any observable outcome of system use may be of interest, it is the analysis of the structuration process that is central to understanding how and why system use appears as it does. A study into the patterns of group interaction is therefore essential to uncover GDSS effects on decision making groups. Careful study of these groups' pattern of interaction should reveal how a particular group 'appropriates' - uses, adopts and reproduces - social and technical structures which it employs in its practices and in turn show how and why GDSS technology can affect group decision making.

### **3.2.2 Implications for GDSS Research**

The central assumption of AST (Poole and DeSanctis, 1992) as applied to this context suggests that group technology effects on group processes and outcomes are mediated by the interactive structuring process, as reflected in the group's mode of appropriation. Based on the theoretical perspective provided by AST, there are at least two implications for GDSS research.

Firstly, any contextual factors that affect member interaction (e.g., task structures, technology characteristics or group composition) will affect GDSS uses. According to AST, features such as equal channel of participation or anonymous input of ideas do not automatically determine how groups use the technology, it is through the structuration process that groups adapt specific structures (rules and resources) which are appropriate to the task or the composition of the groups. This theoretical perspective rejects the notion that decision making performance and GDSS can be studied independently of the type and structure of the task being performed or of any contextual factors that may influence the structuration process of the decision making group. On the contrary, these contextual factors form the basis for how a decision group appropriates the rules and resources in these contextual conditions and only through this process can we understand or predict the outcomes of GDSS use.

Secondly, GDSS research must focus directly on group interaction processes in order to understand how GDSS affect the decision process. According to AST, that is through group communication, each group produces its own structures-in-use and this structuration process is, in turn, dependent on the type and structure of the task and any contextual factors imposed on the decision making group. Hence, the group communication process plays a direct and critical role in explaining how GDSS impact group work. Simply studying the input and output of GDSS use in a decision making group is not enough for understanding how and why GDSS have an impact on group decision making. A study into the patterns of group communication interaction is more likely to uncover useful clues as to GDSS effects on decision making groups.

### **3.2.3 Functional Perspective on Group Decision Making**

Group communication scholars have long been interested in the question of why groups arrive at low or high quality decisions. Efforts to resolve this question have led to an increasing amount of research (for example, Gouran, 1973; Hackman and Morris, 1975; Hirokawa, 1980; Janis, 1982). The general conclusion of this research is that variations in the quality of decision making groups can often be attributed to how

group members communicate in the period that precedes decision making in the group (Hewes, 1986; Weick, 1979; Gouran and Hirokawa, 1983; Hirokawa, 1988).

A series of articles (for example, Gouran and Hirokawa, 1983, 1986; Hirokawa, 1980, 1985; Hirokawa and Scheerhorn, 1986; Gouran, et al., 1992) has begun to explicate a theoretical framework that attempts to clarify the relationship between group communication processes and the quality of decision making outcomes. This framework is based on three general assumptions (Gouran and Hirokawa, 1983). Firstly, decision making tasks are characterised by certain critical requirements. Each task-oriented group encounters unique task requirements that shape and determine the problems it must somehow overcome. The requirements are primarily caused by the structures of the group task, which the group encounters.

Secondly, the successful completion of a decision making task is enhanced by the satisfaction of its critical task requirements. The theory argues that task-oriented groups face certain challenges posed by the structures of the decision task that must be met, and meeting those requirements determines the likelihood and degree of a successful decision outcome. Asking more questions or more equal participation will not necessarily affect the quality of a group's decision, unless such behaviour allows group members to satisfy the requisite condition for successful group decision making for the specific task the group is facing.

Thirdly, group communication interaction represents the means by which the critical requirements of a decision task are satisfied by group members. The various task challenges confronting a decision making group are addressed and subsequently overcome through effective interaction among group members. In short, advocates of this perspective suggest that the role of communication in effective group decision making is a functional one - that is, 'it represents the means by which group members attempt to meet the requisites for successful group decision making' (Gouran and Hirokawa, 1983, p.170).

### **3.2.4 Implications for GDSS research**

At the heart of the functional perspective on group decision making is the notion that all decision tasks impose specific requirements on the group, and these requirements vary according to the specific structure of the decision task (Hirokawa, 1990; Zaccaro and Lowe, 1988; Littlepage, 1991; Steiner, 1972). This theory suggests that the structure of the decision task is an important variable for analysing the quality of the outcome of a decision making group. Different task structures introduce different task requirements for the decision making process (Hackman and Morris, 1975; Zaccaro and McCoy, 1988) and effective group decision making is contingent on the satisfaction of these requirements through an appropriate communication channel.

Different task decision structures can impose different task requirements on the decision group. Compared to traditional face-to-face decision meeting, GDSS introduce new communication features (parallel communication, anonymity and electronic memory) and the functional perspective suggests that the effectiveness of GDSS on group decision making is dependent on whether GDSS can provide the appropriate communication channel for group interaction so that the specific requirements generated by different decision tasks can be met.

According to the functional view of communication theory, the importance of GDSS and their impact on group decision making performance are a function of the task requirements and are best conceptualised within a task-contingency perspective (Hirokawa, 1990). Since different decision task structures may impose different task requirements (McGrath, 1984), a single GDSS cannot be expected to provide effective support for decision tasks with different requirements. Before one can adequately discuss the type of influence that GDSS support exerts on a decision making group to perform effectively, one must first consider the structure of the decision task and the requirements it imposes.

### 3.3 Theoretical Framework

The research framework used in this study is based on the input-process-output scheme proposed by Nunamaker, et al. (1993). GDSS research has had a long tradition of adopting an input-output research framework. Gray, et al. (1990) suggested a research framework for analysing the impact of GDSS. Although it included the major technological factors that may influence the effectiveness of GDSS, it was too restricted and ignored the social and human factors which are important when trying to understand the impact of GDSS.

Benbasat and Lim (1993) proposed a research framework for studying GDSS which, although it acknowledged the importance of some input variables (system and group characteristic) to output (decision quality and group satisfaction) and suggested the possible linked between input and output, failed to acknowledge the importance of the decision process in analysing the impact of GDSS technology.

This research seeks to show that the effects of GDSS on decision making processes and outcomes are task structure dependent and the effects of GDSS cannot be evaluated on the basis of outcomes alone; decision process must also be evaluated in order to understand how decisions are made and why GDSS can improve group outcomes in some situations but have negative effects in others. The input-process-output scheme proposed by Nunamaker, et al. (1993) provides a framework to include input, output and the process as the necessary variables for the analysis of GDSS effects.

Adaptive structuration theory (Poole and DeSanctis, 1990) and the functional perspective of group decision making (Gouran and Hirokawa, 1983, 1986) provide further supports for input-process-output framework. Adaptive structuration theory posits that GDSS effects on group decision making can only be studied by understanding the group communication patterns that occur in interaction among decision group members, and any contextual factors that affect member interaction (e.g., task, group and technology characteristics). The functional perspective on group

decision making posits that the effectiveness of GDSS on group decision making is contingent on the satisfaction of the requirements imposed by the structure of the decision task. The modified input-process-output framework used in this study therefore isolates task structure as the important contextual variable which can moderate the effects of GDSS use. The modified research framework also recognises the importance of group communication as a key process variable for explaining the relationship between the effects of GDSS technology and group decision outcome.

In this framework, the structure of a decision task creates a sense of task requirements facing the group, and the group responds to it by using whatever relevant GDSS structures are available. Rather than just studying the input and output of the decision process, this research framework focuses directly on the patterns of group communication in order to understand how GDSS affect the decision process. The influence of independent variables, particularly task structures, are demonstrated in their impacts on patterns of group communication in the decision making process. The impact of GDSS on the patterns of group communication influences the outcomes of the decision making, including the decision quality and members' satisfaction with outcomes. Eventually outcomes feed back to influence both input and process variables.

Figure 3.1 presents the general theoretical framework used in this study. The input-process-output framework is used to understand how different task structures can influence different decision performances in a computerised decision support environment.

### **3.3.1 Contextual Variables**

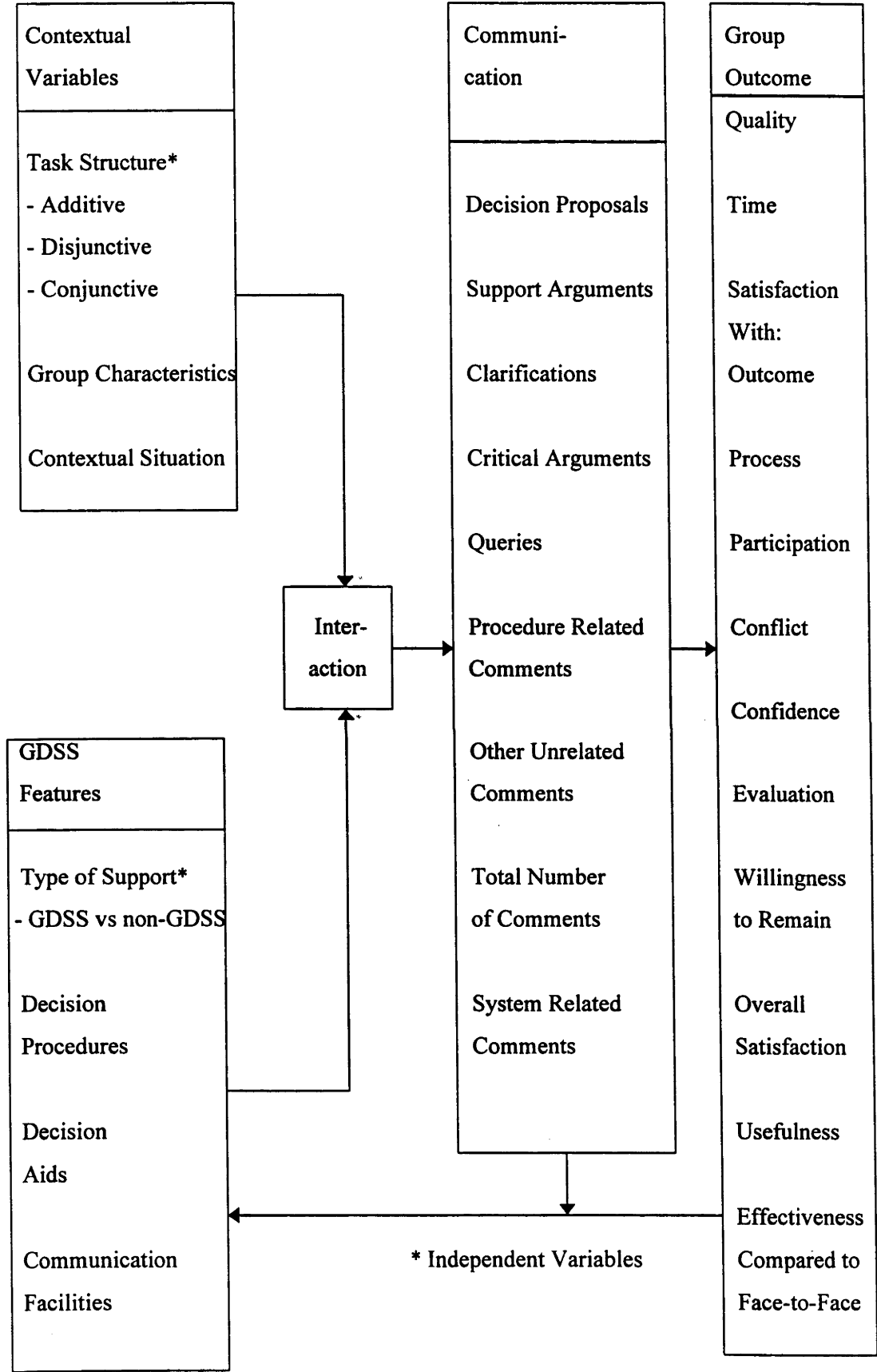
The research framework suggests that the effects of GDSS use are contingent on a myriad of group, task and contextual factors that differ from situation to situation (Nunamaker, et al., 1993). There are three major factors that can moderate the effects of GDSS on group decision making: (a) The structure of the decision task, (b) the characteristics of the group composition, and (c) the contextual situation in which the group operates. As this study focuses exclusively on the effects of task structure on

GDSS, task structure is treated as an independent variable while other contextual variables, such as group characteristics and contextual situation, are controlled.

### **3.3.2 GDSS Features**

GDSS features include four major factors: the type of support, the decision procedures imposed, the decision aids and the communication facilities of the system. GDSS vary in their capability to support group decision making. GDSS can provide support for communication activities, such as public screens for instantaneous display of ideas and anonymous input of ideas and preferences. In addition, GDSS can also provide support for higher-order operations such as decision models or functions support like consensus procedures support and forecasting facilities.

Fig 3.1: Theoretical Framework for the Effects of GDSS on Different Task Structures





### **3.3.3 Interaction**

Different task structures impose different task requirements on the decision group and GDSS technology introduces different communication features and decision aids for the decision group. GDSS can be seen as a decision tool which can be employed by the decision making group to satisfy the requirements of the decision task. Through the interaction process between group members using these features to satisfy the task requirements, patterns of communication change along with this interaction process and then in turn impact the decision outcomes of the group.

### **3.3.4 Patterns of Group Communication**

Patterns of group communication variables refer to characteristics of the group's communication patterns. These variables, adopted from Gettys, et al. (1987), attempt to capture the dynamics of group communication. This study focuses on characteristics of communication patterns in group decision making processes. Both adaptive structuration theory and the functional perspective of communication provide support for the important role of group process interaction in understanding the effect of GDSS on decision outcomes. The research framework adapts a scheme from Gettys, et al. (1987) for measuring group communication. This scheme has been used in other GDSS research to study the communication patterns of group members (Connolly, Jessup, and Valacich, 1990; Jessup, Connolly, and Galegher, 1990; Jessup, and Tansik, 1991). According to the scheme, eight categories can be used to represent an exhaustive list of mutually exclusive categories of comments generated during GDSS or face-to-face sessions. These categories are: proposed decision, support arguments, clarifications, critical arguments, queries, procedural related comments, other unrelated comments and total number of comments. For the GDSS session, the scheme also includes system related comments to capture comments related to the GDSS and its operations. Table 3.1 presents the definition of all the categories of comments.

### **3.3.5 Group Outcomes**

The last component in the research framework is the set of constructs labelled as group outcomes. Various schemes exist for classifying outcome variables in GDSS

research (Mennecke, et al., 1992; Pinsonneault and Kraemer, 1990; Zigurs and Dickson, 1990), and a high degree of agreement can be found among them (Benbasat and Lim, 1993). In particular, two consensual categories have surfaced, decision performance and perceived satisfaction (Zigurs and Dickson, 1990). In this study, twelve outcome measures are taken as indicators of group decision outcome.

The twelve outcomes are categorised into objectively measured performance and perceived satisfaction. These variables are adopted from Gouran, Brown, and Henry (1978) and Green and Taber (1980). The objectively measured decision performance includes decision quality and decision time. Decision quality is the degree to which a group's decision agrees with expert evaluation, and decision time is the time taken by the group to reach the decision. Some GDSS researchers have been concerned with using self-report assessments of system performance (Connolly, Jessup, and Valacich, 1990). Rather than rely on self-report evaluation, decision quality is, in this study, objectively measured by comparing the group's decision with the expert's solution. Decision time is measured by the actual time taken by the group to reach the decision.

The perceptual satisfaction variables include perceived satisfaction with the decision quality; perceived satisfaction with the group decision making process; perceived satisfaction with group participation; perceived satisfaction with the conflict behaviour in the group; perceived confidence in the group decision; perceived satisfaction with the depth of evaluation in the group decision; perceived willingness to remain in the group, and the perceived overall satisfaction with the decision making process. Two variables are also included to evaluate the usefulness of GDSS to the task and to compare the perceived effectiveness of GDSS with face-to-face meetings. Table 3.1 represents the definition of all the group outcome variables.

**Table 3.1 Definition of the Dependent Variables**

| <b>Construct</b>                              | <b>Definition</b>                                                                            |
|-----------------------------------------------|----------------------------------------------------------------------------------------------|
| <b><u>PATTERNS OF GROUP COMMUNICATION</u></b> |                                                                                              |
| <b>Decision Proposals</b>                     | The number of decision proposals.                                                            |
| <b>Support Comments</b>                       | The number of comments supporting a decision proposal.                                       |
| <b>Clarifications</b>                         | The number of comments adding detail or new features to a decision proposal or remark.       |
| <b>Critical Arguments</b>                     | The number of comments opposing a decision proposal or remark.                               |
| <b>Queries</b>                                | The number of comments requesting clarification of a decision proposal or remark.            |
| <b>Procedure Related Comments</b>             | The number of comments related to the procedure process of group decision making.            |
| <b>Other Unrelated Comments</b>               | The number of comments that are ‘off the topic’ and do not fit into the existing categories. |
| <b>Total Number of Comments</b>               | The total number of comments expressed in the whole decision making process.                 |
| <b>System Related Comments</b>                | The number of comments expressed about the computer system and its operation.                |

## **GROUP OUTCOME**

### **1. Decision Performance**

|                         |                                                                             |
|-------------------------|-----------------------------------------------------------------------------|
| <b>Decision Quality</b> | The degree to which a group's decision agrees with the expert's evaluation. |
| <b>Decision Time</b>    | The time taken by the group to reach the final decision.                    |

### **2. Perceived Satisfaction**

|                            |                                                                                                               |
|----------------------------|---------------------------------------------------------------------------------------------------------------|
| <b>Decision Outcome</b>    | The degree to which group members perceive their decision is good.                                            |
| <b>Decision Process</b>    | The degree to which group members perceive they are satisfied with the decision process.                      |
| <b>Participation</b>       | The degree to which group members perceive they have equally participated in the decision process.            |
| <b>Conflict Behaviour</b>  | The degree to which group members perceive they have expressed their negative opinions or suggestions.        |
| <b>Confidence</b>          | The degree to which group members perceive they are committed to the decision.                                |
| <b>Depth of Evaluation</b> | The degree to which group members perceive they have critically assessed the problem in the decision process. |

|                                                                 |                                                                                                                                           |
|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Perceived Willingness to Remain in Group</b>                 | The degree to which group members perceive they are willing to work with the group in future.                                             |
| <b>Perceived Overall Satisfaction</b>                           | The degree to which group members perceive they are satisfied with the overall decision making exercise.                                  |
| <b>Perceived Usefulness of GDSS to Task</b>                     | The degree to which group members perceive they find the GDSS useful to their decision task                                               |
| <b>Perceived Effectiveness of GDSS compared to Face-to-Face</b> | The degree to which group members perceive they find GDSS more effective for their decision task when compared to a face-to-face meeting. |

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### **3.4 Research Hypotheses**

As outlined above, the theoretical framework of this study is based on the input-process-output scheme proposed by Nunamaker, et al. (1993) and further developed by drawing from two relevant theoretical perspectives: adaptive structuration theory and functional perspective on group decision making. This framework suggests that different task structures will generate different decision requirements for the decision group and because of these different requirements, decision groups will use GDSS differently so as to meet these requirements. This will result in a different pattern of communication interaction across different task structures and this in turn will result in different decision outcomes. Based on this theoretical framework, it is hypothesised that GDSS effects will be different across different decision task structures and the differences can be analysed by studying the patterns of group communication among decision group members.

The study involves the manipulation of two independent variables: computer support (GDSS support versus face-to-face meeting) and task structure (additive, disjunctive

and conjunctive) in an experiment. Three categories of dependent variables are measured. They are (1) patterns of group communication in decision making processes and (2) decision quality and time and (3) perceived satisfaction with decision outcome, process and group. 'Patterns of group communication' is measured by nine variables. 'Decision quality' is measured by two variables and 'perceived satisfaction' is measured by ten variables. Altogether twenty one variables are collected.

Twenty-one pairs of hypotheses arise from the research framework. The first in each pair posits that there is a significant difference with respect to each of the dependent variables, between GDSS and non-GDSS groups. If the hypothesis is accepted, it implies that there is a significant difference between GDSS and non-GDSS groups on the dependent variable. The second in each pair of hypotheses posits that there is a significant interaction effect between the GDSS support and task structures with respect to each of the dependent variables. If the hypothesis is accepted, it implies that the effect of GDSS support on the dependent variable is varied as a function of different task structures. The second pair of hypotheses are appropriate to only eighteen of the twenty-one dependent variables because three of them only apply to the GDSS groups. The following hypotheses have been formulated to be tested in this study:

## **GROUP OUTCOME**

### **Decision Quality:**

- H1a: There is a significant difference between the decision quality of GDSS groups and non-GDSS groups.
- H1b: There is a significant interaction effect between the decision quality of GDSS groups and non-GDSS groups across different task structures.

**Decision Time:**

- H2a: There is a significant difference between the decision time of GDSS groups and non-GDSS groups.
- H2b: There is a significant interaction effect between the decision time of GDSS groups and non-GDSS groups across different task structures.

**PATTERNS OF GROUP COMMUNICATION****Decision Proposals:**

- H3a: There is a significant difference between the number of decision proposals in the decision making process of GDSS groups and non-GDSS groups.
- H3b: There is a significant interaction effect between the number of decision proposals in the decision making process of GDSS groups and non-GDSS groups across different task structures.

**Support Arguments:**

- H4a: There is a significant difference between the number of support arguments in the decision making process of GDSS groups and non-GDSS groups.
- H4b: There is a significant interaction effect between the number of support arguments in the decision making process of GDSS groups and non-GDSS groups across different task structures.

**Clarifications:**

- H5a: There is a significant difference between the number of clarifications in the decision making process of GDSS groups and non-GDSS groups.
- H5b: There is a significant interaction effect between the number of clarifications in the decision making process of GDSS groups and non-GDSS groups across different task structures.

**Critical Arguments:**

- H6a: There is a significant difference between the number of critical arguments in the decision making process of GDSS groups and non-GDSS groups.
- H6b: There is a significant interaction effect between the number of critical arguments in the decision making process of GDSS groups and non-GDSS groups across different task structures.

**Queries:**

- H7a: There is a significant difference between the number of queries in the decision making process of GDSS groups and non-GDSS groups.
- H7b: There is a significant interaction effect between the number of queries in the decision making process of GDSS groups and non-GDSS groups across different task structures.

**Procedure Related Comments:**

- H8a: There is a significant difference between the number of procedure related comments in the decision making process of GDSS groups and non-GDSS groups.
- H8b: There is a significant interaction effect between the number of procedure related comments in the decision making process of GDSS groups and non-GDSS groups across different task structures.

**Other Unrelated Comments:**

- H9a: There is a significant difference between the number of other unrelated comments in the decision making process of GDSS groups and non-GDSS groups.
- H9b: There is a significant interaction effect between the number of other unrelated comments in the decision making process of GDSS groups and non-GDSS groups across different task structures.



**Total Comments:**

H10a: There is a significant difference between the total number of comments in the decision making process of GDSS groups and non-GDSS groups.

H10b: There is a significant interaction effect between the total number of comments in the decision making process of GDSS groups and non-GDSS groups across different task structures.

**System Related Comments:**

H11a: There is a significant difference between the number of system related comments in the decision making process across different task structures.

**PERCEIVED SATISFACTION****Perceived Satisfaction with decision outcome:**

H12a: There is a significant difference between the perceived satisfaction with the decision outcome of GDSS groups and non-GDSS groups.

H12b: There is a significant interaction effect between the perceived satisfaction with the decision outcome of GDSS groups and non-GDSS groups across different task structures.

**Perceived Satisfaction with Group Decision Process:**

H13a: There is a significant difference between the perceived satisfaction with the group decision process of GDSS groups and non-GDSS groups.

H13b: There is a significant interaction effect between the perceived satisfaction with the group decision process of GDSS groups and non-GDSS groups across different task structures.

### **Perceived Participation in Group Decision Process:**

- H14a: There is a significant difference between the perceived participation in the group decision making process of GDSS groups and non-GDSS groups.
- H14b: There is a significant interaction effect between the perceived participation in the group decision making process of GDSS groups and non-GDSS groups across different task structures.

### **Perceived Conflict Behaviour in Group Decision Process:**

- H15a: There is a significant difference between the perceived negative behaviour in the group decision process of GDSS groups and non-GDSS groups.
- H15b: There is a significant interaction effect between the perceived negative behaviour in the group decision process of GDSS groups and non-GDSS groups across different task structures.

### **Perceived Confidence in Group Decision:**

- H16a: There is a significant difference between the perceived confidence in the group decision of GDSS groups and non-GDSS groups.
- H16b: There is a significant interaction effect between the perceived confidence in the group decision of GDSS groups and non-GDSS groups across different task structures.

### **Perceived Depth of Evaluation in Group Decision:**

- H17a: There is a significant difference between the perceived depth of evaluation in the group decision of GDSS groups and non-GDSS groups.
- H17b: There is a significant interaction effect between the perceived depth of evaluation in the group decision of GDSS groups and non-GDSS groups across different task structures.

**Perceived Willingness to Remain in the Group:**

H18a: There is a significant difference between the perceived willingness to remain in the group in GDSS groups and non-GDSS groups.

H18b: There is a significant interaction effect between the perceived willingness to remain in group in the GDSS groups and non-GDSS groups across different task structures.

**Perceived Overall Satisfaction:**

H19a: There is a significant difference between the perceived overall satisfaction of GDSS groups and non-GDSS groups.

H19b: There is a significant interaction effect between the perceived overall satisfaction of GDSS groups and non-GDSS groups across different task structures.

**Perceived Usefulness:**

H20a: There is a significant difference between the perceived usefulness of GDSS across different task structures.

**Perceived Effectiveness Compared to Face-to-face:**

H21a: There is significant difference between the perceived effectiveness of GDSS compared to face-to-face meetings across different task structures.

**3.6 Chapter Summary**

The primary objective of this study is to examine whether the structures of a decision task moderate the effects of GDSS on the patterns of group communication and decision performance in group decision making. This chapter developed a research framework for analysing this research objective. The research framework is based on the input-process-output scheme proposed by Nunamaker, et al. (1993) and further developed by drawing from two relevant theoretical perspectives: adaptive structuration theory and functional perspective on group decision making. The

framework consists of two independent variables (task structures and GDSS support), with patterns of group communication and group outcomes treated as dependent variables. For each of the dependent variable, two hypotheses were developed. The first hypothesis states the relationship between GDSS and non-GDSS groups and the second hypothesis states the interaction effect between GDSS support and task structure differences. Thus, sets of hypotheses were developed from the underlying theory and these hypotheses were then tested in an experiment described in Chapter 4.

## **CHAPTER 4**

### **RESEARCH METHOD**

#### **4.1 Introduction**

Having described two theoretical perspectives and the theoretical framework for studying GDSS effects on different task structures, this chapter describes the research method for testing the hypotheses developed in Chapter 3. This chapter is organised into nine sections. Section 4.2 presents an introduction of information systems research approaches. Section 4.3 presents an overall description of the experimental method in this study and discusses the justification of the design. Section 4.4 presents the subjects of the experiment. Section 4.5 describes the experimental task and Section 4.6 discusses the experimental manipulations of the two independent variables. Section 4.7 presents the experimental procedures of the study and Section 4.8 describes the dependent variables of the experiment. Finally, Section 4.9 provides a summary of this chapter.

#### **4.2 Information Systems Research Approaches**

A number of taxonomies of information systems research approaches have been postulated over the years (Galliers, 1992; Vogel and Wetherbe, 1984; Hamilton and Ives, 1982). The information systems research approaches, as reviewed in these taxonomies, can be classified into two categories which can be labelled as the positivist and the interpretivist approaches. The differences between these two approaches can be high-lighted by considering their epistemological and ontological bases. All research in the social sciences makes ontological assumptions about the nature of reality and social beings. The positivists assume that there is an objective reality that can be studied which exists independently of the perceiver and the purpose of research is to come to 'know' this objective reality. In their view, the social world, like the physical world, exists independently of individuals' perceptions as a real, concrete and unchanging structure. This reality is patterned and fragmentable and can, therefore, be accurately measured or studied (Souder, 1980).

The interpretivists, on the other hand, deny that one single real world exists; that is, they view reality as being essentially mental and perceived (Morgan, 1980). Because reality is also socially constructed, multiple realities exist as the result of different individual and group perspectives (Berger and Luckman, 1967). The interpretivists believe that no amount of research will lead to the discovery of a single reality because of the existence of multiple realities which are constantly changing. They consider it essential for the researcher to know the context of any behaviour or event because social beings inevitably construct reality and give it meaning within a context. According to this view, researchers should study people in their natural contexts and view them holistically; they should not be studied out of context. Furthermore, people should be studied according to their own perspectives or frames of reference rather than those of the researcher.

The positivist and interpretivist approaches also make different assumptions about the nature of social beings. The positivist approach holds that human behaviour is determined while the interpretivist approach views people as possessing more voluntaristic: people *actively* create and interact in order to shape their environment and not merely acted upon by outside influences. Therefore, the positivists' overriding goal is 'explanation' by subsuming of the behaviour under universal laws (Anderson, 1986; Bredo and Feinberg, 1982; Kerlinger, 1986); the goal of explanation entails prediction. An explanation is achieved when the systematic association of variables underlying a phenomenon is demonstrated. For the interpretivists, on the other hand, the primary goal of research is understanding behaviour, not predicting it (Rubinstein, 1981). Interpretivist researchers view understanding as more of a process than an end product.

There are also striking differences between what counts as 'knowledge' within the two research approaches. Positivists take a generalising approach to research; that is, they seek out general laws which can be applied to a large number of phenomena, people, settings and times. Interpretivists take a more historical, particularistic approach to research, that is they study a specific phenomenon in a particular place

and time rather than seeking to determine law-like regularities. Interpretivist approach seeks to determine motives, meanings, reasons and other subjective experiences that are time- and context-bound. The positivists, with their goal of explanation and prediction, place a high priority on identifying causal linkages but the interpretivists view the world as being so complex and changing that it is often impossible to distinguish a cause from an effect. Viewing the world holistically, the interpretivists' stance is that mutual, simultaneous shaping occurs between entities (Lincoln and Guba, 1985; Rubinstein, 1981).

The data-collection techniques usually employed by the two schools reflect these differing views of causality. The positivists often use experiments in which there is an attempt to control the variables, the context, and the temporal order of events so that causal relationships can be inferred. The interpretivists frequently prefer descriptive analysis from participant observations and historical documents as they attempt to view the entities holistically, in the context of political, social, economic, cultural and other systems. The key features of the major information system research approaches, based on Galliers (1992), are now considered in turn, followed by a consideration of their relative strengths and weaknesses.

#### **4.2.1 Positivist Approaches**

##### *Laboratory experiments*

The key feature of laboratory experiments is to create a designed and controlled environment in order to study and identify the precise relationships between variables. The researcher manipulates the independent variables, controls the intervening variables, and measures the effect of the independent variables on the dependent variable. This approach enables the researcher to isolate and control a small number of variables which may then be studied intensively. The major weakness of this approach is that it may not be possible to generalise the findings obtained by an experiment to real world due to the over-simplification and artificial environment of the experimental situation which is isolated from the real world.

### *Field experiments*

Field experiments are an attempt to extend laboratory experiments into real world situations. The approach is less artificial than laboratory experiments but finding suitable organisations to participate in the experiment may be difficult and the researchers may not achieve sufficient control over the intervening variables and the effects of the independent variables on the dependent variable cannot be studied without the intervention of other variables.

### *Simulation*

The key feature of simulation is to create a simplified model of a complex environment so that variables can be studied intensively. The strength of this approach is that variables which are not possible to manipulate in the real world can be studied. It may not, however, be possible to generalise the findings obtained by simulation to the real world due again to the over-simplification of the simulation model.

### *Survey*

Survey research involves questioning a large enough sample of people to give a sense of the range of sentiment across the relevant group. The sample may be probabilistic or nonprobabilistic, and the data may be acquired via interviews and/or questionnaires. The survey approach seeks, by studying a representative sample of organisations, to identify relationships that are common across organisations and hence to provide generalisable statements about the object of study. Greater number of variables can be studied than in the experimental approaches but errors can arise in sampling frames, from non-response, from question wording and from interviewer bias. Moreover, the survey approach often only provides only a snap-shot of the situation at a certain time, yielding little information on the underlying meaning of the data.

### *Secondary research*

Existing data or documents are re-examined in the light of a different theoretical framework or research objectives. Although secondary research can use a wide variety of research tools, it tends to emphasise the use of statistical methods to summarise



existing data. The strength of this approach is that it can provide a picture of current information on the research area. However, it may be difficult to collate different data or research outputs and draw a conclusion since most of the data or research results are likely to have been collected by different methods and in different settings.

### *Case studies*

The case study approach refers to a group of methods which emphasise in-depth analysis (Yin, 1984). Data is collected from a number of organisations through such methods as examining documents, participant observation and in-depth interviews. The case study approach seeks to describe or study the relationships that exist in a particular situation. The strengths of this type of research in information systems include: (1) the researcher can study information systems in a natural setting; (2) the method allows the researcher to understand the nature and complexity of the process taking place; and (3) valuable insights can be gained into new topics emerging in the rapidly changing information systems field (Benbasat, et al. 1987). However, fervent critics of the case study approach are many and hail largely from the physical sciences. The major weaknesses of the case study approach are: (1) the inability to manipulate independent variables; (2) the risk of improper interpretation of data; and (3) the conclusions drawn may be specific to the particular organisations studied and may not be generalisable (Kerlinger, 1986). Some researchers argue that case studies should be listed as an interpretivist approach given the particular 'cognitive filter' (Simon, 1976) and the role as data interpreter of the researcher.

## **4.2.2 Interpretivist approaches**

### *Phenomenological/Interpretative research*

The aim of phenomenological/interpretative research is to study real-world phenomena in a natural setting or through examining existing documents to generate new opinion or insights. The strength of this form of research lies in its ability to study and represent reality following an in-depth self-validating process in which pre-suppositions are continually questioned and understanding of the phenomenon under study is refined (Ga'lliers, 1992). The weaknesses of this approach relate to the risk of

improper interpretation of the data and the inability of researchers to identify their biases when interpreting the data.

### *Action research*

Action research was proposed by Lewin (1947) as a mode of social research intended to overcome some of the short-comings of positivism. This approach combines action and research by arguing that a social situation can best be understood if a change is introduced into it and the effects observed. The researcher plays an active role in the object of study by acting as a change-agent in relation to the process being researched. Action research, as such, has the twin aims of providing practical guidance to people faced with immediate problems and contributing to the goals of identifying theoretical outcomes (Argyris and Schon, 1989). Unlike most of the positivist approaches, there is no attempt to study one particular factor in isolation divorced from its wider context. Any aspect, feature, factor or variable which has a bearing on the causes and solution to the problem can be investigated. Action research can use a wide variety of research tools, but it tends to emphasise the use of observational data. The strength of this approach is that it is very practical and problem-solving oriented. Its weaknesses are similar to those of case studies which include the risk of improper interpretation of data and the results of the research may be specific to the particular organisations.

## **4.3 Experimental Design**

An experiment involves the manipulation of one or more variables by the researcher in such a way that the effect on one or more other variables can be measured (Fromkin and Streufert, 1976; Benbasat, 1984; Galliers and Land, 1987; Vogel and Wetherbe, 1984). According to Kerlinger (1986), laboratory experiments are the most suitable way of testing predictions derived from theory or inferences drawn from other studies, because they provide a means for studying relationships under controlled conditions. The principal reasons for adopting an experimental design in this research were as follows:

1. The study was designed to contribute toward the cumulative tradition of GDSS research. Although the variety of methods used has increased in recent years, the majority of GDSS empirical studies have still been laboratory experiments (Zigurs, 1993). This pattern was followed so that research results could be directly compared to other GDSS studies.

2. The purpose of this research was to study the effects of GDSS on group decision making across different task structures. It sought to answer the following questions: (1) Are there any systematic differences in the decision outcomes between GDSS supported and face-to-face decision making groups across different task structures? (2) Are there any systematic differences in the patterns of group communication between GDSS supported and face-to-face decision making groups across different task structures? (3) Is there any systematic relationship between the patterns of group communication and the decision outcomes among the GDSS supported and face-to-face decision making groups across different task structures? Since many factors have the potential for influencing the effects of GDSS on group decision making (Dennis, et al., 1988), it is essential to control other variables so as to permit strong inferences about the cause and effect of GDSS across different task structures. Experimental methods allow careful control of the extraneous variables, while manipulating the independent variables so that their effects on the dependent variables can be directly studied.

3. DeSanctis (1989) argued that the relative newness or novelty of the technology to the groups is an important factor when considering different research approaches, and laboratory studies are a suitable choice for studying the effects of novel technologies. Only when the technology is installed in an organisation will field studies become a realistic possibility. Survey, case studies or action research are a possible way to answer the research questions. However, GDSS technology is still not very common, especially in Hong Kong companies, it would be very difficult to study of the GDSS effects across different task structures in the field. Companies may be using different GDSS technologies and they may not use GDSS for multiple decision task structures.

The issue of validity is a major consideration in the selection of a research method. Internal validity refers to the validity of a researcher's conclusion that the relationship between the independent and dependent variables is causal and that the independent variable (and nothing else) caused the observed effects on the dependent variable. External validity is the degree to which the relationships observed can be generalised to other populations, settings, and times (Cook and Campell, 1979). The main problem with the experimental method is the problem of external validity: the problem of how generalisable the results are (Benbasat, 1984; Galliers and Land, 1987). The main advantage of the experimental method is that it minimises the effects of extraneous variables that might confound the results. Experimental methods can achieve higher internal validity than other methods such as surveys or case studies. This method suits the purpose and the testing of the hypotheses in this research.

While recognising the strengths and limitations (*see limitations of current research in section 6.6*) of the experimental methods, this study aims to provide some initial answers to the research questions and some useful information for other studies using surveys, case studies or action research approaches. In order to improve the external validity of this research, the experimental task and setting were designed to resemble the real organisational setting as closely as possible and instead of using students as subjects, as many GDSS experimental studies have done, this study used practising managers so that generalisability of the results could be improved.

The research method used in this study was an experiment with a 2x3 factorial between-subjects design, manipulating two independent variables: group decision support (computer support and no computer support) and task structure (additive, disjunctive and conjunctive). The subjects were 216 practising managers. Using a personnel recruitment exercise as the experimental task, the experiment was administered when the subjects were participating in a management training course. Three classes of dependent variables examined were objective decision performance, group communication interaction and perceived decision satisfaction.

#### 4.4 Subjects

Most of the experimental research on GDSS has involved students as surrogates. Researchers have widely discussed the validity of using student subjects for experimental research (Gordon, Slade, and Schmitt, 1986; McFarlan, 1986; Burnett and Dunne, 1986; Greenberg, 1987). The criticisms of using student subjects include the low generalisability of the experimental results for practising managers and the students' lack of knowledge of how to perform real organisation tasks in the experiment. In this study, practising managers participating in a five-day management training program were chosen as subjects in the experiment. This approach was selected in order to enhance the ability to generalise the findings for organisations. Secondly, a training environment represents a stable research environment within which the researcher can carefully manipulate the characteristics of the experimental task, while controlling the other variables. Thirdly, a large number of research participants were needed for proper statistical analysis, making this group an attractive subject pool.

The subjects were 216 mid-level managers from thirty five diverse organisations in Hong Kong participating in a five-day management training program. Subjects were required to participate in the experiment as part of their training. Included were five conglomerates, eleven financial institutions, five trading companies, eight manufacturers and six retail companies. Typical job titles of the subjects included sales manager, administrative officer, finance manager and accounting officer. Before the start of the experiment, each subject was asked to fill out a questionnaire which requested their personal demographics, educational background, work experience, typing skill, computer knowledge and experience towards group decision making. The background information of the subjects is summarised in Table 4.1.

The subjects ranged in age from 24 to 41 with a mean age of 28.4 years; 73% were male; 91% had at least high school education; 67% had an undergraduate degree. Subjects had been employed in a full-time job from 4 to 10 years and had been in their present position from 2 to 9 years with a mean tenure of 6.2 years. Average typing

skills of the subjects were very good and they were frequent computer users in their job. The subjects were also familiar, on average, with 3.4 computer applications.

Subjects were randomly assigned to one of the six experimental conditions in three person groups. The group size of 3 was chosen because the average number of people attending a decision-making meeting is less than 5 (Kriesberg, 1950; Filley, 1970) and since much experimental research in GDSS had previously involved a group size of 3 (Steeb and Johnston, 1981; Lewis, 1982; Watson, DeSanctis and Poole, 1988; Gallupe, DeSanctis and Dickson, 1988), the study results could be compared to the previous findings. A total of 72 groups was used (12 groups per treatment).

Statistical tests were conducted to ensure that the backgrounds of the subjects were not significantly different across the six experimental treatments. Table 4.2 presents the results of the statistical tests. The results of these tests confirmed that the subjects did not differ significantly in their backgrounds. Thus, the endeavour of having an even spread of participants across the treatment was achieved.

Table 4.1 Means and Standard Deviations for Subjects' Background Information

| Variables                                                          | Experimental Treatments |       |       |       |       |       | Total  |
|--------------------------------------------------------------------|-------------------------|-------|-------|-------|-------|-------|--------|
|                                                                    | 1                       | 2     | 3     | 4     | 5     | 6     |        |
| Number of groups                                                   | 12                      | 12    | 12    | 12    | 12    | 12    | 72     |
| Number of participants                                             | 36                      | 36    | 36    | 36    | 36    | 36    | 216    |
| Number of male/female                                              | 27/9                    | 28/8  | 24/12 | 23/13 | 27/9  | 29/7  | 158/58 |
| Age of participants                                                |                         |       |       |       |       |       |        |
| Mean                                                               | 28.5                    | 26.7  | 30.1  | 27.6  | 29.5  | 28.0  | 28.4   |
| S.D.                                                               | (3.8)                   | (2.6) | (2.9) | (3.2) | (4.0) | (2.9) | (3.4)  |
| Number of years employed full-time                                 |                         |       |       |       |       |       |        |
| Mean                                                               | 5.9                     | 6.0   | 5.3   | 6.3   | 6.7   | 6.8   | 6.2    |
| S.D.                                                               | (1.2)                   | (2.0) | (1.2) | (1.6) | (1.8) | (1.9) | (1.7)  |
| Percentage of participants having at least an undergraduate degree | 67%                     | 72%   | 61%   | 61%   | 78%   | 61%   | 67%    |
| Level of experience in group decision making (times/months)        |                         |       |       |       |       |       |        |
| Mean                                                               | 5.5                     | 5.6   | 5.6   | 5.1   | 5.7   | 5.5   | 5.5    |
| S.D.                                                               | (1.4)                   | (1.4) | (0.7) | (1.0) | (1.1) | (0.7) | (1.1)  |
| Typing skill <sup>1</sup>                                          |                         |       |       |       |       |       |        |
| Mean                                                               | 2.7                     | 2.6   | 2.8   | 2.8   | 3.0   | 2.9   | 2.8    |
| S.D.                                                               | (0.5)                   | (0.5) | (0.7) | (0.7) | (0.8) | (0.5) | (0.6)  |
| Frequency of computer use in a typical week <sup>2</sup>           |                         |       |       |       |       |       |        |
| Mean                                                               | 3.4                     | 3.6   | 3.6   | 3.5   | 3.7   | 3.4   | 3.5    |
| S.D.                                                               | (0.7)                   | (0.5) | (0.5) | (0.5) | (0.7) | (0.5) | (0.5)  |
| Number of software applications familiar with                      |                         |       |       |       |       |       |        |
| Mean                                                               | 3.3                     | 3.5   | 3.4   | 3.3   | 3.5   | 3.3   | 3.4    |
| S.D.                                                               | (0.6)                   | (0.5) | (0.5) | (0.5) | (0.7) | (0.5) | (0.5)  |

Notes:

#### Experimental Treatment

- 1- non computer support with additive task
- 2- non computer support with disjunctive task
- 3- non computer support with conjunctive task
- 4- computer support with additive task
- 5- computer support with disjunctive task
- 6- computer support with conjunctive task

- 1      scale: 1- hunt and peck  
         2- rough or casual typing  
         3- good typing (30 wpm error free)  
         4- excellent typing (could be employed as a typist)

- 2      scale: 1- never  
         2- once or twice  
         3- three to ten times  
         4- more than ten times
- 

In order to prepare subjects for the experiment, all were exposed to the concepts of group decision making processes and GDSS technology during the training course.

All subjects were also given a training session on GDSS before the experiment. This helped to control individual differences in their understanding and ability in group decision making and their exposure to GDSS. At the beginning of each experimental session, GDSS supported group members were given a brief training session on the use of GDSS.



Table 4.2: Results of Statistical Tests for Background Information Across Treatments

| Variables                                                           | F     | Sig.  | $\chi^2$ | Sig.  |
|---------------------------------------------------------------------|-------|-------|----------|-------|
| Number of male/female                                               |       |       | 3.866    | 0.569 |
| Average age of participants                                         | 1.783 | 0.128 |          |       |
| Average number of years employed full-time                          | 1.321 | 0.266 |          |       |
| Percentage of participants having at least an undergraduate degree  |       |       | 4.000    | 0.549 |
| Average level of experience in group decision making (times/months) | 0.450 | 0.812 |          |       |
| Average typing skill <sup>1</sup>                                   | 0.661 | 0.654 |          |       |
| Average frequency of computer use in a typical week <sup>2</sup>    | 0.387 | 0.856 |          |       |
| Average number of software applications familiar with               | 0.438 | 0.820 |          |       |

Notes:

- 1      scale: 1- hunt and peck  
         2- rough or casual typing  
         3- good typing (30 wpm error free)  
         4- excellent typing (could be employed as a typist)
- 2      scale: 1- never  
         2- once or twice  
         3- three to ten times  
         4- more than ten times

## 4.5 Experimental Task

According to Gallupe (1986), the experimental task for GDSS research should meet the following criteria (p.516):

1. Face Validity: The task must look realistic and be interesting.
2. Content Validity: The task description must be accurate and consistent without errors in logic.
3. External Validity: The task must be relevant and applicable to actual organisational decision situations.
4. Appropriate: The task must be appropriate for support by computer-based GDSS.

Jarvenpaa, Dickson, and DeSanctis (1985) have emphasised the significance of validity with respect to the experimental task. The task must be:

1. Flexible - permit manipulation of relevant variables.
2. Appropriate - create an environment that allows the research issues to be studied.
3. Clear - subjects do not have difficulty in understanding what is expected of them.
4. Unbiased - unbiased towards particular treatment conditions.

The experimental task was adapted from *The Management Game* developed by Burst and Schlesinger (1987). The management game involves a fictitious commodities company, Consolidated Commodities, Inc. (ConCom) which has recently created a new speciality foods division. The speciality foods division's main task is to promote a new line of imported Italian food products. Participants were asked to assist ConCom, Inc. in selecting a product manager for the new division and were given information about the fictitious company, the foods division, and a job description for the new product manager. The product manager would be responsible for strategic

product development and policy implementation for all products within the speciality foods division. A complete description of the task is presented in Appendix A.

The exercise was selected because Burst and Schlesinger (1987) provided a realistic and relevant format for the group decision making process. Most hiring decisions are made in a group and most of the middle managers should have experience in the decision process of hiring for an important position. In addition, since the task was not dependent on the functional speciality of the participant, all the participants could participate actively in the decision process (Swieringa and Weick, 1982), whereas an engineer, for example, might not participate fully in the decision process if he was asked to make a decision on company dividend policy. The exercise was moderately complicated so that the task could look realistic and evolve interest. Furthermore, the task was very flexible which allowed manipulation of the structure of the task to create a research environment for this study (*see Section 4.5: Experimental Manipulations*). This task has also been successfully used in other experimental studies (Murrell, Stewart and Engel, 1993). Another advantage of using this task is because Burst and Schlesinger (1987) also provided an expert solution to which the group's decision could directly be compared.

#### **4.5.1 Pilot Tests On Experimental Task**

The task materials were pilot-tested and iteratively refined over the course of three months, over 60 part-time MBA students participated in these experimental task pilot-tests. The background information of the participants in the pilot-test is summarised in Table 4.3.

All the participants in the pilot-test were part-time MBA students in a major university in Hong Kong. These pilot-test participants were chosen because they had very similar backgrounds to the subjects in the main study. All these pilot-test participants were full-time employees and the typical job titles of the participants were sales and marketing manager, account manager, administrative officer, bank manager and engineering officer.

Table 4.3 Means and Standard Deviations for Pilot-test Participants' Background Information

| Variables                                                           | Background |
|---------------------------------------------------------------------|------------|
| Number of groups                                                    | 20         |
| Number of participants                                              | 60         |
| Number of male/female                                               | 42/18      |
| Average age of participants                                         | 27.0 (2.7) |
| Average numbers of years employed full-time                         | 5.1 (1.4)  |
| Percentage of participants having at least an undergraduate degree  | 95%        |
| Average level of experience in group decision making (times/months) | 5.9 (1.4)  |
| Average typing skill <sup>1</sup>                                   | 2.7 (0.7)  |
| Average frequency of computer use in a typical week <sup>2</sup>    | 3.6 (0.5)  |
| Average number of software applications familiar with               | 3.8 (0.5)  |

Notes:

- 1 scale: 1- hunt and peck  
2- rough or casual typing  
3- good typing (30 wpm error free)  
4- excellent typing (could be employed as a typist)

- 2 scale: 1- never  
2- once or twice  
3- three to ten times  
4- more than ten times

( ) Standard Deviations

The task materials were first reviewed by three faculty members and were then presented to the group of 39 test participants who were asked to complete the task according to the instructions. They were then asked to comment on the task and the task materials. The key goals of this pilot testing were to check that participants clearly understood the task materials and that the task was both relevant and interesting to the participants. As a result of this pilot-test, several sentences in the task materials were reworded to improve their clarity. Wording of the general instructions and introductory material was also modified. The layout of materials was also changed to improve their visual appeal. Almost all of the pilot-test participants reported that they found the task highly interesting and relevant and they could participate freely in the group discussion.

The modified task materials were then presented to a second group of 21 MBA students. Like the first group, they were also asked to complete the task according to the task instructions, they also provided comments on the task and the task materials. Only minor modifications were proposed by this group. All the participants also found the task stimulating and were comfortable with the task materials and the task requirements.

## **4.6 Experimental Manipulations**

### **4.6.1 GDSS Environment**

In the case of the GDSS group, subjects were provided with a GDSS called 'Computer Aided Meeting Helper' (CAMH). The author was involved in the design, development, and testing of CAMH. It runs in the AIX operating system environment which is IBM's version of the Unix operating system. AIX is a multi-user operating system and provided facilities for exchanging messages and data between various programs within the CAMH system. The software ran on an IBM RISC System/6000 model 320. The configuration comprised X-stations and IBM 3151 terminals linked with the server by an ethernet connection.

The CAMH system was organised into three modules. The first module (Group Talk) enabled the users to enter, send, view, modify and delete messages generated by the group members. CAMH had two windows in each station: a private window and a public window. Each workstation had a full-screen window running the private window in which users could enter individual messages and then send them to the public window. A second window allowed users to toggle back and forth between the private and the public windows so that they could view the messages sent by other group members. This module also allowed group members to modify and delete their message on the public window.

The second module (Decision Aid) provided a multicriterion decision model support for users. This module enabled users to define the problem, select decision criteria, weight decision criteria, define and evaluate alternatives. This module was useful for decisions which required consideration of a number of alternatives and criteria. For example, in investment management, the decision of how and where to invest the money involved consideration of a number of alternatives (for example, government securities, mutual funds, and corporate bonds) and criteria (for example, risk of investment, return on investment, and length of investment). This module was also useful for the experimental task in this study. Personnel selection required consideration of different criteria (for example, academic qualification, working experience and personal character) for candidates (the alternatives) who applied for the job. The module allowed the decision makers to express their subjective preferences by weighting the relative importance of different criteria and then systematically evaluating how well the alternatives met the criteria.

The third module (Voter) provided users with a range of voting features. In a typical vote, a ballot was initiated by one of the users, voted upon by the participants in the meeting, and finally the results of the vote were displayed. The module also included a set of Yes/No and rank order voting methods. Under this module, any member could initiate a vote and propose a voting method.

The design of the system was similar to GDSS systems used in the experimental design in the major GDSS research centres (like SAMM - Software Aided Meeting Management in the University of Minnesota and GroupSystems in the University of Arizona). These features have been identified as appropriate for supporting the communication needs of the group (Huber, 1984; DeSanctis and Gallupe, 1987) and similar GDSS features were being used successfully for other studies of GDSS (DeSanctis and Poole, 1989; Jarvenpaa, Rao and Huber, 1988).

The experiment involved two GDSS environments. In the GDSS treatment, each group member worked in a decision room. The room had tables arranged in a U-shaped pattern, swivel chairs with a private terminal in front of each chair. Audio microphones were placed on the tables and an audio recorder was mounted at the front of the U-shaped table. In addition, a chair was separately positioned for the administrator to watch the proceedings of the group session. The administrator monitored the process of the experiment but did not participate in the group decision process. The administrator only answered questions related to the use of the GDSS and ensured that the system was operating properly. Figure 4.1 demonstrates the physical layout of the decision room.

Face-to-face groups without computer support made decisions in a room identical to the one used by the GDSS groups. No GDSS was provided for these groups but a flip chart was provided for recording and displaying public information. Figure 4.2 presents the physical layout of the face-to-face group. In both GDSS and non-GDSS treatments, each group member had the use of a pencil, paper and a small hand calculator.

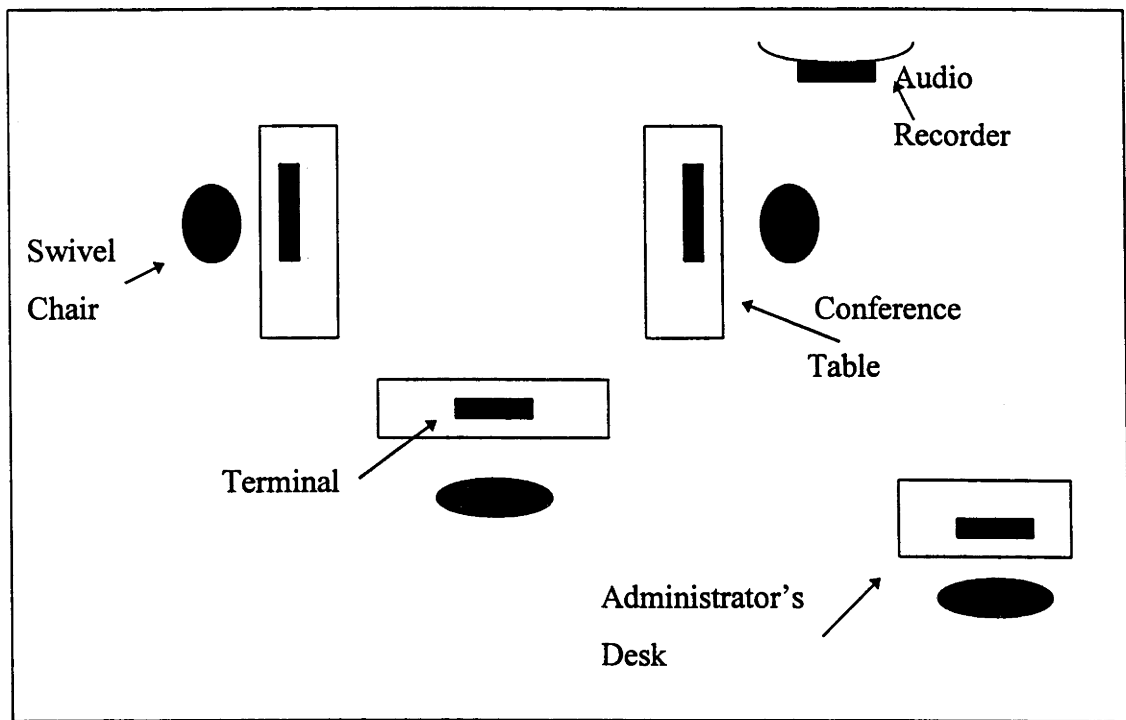


Fig 4.1: Physical Layout of the GDSS Decision Room

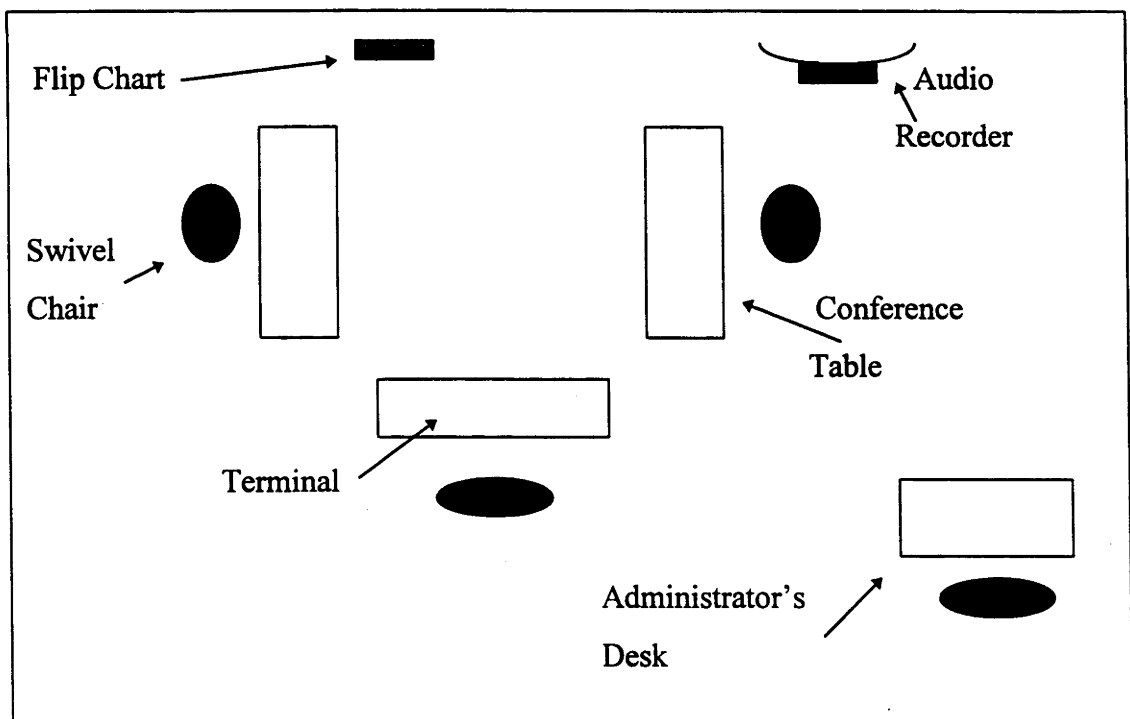


Fig 4.2: Physical Layout of the Face-to-Face Decision Room



#### **4.6.2 Pilot Tests On GDSS Environment**

The same 60 part-time MBA students who participated in the pilot-testing of the experimental task were also involved in the pilot testing of the GDSS. The purpose of this pilot test was to ensure the smooth operation and validation of the system prior to the actual experiment. The first pilot test consisted of 39 students. Prior to the computer sessions, a one and a half hour lecture was conducted to familiarise students with the general background of GDSS technology and the potential benefits of the technology for improving group decision making. Students were then introduced to the CAMH and received a 30 minutes training session on the system.

After the training session, students were asked to solve an investment allocation problem in a group of 3 persons. The task involved making a group decision for how to allocate a budget of \$500,000 across six projects. The sessions were held in a room which had a similar design to the decision room used in the main experiment.

After the session, participants were asked to comment on the operations and the usefulness of specific features of the system. Participants were also asked to comment on the training materials. Overall, the participants were pleased with both the CAMH and the training session. They were comfortable using the system, following a 30-minute training session, and found the CAMH both interesting and useful for the investment allocation task. Some suggestions to improve the system were proposed which included increasing the limit from 2 to 4 lines for each idea, to use a function key rather than CTL-T to toggle back and forth between the private and the public screens and finally that members should be able to view the weights and ratings of the multicriteria model in the public screen. Although most of the participants were satisfied with the training session, suggestions were received from the participants to include in the training session, a demonstration of CAMH can be used to solve a decision problem. Some suggestions for improving the training materials were also received from the participants. Appendix B provides a copy of the training materials for CAMH.

The training session and the CAMH were modified according to the suggestions received from the first pilot group. The modified training session and the CAMH were then presented to a second group of 21 MBA students. Like the first group, they were asked to comment on the training session and operations and usefulness of CAMH. Only minor suggestions were received from this group. The participants expressed satisfaction with both the CAMH and the training session.

#### **4.6.3 Task Structures**

Three types of task structures were manipulated by defining group member roles and responsibilities concerning division and sharing of information. These structures were taken directly from the typology developed by Steiner (1972). Three pieces of information were provided to the group about each candidate: a resume, a detailed work history and a confidential character evaluation report. In the additive task structure, each group member received all three pieces of information and was asked to discuss the decision and to help determine the group ranking. Thus, each group member had the same information and the group ranking depended on the aggregation of combined inputs from the individual group members.

In the disjunctive task, each group member received all three pieces of information, ranked the candidates individually, but was told that the group was then to decide which individual member's ranking was optimal. Thus, each group member had the same information and the group ranking or solution depended on the group's ability to recognise the superior contributions of a solution provided by an individual group member.

In the conjunctive task structure, each group member received only one type of information about each of the three candidates. For example, one group member received all of the resumes for the three candidates while another received all of the confidential performance evaluation reports for the three candidates. Thus, each group member had different information and the group ranking depended on the individual contributions of each group member, as the holder of specific information.

#### 4.6.4 Pilot Tests on Task Structure Manipulation

The task structure manipulation was pilot-tested and iteratively refined over the course of three months. The same 60 part-time MBA students participated in the pilot-testing of the experimental task and GDSS environment. The task materials were presented to the first group of 39 test participants and they were asked to complete the task according to the instructions. To assess the task structure manipulation, participants were asked, “Which of the following best describes how you made the decision on the task you have just finished?” (1) Each group member has the same information and the group works together as a team to reach the best solution; (2) Each group member has the same information and the group selects one best solution from an array of solutions championed by individual group members ; or (3) Each group member has different information and each group member contributes to reach the best solution. Of the 39 responses, only 2 were misclassified (see Table 4.4).

Table 4.4: Classification of Experimental Treatments on Task Structure

| Classification | Experimental Treatments |             |             | Row Total |
|----------------|-------------------------|-------------|-------------|-----------|
|                | Additive                | Disjunctive | Conjunctive |           |
| Additive       | 13                      | 0           | 0           | 13        |
| Disjunctive    | 0                       | 12          | 1           | 13        |
| Conjunctive    | 0                       | 1           | 12          | 13        |
| Column Total   | 13                      | 13          | 13          | 39        |

|                      |    |             |
|----------------------|----|-------------|
| Chi-Square ( $X^2$ ) | df | Significant |
| 66.92                | 4  | 0.00001     |

The single-sample Chi-Square demonstrated a good fit between the experimental conditions (additive task, disjunctive task, and conjunctive task) and the participants' perception of the task structure in the experiment ( $X^2=66.92$   $df=4$ ,  $p<0.00001$ ). This pilot test demonstrated that participants had no problem in identifying the corresponding task structure they were assigned. They were also asked to comment on

the task materials and the manipulations of the task structures. As a result of this pilot-test, several sentences in the general instructions of task materials were reworded to improve their clarity. The modified task materials were then presented to a second group of 21 MBA students. Like the first group, they were also asked to complete the task according to the task instructions and identify the task structure of their decision task. Of the 21 responses, only 1 was misclassified (see Table 4.5). The single-sample chi-square demonstrated a good fit between the experimental conditions (additive task, disjunctive task, and conjunctive task) and the participants' perception of the task structure in the experiment ( $X^2=36.75$   $df=4$ ,  $p<0.00001$ ). This pilot test indicated that task manipulation appeared to have been successful.

Table 4.5: Classification of Pilot-Test Experimental Treatments on Task Structure

| Classification | Experimental Treatments |             |             | Row Total |
|----------------|-------------------------|-------------|-------------|-----------|
|                | Additive                | Disjunctive | Conjunctive |           |
| Additive       | 7                       | 0           | 0           | 7         |
| Disjunctive    | 0                       | 7           | 0           | 7         |
| Conjunctive    | 0                       | 1           | 6           | 7         |
| Column Total   | 7                       | 6           | 8           | 21        |

|                      |    |             |
|----------------------|----|-------------|
| Chi-Square ( $X^2$ ) | df | Significant |
| 36.75                | 4  | 0.00001     |

### 4.7 Experimental Procedures

A group concurrently reported to a seminar room. The researcher introduced the experiment as a session for assessing the decision making skills of the participants. Then they were told that they would be participating in a simulation exercise and that they would be role-playing the part of a member of a strategic decision making team involved in selecting a new product manager from a set of available candidates.

Although the subjects understood that the experimental session was merely an exercise, they were strongly encouraged to treat the experiment as if it were a real situation within their company. As an incentive to do their best in the exercise, the researcher informed the subjects that individuals who performed well would receive a letter recording their success and they were encouraged to show this letter to their employers.

After the introduction of the experiment, subjects were asked to fill out a questionnaire which requested their personal demographics, educational background, work experience, computer knowledge and attitudes to and experience with group decision making.

Each subject was given an information packet that contained case material, an instruction sheet and candidate's information sheets according to the experimental group to which they were assigned. All the groups were asked to follow the same general decision-making steps:

1. read and analyse the material individually,
2. discuss the material,
3. generate possible alternatives,
3. resolve any conflict,
4. make a group decision.

This created a structure for the decision making session but allowed free-flowing discussion.

Groups that were supported by GDSS were instructed to use whatever features of the system they thought might help the group decision making. The final decision was written on the decision forms provided. The time they began the experimental task was noted, but groups were not given a time limit for completing the task. They were asked to hand in their decision on the decision forms immediately after the decision

was again noted and the time they had reached a decision was marked on the decision sheet.

After the group handed in their decision sheet, individual group members were asked to fill out a set of questionnaires that asked about how they made decisions on the task they had just finished, and about the group's decision making environment. These questions served as a check on the successfulness of the experimental manipulation. Individual group members were then asked to fill in two set of questionnaires about their perceived satisfaction with the group's decision process and outcome. A fourth set of questionnaires were distributed to the GDSS group to measure the perceived usefulness of the system to the assigned task. In terms of questionnaire design, subjects in all six environments received the same items in the questionnaire. The questionnaires are shown in Appendix C.

Finally, after they had filled in the questionnaires, a debriefing session was held for each group. The session served to collect qualitative information regarding any questions, comments or feedback on the decision making session. The group were also asked to comment on the experiment as a whole.

#### **4.7.1 Pilot Tests on Experimental Procedures**

The experimental procedures were pilot tested with two groups of part-time MBA students. The first group consisted of 39 students who had participated in the pilot tests for the experimental task, the GDSS and the task structure manipulation of the experiment. The second pilot group consisted of 33 part-time MBA students who had not participated in any of the pilot tests. The background information on these participants is summarised in Table 4.6.

Table 4.6: Means and Standard Deviations for Experimental Procedures Pilot-Test  
Participants' Background Information.

| Variables                                                           | Background |
|---------------------------------------------------------------------|------------|
| Number of groups                                                    | 24         |
| Number of participants                                              | 72         |
| Number of male/female                                               | 49/23      |
| Average age of participants                                         | 26.6 (2.4) |
| Average amount of years employed full-time                          | 4.9 (1.5)  |
| Percentage of participants having at least an undergraduate degree  | 96%        |
| Average level of experience in group decision making (times/months) | 5.7 (1.6)  |
| Average typing skill <sup>1</sup>                                   | 2.7 (0.7)  |
| Average frequency of computer use in a typical week <sup>2</sup>    | 3.5 (0.6)  |
| Average number of software applications familiar with               | 3.7 (0.5)  |

Notes:

- 1 scale: 1- hunt and peck  
2- rough or casual typing  
3- good typing (30 wpm error free)  
4- excellent typing (could be employed as a typist)

- 2 scale: 1- never  
2- once or twice  
3- three to ten times  
4- more than ten times

( ) Standard Deviations

These pilot-test participants were chosen because they had very similar backgrounds to the subjects in the main study. The experimental procedures were performed on the first pilot group. The participants understood that the experimental session was a pilot-test of a major study and the subjects were strongly encouraged to comment on the materials and the procedure in the experiment. The participants were randomly assigned to thirteen groups with three members in each group. The experimental procedure was performed. After the experiment, members were asked to comment on the procedures and the materials used in the experiment.

Overall, the participants were pleased with both the procedures and the materials used in the experiments, only minor suggestions were proposed. Two changes were made to the experimental procedures as a result of this pilot test. Firstly, groups that were supported by GDSS were given a brief rehearsal on the GDSS to refresh their memory on the operations of the system. Secondly, during the debriefing session, group members were asked to comment particularly on how satisfied they were with the decision process as it was judged that subjects may not have been willing to discuss it without initiation. The verbal statement of group satisfaction given in the debriefing session could then be used to compare with questionnaire scores.

The modified experimental procedures were then performed on the second pilot group. This group consisted of 33 part-time MBA students who were not involved in any of the pilot tests for the experimental materials. The reason for conducting the pilot test with this group was to ensure that the experimental procedures were working successfully among groups with no exposure to the task materials. The participants were introduced to the concept of GDSS and were given 30 minutes training on CAMH. Then the participants were randomly assigned to 11 groups with 3 members in each group. The groups were then randomly assigned to the six experimental treatments. The procedures were run in a manner similar to the actual experiment. Overall, the experimental procedures worked very smoothly and the participants were pleased with both the procedures and the materials used in the experiment.



## **4.8 Dependent Variables**

The three classes of dependent variables examined in this study were objective decision performance, group communication interaction and perceived decision satisfaction.

### **4.8.1 Objective Decision Performance**

Decision quality was measured along two dimensions: (1) decision quality - how close the group's decision was to that made by experts; and (2) decision time - how long the group took to arrive at the decision. To measure decision quality, the overall rank ordering for the solution provided by the group was evaluated. Each of the six possible rank orderings of the three candidates was ordered in terms of most to least preferred based on the goals and objectives described by Burst and Schlesinger (1987). The most preferred rank ordering was assigned a score of six points and the least preferred rank ordering was assigned a score of one point. Intermediate rankings were assigned points ranging from two through five. Higher scores indicated higher decision quality.

Decision time was defined as the length of time it took the group to reach a group decision. The groups were informed that consensus was required in the decision task and a group decision was achieved when all group members agreed. Decision time was measured by recording the time it took the group to agree to a decision and fill out the group decision form at the end of the decision meeting.

### **4.8.2 Patterns of Group Communication**

The discussion records, cassette tapes for face-to-face meetings and copies of the electronic logs for GDSS groups, were analysed by two coders. The coding for the discussion content was carried out according to the coding scheme developed by Gettys, et al. (1987). According to this scheme, the discussion records could be parsed into separate units which consisted of a single comment or argument. These units could then be classified into eight categories. These categories are decision proposals, support arguments, clarifications, critical arguments, queries, procedural related comments, other unrelated comments and total number of comments. (See Appendix

D for the coding scheme). For the GDSS session, the scheme also included system related comments to capture comments related to the system and its operations.

In this experiment, the files produced by each group were independently coded by two raters, who were blind as to the experimental conditions and hypotheses. Each rater first parsed a transcript of the file to separate comments and arguments. He then assigned to each parsed unit a code derived from the scheme. After completing these codings independently, the two raters met and discussed both parsings and codings to achieve consensus. The codings were then used as the measure for the group communication interaction.

#### **4.8.3 Perceived Decision Satisfaction**

Perceived decision satisfaction was measured using three sets of post-meeting questionnaires. The first questionnaire (Questionnaire A) was a modified version of Gouran, Brown and Henry (1978) and Green and Taber (1980) for measuring the perceived satisfaction with the decision outcome and the group decision making process. Fifteen questions were used to measure the two constructs. Appendix C presents a copy of all the questionnaires used in this study. The second questionnaire (Questionnaire B) was adopted from Green and Taber (1980) and was used to measure the perceived participation and negative behaviour in the group decision process; the perceived confidence in the group decision; the perceived depth of evaluation in the group decision; the perceived satisfaction with group members and the perceived overall satisfaction with the decision making exercise. Twenty-seven questions were included in the questionnaire to measure the six constructs. Similar measurements developed from Gouran, Brown and Henry (1978) and Green and Taber (1980) have been used in other GDSS studies (Cass, Heintz and Kaiser, 1991; Gallupe and McKeen, 1990). Finally the third questionnaire (Questionnaire C) was developed by the author to measure the subjects' perception towards the usefulness of GDSS and the effectiveness of GDSS compared to face-to-face meetings. Questionnaire C was only administered to GDSS groups, and consisted of four questions to measure the two constructs.

To assess the decision satisfaction of the experimental groups, the individual group members were asked to fill in the post-meeting questionnaires, using a seven point rating scale. Individual values were then summed and divided by the number of members in the group to give an aggregated group satisfaction score. Previous research (Boje and Murnighan, 1982) used the individual measures aggregated to a group measure and found that the procedure was satisfactory. The entire group was also asked during the post-experiment debriefing session, how satisfied they were with the decision process. The verbal statement of group satisfaction given in the debriefing session was compared to the aggregated score. It was found that the aggregated score correlated highly with the verbal score in all groups and therefore the aggregated score was used in the data analysis.

#### **4.8.4 Pilot Tests On Post-Meeting Questionnaires**

The post-meeting questionnaires were pilot-tested and iteratively refined over the course of three months, with the same 60 part-time MBA students participating in these pilot-tests as for the pilot-tests of the experimental task. The questionnaires were first reviewed by three faculty members who had experience in designing questionnaires. The questionnaires were then presented to the group of 39 pilot-test participants. The purpose of the questionnaire was explained and the participants were asked to complete the questionnaire according to the instructions and to comment on the content and the presentation of the questionnaires. The key objective of the pilot test was to ensure the content validity and the presentation of the questionnaires. As a result of this pilot-test, several sentences in the questions were re-worded to improve their clarity and the wording of the instructions was modified. The layouts of the questionnaires were also modified. Two questions in Questionnaire B were deleted because more than half of the participants thought that the questions were not relevant. On average, the participants were able to complete the questionnaire in 10 minutes. The modified questionnaires were then presented to the second group of 21 MBA students. Like the first group, the purpose of the questionnaires was explained and they were also asked to complete the questionnaires according to the instructions on the questionnaires. They were then asked to provide comments on the content and presentation of the questionnaires. Overall, members of this pilot group expressed

satisfaction with the content validity and the presentation of the post-meeting questionnaires.

#### **4.9 Chapter Summary**

This chapter described the experimental method used for testing the research hypotheses developed in Chapter 3. The research design was an experiment with a 2x3 factorial between-subjects design with two independent variables: computer support (GDSS support and non-GDSS support) and decision task structure (additive, disjunctive and conjunctive). The dependent variables were objective decision performance, group communication interaction and perceived decision satisfaction. The chapter described the subjects, the decision task, the manipulations, the procedures and the dependent variables of the experiment. The experimental manipulations and procedure were carefully pilot tested with part-time MBA students. Materials used in the experiment were also pilot tested to ensure clarity. The results of the experiment are described in Chapter 5.

## **CHAPTER 5**

### **ANALYSIS OF EXPERIMENTAL RESULTS**

#### **5.1 Introduction**

This chapter presents the results of the experiment described in Chapter 4. The main focus of this chapter is on the statistical tests of the hypotheses developed in Chapter 3. The discussion, implications and conclusions drawn from these results are presented in Chapter 6. Prior to conducting the tests, the chapter deals with testing for the reliability and the validity of the research instruments, and ensuring that the data meet the requirements of the statistical tests and that the manipulation of treatment is successful.

Twenty one variables were tested. Of these, two variables involved the quality of decision and the time taken to reach a decision. Eight variables involved the coding of content in the patterns of group communication. They included the numbers of decision proposal made; the numbers of supporting comments; the numbers of clarification comments made during decision making; the numbers of critical arguments; the numbers of queries; the numbers of procedural related comments; the numbers of other unrelated comments and the number of total comments made during the whole decision process. One variable also measured the number of comments related to system support in GDSS supported groups. Eight variables involved data collected from post-experimental questionnaires on groups' perceptions of satisfaction. They included the perceived satisfaction with the decision outcome; the perceived satisfaction with the decision making process; the perceived participation in the group decision process; the perceived conflict behaviour in the group decision process; the perceived confidence in the group decision; the perceived depth of evaluation in the decision process; the perceived willingness to remain in the group and the perceived overall satisfaction with the decision process. Two variables evaluated the usefulness of GDSS to the task and compared the effectiveness of GDSS with face-to-face meeting.

Note should be taken of the fact that eighteen of these variables applied to all six treatments: non-GDSS with additive task; non-GDSS with disjunctive task; non-GDSS with conjunctive task; GDSS with additive task; GDSS with disjunctive task and GDSS with conjunctive task. Three variables, system related comments, GDSS usefulness for task and GDSS effectiveness against face-to-face meeting, were relevant only to the three GDSS supported treatment groups.

The first step in the data analysis involved testing questionnaires, used to gather perceptual data, for their construct validity by assessing the fit between the planned constructs and the questions intended to measure these constructs (Cook and Campbell, 1979). In addition, the reliability of each construct was measured to make sure that each had a sufficient reliability level to register the true changes due to treatment differences. Factor analysis was used to assess the construct validity of the questionnaires and the reliability of the construct was assessed using the standard Cronbach coefficient alpha.

The second step in the process of data analysis was to ensure that the requirements of the statistical tests were satisfied. The statistical test used in testing the hypotheses was ANOVA. Before subjecting the data to the test, the assumptions of this statistical test were verified. Hartley's test (Neter, et al., 1985) was used to test for homogeneity of variance of the dependent variables and the Lillefors' test (Conover, 1971) was used to test the normality of the data.

The third step in the data analysis dealt with the manipulation check of the experimental treatments. The task structure and the GDSS support manipulations were assessed. The single sample chi-square was used to demonstrate the good fit between the experimental conditions and the subjects' perception of the experimental environments.

The final step led to the statistical tests of the hypotheses using ANOVA. Two-way ANOVA was applied to each of the eighteen variables across six experimental treatments. If the main effects of the two-way ANOVA were significant, Newman-

Keuls post-hoc multiple comparison analysis (Kirk, 1982) was used to investigate the difference in means of individual groups. If the interaction effect was significant in the two-way ANOVA, simple effect analysis was carried out to assess the effect on each experimental treatment. Three variables were only relevant to the three GDSS support treatment groups. A one-way ANOVA was applied to each of these variables and Newman-Keuls post-hoc multiple comparison analysis (Kirk, 1982) was used to assess the difference in means of individual groups if the result of the one-way ANOVA was significant.

The remainder of the chapter is organised into seven principal parts. Section 5.2 reports the results of construct validity and Section 5.3 reports the reliability of the questionnaires used to gather the perceptual satisfaction variables. Section 5.4 reports on analysing the data to ensure that the requirements of the statistical tests were met. This section also describes how data was transformed in those cases where requirements were violated. Section 5.5 covers the manipulation check of the experimental treatments. Section 5.6 provides the results of conducting the statistical tests involved in testing the hypotheses and Section 5.7 provides a summary of the chapter.

## **5.2 Construct Validity**

All of the post-experimental instruments were self-reported questionnaires and were subjected to both validity and reliability tests to ensure that the questions were good indicators of the construct intended, and had high internal consistency. Three post-experimental instruments were used in this study. The type and nature of these instruments are shown in Table 5.1.

Two other dependent variables were extracted directly from the experiment. They were decision quality and decision time. Another eight dependent variables were

Table 5.1 Post-experimental Instruments and the Corresponding Constructs Measures

| Instruments                                                                                                                      | Constructs                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Questionnaire A: self-reported questionnaire; a modified version of Gouran, Brown and Henry (1978) and Geen and Taber (1980). | 1. Perceived satisfaction with the decision outcome.<br>2. Perceived satisfaction with the group decision making process.                                                                                                                                                                                                                                            |
| 2. Questionnaire B: self-reported questionnaire; a modified version of Green and Taber (1980).                                   | 1. Perceived participation in the group decision process.<br>2. Perceived conflict behaviour in the group decision process.<br>3. Perceived confidence in the group decision.<br>4. Perceived depth of evaluation in the group decision.<br>5. Perceived willingness to remain in the group.<br>6. Perceived overall satisfaction with the decision making exercise. |
| 2. Questionnaire C: self-reported questionnaire for GDSS supported groups.                                                       | 1. Perceived usefulness of GDSS for the task.<br>2. Perceived effectiveness of GDSS compared to face-to-face meeting.                                                                                                                                                                                                                                                |



from the content coding of the comments made in the groups. These variables were objectively measured in the experiment and were not subjected to the construct validity and reliability tests.

Factor analysis was performed separately on the subjects' responses to questions in Questionnaire A, Questionnaire B and Questionnaire C, to test the construct validity of the dependent variables from these self-reported questionnaires. Principal component analysis employing a varimax rotation was carried out to determine the number of factors responsible for systematic variation in the data. All factors with eigenvalues greater than one were selected (Johnson and Wichern, 1982). As the post-experimental questionnaires were taken from the instrument developed by Gouran, Brown and Henry (1978) and Green and Taber (1980), the factors obtained in this analysis were compared with those obtained by the original developers of the instruments.

#### **5.2.1 Factor Analysis of Questionnaire A**

Factor analysis was performed on the subject's responses in Questionnaire A. Factor analysis revealed that A7 and A8 had factor loadings of less than 0.50 and appeared not to be associated with any of the construct variables. Items with high loadings on each factor are good measuring items for these factors. Items that have low loadings on the factors are poor measuring items for the factors. As a result, questions yielding data generating low factor loadings (of less than 0.50) were removed from further analysis. The remaining items were subjected to a fresh round of factor analysis. Two factors were extracted. The factor loadings matrix of Questionnaire A is shown in Table 5.2.

They corresponded to two constructs: perceived satisfaction with decision outcome and perceived satisfaction with the group decision making process. The first construct, perceived satisfaction with decision outcome, was comparable to the factor of satisfaction with outcome obtained by Gouran, Brown and Henry (1978). The second construct, perceived satisfaction with the group decision making process, coincided

Table 5.2 Factor Loadings Matrix for Questionnaire A

| Item                          | Item Description                                                                                                                  | Factor 1<br>Satisfaction with<br>Decision Outcome | Factor 2<br>Satisfaction with<br>Group Process |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|------------------------------------------------|
| A1                            | The overall quality of the decision was poor/good.                                                                                | .7563                                             |                                                |
| A2                            | The decision discussion, on the whole, was ineffective/effective.                                                                 | .6123                                             |                                                |
| A3                            | The outcome of the decision discussion was unsatisfactory/satisfactory.                                                           | .6874                                             |                                                |
| A4                            | The decision discussion was incompetently /competently executed.                                                                  | .6941                                             |                                                |
| A5                            | The issues explored in the decision discussion were trivial/substantial.                                                          | .7833                                             |                                                |
| A6                            | The content of the decision discussion was carefully/carelessly developed.                                                        | .8176                                             |                                                |
| A9a                           | The group's decision making process was efficient/inefficient.                                                                    |                                                   | .6732                                          |
| A9b                           | The group's decision making process was co-ordinated/uncoordinated.                                                               |                                                   | .7541                                          |
| A9c                           | The group's decision making process was fair/unfair.                                                                              |                                                   | .7143                                          |
| A9d                           | The group's decision making process was understandable/confusing.                                                                 |                                                   | .8238                                          |
| A9e                           | The group's decision making process was satisfying/dissatisfying.                                                                 |                                                   | .6321                                          |
| Eigenvalues                   |                                                                                                                                   | 5.55                                              | 2.64                                           |
| Variance explained            |                                                                                                                                   | 50.45%                                            | 24.00%                                         |
| Cumulative variance explained |                                                                                                                                   | 50.45%                                            | 74.45%                                         |
| Kaiser-Meyer-Olkin:           |                                                                                                                                   | .82341                                            |                                                |
| Bartlett Test of Sphericity:  |                                                                                                                                   | 745, .0000                                        |                                                |
| A7                            | The manner in which participants examined the issue was non-constructive/constructive.                                            |                                                   |                                                |
| A8                            | The group's movement toward reaching a conclusion on the decision question under the circumstances was insignificant/significant. |                                                   |                                                |

with the factor satisfaction with decision process extracted by Green and Taber (1980) for the five questions measuring this construct.

### **5.2.2 Factor Analysis of Questionnaire B**

From the subjects' responses to questions in Questionnaire B, four factors were extracted in the first factor analysis. Given the prediction of significant correlation amongst these factors, the potential for confused results was not unanticipated. A second factor analysis was run, forcing a six factor solution. Four items (B4, B11, B15 and B17) had very low factor loadings and were removed from further analysis. The remaining items were subjected to a fresh round of factor analysis, forcing a six factor solution. Table 5.3 lists factor loadings for the final solution.

Six factors were identified from the factor analysis. They corresponded to six a priori dimensions and were matched with the factors developed by Green and Tabor (1980). The loading of B16 and B18 on participation were not predicted, and appeared to be associated items measuring the same construct. The subjects, in the present study, did not differentiate between the constructs of participation and decision leader as indicated in the Green and Taber (1980). Given that no distinction was made by the subjects in the current study on these two constructs, they were combined into one construct.

### **5.2.3 Factor Analysis of Questionnaire C**

Questionnaire C was developed by the author to examine the subjects' perception towards GDSS. Questionnaire C was only administrated to GDSS supported groups. Factor analysis revealed two factors which corresponded to the perceived system usefulness for task and perceived system effectiveness compared to face-to-face meeting. The factor loadings matrix of Questionnaire C is shown in Table 5.4.

Table 5.3      Factor Loadings Matrix for Questionnaire B

| Item                                    | Factor 1<br>Participation | Factor 2<br>Conflict<br>Behaviour | Factor 3<br>Confidence | Factor 4<br>Depth of<br>Evaluation | Factor 5<br>Remain in<br>Group | Factor 6<br>Overall<br>Satisfaction |
|-----------------------------------------|---------------------------|-----------------------------------|------------------------|------------------------------------|--------------------------------|-------------------------------------|
| B1                                      | .7364                     |                                   |                        |                                    |                                |                                     |
| B2                                      | .6351                     |                                   |                        |                                    |                                |                                     |
| B3                                      | .7263                     |                                   |                        |                                    |                                |                                     |
| B5                                      | .7149                     |                                   |                        |                                    |                                |                                     |
| B6                                      |                           | .7836                             |                        |                                    |                                |                                     |
| B7                                      |                           | .7634                             |                        |                                    |                                |                                     |
| B8                                      |                           | .6734                             |                        |                                    |                                |                                     |
| B9                                      |                           | .8232                             |                        |                                    |                                |                                     |
| B10                                     |                           | .7363                             |                        |                                    |                                |                                     |
| B12                                     |                           |                                   | .7363                  |                                    |                                |                                     |
| B13                                     |                           |                                   | .7172                  |                                    |                                |                                     |
| B14                                     |                           |                                   | .8165                  |                                    |                                |                                     |
| B16                                     | .587                      |                                   |                        |                                    |                                |                                     |
| B18                                     | .721                      |                                   |                        | .6872                              |                                |                                     |
| B19                                     |                           |                                   |                        | .7841                              |                                |                                     |
| B20                                     |                           |                                   |                        |                                    | .7871                          |                                     |
| B21                                     |                           |                                   |                        |                                    | .6474                          |                                     |
| B22                                     |                           |                                   |                        |                                    |                                | .8127                               |
| B23                                     |                           |                                   |                        |                                    |                                | .8252                               |
| Eigenvalues                             |                           |                                   |                        |                                    |                                |                                     |
|                                         | 4.44                      | 3.55                              | 2.11                   | 1.43                               | 1.23                           | 1.64                                |
| Variance explained                      |                           |                                   |                        |                                    |                                |                                     |
|                                         | 23.37%                    | 18.68%                            | 11.11%                 | 7.53%                              | 6.47%                          | 8.63%                               |
| Cumulative variance explained           |                           |                                   |                        |                                    |                                |                                     |
|                                         | 23.37%                    | 42.05%                            | 53.16%                 | 60.69%                             | 67.16%                         | 75.79%                              |
| Kaiser-Meyer-Olkin: .80378              |                           |                                   |                        |                                    |                                |                                     |
| Bartlett Test of Sphericity: 698, .0000 |                           |                                   |                        |                                    |                                |                                     |

- B1    Made suggestions about doing the task.
- B2    Gave information about doing the task.
- B3    Asked others for their thoughts or opinions.
- B4    Showed attention and interest in the groups' discussion.
- B5    Asked for suggestions from others in the group.
- B6    Felt frustrated or tense about others' behaviour.
- B7    Rejected others' opinions or suggestions.

- B8 Expressed negative opinions or suggestions.
  - B9 Opinions or suggestions were rejected.
  - B10 Expressed a negative opinion about your behaviour.
  - B11 Felt satisfied with the quality of your group's solution.
  - B12 Final solution reflected your inputs.
  - B13 Felt committed to the group solution.
  - B14 Confident that the group solution was correct.
  - B15 Personally responsible for the correctness of the decision.
  - B16 One person influenced the final solution.
  - B17 One member emerged as information leader.
  - B18 One member strongly influenced the group decision.
  - B19 Uncovered valid recommendations and assumptions.
  - B20 Critically re-evaluated the validity of recommendations and assumptions.
  - B21 Enjoyed working with group members.
  - B22 Willing to remain in group in future.
  - B23 Overall satisfied with the decision making exercise.
  - B24 Overall satisfied with the experiment.
- 

Table 5.4 Factor Loadings Matrix of Questionnaire C

| Item                          | Item Description                                                | Factor 1          | Factor 2                                         |
|-------------------------------|-----------------------------------------------------------------|-------------------|--------------------------------------------------|
|                               |                                                                 | System Usefulness | System Effectiveness<br>Compared to Face-to-Face |
| C1                            | GDSS useful for task.                                           | .8134             |                                                  |
| C2                            | GDSS contributed positively<br>to the decision quality of task. | .6932             |                                                  |
| C3                            | GDSS more effective than<br>face-to-face.                       |                   | .7465                                            |
| C4                            | GDSS better than face-to-face                                   |                   | .8741                                            |
| Eigenvalues                   |                                                                 | 1.23              | 1.85                                             |
| Variance explained            |                                                                 | 30.75%            | 46.25%                                           |
| Cumulative variance explained |                                                                 | 30.75%            | 77.00%                                           |
| Kaiser-Meyer-Olkin:           |                                                                 | .91231            |                                                  |
| Bartlett Test of Sphericity:  |                                                                 | 877, .0000        |                                                  |

---

5.3 Reliability

Reliability for the validated constructs were assessed using the Cronbach coefficient alpha. The Cronbach coefficient alpha obtained for these dependent variables is presented in Table 5.5.

Table 5.5 Cronbach Alpha of the Constructs Used as Dependent Variables

| Dependent Variables                                              | Cronbach Alpha |
|------------------------------------------------------------------|----------------|
| Perceived satisfaction with decision outcome                     | .834           |
| Perceived satisfaction with group decision making process        | .901           |
| Perceived participation in group decision process                | .855           |
| Perceived conflict behaviour in group decision process           | .867           |
| Perceived confidence in group decision                           | .892           |
| Perceived depth of evaluation in group decision                  | .844           |
| Perceived willingness to remain in group                         | .784           |
| Perceived overall satisfaction with the decision making exercise | .821           |
| Perceived usefulness of GDSS for task                            | .864           |
| Perceived effectiveness of GDSS compared to face-to-face meeting | .874           |

Reliability refers to the extent to which a measuring instrument contains variable errors (Nachmias and Nachmias, 1987). The errors are called variable errors because the amount of error varies from one observation to another and also because the amount of error varies from time to time for a given unit of analysis. A high reliability implies a low level of variable errors and hence a high degree of internal consistency. Nunnally (1978) suggests that a reliability of .70 is a sufficient indication of a high degree of internal consistency of that instrument. The Cronbach alphas obtained for the constructs in the current study were all above the .70 level. Thus, all the constructs were shown to have high internal consistency.

## **5.4 Requirements of Statistical Tests**

The statistical test used to test the hypotheses in this study was ANOVA. Before subjecting the data to the test, it was necessary to verify that the assumptions of the statistical test were not violated. The ANOVA models must meet three conditions (Neter, et al., 1985). They are:

1. Independent samples;
2. Homogeneity of variances of the dependent variables, and
3. Normality of error terms.

Independence of sample was ensured by random assignment of groups to the different treatments (see Chapter 4). The homogeneity of variances and the normality of error terms had to be assessed before ANOVA could be applied to test the hypotheses. Where a dependent variable did not meet the requirements of homogeneity of variance or normality of error terms, the data was transformed to meet the required conditions before applying ANOVA.

### **5.4.1 Homogeneity of Variance**

Hartley's test (Neter, et al., 1985) was used to test for homogeneity of variance. The H-statistics were calculated for each dependent variable. The hypothesis of equality of variance was rejected if the H-value was greater than the critical H (.05, 3, 18), which was approximated to be 3.20 (Neter, et al., 1985, p.110). Table 5.6 displays the H-values for all the dependent variables.

Three dependent variables did not meet the requirements for homogeneity of variance. They were: perceived conflict behaviour in group decision process, perceived confidence in group decision and perceived willingness to remain in group. On further examination, it was detected that four outliers from the perceived conflict behaviour in group decision process, perceived confidence in group decision and the perceived willingness to remain in group were the reason for the violations of the homogeneity of variance. These outliers were replaced with the mid-point value of the scale and the

Table 5.6 Hartley's Test for the Homogeneity of Variance

| Dependent Variables                                          | H statistic   |
|--------------------------------------------------------------|---------------|
| Decision outcome:                                            |               |
| Decision quality                                             | 1.887         |
| Decision time                                                | 2.162         |
| Patterns of group communication:                             |               |
| Decision proposal                                            | 1.841         |
| Support argument                                             | 1.463         |
| Clarification                                                | 2.464         |
| Critical argument                                            | 1.841         |
| Query                                                        | 1.240         |
| Group related comments                                       | 2.924         |
| Other unrelated comments                                     | 2.210         |
| Total comments                                               | 1.023         |
| System related comments                                      | 1.764         |
| Perceived satisfaction:                                      |               |
| Perceived satisfaction with decision outcome                 | 1.431         |
| Perceived satisfaction with group decision making process    | 2.145         |
| Perceived participation in group decision process            | 2.322         |
| Perceived conflict behaviour in group decision process       | 4.331* 2.341+ |
| Perceived confidence in group decision                       | 4.874* 2.634+ |
| Perceived depth of evaluation in group decision              | 1.237         |
| Perceived willingness to remain in group                     | 5.231* 1.346+ |
| Perceived overall satisfaction with decision making exercise | 2.561         |
| Perceived usefulness of GDSS for task                        | 2.042         |
| Perceived effectiveness of GDSS compared to face-to-face     | 2.937         |

Note: \* Significant at 0.05

+ Indicates with outliers replaced.



scale and the H-statistics re-calculated. Table 5.5 shows the H-statistics when the outliers were removed. With the outliers removed, the requirement for homogeneity of variance of all the dependent variables were met. These four outlier values were not included in further analysis.

#### **5.4.2 Normality of Error Terms**

In order to meet the requirement of the ANOVA model, the residual error should be normally distributed for each factor level. When the factor level sample sizes are not large and provided that there are no major differences in the error term variances of the factors, the residuals for each factor level can be combined (Neter, et al., 1985). This approach was used in the analysis of error terms.

Lillefors' test (Conover, 1971) on the two-sided Kolmogorov D statistic was used to test for normality of error terms. The hypothesis that the residuals were not normally distributed was rejected if the D-statistic was greater than the critical D (.05, 54) of .1206 (Conover, 1971, p. 398). Table 5.7 shows the D statistics for the residuals for each variable.

The four outliers removed from the homogeneity of variance test were not included in the Lillefors' test. Perceived confidence in group decision did not meet the normality of residuals requirement.  $A1/(Y+1)$  transformation was performed. The transformation was successful in satisfying the normality of residuals requirements. H statistics were recalculated on the transformed variable and the transformation was successful in maintaining the requirement of homogeneity of variance.

Table 5.7 Lillefors' Test for the Normality of Error Terms

| Dependent Variables                                          | D statistic | H statistic |
|--------------------------------------------------------------|-------------|-------------|
| Decision outcome:                                            |             |             |
| Decision quality                                             | .0483       |             |
| Decision time                                                | .0948       |             |
| Patterns of group communication:                             |             |             |
| Decision proposal                                            | .0363       |             |
| Support argument                                             | .0841       |             |
| Clarification                                                | .1123       |             |
| Critical argument                                            | .0871       |             |
| Query                                                        | .0927       |             |
| Group related comments                                       | .0675       |             |
| Other unrelated comments                                     | .1110       |             |
| Total comments                                               | .1132       |             |
| System related comments                                      | .0833       |             |
| Perceived satisfaction:                                      |             |             |
| Perceived satisfaction with decision outcome                 | .1011       |             |
| Perceived satisfaction with group decision making process    | .0874       |             |
| Perceived participation in group decision process            | .0758       |             |
| Perceived conflict behaviour in group decision               | .1047+      |             |
| Perceived confidence in group decision                       | .1521+*     |             |
| 1/(perceived confidence in group decision+1)                 | .0733+      | 2.167       |
| Perceived depth of evaluation in group decision              | .0985       |             |
| Perceived willingness to remain in group                     | .1085       |             |
| Perceived overall satisfaction with decision making exercise | .0982       |             |
| Perceived usefulness of GDSS for task                        | .1020       |             |
| Perceived effectiveness of GDSS compared to face-to-face     | .1044       |             |

Note: \* Significant at 0.05

+ Indicates with outliers replaced.

## 5.5 Manipulation Checks

Checks on both experimental manipulations were embodied in the post-experimental questionnaire. To assess the task structure manipulation, participants were asked, “Which of the following best describes how you made a decision on the task you have just finished?” (1) Each group member has the same information and the group works together as a team to reach the best solution; (2) Each group member has the same information and the group selects one best solution from an array of solutions championed by individual group members ; or (3) Each group member has different information and each group member contributes to reach the best solution. Of the 216 responses, only 7 were misclassified (see Table 5.8). The single sample chi-square demonstrated a good fit between the experimental conditions (additive task, disjunctive task, and conjunctive task) and the subjects’ perception of the task structure in the experiment ( $X^2=391.86$   $df=4$ ,  $p<0.00001$ ).

Table 5.8: Classification of Experimental Treatments on Task Structure

| Classification | Experimental Treatments |             |             | Row Total |
|----------------|-------------------------|-------------|-------------|-----------|
|                | Additive                | Disjunctive | Conjunctive |           |
| Additive       | 70                      | 0           | 0           | 70        |
| Disjunctive    | 0                       | 69          | 2           | 71        |
| Conjunctive    | 2                       | 3           | 70          | 75        |
| Column Total   | 72                      | 72          | 72          | 216       |

|                      |    |             |
|----------------------|----|-------------|
| Chi-Square ( $X^2$ ) | df | Significant |
| 391.86               | 4  | 0.00001     |

Next, decision support manipulation was assessed using responses to a post-experimental question, “Which of the following best describes your group’s decision making environment?” (1) a face-to-face meeting; or (2) a computer supported environment. Of the 216 responses, only 6 were misclassified (see Table 5.9). The single sample chi-square showed a good fit between the experimental conditions (non-

GDSS and GDSS supported) and the subjects' perception of the decision support environment in the experiment ( $X^2=192.67$   $df=1$ ,  $p<0.00001$ ). Both manipulations, then, appear to have been successful.

Table 5.9: Classification of Experimental Treatments on GDSS Support

| Classification | Experimental Treatments |      |           |
|----------------|-------------------------|------|-----------|
|                | Non-GDSS                | GDSS | Row Total |
| Non-GDSS       | 105                     | 3    | 108       |
| GDSS           | 3                       | 105  | 108       |
| Column Total   | 108                     | 108  | 216       |

|                      |    |             |
|----------------------|----|-------------|
| Chi-Square ( $X^2$ ) | df | Significant |
| 192.67               | 1  | 0.00001     |

### 5.6 Testing of Hypotheses

This section presents the results of the statistical analyses used to test the hypotheses proposed in this study.

#### 5.6.1 Decision Quality

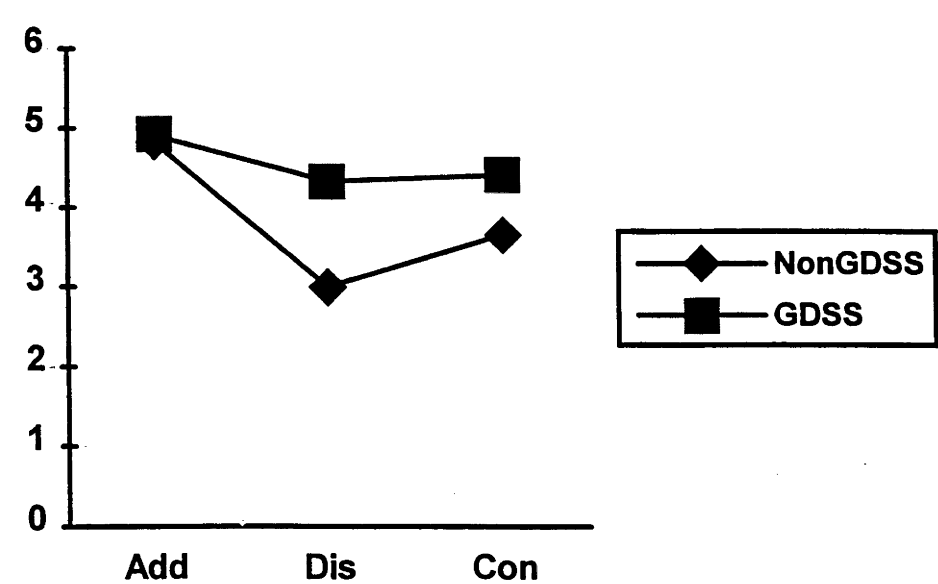
Decision Quality was measured by evaluating the rank ordering of the solution provided by the group. The ranking was assessed based on the preferred ranking given by Burst and Schlesinger (1987). The most preferred rank ordering was assigned a score of six points and the least preferred rank ordering was assigned a score of one point. Intermediate rankings were assigned points from two to five. Higher scores indicated higher decision quality.

Table 5.10 presents the means and standard deviations of decision quality across GDSS supported, non-GDSS supported and additive, disjunctive and conjunctive task structure experimental environments. Fig 5.1 shows the variations of means of decision quality across different experimental treatments.

Table 5.10: Means and Standard Deviations for Decision Quality across Experimental Treatments.

|                        | Decision Quality         |                          |                          | Row total                |
|------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                        | Additive                 | Disjunctive              | Conjunctive              |                          |
| Non-GDSS               | 4.833<br>(0.835)<br>n=12 | 3.000<br>(1.128)<br>n=12 | 3.667<br>(0.985)<br>n=12 | 3.833<br>(1.231)<br>n=36 |
| GDSS                   | 4.917<br>(0.793)<br>n=12 | 4.333<br>(0.651)<br>n=12 | 4.417<br>(0.669)<br>n=12 | 4.556<br>(0.735)<br>n=36 |
| Column total           | 4.875<br>(0.797)<br>n=24 | 3.667<br>(1.129)<br>n=24 | 4.042<br>(0.908)<br>n=24 | 4.194<br>(1.070)<br>n=72 |
| ( ) standard deviation |                          |                          |                          |                          |

Fig 5.1: Means for Decision Quality across Experimental Treatments.



H1a posited that the decision quality of GDSS supported groups would be significantly different to non-GDSS supported groups. A two-way ANOVA on the decision quality (see Table 5.11) revealed significantly higher mean scores in GDSS supported groups when compared with non-GDSS supported groups ( $F_{1,66} = 12.689$ ,  $p < 0.05$ ). H1a was therefore accepted. As predicted, the decision quality of GDSS supported groups was significantly different to non-GDSS supported groups. On average, GDSS supported groups outperformed non-GDSS supported groups in terms of decision quality.

H1b posited that the effect of GDSS support on decision quality will vary as a function of different task structures. A two-way ANOVA on decision quality (see Table 5.11) revealed a significant interaction effect ( $F_{2,66} = 3.17$ ,  $p < 0.05$ ) between GDSS support and task structure. The interaction effect indicated that the effect of GDSS on decision quality was dependent upon the decision task structure it supported. H1b was therefore accepted. As depicted in Fig 5.1, there was a strong interaction between GDSS and different task structures on decision quality. Simple effects analysis on the decision quality (see Table 5.11) revealed the different effects of GDSS support on different decision task structures. In the additive task structure, the simple effect revealed no significant differences between non-GDSS and GDSS supported groups ( $F_{1,66} = 0.0564$ , ns), at the significance level of 0.05. GDSS support was found to have no significant impact on the decision quality of additive tasks. In the disjunctive task structure, however, the simple effect analysis demonstrated a significantly higher decision quality in GDSS supported groups than non-GDSS supported groups ( $F_{1,66} = 14.415$ ,  $p < 0.01$ ). In the conjunctive task structure, simple effect analysis again showed a significantly higher decision quality in GDSS supported groups than non-GDSS supported groups ( $F_{1,66} = 4.561$ ,  $p < 0.05$ ). GDSS support was found to have a significant impact on improving the decision quality in disjunctive and conjunctive tasks. These results strongly indicated that the effects of GDSS support on group decision quality was a function of the task structures GDSS were supporting.

Table 5.11: Two-way ANOVA Results for Decision Quality across GDSS and Non-GDSS Supported Groups on Different Task Structures.

| Source of Variation    | D.F. | Sum of Squares | Mean Squares | F Ratio |
|------------------------|------|----------------|--------------|---------|
| Main Effects           | 3    | 27.750         | 9.250        | 12.502* |
| GDSS                   | 1    | 9.389          | 9.389        | 12.689* |
| Task                   | 2    | 18.361         | 9.181        | 12.408* |
| 2-way Interactions     |      |                |              |         |
| GDSS x Task            | 2    | 4.694          | 2.347        | 3.172** |
| Simple Effects         |      |                |              |         |
| GDSS x Additive        | 1    | 0.0417         | 0.0417       | 0.0564  |
| GDSS x Disjunctive     | 1    | 10.667         | 10.667       | 14.415* |
| GDSS x Conjunctive     | 1    | 3.375          | 3.375        | 4.561** |
| Task x non-GDSS        | 2    | 20.667         | 10.333       | 13.964* |
| Task x GDSS            | 2    | 2.389          | 1.194        | 1.614   |
| Explained              | 5    | 32.444         | 6.489        | 8.770*  |
| Residual               | 66   | 48.833         | 0.740        |         |
| Total                  | 71   | 81.278         | 1.145        |         |
| * Significant at 0.01  |      |                |              |         |
| ** Significant at 0.05 |      |                |              |         |

With the two-way ANOVA analysis, a significant main effect relationship was also found between task structure and decision quality ( $F_{2,66} = 12.408, p < 0.01$ ). The results also demonstrated that the effect of task structure on decision quality varied across GDSS supported and non-GDSS supported groups. A simple effect analysis on task structure found no significant differences in decision quality across different decision task structures ( $F_{2,66} = 1.614, ns$ ) in GDSS supported groups at the 0.05 significance level, indicating that the decision quality of GDSS supported groups was not significantly different across different decision task structures. Although not statistically significant at the 0.05 level, decision quality of the additive groups ( $m=4.917$ ) was higher than that of both the disjunctive ( $m=4.333$ ) and conjunctive groups ( $m=4.417$ ) in a GDSS supported environment, and the decision quality of the conjunctive groups was higher than that of the disjunctive groups (see Fig 5.1).

However, in non-GDSS supported groups, decision quality was significantly different across different decision task structures. The results of the simple effect analysis showed a significant difference ( $F_{2,66} = 13.964, p < 0.01$ ) in decision quality across different decision tasks. Post-hoc multiple comparison analyses (Kirk 1982) showed that non-GDSS supported groups performed better in an additive task environment ( $m=4.833$ ) than in a disjunctive ( $m=3.000$ ) or a conjunctive environment ( $m=3.667$ ) (Newman-Keuls,  $p < 0.05$ ). There was no significant difference in decision quality between the disjunctive and the conjunctive groups.

These results provided additional evidence for the interaction effect between GDSS support and task structure on decision quality. Decision quality of GDSS supported groups showed no significant difference across different decision task structures whereas for non-GDSS groups, the decision quality was significantly different across task structures.

### **5.6.2 Decision Time**

Decision time was measured by the length of time it took the group to reach a decision. The decision time was measured in minutes. Table 5.12 presents the means and standard deviations of decision time across GDSS supported, non-GDSS



supported and additive, disjunctive and conjunctive task structure environments. Fig 5.2 shows the variations of means of decision time across the three task structures.

H2a posited that the decision time of GDSS supported groups would be significantly different to non-GDSS supported groups. A two-way ANOVA on the decision time (see Table 5.13) showed significantly higher means scores for the GDSS supported groups than non-GDSS supported groups ( $F_{1,66} = 909.033$ ,  $p < 0.01$ ). H2a was therefore accepted. The decision time of GDSS supported groups was significantly different to non-GDSS supported groups. On average, GDSS supported groups took 2.3 times longer to reach a decision when compared to non-GDSS supported groups.

H2b posited that the effect of GDSS support on decision time will vary as a function of different task structures. A two-way ANOVA on the decision time (see Table 5.13) showed a significant interaction effect ( $F_{2,66} = 3.604$ ,  $p < 0.05$ ) between GDSS support and task structure. H2b was therefore accepted. This result indicated that the effect of GDSS on decision time was dependent upon the decision task structure it supported. Fig 5.2, also showed a strong interaction between the GDSS and different task structures on decision time.

Simple effect analysis showed the different effects of GDSS support on different decision task structures. In the additive task structure, a high significant difference in decision time was found between the GDSS and non-GDSS supported groups ( $F_{1,66} = 258.884$ ,  $p < 0.01$ ). GDSS support had a significant impact on the decision time in the additive task. On average, GDSS supported groups took twice as long to reach a decision in an additive task structure when compared to non-GDSS supported groups. In the disjunctive task structure, the simple effect analysis also showed a significantly longer decision time in GDSS supported groups than non-GDSS supported groups ( $F_{1,66} = 383.521$ ,  $p < 0.01$ ). On average, GDSS supported groups took nearly three times as long as non-GDSS supported groups to reach a decision. In the conjunctive task structure, the simple effect again revealed a significantly longer decision time in GDSS supported groups than non-GDSS supported groups ( $F_{1,66} = 273.889$ ,  $p < 0.01$ ). In the conjunctive task structure, GDSS groups took about twice the time to reach a

Table 5.12: Means and standard Deviations for Decision Time across Experimental Treatments.

|              | Decision Time             |                            |                            | Row total                 |
|--------------|---------------------------|----------------------------|----------------------------|---------------------------|
|              | Additive                  | Disjunctive                | Conjunctive                |                           |
| Non-GDSS     | 12.833<br>(3.100)<br>n=12 | 10.667<br>(3.394)<br>n=12  | 12.750<br>(2.340)<br>n=12  | 12.083<br>(3.065)<br>n=36 |
| GDSS         | 25.417<br>(1.929)<br>n=12 | 29.917<br>(2.999)<br>n=12  | 32.333<br>(4.185)<br>n=12  | 29.222<br>(4.237)<br>n=36 |
| Column total | 19.125<br>(6.910)<br>n=24 | 20.291<br>(10.319)<br>n=24 | 22.542<br>(10.538)<br>n=24 | 20.653<br>(9.378)<br>n=72 |

( ) standard deviation

Fig 5.2: Means for Decision Time across Experimental Treatments.

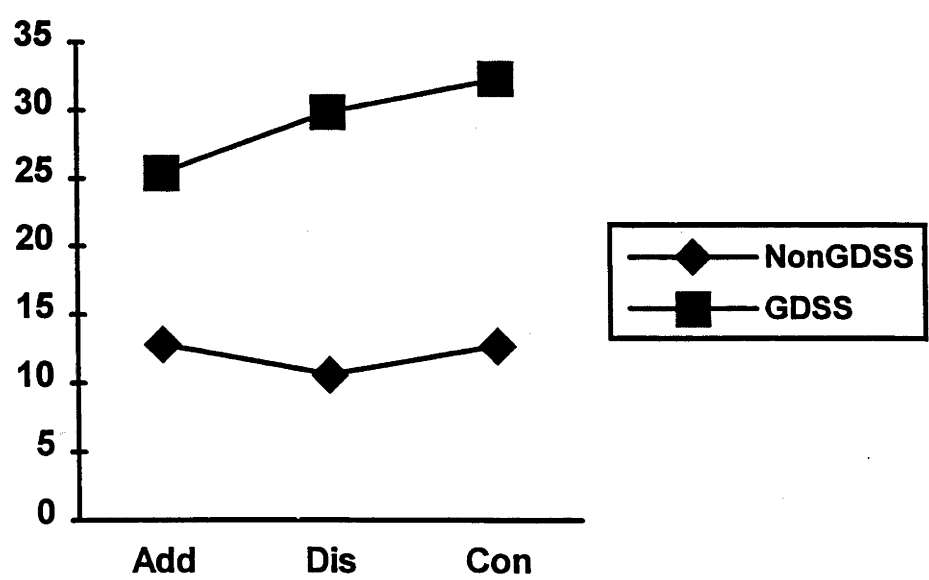


Table 5.13: Two-way ANOVA Results for Decision Time across GDSS Supported and Non-GDSS Supported Groups on Different Task Structures.

| Source of Variation | D.F. | Sum of Squares | Mean Squares | F Ratio  |
|---------------------|------|----------------|--------------|----------|
| Main Effects        | 3    | 5432.125       | 1810.708     | 191.185* |
| GDSS                | 1    | 5287.347       | 5287.347     | 558.269* |
| Task                | 2    | 144.778        | 72.389       | 7.643*   |
| 2-way Interactions  |      |                |              |          |
| GDSS x Task         | 2    | 187.111        | 93.556       | 9.878*   |
| Simple Effects      |      |                |              |          |
| GDSS x Additive     | 1    | 950.042        | 950.042      | 100.310* |
| GDSS x Disjunctive  | 1    | 2223.375       | 2223.375     | 334.756* |
| GDSS x Conjunctive  | 1    | 2301.041       | 2301.041     | 242.956* |
| Task x non-GDSS     | 2    | 36.1667        | 18.083       | 1.909    |
| Task x GDSS         | 2    | 295.722        | 147.861      | 15.611*  |
| Explained           | 5    | 5619.236       | 1123.847     | 118.662* |
| Residual            | 66   | 625.083        | 9.471        |          |
| Total               | 71   | 6244.319       | 87.948       |          |

\* Significant at 0.01

decision compared to non-GDSS groups. GDSS support was found to have a significant impact on the time taken to reach a decision in the additive, disjunctive and conjunctive tasks, but the effects of GDSS support on decision time were different across different task structures.

Two-way analysis also showed a significant relationship between task structure and decision time ( $F_{2,66} = 11.516$ ,  $p < 0.001$ ). As with decision quality, the results of decision time also showed the different effects of task structure across GDSS supported and non-GDSS supported groups. Simple effect analysis on the decision time found no significant differences across different decision task structures ( $F_{2,66} = 1.8935$ , ns) in GDSS supported groups, at a significance level of 0.05. On average, the decision time between different task structures in GDSS supported groups were very small (see Fig 5.2).

In non-GDSS supported groups, however, simple effect analysis showed a high significant difference ( $F_{2,66} = 13.2267$ ,  $p < 0.01$ ) in decision time across different decision tasks. Post-hoc multiple comparison analyses (Kirk 1982) showed that non-GDSS supported groups took significantly less time (Newman-Keuls,  $p < 0.05$ ) to reach a decision in a disjunctive task environment ( $m=9.167$ ) than in an additive ( $m=12.667$ ) and conjunctive environment ( $m=13.583$ ). However, there was no significant difference at the 0.05 level of significance in decision time between the additive and the conjunctive groups.

### **5.6.3 Patterns of Group Communication**

After the experiment, each group's text file was content coded using a coding scheme modified from the one developed by Gettys, et al., (1987) and Connolly, Jessup and Valacich (1990). The files produced by each group were independently coded by two raters, who were blind as to experimental conditions and hypotheses.

The reliability of this process was assessed by recording the number of times the raters changed either parsing or codings in reaching their consensus. The first rater changed an average 2.3 parsings and 7.2 codings per file. The second rater only

changed an average 2.0 parsings and 5.2 codings per file. Given an average file size of 66 comments per file, the initial parsings were agreed for over 94.0 percent (61.7/66) of the comments. Since a change of parsing generated at least one or two changes of coding, as when a single remark was cut to produce two new comments, initial coding reliability was 87.7 percent (57.9/66). Both parsing and coding have thus achieved high inter-rater reliability.

Table 5.14 presents means and standard deviations for all the group communication variables. These measures are counts from the content coding. Table 5.15 shows the percentage statistics of group communication variables and Table 5.16 presents the ANOVA results for the group communication variables.

The query and clarification constituted a relatively large portion of each group's discussion content. Query accounted for 30.21% and clarification accounted for 20.8% of the content. Support argument and critical argument accounted for 11.3% and 18.9% of the content respectively. Proposed decision to the problem made up a relatively small portion (5.8%) of the group's discussion. Procedure related comments made up 7.7% of the content and other unrelated comments accounted for only 5.4% of the group's content. It seems that groups spend most of the time clarifying their proposed decisions and querying the assumptions behind their decision proposals. The groups were very task-oriented and only a small portion of their discussion was totally unrelated to the task. Very few system related comments were exchanged in GDSS supported groups.

H3a to H10a posited that in groups working with GDSS support there will be a significant effect on the discussion content when compared to non-GDSS supported groups. Table 5.16 suggests that GDSS support had significant effects on the discussion content. Groups working with GDSS support generated more critical arguments ( $F_{1,66}=113.38$ ,  $p<0.01$ ), more procedure related comments ( $F_{1,66}=7.23$ ,  $p<0.01$ ), and more total number of comments ( $F_{1,66}=40.16$ ,  $p<0.01$ ). Therefore, H6a, H8a and H10a were accepted. However, No statistically significant differences (0.05 level) were found for the number of decision proposals ( $F_{1,66}=0.21$ , ns), support

Table 5.14: Means and Standard Deviations for Group Communication Variables

| Content<br>Category        | Non-GDSS |        |        |                      | GDSS   |        |        |               |
|----------------------------|----------|--------|--------|----------------------|--------|--------|--------|---------------|
|                            | Add      | Dis    | Con    | Non<br>GDSS<br>Total | Add    | Dis    | Con    | GDSS<br>Total |
| Decision Proposal          |          |        |        |                      |        |        |        |               |
|                            | 4.67     | 5.67   | 5.75   | 5.36                 | 5.08   | 5.08   | 5.50   | 5.22          |
|                            | (1.37)   | (1.50) | (1.22) | (1.42)               | (1.44) | (1.16) | (0.90) | (1.17)        |
| Support Comment            |          |        |        |                      |        |        |        |               |
|                            | 10.58    | 10.50  | 12.08  | 11.06                | 9.33   | 8.50   | 11.00  | 9.61          |
|                            | (3.27)   | (2.81) | (3.92) | (3.38)               | (3.11) | (2.88) | (3.54) | (3.27)        |
| Clarification              |          |        |        |                      |        |        |        |               |
|                            | 19.67    | 16.67  | 16.08  | 17.47                | 19.00  | 18.33  | 20.92  | 19.42         |
|                            | (4.44)   | (5.48) | (3.15) | (4.61)               | (5.51) | (1.83) | (3.15) | (3.86)        |
| Critical Argument          |          |        |        |                      |        |        |        |               |
|                            | 20.08    | 10.25  | 11.17  | 13.83                | 20.50  | 19.50  | 21.67  | 20.56         |
|                            | (3.26)   | (0.97) | (1.64) | (4.97)               | (3.97) | (2.78) | (2.31) | (3.14)        |
| Query                      |          |        |        |                      |        |        |        |               |
|                            | 26.42    | 27.50  | 27.75  | 27.22                | 26.67  | 27.58  | 29.33  | 27.86         |
|                            | (2.57)   | (2.68) | (4.00) | (3.12)               | (2.57) | (3.23) | (1.77) | (2.76)        |
| Procedural Related Comment |          |        |        |                      |        |        |        |               |
|                            | 5.83     | 6.25   | 7.00   | 6.36                 | 6.67   | 9.92   | 6.58   | 7.72          |
|                            | (1.85)   | (1.22) | (1.95) | (1.72)               | (2.67) | (2.87) | (1.89) | (2.90)        |
| Other Unrelated Comment    |          |        |        |                      |        |        |        |               |
|                            | 4.42     | 5.17   | 4.58   | 4.72                 | 5.33   | 5.00   | 4.83   | 5.06          |
|                            | (1.44)   | (1.27) | (0.67) | (1.19)               | (1.50) | (1.04) | (0.72) | (1.12)        |
| System Related Comment     |          |        |        |                      |        |        |        |               |
|                            |          |        |        |                      | 0.67   | 0.75   | 0.50   | 0.64          |
|                            |          |        |        |                      | (0.65) | (1.06) | (0.67) | (0.8)         |

Total Comment

|        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 91.67  | 82.00  | 84.42  | 86.03  | 93.25  | 94.67  | 100.33 | 96.08  |
| (6.81) | (5.64) | (7.06) | (7.59) | (6.12) | (7.92) | (6.61) | (7.40) |

Numbers of Cases

|    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|
| 12 | 12 | 12 | 36 | 12 | 12 | 12 | 36 |
|----|----|----|----|----|----|----|----|

( ) Standard Deviation

Table 5.15: Percentage Statistics for Group Communication Variables

| Content                    | Non-GDSS(%) |      |      |                   | GDSS(%) |      |      | Total         |      |
|----------------------------|-------------|------|------|-------------------|---------|------|------|---------------|------|
|                            | Add         | Dis  | Con  | Non-GDSS<br>Total | Add     | Dis  | Con  | GDSS<br>Total |      |
| Decision proposal          | 5.1         | 6.9  | 6.8  | 6.2               | 5.4     | 5.4  | 5.5  | 5.4           | 5.8  |
| Support Comment            | 11.5        | 12.8 | 14.3 | 12.8              | 10.0    | 9.0  | 11.0 | 10.0          | 11.3 |
| Clarification              | 21.5        | 20.3 | 19.0 | 20.3              | 20.4    | 19.4 | 20.9 | 20.2          | 20.3 |
| Critical Argument          | 21.9        | 12.5 | 13.2 | 16.1              | 22.0    | 20.6 | 21.6 | 21.4          | 18.9 |
| Query                      | 28.8        | 33.5 | 32.9 | 31.6              | 28.6    | 29.1 | 29.2 | 29.0          | 30.2 |
| Procedural Related Comment | 6.4         | 7.6  | 8.3  | 7.4               | 7.2     | 10.5 | 6.6  | 8.0           | 7.7  |
| Other Unrelated Comment    | 4.8         | 6.3  | 5.4  | 5.5               | 5.7     | 5.3  | 4.8  | 5.3           | 5.4  |

|                        |     |     |     |     |     |     |     |     |     |
|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| System Related Comment | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.8 | 0.5 | 0.4 | 0.4 |
| Total Comments         | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Numbers of Cases       | 12  | 12  | 12  | 36  | 12  | 12  | 12  | 36  | 72  |

Table 5.16: Two-way ANOVA Results for Group Communication Variables

| Content Category   | Main Effect |         | Main Effect |        | Interaction |        |
|--------------------|-------------|---------|-------------|--------|-------------|--------|
|                    | GDSS        |         | Task        |        | GDSS x Task |        |
|                    | Source      | F       | Source      | F      | Source      | F      |
| Decision proposal  | 0.35        | 0.21    | 3.50        | 2.13   | 1.56        | 0.95   |
| Support Comment    | 37.56       | 3.46    | 27.54       | 2.54   | 1.43        | 0.13   |
| Clarification      | 68.06       | 3.95    | 20.22       | 1.18   | 45.72       | 2.66   |
| Critical Argument  | 813.39      | 113.38* | 186.93      | 26.06* | 181.26      | 25.27* |
| Query              | 7.35        | 0.88    | 24.00       | 2.88   | 4.06        | 0.49   |
| Procedural Related | 33.35       | 7.23*   | 21.29       | 4.62** | 26.26       | 5.69*  |
| Other Unrelated    | 2.00        | 1.50    | 0.85        | 0.64   | 1.79        | 1.35   |
| System Related     |             |         | 0.19        | 0.293+ |             |        |
| Total Comment      | 1820.06     | 40.16*  | 133.43      | 2.94   | 338.85      | 7.48*  |

\* Significant at 0.01

\*\* Significant at 0.05

+One-way ANOVA result on System Related Comments on GDSS supported groups

-The “Source” column lists mean-square of variance for treatments.

-The “F “ column lists F-Ratio and indicates significant main and interaction effects for treatments.



arguments ( $F_{1,66}=3.46$ , ns), clarifications ( $F_{1,66}=3.95$ , ns), queries ( $F_{1,66}=0.88$ , ns) and unrelated comments ( $F_{1,66}=1.50$ , ns). H3a, H4a, H5a, H7a and H9a were therefore rejected.

One group communication variable measured the number of comments related to the system support in GDSS supported groups. H11a posited that there will be a significant difference between the number of systems related comments in the decision making process across different task structures. One-way ANOVA results on system related comments in GDSS supported groups (see Table 5.16) revealed no significant difference between the different task structures on the number of system related comments. H11a was therefore rejected.

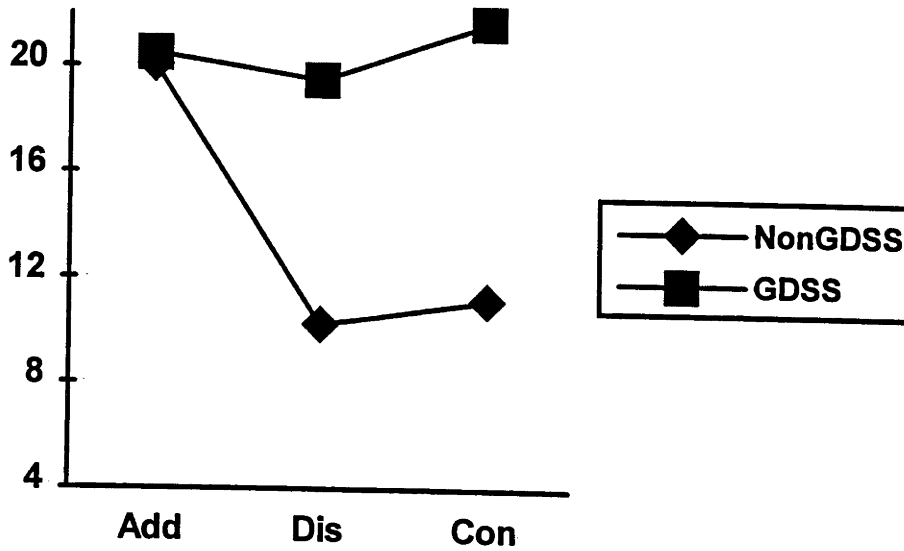
H3b to H10b posited that the effect of GDSS support on discussion content will vary as a function of different task structures. A two-way ANOVA on the communication content variable (see Table 5.16) showed significant interaction effects between GDSS support and task structure on three variables at the 0.05 level of significance.

H6b posited that the effect of GDSS support on the number of critical arguments in the decision making process will vary as a function of different task structures. A two-way ANOVA on the number of critical arguments (see Table 5.17) revealed a significant interaction effect ( $F_{2,66} = 25.27$ ,  $p<0.01$ ) between GDSS support and task structure. The interaction effect indicated that the effect of GDSS on the number of critical arguments depended upon the decision task structure it supported. H6b was therefore accepted. As depicted in Fig 5.3, there was a strong interaction between GDSS and different task structures on the numbers of critical arguments in the decision making process. Simple effects analysis on the number of critical arguments (see Table 5.17) revealed different effects of GDSS support on different decision task structures. In the additive task structure, the simple effect revealed no significant differences in GDSS and non-GDSS supported groups ( $F_{1,66} = 0.145$ , ns), at the significance level of 0.05. GDSS support was found to have no significant impact on the number of critical arguments in the additive task. In the disjunctive task structure,

Table 5.17: Two-way ANOVA Results for Critical Arguments across GDSS and Non-GDSS Supported Groups on Different Task Structures.

| Source of Variation   | D.F. | Sum of Squares | Mean Squares | F Ratio  |
|-----------------------|------|----------------|--------------|----------|
| Main Effects          | 3    | 1187.250       | 395.750      | 55.163*  |
| GDSS                  | 1    | 813.389        | 813.389      | 113.376* |
| Task                  | 2    | 373.861        | 186.931      | 26.056*  |
| 2-way Interactions    |      |                |              |          |
| GDSS x Task           | 2    | 362.528        | 181.264      | 25.266*  |
| Simple Effects        |      |                |              |          |
| GDSS x Additive       | 1    | 1.042          | 1.042        | 0.145    |
| GDSS x Disjunctive    | 1    | 513.375        | 513.375      | 71.560*  |
| GDSS x Conjunctive    | 1    | 661.500        | 661.500      | 92.207*  |
| Task x non-GDSS       | 2    | 708.167        | 354.083      | 49.356*  |
| Task x GDSS           | 2    | 28.222         | 14.111       | 1.967    |
| Explained             | 5    | 1549.778       | 309.956      | 43.204*  |
| Residual              | 66   | 473.500        | 7.174        |          |
| Total                 | 71   | 2023.278       | 28.497       |          |
| * Significant at 0.01 |      |                |              |          |

Fig 5.3: Means of Critical Arguments across Experimental Treatments.



however, the simple effect analysis showed a significantly higher number of critical arguments in GDSS supported groups than non-GDSS supported groups ( $F_{1,66} = 71.560$ ,  $p < 0.01$ ). In the conjunctive task structure, simple effect analysis again demonstrated a significantly higher number of critical arguments in GDSS supported groups than non-GDSS supported groups ( $F_{1,66} = 92.207$ ,  $p < 0.05$ ). These results strongly indicated that the effects of GDSS support on the number of critical arguments was a function of the task structures that GDSS supported.

H8b posited that the effect of GDSS support on the number of procedure related comments in the decision making process will vary as a function of different task structures. A two-way ANOVA revealed (see Table 5.18) a significant interaction effect ( $F_{2,66} = 5.69$ ,  $p < 0.01$ ) between GDSS support and task structure on the number of procedure related comments. H8b was therefore accepted. The interaction effect indicated that the effect of GDSS on the number of procedure related comments was dependent upon the decision task structure it supported. Fig 5.4 also showed a strong interaction between GDSS and different task structures on the numbers of procedure related comments in the decision making process. Simple effects analysis on the number of procedure related comments (see Table 5.18) revealed different effects of GDSS support on different decision task structures. In the additive task structure, the

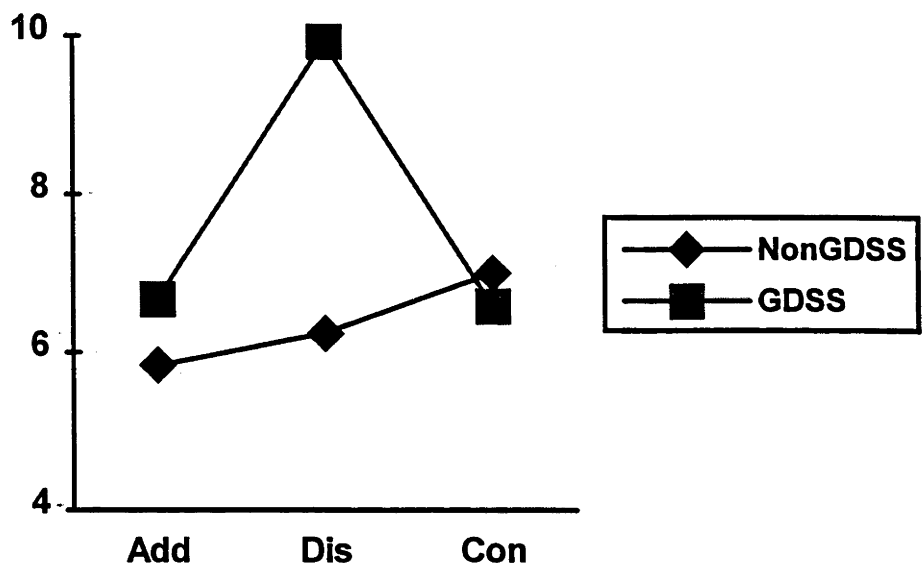
Table 5.18: Two-way ANOVA Results for Procedure Related Comments across GDSS and Non-GDSS Supported Groups on Different Task Structures.

| Source of Variation | D.F. | Sum of Squares | Mean Squares | F Ratio |
|---------------------|------|----------------|--------------|---------|
| Main Effects        | 3    | 75.931         | 25.310       | 5.487*  |
| GDSS                | 1    | 33.347         | 33.347       | 7.230*  |
| Task                | 2    | 42.583         | 21.292       | 4.616** |
| 2-way Interactions  |      |                |              |         |
| GDSS x Task         | 2    | 52.528         | 52.528       | 5.694*  |
| Simple Effects      |      |                |              |         |
| GDSS x Additive     | 1    | 4.167          | 4.167        | 0.903   |
| GDSS x Disjunctive  | 1    | 80.667         | 80.667       | 17.49*  |
| GDSS x Conjunctive  | 1    | 1.042          | 1.042        | 0.226   |
| Task x non-GDSS     | 2    | 8.388          | 4.194        | 0.910   |
| Task x GDSS         | 2    | 86.722         | 43.361       | 9.402*  |
| Explained           | 5    | 128.458        | 25.692       | 5.570*  |
| Residual            | 66   | 304.417        | 4.612        |         |
| Total               | 71   | 432.875        | 6.097        |         |

\* Significant at 0.01

\*\* Significant at 0.05

Fig 5.4: Means of Procedure Related Comments across Experimental Treatments.



simple effect revealed no significant differences in GDSS and non-GDSS supported groups ( $F_{1,66} = 0.910$ , ns), at the significance level of 0.05. GDSS support was found to have no significant impact on the number of procedure related comments in the additive task. In the disjunctive task structure, however, the simple effect analysis demonstrated a significantly higher number of procedure related comments in GDSS supported groups than the non-GDSS supported groups ( $F_{1,66} = 17.49$ ,  $p < 0.01$ ). In the conjunctive task structure, simple effect analysis again showed no significantly higher number of procedure related comments in GDSS supported groups than non-GDSS supported groups ( $F_{1,66} = 0.226$ , ns). These results strongly indicated that the effects of GDSS support on the number of procedure related comments vary across different task structures.

H10b posited that the effect of GDSS support on total number of comments in the decision making process will vary as a function of different task structures. A two-way ANOVA on the number of total comments (see Table 5.19) revealed a significant interaction effect ( $F_{2,66} = 7.477$ ,  $p < 0.05$ ) between GDSS support and task structure. The interaction effect indicated that the effect of GDSS on the total number of comments in the group decision making process depended upon the decision task structure it supported. H10b was therefore accepted. As depicted in Fig 5.5, there was

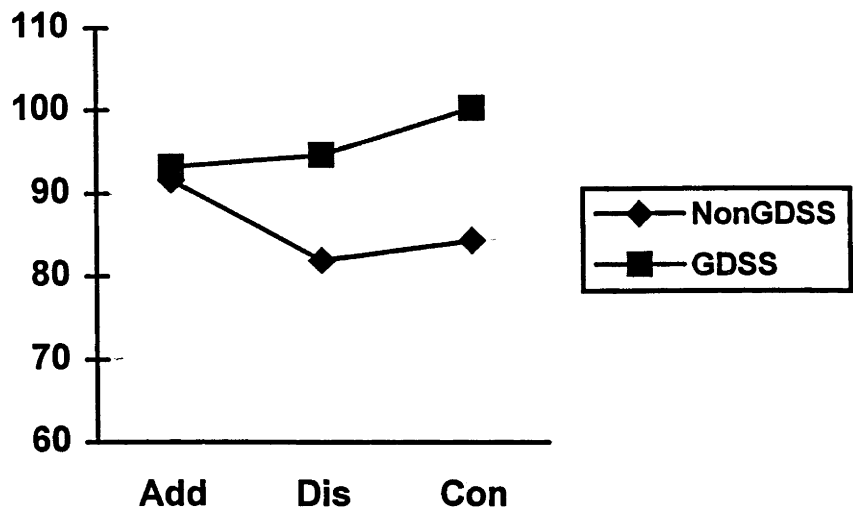
Table 5.19: Two-way ANOVA Results for Total Comments across GDSS and Non-GDSS Supported Groups on Different Task Structures.

| Source of Variation | D.F. | Sum of Squares | Mean Squares | F Ratio  |
|---------------------|------|----------------|--------------|----------|
| Main Effects        | 3    | 2086.917       | 695.639      | 15.349*  |
| GDSS                | 1    | 1820.056       | 1820.056     | 40.159*  |
| Task                | 2    | 266.861        | 133.431      | 2.944    |
| 2-way Interactions  |      |                |              |          |
| GDSS x Task         | 2    | 677.694        | 338.847      | 7.477*   |
| Simple Effects      |      |                |              |          |
| GDSS x Additive     | 1    | 11.456         | 11.456       | 1.210    |
| GDSS x Disjunctive  | 1    | 2223.375       | 2223.375     | 334.756* |
| GDSS x Conjunctive  | 1    | 2301.041       | 2301.041     | 242.956* |
| Task x non-GDSS     | 2    | 607.389        | 303.694      | 6.700*   |
| Task x GDSS         | 2    | 337.167        | 168.583      | 3.712**  |
| Explained           | 5    | 2764.611       | 552.922      | 12.200*  |
| Residual            | 66   | 2991.167       | 45.321       |          |
| Total               | 71   | 5755.778       | 81.067       |          |

\* Significant at 0.01

\*\* Significant at 0.05

Fig 5.5: Means of Total Comments across Experimental Treatments.



a strong interaction between GDSS and different task structures on the total numbers of comments in the decision making process. Simple effects analysis on the total number of comments (see Table 5.19) revealed different effects of GDSS support on different decision task structures. In the additive task structure, the simple effect revealed no significant differences in GDSS and non-GDSS supported group ( $F_{1,66} = 1.21$ , ns), at the significance level of 0.05. GDSS support was found to have no significant impact on the number of total comments in the additive task.

In the disjunctive task structure, however, the simple effect analysis showed a significantly higher number of total comments in GDSS supported groups than non-GDSS supported groups ( $F_{1,66} = 334.756$ ,  $p < 0.01$ ). In the conjunctive task structure, simple effect analysis again showed a significantly higher number of total comments in GDSS supported groups than non-GDSS supported groups ( $F_{1,66} = 242.956$ ,  $p < 0.05$ ). These results strongly indicated that the effects of GDSS support on the total number of comments in the group decision making process was a function of the task structures the GDSS was supporting.

Two-way analysis also showed no significant interaction effects between GDSS support and task structure on decision proposal ( $F_{2,66} = 0.95$ ,  $p < 0.05$ ), support

comments ( $F_{2,66} = 0.13$ ,  $p < 0.05$ ), clarification ( $F_{2,66} = 2.66$ ,  $p < 0.05$ ), query ( $F_{2,66} = 0.49$ ,  $p < 0.05$ ), and other unrelated comments ( $F_{2,66} = 1.35$ ,  $p < 0.05$ ). Therefore, H3b, H4b, H5b, H7b and H9b were rejected.

#### **5.6.4 Perceived Satisfaction**

Perceived satisfaction was measured by three post-experimental self-reported questionnaires. Questionnaire A measured the subject's perceived satisfaction with the decision outcome and perceived satisfaction with the group decision making process. Questionnaire B measured the subject's perceived participation in the group decision process, perceived conflict behaviour in the group decision process, perceived confidence in the group decision, perceived depth of evaluation in the group decision, perceived willingness to remain in the group, and perceived overall satisfaction with the decision making exercise. Questionnaire C measured how the subjects perceived the effectiveness of GDSS for the task, and its effectiveness compared to face-to-face meetings. All the questionnaires were seven point rating.

Table 5.20 summarises means and standard deviations for the measure of perceived satisfaction. The rating of satisfaction variables by both GDSS and non-GDSS supported groups was high. The average was on the positive side of a mid-point of 4 on a 7-point scale. These data suggest that on average the participants generally expressed satisfaction with the outcome and the process of the decision making exercise. Table 5.21 presents the results of the ANOVA on the satisfaction variables.

H21a to H19a posited that groups working under GDSS support will have significant effects on perceived satisfaction with the decision making process when compared with those not supported by a GDSS. Table 5.21 provides evidence to support the hypothesis. Groups working under GDSS support perceived less satisfaction with the decision making process ( $F_{1,66} = 4.53$ ,  $p < 0.05$ ); perceived more conflict behaviour ( $F_{1,66} = 18.33$ ,  $p < 0.01$ ); had less confidence in the group decision ( $F_{1,66} = 10.93$ ,  $p < 0.01$ ); and less overall satisfaction ( $F_{1,66} = 4.42$ ,  $p < 0.05$ ) than non-GDSS supported groups. Therefore, H13a, H15a, H16a, H19a were accepted. However, no statistically significant differences ( at 0.05 level) were found for the scores of perceived



Table 5.20: Means and Standard Deviations for Perceived Satisfaction

| Perceived                                    | Non-GDSS |        |        |                  | GDSS   |        |        |               |
|----------------------------------------------|----------|--------|--------|------------------|--------|--------|--------|---------------|
| Satisfaction                                 | Add      | Dis    | Con    | NonGDSS<br>Total | Add    | Dis    | Con    | GDSS<br>Total |
| Satisfaction with decision outcome           |          |        |        |                  |        |        |        |               |
|                                              | 5.33     | 5.19   | 4.97   | 5.17             | 4.61   | 5.06   | 5.00   | 4.89          |
|                                              | (0.89)   | (0.95) | (0.94) | (0.91)           | (0.98) | (0.62) | (0.85) | (0.83)        |
| Satisfaction with group decision process     |          |        |        |                  |        |        |        |               |
|                                              | 4.50     | 4.90   | 4.90   | 4.76             | 4.28   | 4.25   | 4.33   | 4.28          |
|                                              | (1.00)   | (0.81) | (0.54) | (0.80)           | (1.03) | (0.95) | (1.18) | (1.03)        |
| Participation in group decision process      |          |        |        |                  |        |        |        |               |
|                                              | 5.08     | 4.92   | 5.25   | 5.08             | 5.00   | 5.08   | 5.08   | 5.06          |
|                                              | (0.79)   | (0.53) | (0.55) | (0.63)           | (0.84) | (0.55) | (0.70) | (0.69)        |
| Conflict behaviour in group decision process |          |        |        |                  |        |        |        |               |
|                                              | 4.89     | 3.61   | 3.58   | 4.03             | 5.00   | 4.78   | 4.83   | 4.87          |
|                                              | (0.90)   | (0.71) | (1.06) | (1.07)           | (0.74) | (0.52) | (0.98) | (0.75)        |
| Confidence in group decision+                |          |        |        |                  |        |        |        |               |
|                                              | 0.158    | 0.162  | 0.164  | 0.161            | 0.178  | 0.186  | 0.180  | 0.181         |
|                                              | (.019)   | (.017) | (.020) | (.019)           | (.028) | (.029) | (.036) | (.030)        |
| Depth of evaluation in group decision        |          |        |        |                  |        |        |        |               |
|                                              | 4.81     | 5.00   | 4.72   | 4.84             | 4.63   | 4.94   | 5.19   | 4.93          |
|                                              | (0.80)   | (0.57) | (0.96) | (0.78)           | (0.74) | (0.81) | (0.75) | (0.78)        |
| Willingness to remain in group               |          |        |        |                  |        |        |        |               |
|                                              | 4.83     | 4.81   | 4.78   | 4.81             | 4.78   | 4.36   | 4.36   | 4.50          |
|                                              | (0.36)   | (0.69) | (1.15) | (0.78)           | (0.98) | (1.21) | (0.98) | (1.05)        |
| Overall satisfaction                         |          |        |        |                  |        |        |        |               |
|                                              | 4.58     | 4.80   | 4.83   | 4.74             | 4.25   | 4.22   | 4.42   | 4.29          |
|                                              | (1.01)   | (0.75) | (0.48) | (0.76)           | (0.90) | (0.90) | (1.19) | (0.98)        |

|                                                     |    |    |    |    |        |        |        |        |
|-----------------------------------------------------|----|----|----|----|--------|--------|--------|--------|
| GDSS usefulness to task                             |    |    |    |    | 4.42   | 5.50   | 5.42   | 5.11   |
|                                                     |    |    |    |    | (0.98) | (1.18) | (0.85) | (1.10) |
| GDSS effectiveness against face-to-face meeting     |    |    |    |    | 4.08   | 4.33   | 4.36   | 4.26   |
|                                                     |    |    |    |    | (1.60) | (1.84) | (1.94) | (1.75) |
| Nos of Cases                                        | 12 | 12 | 12 | 36 | 12     | 12     | 12     | 36     |
| ( ) Standard Deviation                              |    |    |    |    |        |        |        |        |
| + 1/(1/Y+1) transformation of the confidence scores |    |    |    |    |        |        |        |        |

Table 5.21: ANOVA Results for Satisfaction Variables

| Perceived Satisfaction                       | Main Effect |        | Main Effect |       | Interaction |        |
|----------------------------------------------|-------------|--------|-------------|-------|-------------|--------|
|                                              | GDSS        |        | Task        |       | GDSS x Task |        |
|                                              | Source      | F      | Source      | F     | Source      | F      |
| Satisfaction with decision outcome           | 1.38        | 1.78   | 0.17        | 0.22  | 0.94        | 1.21   |
| Satisfaction with group decision process     | 4.01        | 4.53** | 0.34        | 0.38  | 0.29        | 0.33   |
| Participation in group decision process      | 0.01        | 0.03   | 0.18        | 0.40  | 0.18        | 0.40   |
| Conflict behaviour in group decision process | 12.78       | 18.33* | 4.42        | 6.34* | 2.42        | 3.47** |
| Confidence in group decision+                | 0.01        | 10.93* | 0.00        | 0.34  | 0.00        | 0.14   |

|                                                      |      |        |      |        |      |      |
|------------------------------------------------------|------|--------|------|--------|------|------|
| Depth of evaluation in group decision                | 0.13 | 0.21   | 0.48 | 0.78   | 0.70 | 1.15 |
| Willingness to remain in group                       | 1.68 | 1.90   | 0.42 | 0.48   | 0.28 | 0.32 |
| Overall satisfaction                                 | 3.56 | 4.42** | 0.26 | 0.32   | 0.01 | 0.12 |
| Usefulness of GDSS for task++                        |      |        | 4.36 | 4.24** |      |      |
| Effectiveness of GDSS against face-to-face meeting++ |      |        | 0.28 | 0.09   |      |      |

\* Significant at 0.01

\*\* Significant at 0.05

+ 1/(1+Y) transformation on the confidence scores.

++One-way ANOVA result on GDSS usefulness and effectiveness against face-to-face meeting.

-The "Source" column lists mean-square of variance for treatment.

-The "F " column lists F-Ratio and indicates significant main and interaction effects for treatments.

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satisfaction with decision outcome ( $F_{1,66} = 1.78$ , ns); perceived participation in group decision process ( $F_{1,66} = 0.33$ , ns); depth of evaluation in group decision ( $F_{1,66} = 0.21$ , ns), and willingness to remain in group ( $F_{1,66} = 1.90$ , ns). H12a, H14a, H17a and H18a were therefore rejected.

One-way ANOVA (Table 5.21) also revealed a significant difference ( $F_{2,33} = 4.24$ ,  $p < 0.05$ ) in perceived usefulness of GDSS for task across different task structures. H20a was accepted. Post-hoc multiple comparison analyses (Kirk 1982) showed that GDSS supported groups perceived GDSS to be significantly less useful (Newman-Keuls,  $p < 0.05$ ) in the additive task environments ( $m = 4.42$ ) than in the disjunctive ( $m$

= 5.50) and conjunctive environments ( $m = 5.42$ ). However, there was no significant difference at the 0.05 level between the disjunctive and the conjunctive groups.

One-way ANOVA revealed no significant difference ( $F_{2,33} = 0.0867$ , ns) in the perceived GDSS effectiveness against face-to-face meeting across different task structures at the 0.05 significant level. H21a was rejected. Further analysis, however, revealed very high standard deviations on the scores. The total mean was 4.26 with a standard deviation 1.75. The scores also exhibited a wide range from 2.00 to that of 6.67 in the additive; 1.67 to 6.67 in the disjunctive task, and 2.00 to 7.00 in the conjunctive task.

H12b to H19b posited that the effect of GDSS support on perceived satisfaction will vary as a function of different task structures. A two-way ANOVA on satisfaction with group decision making process (see Table 5.21) revealed a significant interaction effect (at the 0.05 significance level) between GDSS support and task structure on perceived conflict behaviour.

H15b posited that the effect of GDSS support on perceived conflict behaviour in the decision making process will vary as a function of different task structures. A two-way ANOVA on perceived conflict behaviour (see Table 5.22) revealed a significant interaction effect ( $F_{2,66} = 3.466$ ,  $p < 0.05$ ) between GDSS support and task structure. The interaction indicated that the effect of GDSS on perceived conflict behaviour depended upon the decision task structure it supported. H15b was therefore accepted. As depicted in Fig 5.6, there was a strong interaction between GDSS and different task structures on the perceived conflict behaviour in the decision making process. Simple effects analysis on the decision quality (see Table 5.22) revealed the different effects of GDSS support on different decision task structures. In the additive task structure, the simple effect revealed in significant differences on GDSS and non-GDSS supported groups ( $F_{1,66} = 0.106$ , ns), at the significance level of 0.05. GDSS support was found to have no significant impact on the perceived conflict behaviour in the additive task. In the disjunctive task structure, however, the simple effect analysis showed a significantly higher perceived conflict behaviour in GDSS

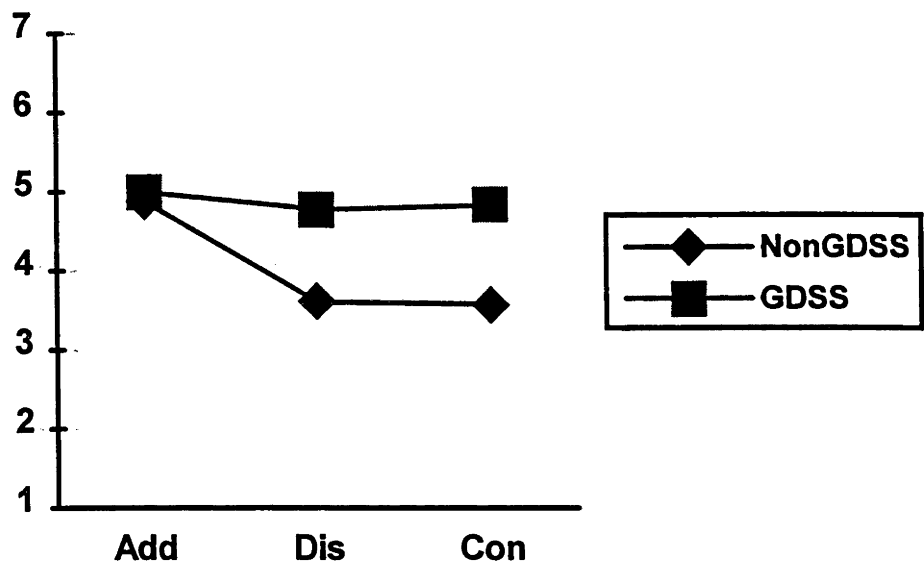
Table 5.22: Two-way ANOVA Results for Conflict Behaviour across GDSS and Non-GDSS Supported Groups on Different Task Structures.

| Source of Variation | D.F. | Sum of Squares | Mean Squares | F Ratio |
|---------------------|------|----------------|--------------|---------|
| Main Effects        | 3    | 21.623         | 7.208        | 10.333* |
| GDSS                | 1    | 12.782         | 12.782       | 18.326* |
| Task                | 2    | 8.840          | 4.420        | 6.337*  |
| 2-way Interactions  |      |                |              |         |
| GDSS x Task         | 2    | 4.836          | 2.418        | 3.466** |
| Simple Effects      |      |                |              |         |
| GDSS x Additive     | 1    | 0.074          | 0.074        | 0.106   |
| GDSS x Disjunctive  | 1    | 8.157          | 8.157        | 11.682* |
| GDSS x Conjunctive  | 1    | 9.386          | 9.386        | 13.447* |
| Task x non-GDSS     | 2    | 13.354         | 6.677        | 9.566*  |
| Task x GDSS         | 2    | 0.322          | 0.161        | 0.231   |
| Explained           | 5    | 26.458         | 5.292        | 7.586*  |
| Residual            | 66   | 46.036         | 0.698        |         |
| Total               | 71   | 72.495         | 1.021        |         |

\* Significant at 0.01

\*\* Significant at 0.05

Fig 5.6: Means of Perceived Conflict Behaviour across Experimental Treatments.



supported groups than non-GDSS supported groups ( $F_{1,66} = 11.682, p < 0.01$ ). In the conjunctive task structure, simple effect analysis again showed significantly higher perceived conflict behaviour in GDSS supported groups than non-GDSS supported groups ( $F_{1,66} = 13.447, p < 0.05$ ). These results indicated that the effects of GDSS support on perceived conflict behaviour was a function of the task structures GDSS supported.

Two-way analysis also showed no significant interaction effects between GDSS support and task structure on perceived satisfaction with decision outcome ( $F_{2,66} = 1.21, ns$ ), perceived satisfaction with group decision process ( $F_{2,66} = 0.33, ns$ ), perceived participation in group decision process ( $F_{2,66} = 0.40, ns$ ), perceived confidence in group decision, ( $F_{2,66} = 0.14, ns$ ), perceived depth of evaluation in group decision ( $F_{2,66} = 1.15, ns$ ), perceived willingness to remain in group ( $F_{2,66} = 0.32, ns$ ) and perceived overall satisfaction with the decision process ( $F_{2,66} = 0.12, ns$ ). Therefore, H12b, H13b, H14b, H16b, H17b, H18b and H19b were rejected.

## **5.7 Chapter Summary**

This chapter presented the results of the experiment described in Chapter 4. The statistical methods for testing the research hypotheses were described. The chapter also dealt with the testing of the construct validity and the reliability of the research instruments. The requirements of the statistical tests and the manipulation check of the experimental treatments were described. The results of testing the research hypotheses were then provided by applying two-way ANOVA to each of the twenty-one dependent variables across six experimental treatments. The discussion, implications and conclusions drawn from these results are presented in Chapter 6.

## CHAPTER 6

### SUMMARY AND CONCLUSION

#### 6.1 Introduction

The primary objective of this research has been to examine whether structures of decision tasks mediate the effects of group decision support systems (GDSS) on patterns of communication and decision outcomes of decision making groups. This research also examines the relationship between patterns of group communication and decision outcomes to see if a change in group communication can have a direct impact on group decision outcomes. Although prior research has shown that the effects of GDSS on group decision making are not uniformly positive, conditions under which the use of GDSS is appropriate and beneficial are not well understood. The characteristics of the group task are emerging as important variables that can moderate the effects of GDSS on group decision making. Failure to study explicitly the role of group communication in group decision making is another reason why prior research in GDSS has yielded much conflicting evidence. The group communication process is the centrepiece to any explanations about group performance. Process-oriented research should enable us to understand how the group communication process mediates the effects of GDSS and therefore develop better insights into the nature of group outcomes observed in GDSS use. This research has sought to show that the effects of GDSS on the decision making process and outcomes are task-structure dependent and therefore cannot be evaluated on the basis of outcomes alone. The decision process must also be evaluated in order to understand how decisions are made and why GDSS can improve group outcomes in some situations but produce negative effects in others.

A controlled laboratory experiment was conducted with a 2x3 factorial between-subjects design, manipulating two independent variables: level of support (GDSS support and no support) and task structure (additive, disjunctive and conjunctive). Practising managers were chosen as subjects. Using a personnel recruitment exercise as the experimental task, the structures of the task were



manipulated by varying the group members' roles and the information distribution. The experiment was administered to the participants on a management training course. The discussion records of the decision making process were coded using a carefully designed coding scheme. Other dependent variables were decision quality, decision time and perceived satisfaction with process and outcome.

This chapter summarises and discusses the implications of the statistical findings presented in Chapter 5, and is organised into seven sections. In Section 6.2, main research findings for each research question are summarised and Section 6.3 provides an explanation and discussion of the results, within the context of this and prior research. Section 6.4 then identifies the theoretical implications of the present research and Section 6.5 discusses the practical implications of the findings. Section 6.6 describes the limitations of the current research and Section 6.7 concludes with directions for future research.

## **6.2 Findings regarding Research Questions**

The main research findings for each of the three research questions are summarised.

### **6.2.1 Research Question 1**

**Are there any systematic differences in the decision outcomes between GDSS supported and face-to-face decision making groups across different task structures?**

In this study, decision outcomes of a decision making group were measured by the objective decision quality and decision time, and perceived satisfaction with the decision and group process.

#### **6.2.1.1 Decision Quality**

The results of this experiment show that a GDSS in general increases the decision quality of the decision making groups. There exists a main effect between GDSS support and group decision quality. This result is consistent with Gallupe (1985),

Jarvenpaa, Rao, and Huber (1988), and Cass, Heintz, and Kaiser (1992) who reported significant positive effects of GDSS on decision quality of decision making groups. However, a conclusion regarding the main effect between GDSS support and decision quality can only be stated with caution due to the presence of the interaction effect on task structures. It is found in this experiment that GDSS significantly improves group decision quality when the decision groups are working in a disjunctive or conjunctive task situation. GDSS results in no significant quality gain when the groups are working with an additive task.

These results suggest that there are significant differences in decision quality between GDSS-supported and face-to-face decision-making groups and that the effects of GDSS are moderated by the structure of the decision task on which the groups are working. More precisely, the results indicate that the effectiveness of GDSS for improving group decision quality tends to increase as the 'complexity' of the task structure increases. Gallupe, DeSanctis and Dickson (1988) have suggested that GDSS are particularly helpful in the groups working on tasks of higher difficulty. The results of this experiment reveal that GDSS is helpful not only in difficult task types but in difficult task structures. When the task structure is straightforward (i.e., all members have the same information and no information sharing or task co-ordination are required in an additive task), GDSS support results in no decision quality gains. But GDSS can improve decision quality of the groups working with disjunctive and conjunctive tasks when task co-ordination and information sharing play a major role in determining the quality of the group decision outcome.

#### **6.2.1.2 Decision Time**

Although the results show that GDSS can improve decision quality, GDSS groups are in general less efficient than face-to-face groups in terms of the time needed to reach a group decision. In this experiment, there exists a main effect between GDSS support and group decision time. The GDSS groups take, on average, 2.3 times longer to reach a decision when compared to the face-to-face groups. This result is consistent with the findings of Steeb and Johnston (1981), Kiesler, Siegel, and McGuire (1984), and

Kiesler and Sproull (1992), which found that GDSS groups tended to take longer to reach a consensus decision.

Although the results suggest that the time to reach a consensus decision is significantly affected by the use of GDSS, the effects of GDSS on decision time are not proportional among decision groups working with different task structures. The results of this experiment reveal a significant interaction effect between GDSS support and task structures on decision time. Although time to reach a decision in GDSS groups is significantly longer than face-to-face groups in both additive, disjunctive and conjunctive task, the effect of GDSS is more significant in conjunctive tasks. In conjunctive tasks, GDSS groups take nearly three times longer to reach a decision than face-to-face groups whereas in both the additive and disjunctive task, the difference is about twice the time when comparing to GDSS with face-to-face groups. This result provides additional evidence that the effects of GDSS on group decision outcomes are moderated by the structures of the decision task.

#### **6.2.1.3 Perceived Satisfaction**

Group members working in GDSS conditions report lower levels of satisfaction than group members working in face-to-face groups. GDSS groups report less perceived satisfaction with the decision making process, experiencing more conflict behaviour and being less confident about the group decision. There are no significant differences between GDSS and face-to-face groups in the perceived satisfaction with decision outcome, participation, depth of evaluation, willingness to remain in group and overall satisfaction. The anticipated interactions between GDSS support and task structure are not observed. Only the perceived conflict behaviour was shown to vary between GDSS and non-GDSS groups across different task structures. Overall, the effects of GDSS on perceived satisfaction with the group decision do not vary as a function of task structure. GDSS groups were generally less satisfied across all three task structures when compared to non-GDSS groups. GDSS groups also reported no significant differences in the perceived usefulness of GDSS across task structure. These results are consistent with Gallupe (1985) and Watson (1987) that GDSS groups were less satisfied compared with face-to-face groups. The results also support

the findings of Gallupe, DeSanctis and Dickson (1988) that group members' decision confidence and satisfaction with decision process were lower in GDSS supported groups.

### **6.2.2 Research Question 2**

**Are there any systematic differences in the patterns of group communication between GDSS supported and face-to-face decision making groups across different task structures?**

The results of this experiment suggest that the effects of GDSS on group communication interaction vary as a function of task structures. There exists a strong interaction effect in the patterns of group communication between GDSS-supported and face-to-face decision-making groups across different task structures. In additive tasks, GDSS support made no significant difference in terms of how groups communicated in reaching a decision. There were no significant differences in the numbers of decision proposals, supportive comments, clarifications, critical arguments, queries, procedural related comments, other unrelated comments and the total number of comments in group communication between GDSS and face-to-face groups. The patterns of communication interaction between group members in GDSS groups are very similar to face-to-face groups in an additive task.

In disjunctive tasks, the total number of comments exchanged in GDSS groups are significantly more than in face-to-face groups. The content exchanged in the two conditions is also different. GDSS groups exchanged significantly more critical arguments and procedural related comments when compared to face-to-face groups. There were no significant differences in the number of decision proposals, supportive comments, clarifications, queries and task-unrelated comments between GDSS and face-to-face groups. In other words, GDSS groups working on a disjunctive task engaged in more discussion, were more critical in their discussion and spent more time discussing how to approach the decision task than face-to-face groups.

GDSS support also has significant effects on how decision groups communicate when working on a conjunctive task, and the effects are similar to the effects in the disjunctive task. Like the group working with a disjunctive task, conjunctive GDSS groups engaged in more discussion and exchanged more critical arguments than face-to-face groups. But unlike the disjunctive task, there were no significant differences in the numbers of procedural related comments between GDSS and face-to-face groups. There were no significant differences in the numbers of decision proposals, supportive comments, clarifications, queries, procedural related comments and other unrelated comments between the GDSS and face-to-face groups.

These results indicate that the effects of GDSS on the patterns of group communication interaction between GDSS supported and face-to-face decision making groups are moderated by the structure of the decision task in which the groups are working. As with the GDSS effects on group decision quality across different task structures, the results suggest that the effectiveness of GDSS on group communication patterns also tends to increase as the 'complexity' of the task structure increases. When the task structure is additive with all members having the same information and less demand on task co-ordination, GDSS support results in no direct effects on how groups communicate to reach a decision. However, GDSS alters the group communication patterns when the groups are working on a disjunctive or a conjunctive task, when task co-ordination and information sharing play a significant role in determining the quality of the group decision outcome.

### **6.2.3 Research Question 3**

**Is there a systematic relationship between the patterns of group communication and the decision outcomes among the GDSS supported and face-to-face decision making groups across different task structures?**

The results provide strong support for the existence of a systematic relationship between the patterns of communication interaction and the decision outcomes among the GDSS supported and face-to-face decision making groups. The results also provide empirical evidence for the understanding of how GDSS shape the patterns of

group communication which is likely to explain why GDSS can improve group outcomes in some task structures but is not helpful in other task structures. In this experiment, GDSS support has significantly shaped the patterns of communication interaction among the groups working on disjunctive and conjunctive tasks. In reaching a decision on a disjunctive task, group members with GDSS support are more critical and procedural, and communicate more than face-to-face groups. Moreover, the results reveal a significant improvement in terms of the quality of the decision in GDSS groups over face-to-face groups working on disjunctive tasks.

In the case of conjunctive tasks, group members with GDSS support are more critical and communicate more than face-to-face groups working on the same task, and results also reveal significant decision quality improvements in GDSS groups when compared to face-to-face groups.

In the case of an additive task, however, no significant changes in group communication are detected as a result of GDSS support, and the results show no significant improvement in GDSS groups over face-to-face groups working on the same task.

The results also reveal a strong relationship between critical arguments and procedural related comments on the decision quality, the groups' perceived satisfaction with the decision process and the groups' confidence in the decision. In short, these results strongly suggest that a relationship exists between the patterns of group communication and group decision outcomes. It is clearly revealed in the results that, if the patterns of group communication change as a result of GDSS support, the outcomes of the group's decision also change.

## **6.3 Discussion**

### **6.3.1 GDSS Support and Group Communication**

How does GDSS use affect the patterns of group communication in this experiment? Several investigations (Sproull and Keisler, 1986; Keisler, Siegel, and McGuire,

1984; Siegel, et al., 1986) have suggested that computer-mediated communication results in de-individuated interaction. According to this explanation, computer-mediated communication causes persons to become 'depersonalised' because it reduces social context information (i.e., nodding approval or frowning with displeasure and social artefacts in the physical environment) resulting in persons acting in a more impulsive and assertive manner, with less regard for the feelings of those who are on the receiving end of a communication. This argument is applied to explain why people are typically less inhibited and more critical when communicating in a computer-mediated environment. This argument is consistent with the empirical evidence in this experiment. In this experiment, members of GDSS groups were more critical during group discussion and they also perceived a higher level of conflict behaviour than face-to-face groups. Data gathered in the debriefing sessions also supported this explanation. Members in GDSS groups report more open discussion and see computer-mediated communication as less of a threat and a more impersonal medium than face-to-face communication.

Although prior research shows that GDSS groups are generally more critical (Sproull and Kiesler, 1986; Siegel et al., 1986), in this experiment GDSS support changed the patterns of group communication only in the disjunctive and conjunctive groups and not the additive groups. These results can be explained by adaptive structuration theory (Poole and DeSanctis, 1990, 1992) and the theory of functional perspective of group decision making (Gouran and Hirokawa, 1983; Hirokawa, 1983, 1985, 1988). Decision making groups utilise different GDSS features in different situations so as to meet the requirement of the task and GDSS can not be expected to have the same effects in all task situations.

In a conjunctive task, the information requirement of the task increases (Steiner, 1972). Individual members (even highly competent ones) find it difficult to work through the task alone, because they do not possess all the information needed to arrive at a viable decision. Consequently, they find it necessary to interact with other group members in order to obtain or properly interpret task-relevant information. Moreover, through interaction, group members are often able to assist one another to a

better understanding of how information can be applied to arrive at a high-quality decision (Hackman and Morris, 1975). Thus, the increased information requirement of the task structure decreases the likelihood that individual members will be able to work successfully through the task without interacting with other group members. The role of group interaction communication in determining group performance likewise increases.

In this study, GDSS significantly changed the patterns of how groups communicated in a conjunctive task. According to adaptive structuration theory and the theory of functional perspective of group decision making, these results can be explained in that GDSS groups seem to recognise the specific requirements of a conjunctive task and the groups then adopt the specific features that a GDSS provides (the more open and impersonal computer-mediated communication channel) to facilitate the decision making process. As a result, GDSS groups generate significantly more critical arguments and more group interaction (in terms of the total numbers of comments) when compared with non-GDSS groups when working on a conjunctive task. In a conjunctive task, GDSS support seems to provide a communication environment in which group members can enhance the sharing and critical evaluation of information.

In a disjunctive task, when the task requires group members to evaluate critically and to select the most preferred decision among group members (Steiner, 1972), GDSS support reinforces the disjunctive task structure. Without these high-conflict processes, the group tends toward 'groupthink' (Janis, 1982) or to pursue conformity within a group rather than find the optimal decision (Weick, 1979). Conformity pressures and conflict minimisation result in less information sharing, poorer communication, fewer challenged assumptions, and sub-optimal decisions (Janis, 1982). A face-to-face process would be less effective because the merits of each individual proposal would not be fully explored. Thus, in a disjunctive task, a face-to-face process may exacerbate tendencies toward conformity and 'groupthink'. The procedural requirement of a disjunctive task can be higher than both the additive and conjunctive task (Steiner, 1972). As the group needs to select a solution for the decision proposed by its members, the need for organising how the group should



decide which solution to take becomes critical. In this experiment, the results show that GDSS groups seem to recognise these task requirements and adapt GDSS effectively to meet these requirements. GDSS support seems to provide an environment so that group members can enhance their organisation to proceed effectively with the task and the critical evaluation of the information.

In an additive task, each member has the same information and the group has to reach a decision collectively (Steiner, 1972). In this experiment, the results revealed no significant difference in the patterns of group communication between GDSS and face-to-face groups. One explanation is that, unlike the conjunctive task, each group member has similar information and the group is not required to evaluate each member's proposed solutions. Co-operation and co-ordination among group members are less critical to the success of the additive task. Although GDSS can provide a critical process for decision making and provide a communication means to discuss decision procedures, group members may not see the need to adopt these features. As a result, GDSS support has not made a significant impact on the patterns of group communication.

In summary, the results of this experiment are consistent with the adaptive structuration theory and the theory of functional perspective of group decision making. The structure of the decision task seems to create specific task requirements for the decision making group and the specific features of GDSS are adapted in the decision making process to meet these task requirements. It is through this structuration process that GDSS can have an impact on the group decision making process and outcomes.

### **6.3.2 Group Communication and Decision Outcomes**

The previous section provides an explanation for how the patterns of group communication are influenced as a result of GDSS use. In this section, an explanation is provided for how these changes in group communication may alter the group decision outcomes. The results of this experiment show a strong relationship between how groups communicate and the decision outcomes. As the results of GDSS support

demonstrate, group communication becomes more critical and procedural oriented in a disjunctive task, which in turn results in improved decision quality. In a conjunctive task, GDSS groups are also more critical, they communicate more and ultimately have better quality decisions than face-to-face groups. There are no significant differences in both the group communication and decision quality between additive GDSS and face-to-face groups. The results also reveal a significant relationship between critical arguments and decision quality. The effect of group communication on the quality of the group decision is clear. These results provide support for the theory of functional perspective of decision making (Gouran and Hirokawa, 1983; Hirokawa, 1983, 1985, 1988) that group communication has a direct effect on decision outcome.

Although computer-mediated discussion is widely experienced as impersonal and critical (Hiltz and Turoff, 1978), the critical discussion processes have not been shown to have a consistently positive effect on decision quality (Sproull and Keisler, 1986; Connolly, Jessup and Valacich, 1990; Jessup and Tansik (1991). The results of this study provide some support for the view that critical argument during the decision process can improve the decision quality of the decision making group. One explanation for this inconsistency is that, in GDSS research, different scholars have used different definitions for measuring critical arguments. For example, in Sproull and Keisler (1986), critical arguments are measured in terms of uninhibited speech like swearing or insulting among group members. In Connolly, Jessup and Valacich (1990), critical arguments are measured by the critical remarks that group members expressed to oppose a decision. In this study, GDSS groups were more impulsive and assertive and generated significantly more critical discussion and arguments in comparison to non-GDSS groups. However, when carefully examining the content of these critical arguments, uninhibited speech like swearing, insulting or hostile comments only make up a very small portion (less than 2%) of these critical comments. Almost all of these critical comments represented differences of opinion regarding the task when group members tried to resolve conflicting ideas, rather than the personality or personal differences among group members.

In the field of conflict management, scholars have divided group conflict into task and social types (Burgoon, Heston and McCroskey, 1974; Fisher, 1980; Hoffman, Harburg and Maier, 1965; Holloman and Hendrick, 1972). Falk (1982) noted that task conflict is constructive and represents a difference of opinion regarding the issues involving the analysis of the problem, interpretation of information, criteria for achieving a solution, and selection of solutions, whereas social conflict is disruptive and reflects clashes stemming from personality and personal differences. Conflict has also been differentiated into productive (constructive) and dysfunctional (destructive) types (Folger and Poole, 1984; Putnam, 1986; Wall, et al., 1987). Productive conflict involves the critical evaluation of ideas. In dysfunctional conflict, members either completely suspend evaluation or focus it on the behaviour and personality of other members.

In this experiment, very little social conflict type of comments (like name calling or swearing) occurred. These findings may be due to the cultural norms of Hong Kong Chinese managers in the sample. Chinese managers have a quest for harmony (Chan, 1967) and are more likely to participate in group decision making (Han, 1983; Cascio, 1974). Social conflict behaviour is seen as disruptive to the harmony. This may explain why most of the conflict that occurred in the experiment was productive, involving the critical evaluation of ideas or providing constructive feedback for a proposal.

Although some view conflict as a condition that should be prevented or resolved (Folger and Poole, 1984), an increasingly acceptable assumption is that constructive conflict may be beneficial to group processes (Smith and Berg, 1987; Putnam, 1986), if it involves the critical evaluation of ideas rather than focusing on the behaviour and personality of other members. Gouran (1982) also suggests that when a group entertains many different ideas and focuses on the task, higher quality decisions are more likely to result. In this study, GDSS groups outperformed non-GDSS groups when groups were participating in a more critical task evaluation. According to the discussion above, the cause of the increase in decision quality can be attributed to the fact that GDSS tended to increase the task-focus and critical decision evaluation in

disjunctive and conjunctive tasks which in turn impacted on the decision quality of the decision making groups.

How group members communicate also has a direct impact on the time need to reach a decision in a decision making group. The results show that the time taken to reach a consensus decision was significantly longer in GDSS groups and this effect is most significant in conjunctive groups. One explanation for these results is that typing text at a computer terminal is in general slower than speaking in a face-to-face situation. Lack of body signals may also reduce the efficiency of the message transmission in computer-mediated communication. These explanations suggest that it takes more time in GDSS supported environments to communicate the same amount of information when compared with face-to-face groups. In conjunctive tasks, the results indicated that the total numbers of comments communicated among group members with GDSS support were significantly higher than those of face-to-face groups. This therefore implies that GDSS groups working on a conjunctive task have to spend more time in communication, hence the observed increase in decision time when compared to the disjunctive and conjunctive groups.

The patterns of group communication also provide a possible explanation as to why GDSS groups are in general less satisfied with the decision process and less confident with the decision outcomes. One possible explanation suggested by Watson, DeSanctis and Poole (1988) for low satisfaction among GDSS groups is that GDSS groups have high and ungrounded expectations of GDSS technology and, when the technology does not meet such expectations, participants then tend to report lower satisfaction with the technology. Data gathered in the debriefing sessions provided some support for this explanation. Some members in the GDSS group expected the technology to solve their decision task automatically, and some felt dissatisfied and dismayed when so much effort was still required for the decision. However, another explanation of the low satisfaction and low confidence in the group decision has to do with the critical arguments that the GDSS generated. Research into conflict management has shown that competitive and critical orientations of decision making can have a negative effect on the satisfaction and the confidence of the group decision

making process (Deutsch, 1973; Goodge, 1978; Falk, 1982). These research findings suggest that decision group members in general do not feel comfortable when working in a highly critical atmosphere, and because more critical or opposite opinions are encouraged in the group, group members feel less confident with the decision result. The results of this experiment are consistent with this explanation; a relationship between critical argument in group communication and the perceived satisfaction with the group decision making process was revealed. The number of critical arguments were found to be negatively correlated to the perceived satisfaction with the group decision process and the perceived confidence in the group decision. These results provide support for the above argument that members in the GDSS group may not like critical discussion and this leads to a low level of satisfaction with the group decision process and to lower decision confidence.

The participants in this experiment were practising managers in Hong Kong and their cultural norms probably influenced how they made group decision in the experiment. Hofstede (1991) defined culture as “.. the collective programming of the mind which distinguishes the members of one group or category of people from another.” Culture may be reflected in general tendencies of persistent preference for particular states of affairs or actions. The differences between the Chinese and North American culture are well documented and one of the prime distinctions between Chinese and North American cultures appears to be the collective orientation of the former and the individualistic orientation of the latter (Hofstede, 1980; Ch'ien 1973; Chan, 1986). Collectivism emphasises group harmony (Redding, 1990) and interdependence while individualism stress individual rights (Hofstede, 1980). These differences are known to affect how organisations perform (Adler and Doktor, 1986) and how group decisions are made (Hofstede, 1980; Tse, et al. 1988). For example, Goldenberg (1988) reported that American managers tend to be authoritative and in a hurry to make a decision, while Chinese managers dislike conflict or critical discussion and pay more attention to maintaining a harmonious relationship. Ting-Toomey (1988) also reported that Chinese managers prefer to avoid open conflict and tend to go along with ‘groupthink’ in group decision making.

The results of this experiment were in general consistent with the cultural norms of Chinese managers. Very few critical comments were exchanged in face-to-face groups and they spent very little time arguing about their proposed decisions. However, members of GDSS groups were more critical during group discussion and exchanged more critical comments before they could reach a group decision. These results suggest that GDSS may lessen 'groupthink' among Chinese managers in group decision making. One explanation of this may be that GDSS probably reduce the 'face saving' factor among Chinese managers. 'Face' refers to the respect, pride, and dignity of an individual as a consequence of his or her position in a group (Moore, 1967) and it influences many facets of Chinese life and is regarded as a means of fostering harmony (Moore, 1967). It prescribes that the dignity of the individual, even in trivial matters, must be respected (Chan, 1967). As GDSS provide an interactive computer-based communication, rather than face-to-face discussion, group members may be able to evaluate ideas on their own merits, rather than on the basis of who contributed them and this may reduce the 'face saving' factor in group discussion. The results also indicated that GDSS groups were less satisfied compared with the non-GDSS groups. These research findings are also consistent with the cultural norms of Chinese managers, as research has shown that Chinese managers did not feel comfortable when working in a highly critical atmosphere (Chan, 1967) and since more critical comments were encouraged in the GDSS group, its members predictably felt less satisfied with the decision process.

### **6.3.3 Decision Quality Versus Group Satisfaction**

Analysis of the influence of task structure and decision process on group satisfaction suggests a conflict between the combined effects of task structure and decision process in group decision making. The results suggest that members feel better about the group process and are more confident with the decision in face-to-face groups. However, the face-to-face process is not always the most effective decision process given the task structure. The results in this experiment reveal that GDSS can help group members to arrive at a better decision in disjunctive and conjunctive tasks and at a decision of similar quality in an additive task, even though it takes more time for the group to reach a decision.

The result raises serious doubt about the usefulness of GDSS in additive tasks. The results suggest that in an additive task situation, GDSS does not improve the group decision quality, it takes more time for the group to reach a decision and the groups generally feel less satisfied with the process.

In conjunctive and disjunctive tasks, GDSS groups can produce better decision outcomes although it takes longer to arrive at a decision. However, group satisfaction was not always positive when group performances were high. The findings suggest that face-to-face meetings are more effective than GDSS in providing a less conflictive atmosphere within a group. The findings also indicate that face-to-face meetings are more effective than the GDSS supported environment in promoting group confidence in the group decision. Overall, these results pose a dilemma in selecting a decision making method. On the one hand, GDSS can improve decision quality in some task structures; on the other, GDSS supported decisions may take longer, weaken the decision confidence of a group and increase dissatisfaction with the decision process.

#### **6.4 Theoretical Implications**

While there have been attempts to integrate findings about the effectiveness of GDSS and to draw general conclusions about decision groups' behaviour and outcomes, so far no general theory for GDSS effectiveness has appeared. This research suggests the possibility that no single general theory can encompass and deal simultaneously with the complexity of factors that have an effect on how groups use GDSS in different situations. The results indicate that a single general GDSS theory may not explain or predict the relationship of all the relevant factors and how they are related to group decision processes and outcomes. Instead, it may be necessary to settle for a number of theories, each of which is able to offer an explanation for a specific aspect or phase of the GDSS decision process and outcomes under certain specific circumstances. While this is not as elegant a solution as some might desire, the development of sub-theories of process-performance relationships would nonetheless represent a notable

improvement over current understanding of group processes with GDSS use and their impacts on group effectiveness.

This research, in particular, has attempted to examine in some depth the role of the task structures which have powerful influences on how GDSS are used and their effectiveness in group decision making. The results clearly indicate that task structures moderate process and outcome relationships in GDSS decision making groups; that is, how groups use GDSS and how GDSS influence the group decision outcomes depends to a substantial extent, on the structure of the decision task itself. Thus, any attempt to understand GDSS effects on the decision process and outcome must take account of the contingencies in the task structure. Such contingencies can be referred to as critical task contingencies (Hackman and Morris, 1975; Hirokawa, 1990). It is the task structure that specifies what kinds of behaviour are critical to the successful performance. Whether GDSS can effectively improve the outcome of the group depends on specific features of GDSS and whether group members can willingly and successfully employ those features in meeting the task requirements. Only if the effects of GDSS can be described in terms of the task itself will it become possible to generate unambiguous and objectively operational propositions about the interaction relationship between the task, the group process and group effectiveness.

The second theoretical implication of this research is that input factors affect performance outcomes in GDSS support through the group members' communication interaction process. Thus, if groups perform better or worse on some tasks using GDSS, it should be possible to explain the performance difference by examining the difference between the communication interaction processes of the GDSS and non-GDSS groups. That is, the 'reason' for the input-outcomes relationships is available - albeit sometimes well-hidden - in the interaction process itself; by appropriate analysis of the interaction process, it should be possible to develop a more complete understanding of input-output relationships in any performance setting.

The current study clearly demonstrates that the impact of GDSS on group communication interaction can be analysed systematically and that the results of such



an analysis can increase understanding of the reasons why GDSS technology can be more useful in some situations than others. The impacts of GDSS technology are revealed in the patterns of interpersonal communication within a group which, in turn, influence decision quality and other outcomes. The results clearly indicate that group communication interaction represents the means by which critical requirements of a decision task are satisfied and the manner in which group members interact has a direct impact on the group decision outcomes. These results suggest that GDSS support does not have a direct, determinant effect on group decision outcomes, but rather the individual group usage of GDSS mediates its influences on group process and outcome. Supporting group decision making primarily involves changing the interpersonal exchange that occurs as a group proceeds through the decision making process. In this sense the goal of GDSS is to alter the communication process within the group. The greater the degree of change in group communication introduced by the technology, the more dramatic the impacts on the decision process and, in turn, on the decision outcomes. Therefore, researchers must study the flow of interaction communication within a group to discover the true impact the technology is having on the nature of decision groups' actions and feelings, and to understand how these attributes affect the information exchange and decision outcomes.

## **6.5 Practical Implications**

The results of this experiment have several practical implications for GDSS use in group decision making. For practitioners, one implication from these results is that the use of GDSS cannot be considered to have a universal effect on all kinds of tasks. The results indicate that GDSS support is effective in improving the decision quality in disjunctive and conjunctive tasks but it has no significant effect on decision quality in an additive task. The results of this study can help organisations in deciding whether to acquire a GDSS, and how to use the GDSS effectively to improve group decision making.

Group decision making may be structured differently in different organisations. In one organisation, the hiring decision may be structured as an additive task with all group

members receiving information about possible candidates and each group member evaluating the information and communicating his or her opinion to the rest of the group so that the group can work together to select the best candidate. In another organisation, the hiring decision may resemble a disjunctive task with each group member identifying his or her primary preference and then the individual group member convincing the other members that his or her suggestion is the most appropriate. In yet another type of organisation, the hiring process may resemble a conjunctive task. One member of the group may examine the education and qualifications of all the candidates. Another group member may evaluate their work experience. Hence no one group member has all the information needed to make the decision. Only if all members effectively communicate their unique information to the group is it likely to identify the best solution.

Not only will decision task structures vary across organisations, but the task structure of different types of decisions may vary within an organisation as well. A human resources decision may be additive, a strategic acquisition decision may be disjunctive, and a decision concerning global expansion could be conjunctive. The results of this research have provided empirical evidence for how GDSS use changes the patterns of group communication in group decision making and under which of the various decision task structures GDSS are most effective. Organisations deciding whether to acquire a GDSS are able to do so with the knowledge that the technology is only useful in particular task structures. Organisations must therefore evaluate the task structure of their decision making group before deciding whether and when to use the GDSS technology.

Another implication for practitioners is that when using GDSS in group decision making, organisations must address the desired balance between decision quality, decision time and satisfaction with the group process. The results of this study have shown that GDSS can improve decision quality, but that it takes a longer time for the group to reach a decision. GDSS use also leads to more critical evaluation and sharing of information among decision group members than face-to-face meetings and such an increase in critical argument among group members can lead to lower decision

confidence and reduces satisfaction with the decision process. Research has shown that objective decision quality has a low correlation with the group members' acceptance of the decision (Hoffman and Maier, 1961). In this study, the results indicate that objective quality of the decision can be higher despite the low degree of confidence of group members in the decision. In reality, quality is often sacrificed to gain group confidence, time or acceptance of the decision. Turoff and Hiltz (1982) argue that high satisfaction and high decision quality cannot be simultaneously achieved. In this study, the results show that these two objectives by their nature are conflicting and GDSS technology seems to provide support to improve decision quality and as a result, groups become less satisfied and less confident with the decision.

Decision time sometimes is the most important criterion in group decision making. Lower group decision confidence can affect the implementation stage of the decision and lower group satisfaction with the decision process can have a significant effect on the desire of groups to work together in the future. The results of this study pose a dilemma in selecting a decision making method. On the one hand, GDSS improves decision quality in some task structures; on the other, it may lower the groups' confidence in the decision and weaken the ability of a group to implement the decision. This is less of a problem if the group is not responsible for the implementation of the decision. However, if the group is also responsible for the implementation of the decision, then group confidence in the decision can be critical to the implementation of the decision. The GDSS can lower group satisfaction with the decision making process and it may have an impact on the willingness of a group to work together in the future. This is obviously not a problem for ad hoc groups but may prove critical for an ongoing group such as a top management team. Organisations must choose which decision goal is more important before making use of GDSS technology.

The results of this study also have practical implications for the designers and vendors of GDSS. A single GDSS design cannot be expected to meet all the task requirements in all situations. GDSS designers and vendors must make potential clients aware of

the need for a good task-technology 'fit' and GDSS must not be designed or implemented without regard to the task that it is intended to support. Selection of tasks that suit the technology should increase system effectiveness, ease of training and ease with which the system can be sold to organisations. The long-term objective of the GDSS design should be to improve the features of GDSS so that GDSS not only enhance decision quality but also efficiency, user confidence and satisfaction. Member satisfaction with the process is a necessary but not sufficient condition for a successful GDSS. Designers of GDSS should be deeply concerned with not only the decision quality but also to improve efficiency and the satisfaction with organisational decision meetings.

## **6.6 Limitations of Current Research**

As with any research study, this work has its limitations. McGrath (1982) points out that in any research, researchers are faced with the dilemma of balancing three conflicting objectives: (1) generalisation of the findings to other populations, (2) precision in control and measurement of variables of interest, and (3) study of the phenomena in a realistic setting. This study focused particularly on achieving objective two: control and manipulation of variables of interest. The laboratory study used in this research allowed precise control of the setting, subjects, and task used in testing the hypothesised effects. This study carefully monitored the experimental procedures to ensure consistency across the treatments.

The major limitations of this research are linked to the use of a laboratory setting. The most commonly cited concerns regarding laboratory studies relate to their external validity, i.e., the findings obtained by an experiment may not be generalised (Galliers and Land, 1987). Although, in this experiment, special attention has been given to the experimental design in order to minimise the potential threats of external validity (including the use of practising managers as subjects and creating an experimental environment and task relevant to the organisational settings), the research conducted cannot completely overcome the problem of external validity for its findings.

The subjects in this experiment were aware of the fact that the exercise was being conducted for experimental purposes. The subjects were not explicitly rewarded for good performance. The consequences of their decision would not extend beyond the laboratory session, so it is not possible to be sure of the degree of commitment that each subject brought to the experiment.

Secondly, using a personnel recruitment exercise as the experimental task, subjects were asked to formulate a group decision. The experiment ran for about 40 minutes and all the subjects made a group decision within that time frame. Although managers may make many decisions this quickly, it is likely that in an actual organisational setting, the same personnel recruitment task may take much longer and possibly require more than one meeting.

Thirdly, this study, like most group decision making studies conducted in laboratory settings, relies exclusively on ad hoc groups with zero history. Clearly, group decision making is generally conducted in ongoing groups or management teams within an organisation.

Fourthly, a GDSS system called CAMH was used for this study. CAMH was not specifically designed for the experimental task. It was designed to provide group decision support (i.e., group communication plus a decision model) to aid general group decision making. The strengths and weakness of the design characteristics of CAMH could have influenced the impact of using the GDSS for different decision task structures. While research on group decision making support has shown that the impacts of technology are relatively robust with respect to system variations (Siegel, et al., 1986) , it is still possible that a different GDSS design could change the nature of the findings of this study. By using a specific GDSS and by having groups use the GDSS for just a single meeting, and by using a particular task, caution must be exercised in generalising the findings of this study far beyond the context of the research.

Regardless of the type of research performed, it is not possible to achieve external validity with a single study (Tunnell, 1977). Laboratory research is not a perfect research method, but there are no existing perfect research methods. Each has its advantages and drawbacks (Galliers, 1992). According to McGrath and Altman (1966), 'it is not possible, in principle, to do an unflawed study'. Despite the limitations, the laboratory experiment has a useful role to play in an overall research program on GDSS. The current rapid progress in GDSS research has generated some doubts as to the claims of GDSS effectiveness. It is clear that GDSS can sometimes be useful. The question now is to identify under which circumstances GDSS is useful and why. Establishing the empirical base for such a contingency theory of GDSS effectiveness certainly is a large undertaking. The present study has presented one part of this effort. This study contributes to GDSS research because it suggests that GDSS effectiveness may depend on the structure of the task it is intended to support, and understanding how groups communicate in the decision making is critical in determining why GDSS are effective in some tasks and fail in others. The study does not claim that task structure difference is the sole cause of GDSS effects, or that understanding group communication interaction can provide all the explanations for how GDSS affect group decision making. It has, however, demonstrated that task structure is one important variable and that studying group communication patterns is one important means to understanding how GDSS affect decision making groups.

## **6.7 Directions of Future Research**

A number of future research directions arise out of the current study. These include:

Firstly, a logical extension of the present study would be to replicate the research design in other countries. Hong Kong's culture is very different to that of American and European cultures (Hofstede, 1980; Redding, 1990). For example, the prime distinction between Chinese and North American cultures appears to be the collective orientation of the former and the individualistic orientation of the latter (Chan 1986, Moore 1967). Cultural norms may influence how people use GDSS technology in a decision making group. The Chinese managers in Hong Kong represent an Oriental

business community with intense and continuous interactions with the Western business world. If globalisation of markets has eroded the impact of ethnicity on group decision making, one would expect Hong Kong managers to behave similarly to North American managers. It would be valuable to replicate this experiment in North America and examine whether the impact of home culture does have an impact on GDSS use.

Secondly, it would be useful to carry the analysis of patterns of communication further by investigating how GDSS can enhance the ability of a decision making group in developing a group decision. Groups supported by GDSS may not only communicate differently, as this study demonstrated, they may also follow different sequences of decision paths when compared to non-supported groups (Poole and Roth, 1989). In this study, the analysis focused on the types of communication activities in a decision making group, but not in the order or sequence in which these activities are enacted in a group decision. This research clearly demonstrates the way in which patterns of group communication can be examined in a decision making meeting. Using a modified coding system, the different types of communication activities can be coded and mapped over different decision phases. The decision paths between the GDSS supported and non-supported groups, and across different tasks can be compared, and the relationship between group decision paths and decision outcomes can be analysed. Studying how GDSS can shape the decision path should enable us to examine directly how GDSS influences the way a decision is formed in a decision making group.

Thirdly, the objectives of this research were to study whether the structures of decision tasks mediate the effects of GDSS. Using a decision task as the experimental task, the structures of task were manipulated by varying the roles of group members and information distribution among group members. A logical extension of this study would be to replicate the study using a different type of task. For example, an idea-generating task (McGrath, 1984) could be used and the structure of the task manipulated in much the same way as the experimental procedures in this study. The

results could then be compared to see whether the same results hold true for different task types.

Fourthly, the analysis of the influence of the task structures and GDSS support on group satisfaction offers a paradox for the combined effects of task structure and decision tools on group decision making. The results suggest that most members feel more satisfied when a face-to-face process is used. However, group decision quality is not always maximised when group satisfaction is high. The results suggest that one possible explanation is that discussions in GDSS group are more critical, therefore group members are not satisfied because the atmosphere is not friendly. Future studies need to examine in more detail the impact of GDSS on group satisfaction. In particular, future research should look more closely at why group members in GDSS supported groups are less satisfied when compared to face-to-face groups. Further content analysis of the group discussion recording may provide additional information and direct observation of the discussion process could also provide valuable information which may not be captured in the discussion records.

Fifthly, the groups in this study used the GDSS for only a single session in reaching their decision. Chidambaram (1989) shows that the effects of GDSS can vary over time. While the findings of this study may hold for one-time GDSS use, they may not hold when using GDSS across different task structures over a period of time. Long-term use can reveal the effects of decision processes more clearly and may alter the effects of GDSS due to the decreased novelty of the technology (Poole et. al., 1991). Rather than gather data after a single meeting, future research could observe and gather data over a series of meetings, enabling the longitudinal impacts of GDSS and task structures on group decision making to be studied over time.

Finally, the design characteristics of the GDSS used in this study may have influenced the impact of the way GDSS was used in different decision task structures. The design of the GDSS used in this experiment is very similar to those used in other research programs so that the results from the current study could be compared to the findings from other GDSS research, like SAMM - Software Aided Meeting Management in the



University of Minnesota (DeSanctis and Gallupe, 1987) and GroupSystems in the University of Arizona (Nunamaker, et al., 1993). Research results in this study suggest that GDSS is useful in improving the decision quality in disjunctive and conjunctive tasks but has no effect in additive tasks. The study suggests that decision groups use GDSS differently in meeting the requirements of the task at hand. It is possible that there are other GDSS with particular design characteristics which may be useful in additive tasks but have no effect on disjunctive or conjunctive tasks. If we are to understand how decision making groups use GDSS differently for different task structures, it is important to introduce variation in the tools that groups use. Some researchers have examined the effects of GDSS capabilities on decision making processes in groups working on a planning task (Sambamurthy, Poole, and Kelly, 1993). It would be valuable to use similar procedures on additive, disjunctive and conjunctive tasks. If the results show that variations in the design of GDSS have different impacts on group decision making processes and outcomes across different task structure, it would then provide additional evidence to the findings in this study and, together with these findings, provide further understandings of GDSS effects on group decision making.

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**APPENDIX A**  
**DESCRIPTION OF THE EXPERIMENTAL TASK**  
**ADDITIVE TASK**

|                                                      |
|------------------------------------------------------|
| <b>SIMULATION EXERCISE ON DECISION MAKING (SEDM)</b> |
|------------------------------------------------------|

**INSTRUCTION SHEET**

*Consolidated Commodities Ltd (ConCom) is a well-known food products distributor. Recently, the company has set up a new Speciality Foods Division. Your goal is to assist ConCom in selecting the most appropriate Division Product Manager for the new division. You must evaluate all the candidates in the file and make a group decision on their respective ranking.*

*Attached is the information packet that contains background information on ConCom, the new Speciality Foods Division, a job description of the new division product manager, the candidates' information sheets and a decision sheet for recording your group decision. Each group member has the same information.*

**Directions:**

*You are asked to follow the general decision making steps:*

- 1. Read and analyse the materials individually*
- 2. Discuss your materials in your group*
- 3. Generate possible rankings*
- 4. Resolve any conflicts*
- 5. Vote on rankings to reach consensus*
- 6. Record your decision on the decision sheet*

*Please hand in your decision sheet immediately after your group has made a decision.*

*To be filled in by the Co-ordinator:*

-----

|                      |             |                 |
|----------------------|-------------|-----------------|
| <i>Group Number:</i> | <i>S/nS</i> | <i>Ta/Td/Tc</i> |
|----------------------|-------------|-----------------|

*Date:*

*Time decision process began:*

## DISJUNCTIVE TASK

### SIMULATION EXERCISE ON DECISION MAKING (SEDM)

#### INSTRUCTION SHEET

*Consolidated Commodities Ltd (ConCom) is a well-known food products distributor. Recently, the company has set up a new Speciality Foods Division. Your goal is to assist ConCom in selecting the most appropriate division product manager for the new division. You must evaluate all the candidates in the file and make a group decision on their respective ranking.*

*Attached is the information packet that contained background information on the new Speciality Foods Division, a job description of the new division manager, the candidates' information sheets and a decision sheet for recording your group decision. Each group member has the same information.*

#### **Directions:**

*You are asked to follow the general making decision steps*

- 1. Read and analyse the materials individually*
- 2. Rank each candidate individually*
- 3. Discuss your ranking in your group*
- 4. Decide which member's ranking is the best*
- 5. Resolve any conflicts*
- 6. Vote on rankings to reach consensus*
- 7. Record you decision on the decision sheet*

*Please hand in your decision sheet immediately after your group has made a decision.*

*To be filled in by the Co-ordinator:*

-----

|                      |             |                 |
|----------------------|-------------|-----------------|
| <i>Group Number:</i> | <i>S/nS</i> | <i>Ta/Td/Tc</i> |
|----------------------|-------------|-----------------|

*Date:*

*Time decision process began:*

## CONJUNCTIVE TASK

### SIMULATION EXERCISE ON DECISION MAKING (SEDM)

#### INSTRUCTION SHEET

*Consolidated Commodities Ltd (ConCom) is a well-known food products distributor. Recently, the company has set up a new Speciality Foods Division. Your goal is to assist ConCom in selecting the most appropriate Division Product Manager for the new division. You must evaluate all the candidates in the file and make a group decision on their respective ranking.*

*Attached is the information packet that contains background information on ConCom, the new Speciality Foods Division, a job description of the new division product manager, the candidates' information sheets and a decision sheet for recording your group decision. Each group member has different information.*

#### **Directions:**

*You are asked to follow the general decision making steps:*

- 1. Read and analyse the materials individually*
- 2. Discuss your materials in your group*
- 3. Generate possible rankings*
- 4. Resolve any conflicts*
- 5. Vote on rankings to reach consensus*
- 6. Record your decision on the decision sheet*



*Please hand in your decision sheet immediately after your group has made a decision.*

*To be filled in by the Co-ordinator:*

---

|                                     |             |                 |
|-------------------------------------|-------------|-----------------|
| <i>Group Number:</i>                | <i>S/nS</i> | <i>Ta/Td/Tc</i> |
| <i>Date:</i>                        |             |                 |
| <i>Time decision process began:</i> |             |                 |

|                                              |
|----------------------------------------------|
| <b>CONSOLIDATED COMMODITIES LTD (CONCOM)</b> |
|----------------------------------------------|

*Consolidated Commodities Ltd (ConCom) is a well-known food products distributor in the Far East with its headquarters located in Hong Kong. The past ten years have been very successful ones for ConCom. New products or line extensions were successfully introduced in the areas of cat food, main sidedishes and gourmet food. Recently, the company announced its restructuring, focusing on two key areas: divestment of businesses unrelated to the company's strengths; and internal reorganisation of food products, primarily focusing on the establishment of a Speciality Foods Division.*

### **Speciality Foods Division**

*The Speciality Foods Division was formed last year in a reorganisation that drew together a variety of products targeted or potentially targeted towards an emerging segment of the grocery-buying population.*

*The present basis of the Speciality Foods Division is the Italiano line of imported food products. Previously part of the Dry Groceries Division, Italiano includes a variety of products ranging from such basic items as canned Italian tomatoes and tomato paste to gourmet items such as sun-dried Italian tomatoes and pignoli nuts. Sales of the total Italiano line were \$25 million in 1993. Historically, the greatest part of the Italiano sales has been in supermarkets.*

*The other major component of Speciality Foods is the Mountain Gourmet line of products. These products, which were acquired from Scarborough Foods during 1988, include maple syrup, apple products, cheese, and a large variety of jams and jellies. Mountain Gourmet products are distributed primarily through Speciality food retailers, including gourmet shops, food departments of large department stores, and mail-order food merchandisers. Sales of Mountain Gourmet products were \$10 million in 1993.*

*In addition, Speciality Foods has a trial entry in the fresh foods segment of the gourmet food business called 'Salsa'. This product, originally developed in the Institutional Foods Division, is distributed on a limited basis.*

|                        |
|------------------------|
| <b>JOB DESCRIPTION</b> |
|------------------------|

**Division Product Manager, Speciality Foods Division**

*Open 1/1/95*

*Responsible for strategic product development and policy implementation for all products in the Speciality Foods Division that are marketed primarily or exclusively through Speciality food retailers. These include Mountain Gourmet line, Italiano line and Salsa.*

*Specific responsibilities include:*

*--Annual marketing plan development*

*--Annual volume and earnings projections*

*--Realisation of volume and earnings projections and marketing strategy as determined by above plans*

*--Implementation of plans, including:*

*-Advertising management*

*-Promotion management*

*-Packaging management*

*-Product development*

*--Co-ordination with:*

*-Sales*

*-Production*

*-Other line services, including importing*

*-Advertising agency*

*-Corporate staff, including legal and consumer affairs*

|                         |
|-------------------------|
| CANDIDATE'S INFORMATION |
|-------------------------|

**RESUME OF David Lam**

*301 Cotton Mather Hall*

*Kowloon Bay*

*Hong Kong*

*Tel: 555-9987*

*Career Objective*

*Marketing position leading to general management responsibilities.*

*ConCom Employment*

*1987-           Product Manager, Italiano Product Line, Dry Groceries Division.*

*1982- 1987   Assistant Product Manager, Italiano Product Line, Dry Groceries Division.*

*Previous Employment*

*1980-1982   Assistant to the President, Shawmut Bank, Hong Kong.  
Conducted market study for new branch locations.*

*1976-1980   Held a number of positions at Shawmut Bank, including Teller (1976); Head Teller, Milk St. Branch (1977-78); Management Training Program Participant (1978); Assistant to Vice-President, Marketing (1979).*

*1970-1976   Counsellor. Worked with pre- adolescent boys in camp for deprived children.*

## *Education*

*1979- 1981    M.B.A., Chinese University of Hong Kong, with Honours.  
Major in Marketing.*

*1972-1976    B.A., Chinese University of Hong Kong.  
Major in History.*

## *Personal History*

*Grew up, oldest of six children, in Tai Po, NT. Financed own college  
and graduate education. Hobbies include camping.*

|                         |
|-------------------------|
| CANDIDATE'S INFORMATION |
|-------------------------|

**RESUME OF Tony Lee**

*25 High Court Road  
Midlevel, Hong Kong  
Tel: 555-2345*

*Career Objective*

*Dynamic management position with significant growth opportunity in major corporation.*

*ConCom Employment*

*1990-           Product Manager, Mountain Gourmet Line.*

*1988- 1990   Assistant Product Manager, Mountain Gourmet Line.*

*Previous Employment*

*1984- 1988   Asia Consulting Groups, Management consultant specialising in international marketing strategy issues, primarily with clients in the Far East.*

*Education*

*1982-1984   M.B.A., Graduate School of Business Administration, Harvard University, Cambridge, Massachusetts, USA.  
Major in Management.*

*1978-1982   B.A., Harvard College, Cambridge, Massachusetts, USA.  
Major in Asian Studies.*

### *Personal History*

*Grew up, an only child, in USA. Have travelled extensively. Hobbies include travel and racquet sports.*



|                         |
|-------------------------|
| CANDIDATE'S INFORMATION |
|-------------------------|

**RESUME OF Amy Wong**

*456 West End Avenue*

*Kowloon, Hong Kong*

*Tel: 989-9200*

*Career objective*

*Marketing position in medium or large corporation that provides opportunities for hands-on, day-to-day marketing management as well as for growth into general management responsibilities.*

*Employment History*

*1989-           Group product manager, AAM Foods Ltd. Responsibilities included product development in the Japanese Foods Division.*

*1985-1989    Account manager, AAM advertising Ltd, Responsibilities included development, with client, of strategic advertising objectives and co-ordination of creative and product planning and development. Advertising budgets for clients ranged from \$1.1 to \$17.9 million. Clients' products included lines of mainstream Italian food products, lines of wine coolers, and two children breakfast cereals. Other responsibilities included annual planning on the volume and earnings projections of the Japanese Foods Division of AAM Foods Ltd.*

*1982-1985    Assistant account manager, AAM advertising Ltd, Responsible for co-ordination of all creative activities in both advertising and promotion areas for multiproduct snack food group.*

*1977-1982    Media buyer, spot markets throughout the Far East.*

## *Education*

*1982-1985 M.B.A., University of Hong Kong, Hong Kong.*

*Major in Marketing.*

*1973-1977 B.A., University of Hong Kong, Hong Kong.*

*Major Childhood Education, Minor in Psychology.*

## *Personal History*

*Grew up, oldest of two children, in Kowloon. Father is a medical doctor. She has been awarded a Governors' Silver Medal for her community work. Hobbies include reading and domestic arts.*

|                         |
|-------------------------|
| CANDIDATE'S INFORMATION |
|-------------------------|

**CHARACTER AND PSYCHOLOGICAL ASSESSMENT**

**Report on Amy Wong**

**Confidential**

*All previous education and work experiences verified.*

*All check out as per report of subject.*

*Character interviews:*

*Investigation into background of subject yielded information that subject has strong background in domestic arts, interest in children and in small animals. Active participation in community work up to and including present time. Regular church attendance. Appears to be happily married, though no children.*

*Psychological assessment:*

*Subject appears normal, with internally consistent values and standards. Only significant deviation: high scores relative to female norm on aggression scale.*

|                         |
|-------------------------|
| CANDIDATE'S INFORMATION |
|-------------------------|

CHARACTER AND PSYCHOLOGICAL ASSESSMENT

Report on Tony Lee

Confidential

*All previous education and work experiences verified.*

*All check out as per report of subject.*

*Character interviews:*

*Subject comes from socially prominent family and has displayed no conflict between personal interests and those appropriate to social class and background. From an early age displayed strong interest in business and commerce, apparently operating an import-export business during prep school. Subject displayed structured altruism, as appropriate to social standing, donating profits of business to Alumni Association of said school.*

*Psychological assessment:*

*General internal consistency in values and attitudes. Some conflicts between entrepreneurial tendencies and desire to be a team player.*

|                         |
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| CANDIDATE'S INFORMATION |
|-------------------------|

CHARACTER AND PSYCHOLOGICAL ASSESSMENT

Report on David Lam

Confidential

*All previous education and work experience verified.*

*All check out as per report of subject.*

*Character interviews:*

*Subject appears to have had a strong interest in helping others, especially those less fortunate than himself, since an early age. Active in scouting, youth and church groups. Strong identification with "big brother" role, both with siblings and with other children. Was politically active in his early twenties, along an ultra-liberal line.*

*Psychological assessment:*

*Although generally normal in terms of overall functioning, subject displays severe conflict between desire to help others and desire to help self. Altruistic tendencies are not well integrated at this time. Potential for reduced functioning levels if resolution is not reached.*

*Warning: This employee may present risk to the employer.*

|                         |
|-------------------------|
| CANDIDATE'S INFORMATION |
|-------------------------|

**JOB EVALUATION REPORT**

**David Lam**

*David Lam is the manager responsible for the entire line of Italiano products, with sales around \$25 million per year.*

*David is experienced as a product manager and this will be a big advantage in trying to form a cohesive whole out of the widely diversified products that will fall under the new job's authority. Besides that, David seems to have both common sense and the ability to anticipate marketing direction of new products.*

*Shawmut Bank was probably pretty sorry to lose him. The job as assistant to the President meant they were trying to entice him back to the fold and let him know he had a chance of reaching the upper levels. But somebody from ConCom had apparently convinced him he was better off getting out of banking and developing his marketing skills in product management.*

*He has come in, as most do, at the assistant product manager level. Has moved ahead to product manager in five years.*

|                         |
|-------------------------|
| CANDIDATE'S INFORMATION |
|-------------------------|

**JOB EVALUATION REPORT**

**Tony Lee**

*Tony Lee is the product manager responsible for the entire line of Mountain Gourmet products, with sales around \$10 million per year.*

*Tony was born into a very rich family and educated in prestigious colleges. His family is very well connected in the business world and his father is the CEO of Far East Investor Ltd, a well known investment house in Hong Kong.*

*Tony's employment history at ConCom is interesting. Whereas the norm, from the Human Resources Department's point of view, is that no one could be promoted to product manager in under three years, Tony has got there in only a little over two. Either this meant that his boss thought he was a very high performer or Tony was very well connected somewhere at ConCom as well as everywhere else. Furthermore, he has indicated to the Human Resources Department that he may decide to quit the present job and work for his father in Far East Investor in three years time. Obviously, the Human Resources Department does not want him to go.*

|                                |
|--------------------------------|
| <b>CANDIDATE'S INFORMATION</b> |
|--------------------------------|

**JOB EVALUATION REPORT**

**Amy Wong**

*Amy Wong is the group product manager in AAM foods Ltd., one of the largest food manufacturing firms in town. Her responsibilities include product development specialising in Japanese food products. She has been working in the position for only three years. 'Definitely promising' is her bosses comment. She is one of those willing employees who makes an extra effort and puts in the time required to get a grip on her job. Her previous boss has just informed the Human Resources Department that Amy is three months pregnant.*



**GROUP DECISION SHEET**

**Please rank the following option in terms of most (1) to least (3) preferred candidate.**

|               | <b>RANK</b> |
|---------------|-------------|
| 1. David Lam. | _____       |
| 2. Tony Lee.  | _____       |
| 3. Amy Wong.  | _____       |

*Group Number:*  
*Time decision reach:*

## **APPENDIX B**

### **CAMH TRAINING GUIDE**

#### **CAMH Training Guide**

Welcome to the Group Decision Lab. The system you will be using for this exercise is called CAMH - Computer Aided Meeting Helper. Please do not hesitate to ask if you have any questions during the training.

#### **Signing On**

Your screen should have the word CAMH displayed on it. If it does not, please press the <return> key.

The system will ask for you identification, please type in your group number and your first and last name, then press <return> key again.

You will now be at the main menu. The CAMH system allows you to access all components of the system through the selection of items from a series of menus. For our purposes, the system can only access three options - Option 2, Group Talk, Option 3, Decision Aids and Option 4, Voter.

Before we proceed, let us familiarise ourselves with some important keys.

|           |                                                                                            |
|-----------|--------------------------------------------------------------------------------------------|
| Home      | brings you from one submenu to the main menu.                                              |
| ESC       | sends message to public screen and brings you from one submenu to the next higher submenu. |
| Arrows    | are used to move up or down the menu to select the desired option.                         |
| Backspace | is used during editing of text to delete a character to the left.                          |
| F1        | is used to toggle between private screen and public screen.                                |
| Return    | is the return key.                                                                         |

## Group Talk

Let's look at the Option 2 - Group Talk

The purpose of Group Talk is to allow each individual in the group to communicate with other group members. You may use this module any time during you meeting. There are four tools in this module. The first is called Enter.

- \* Select Group Talk.
- \* Select Enter from the Group Talk menu using your arrow key then press <Return>.

The <Enter> command allows you to type out your messages and add them to the public screen. Each terminal has a full-screen window running the private screen in which you can enter and send messages to the public screen. Function key <F-1> allows you to toggle back and forth between the private and the public screens so that you can view the messages sent by other group members.

The <Modify> command allows the group to modify the messages already entered. The <Delete> command allows the group to remove the messages down the public screen.

These commands will be found throughout this system and mean the same thing each time they are encountered.

- \* Select the <Enter> commend, this provides you with a screen where you can compose your message. There is a limit of 4 lines for each message and you can only work with one message at a time. When you are entering textual data, to erase text, you move your cursor to the right of the material to be erased then use the <Backspace> key.
- \* Type in your message, press ESC to send the message and go back to the Group Talk menu.
- \* Press <F-1> to view your message in the public screen. Press <F-1> again to go back to the Group Talk menu. Select <Modify> to modify you message and press ESC to go back to the Group Talk menu. Select <Delete> to remove the message from the screen and press ESC to go back to the Group Talk menu.
- \* Press <Home> to go back to the main menu.

## Decision Aids

Let's now move to the next module of the system, Option 3 - Decision Aids.

- \* Select Decision Aids from the main menu. Notice that you now have a new menu, the decision aids menu, on the screen.

Today we will walk through an exercise so that you can get a feel for how to operate the system and an understanding of what its features provide. Consider this example:

Suppose you are a committee within a large financial company. The company is going to invest \$500,000 dollars and you have three projects to consider. You are asked to decide how much should be invested in each of these projects.

- \* Select <Define Criteria> from the Decision Aids menu.

Example of criteria in our investment problem might include:

Return  
Risk  
Flexibility

- \* Type in the three criteria. When you have finished the first criterion, press <Return> key then type the second criterion. When you have completed entering the criteria, press ESC key to record the criteria in the public screen.
- \* Select <Weighting Criteria> from the Decision Aids menu.

This allows you to weight the importance of each of the criteria. Type in your distribution of a total of 100 points across the criteria listed. More points imply more importance of the criterion. When you have completed entering your weights, press the ESC key to record them in the public screen.

- \* Select <Define Alternatives> from the Decision Aids menu.

The alternatives in our sample problem are:

Project A  
Project B  
Project C

- \* Type in the three alternatives. When you have finished the first alternative, press <Return> key then type the second alternative. When you have completed entering the alternatives, press ESC key to record in the public screen.

- \* Select <Rating Alternatives> from the Decision Aids menu.

Rate how well each of the alternatives meets the criteria on a scale of 1 (worst) to 10 (best). Rate each alternative on all criteria. Press ESC key to record in the public screen.

- \* At any point, you can use <F-1> to see the criteria and weightings of other group members and use Group Talk to discuss the implications of how you view the criteria, the relative importance of each criterion and to discuss the alternatives among your group.

## **Voters**

Let's move to the next module, Option 4 - Voters .

Group members may have different criteria and weightings. Members can use Voters to arrive at a consensus on criteria and weightings.

- \* Any member can initiate a vote by selecting Voters on the main menu. Notice that you now have a new menu, the Voters menu, on the screen.
- \* Select <Vote Format>. There are two voting formats in the menu. The Yes/No and Rank Order format. The first voting method allows you to vote Yes or No to the proposed motion and the second method allows you to rank your preferences for the proposed motions.
- \* Select <Yes/No> from the Vote Format menu. Type in the proposed motion you want to put to vote. Only one motion is allowed in this format. You may type in 'Member A's weightings are the most reasonable and should be adopted as our groups' weightings.' When you have completed entering the proposed vote, press ESC key to record in the public screen.
- \* Select <Ranking> from the Vote Format menu. Type in the proposed motion you want to put to vote. You can type in more than one motion in this screen (maximum is 5). You may type in 'Member A weightings, Use weightings 10, 50, 40 and Use group's average weightings.' When you have finished the first motion, press <Return> key then type the second motion. When you have completed entering the motions, press ESC key to record the motions in the public screen.
- \* Select <Voting> from the Voters menu. Enter your vote by inputting either Yes/No or the ranking the motion. Notice that a reminder appears in the public screen to remind members to vote on the motions and an error message appears when inappropriate votes are entered. The result of the vote then appears in the public screen.

## Decision Making

At this point the group should have agreed the criteria and the corresponding weightings for the decision problem. You can use Decision Aids to calculate the scores for each of the alternatives and make a group decision.

- \* If you are not already in the main menu, press ESC.
- \* Select <Decision Aids> in the main menu. Select <Group Scoring> from the Decision Aids menu.
- \* Select <Group Criteria> from the Group Scoring menu. Type in the group's agreed criteria. When you have finished the first criterion, press <Return> key then type the second criterion. When you have completed entering the criteria, press ESC key to record in the public screen.
- \* Select <Group Criteria Weightings> from the Group Scoring menu. Type in the group's agreed weightings. When you have finished the first weighting, press <Return> key then type the second weighting. When you have completed entering the weightings, press ESC key to record in the public screen.
- \* Select <Group Alternatives> from the Group Scoring menu. Type in the group's agreed alternatives. When you have finished the first alternative, press <Return> key then type the second alternative. When you have completed entering the alternatives, press ESC key to record in the public screen.
- \* Select <Group Alternatives Ratings> from the Group Scoring menu. Type in the group's agreed ratings. When you have finished the first rating, press <Return> key then type the second rating. When you have completed entering the ratings, press ESC key to record in the public screen.
- \* Select <Calculate> from the Group Scoring menu. The group will see on the public screen the scores attributed to each alternative based upon agreed upon weightings and ratings.
- \* Now, we are ready to go to the final step in our investment problem; that is the allocation of funds among the three projects.
- \* If you are not already in the Decision Aids menu, press ESC.
- \* Select <Decision> from the Decision Aids menu. The group's agreed alternatives appear on the screen. You can enter the funds allocated to each project. Press ESC to record the decision on the public screen.
- \* At this point the group might decide to go back to the previous step, re-calculate scorings, and choose another combination of criteria, weightings and ratings.
- \* This concludes the training on the CAMH. Press the <Home> key.

- \* If you have any questions about the operation of CAMH, please do not hesitate to ask me.



## BACKGROUND QUESTIONNAIRE

10. I think these group decision making sessions in my company are:

---

---

---

---

11. How well do you type? (Check one)

- 1. \_\_\_\_\_ hunt and peck
- 2. \_\_\_\_\_ rough or casual typing
- 3. \_\_\_\_\_ good typing (30 wpm error-free)
- 4. \_\_\_\_\_ excellent typing (could be employed as a typist)

12. How frequently do you use a computer during a typical week?

(Check one)

- 1. \_\_\_\_\_ never
- 2. \_\_\_\_\_ once or twice
- 3. \_\_\_\_\_ three to ten times
- 4. \_\_\_\_\_ more than ten times

13. List below the computer software applications in which you have a good working knowledge?

(List up to 5 applications.)

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_

---

Date:

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# POST-MEETING QUESTIONNAIRE A

**Direction:**

We are interested in how your group approached the task. Please indicate your choice by circling the appropriate marker, the degree to which each statement applies to your group. There are no right or wrong answers, this is not a test. Many of the statements are similar. Do not be concerned about this. Please work quickly, recording your first impressions. Your answers will be kept confidential. Please circle ONE number for each statement.

- 1. The overall quality of the decision discussion was:**

poor                    1    2    3    4    5    6    7    good

- 2. The decision discussion, on the whole, was:**

**ineffective**      1   2   3   4   5   6   7   **effective**

- 3. The outcome of the decision discussion was:**

unsatisfactory    1   2   3   4   5   6   7    satisfactory

- 4. The decision discussion was:**

|               |   |   |   |   |   |   |   |             |
|---------------|---|---|---|---|---|---|---|-------------|
| incompetently | 1 | 2 | 3 | 4 | 5 | 6 | 7 | competently |
| executed      |   |   |   |   |   |   |   | executed    |

- 5. The issues explored in the decision discussion were:**

trivial                    1    2    3    4    5    6    7    substantial

6. The content of the decision discussion was:

|           |   |   |   |   |   |   |   |            |
|-----------|---|---|---|---|---|---|---|------------|
| carefully | 1 | 2 | 3 | 4 | 5 | 6 | 7 | carelessly |
| developed |   |   |   |   |   |   |   | developed  |

7. The manner in which participants examined the issue was:

|              |   |   |   |   |   |   |   |              |
|--------------|---|---|---|---|---|---|---|--------------|
| non-         | 1 | 2 | 3 | 4 | 5 | 6 | 7 | constructive |
| constructive |   |   |   |   |   |   |   |              |

8. The group’s movement toward reaching a conclusion on the decision question under the circumstances was:

|               |   |   |   |   |   |   |   |             |
|---------------|---|---|---|---|---|---|---|-------------|
| insignificant | 1 | 2 | 3 | 4 | 5 | 6 | 7 | significant |
|---------------|---|---|---|---|---|---|---|-------------|

9. How would you describe your group’s decision making process?

|                   |   |   |   |   |   |   |   |               |
|-------------------|---|---|---|---|---|---|---|---------------|
| a. efficient      | 1 | 2 | 3 | 4 | 5 | 6 | 7 | inefficient   |
| b. coordinated    | 1 | 2 | 3 | 4 | 5 | 6 | 7 | uncoordinated |
| c. fair           | 1 | 2 | 3 | 4 | 5 | 6 | 7 | unfair        |
| d. understandable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | confusing     |
| e. satisfying     | 1 | 2 | 3 | 4 | 5 | 6 | 7 | dissatisfying |

POST-MEETING QUESTIONNAIRE B

**Directions:**

We would like to gather information about your experience in the group decision making meeting you have just attended. Using the 1 to 7 scale indicated, please indicate your level of agreement or disagreement with each statement by circling one of the appropriate markers. Many of the statements are similar. Do not be concerned about this. Please work quickly, recording your first impressions. Your answers will be kept confidential. Please circle ONE number for each statement.

|                                                                | 1        | 2        | 3        | 4       | 5        | 6     | 7        |
|----------------------------------------------------------------|----------|----------|----------|---------|----------|-------|----------|
|                                                                | Strongly | Disagree | Somewhat | Neutral | Somewhat | Agree | Strongly |
|                                                                | Disagree |          | Disagree |         | Agree    |       | Agree    |
| 1. You made suggestions about doing the task.                  | 1        | 2        | 3        | 4       | 5        | 6     | 7        |
| 2. You gave information about doing the task.                  | 1        | 2        | 3        | 4       | 5        | 6     | 7        |
| 3. You asked others for their thoughts or opinions.            | 1        | 2        | 3        | 4       | 5        | 6     | 7        |
| 4. You showed attention and interest in the groups discussion. | 1        | 2        | 3        | 4       | 5        | 6     | 7        |
| 5. You asked for suggestions from others in the group.         | 1        | 2        | 3        | 4       | 5        | 6     | 7        |
| 6. You felt frustrated or tense about other's behaviour.       | 1        | 2        | 3        | 4       | 5        | 6     | 7        |
| 7. You rejected others' opinions or suggestions.               | 1        | 2        | 3        | 4       | 5        | 6     | 7        |
| 8. You expressed negative opinions or suggestions.             | 1        | 2        | 3        | 4       | 5        | 6     | 7        |
| 9. Your opinions or suggestions were rejected.                 | 1        | 2        | 3        | 4       | 5        | 6     | 7        |

- |                                                                                                           |   |   |   |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|
| 10. Others expressed a negative opinion about your behaviour.                                             | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 11. You felt satisfied with the quality of your group's solution.                                         | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 12. The final solution reflected your inputs.                                                             | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 13. You felt committed to the group solution.                                                             | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 14. You were confident that the group solution was correct.                                               | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 15. You felt personally responsible for the correctness of the group solution.                            | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 16. You felt that one person influenced the final solution more than the rest of the group.               | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 17. One member emerged as an information leader.                                                          | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 18. One member strongly influenced the group decision.                                                    | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 19. You felt that your group has uncovered valid recommendations and assumptions.                         | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 20. You felt that your group has critically re-evaluated the validity of recommendations and assumptions. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 21. You enjoyed working with your group members.                                                          | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 22. You are willing to remain with this group in future.                                                  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 23. You felt satisfied overall with the decision making exercise.                                         | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 24. You felt satisfied overall with the experiment.                                                       | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

|                              |
|------------------------------|
| POST-MEETING QUESTIONNAIRE C |
|------------------------------|

**Direction:**

We are interested in your perceptions of the computer support system used in the task you has just completed. Please rate the computer support system used in the task your group has just completed (do not think about other computer systems or decision tasks). Using the 1 to 7 scale indicated, please indicate your level of agreement or disagreement with each statement by circling one of the appropriate markers. Please work quickly, recording your first impressions. Your answers will be kept confidential. Please circle ONE number for each statement.

|          |          |          |         |          |       |          |
|----------|----------|----------|---------|----------|-------|----------|
| 1        | 2        | 3        | 4       | 5        | 6     | 7        |
| Strongly | Disagree | Somewhat | Neutral | Somewhat | Agree | Strongly |
| Disagree |          | Disagree |         | Agree    |       | Agree    |

1. The computer support system was useful for the assigned task.

1 2 3 4 5 6 7
2. The computer support system has contributed positively to the decision quality of the assigned task.

1 2 3 4 5 6 7
3. You felt that the computer supported environment was more effective than a face-to-face meeting.

1 2 3 4 5 6 7
4. You felt that the computer supported environment was better than a face-to-face meeting.

1 2 3 4 5 6 7



\_\_\_\_\_

\_\_\_\_\_

*Date:*

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## **APPENDIX D**

### **COMMUNICATION CODING SCHEME**

#### **Parsing Rules:**

1. Text continuing or developing a single idea should be coded as one unit.
2. Assign text into the first category which shows a good fit (i.e., first try to assign as **DE**; if this fails, try **SU**; etc.).

#### **Categories:**

**DE**    Decision Proposal,

Proposes decision or solution.

e.g., “I think we should select candidate C for this job”.

**SU**    Supportive Comment,

Supportive remark or argument. Expresses support for a decision proposal with or without adding evidence or argument.

e.g., “I like the proposal”, “I think you are right that we should go for candidate A, he is an obvious choice’.

**CL**    Clarification,

Adds detail or new features to a decision proposal or remark.

e.g., “I am trying to look at qualifications first, then work experience” ; “I haven’t got the details of the academic qualifications of candidate A, but his experience looks quite good’.

**CR**    Critical Argument,

Expresses opposition to a decision proposal or remark with or without adding evidence or argument.

e.g., “I don’t think it is a good idea” ; “I think you have missed the point, the real issue here is relevant work experience not academic qualifications”.

**QU** Query,

Requests clarification for a decision proposal or remark.

e.g., “Are we trying to see whether A’s work experience is relevant” ; “How about candidate C, is his work experience relevant”.

Responses will be coded as one of the other categories.

**PR** Procedural Related Comment,

Remark related to procedural process of group decision.

e.g., “I think each of us should take turns to report what information we have”;  
“We had better made sure that all of us agree before we fill in the decision form”.

**SY** System Related Comment,

Remark related to the operations of the computer system.

e.g., “Where is the ESC key” ; “I can’t get back to the main screen”.

**OT** Other Unrelated Comment,

Remark that is ‘off the topic’.

e.g., “Let’s have coffee after the meeting” ; “This morning’s lecture is very hard, can you understand it’

**UN** Uncodable Text