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The effectiveness of virtual facilitation in supporting GDSS appropriation and structured group decision making

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THE EFFECTIVENESS OF VIRTUAL FACILITATION IN SUPPORTING GDSS APPROPRIATION AND STRUCTURED GROUP DECISION MAKING

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ABSTRACT

Since their introduction a quarter of a century ago, group decision support systems (GDSS) have evolved from applications designed primarily to support decision making for groups in face-to-face settings, to their growing use for "web conferencing," online collaboration, and distributed group decision-making. Indeed, it is only recently that such groupware applications for conducting face-to-face, as well as "virtual meetings" among dispersed workgroups have achieved mainstream status, as evidenced by Microsoft's ubiquitous advertising campaign promoting its "Live Meeting" electronic meeting systems (EMS) software. As these applications become more widely adopted, issues relating to their effective utilization are becoming increasingly relevant. This research addresses an area of growing interest in the study of group decision support systems, and one which holds promise for improving the effective utilization of advanced information technologies in general: the feasibility of using virtual facilitation (system-directed multi-modal user support) for supporting the GDSS appropriation process and for improving structured group decision-making efficiency and effectiveness. A multi-modal application for automating the GDSS facilitation process is used to compare conventional GDSS-supported groups with groups using virtual facilitation, as well as groups interacting without computerized decision-making support. A hidden-profile task designed to compare GDSS appropriation levels, user satisfaction, and decision-making efficiency and effectiveness is utilized in an experiment employing auditors, accountants, and IT security professionals as participants. The results of the experiment are analyzed and possible directions for future research efforts are discussed.

CHAPTER 1

INTRODUCTION AND RESEARCH OVERVIEW

1.1 Introduction

Since their introduction a quarter of a century ago, group decision support systems (GDSS[1]) have evolved from applications designed primarily to support groups engaged in decision making in face-to-face settings, to their growing use for “web conferencing,” online collaboration, and distributed group decision-making. Indeed, only recently have such *groupware* applications for conducting face-to-face, as well as “virtual meetings” among dispersed workgroups achieved mainstream status, as evidenced by Microsoft’s ubiquitous advertising campaign promoting its “Live Meeting” electronic meeting systems (EMS) software. As these applications become more widely adopted, issues relating to their effective utilization are becoming increasingly relevant.

This study addresses two issues which have proven critical in realizing the potential benefits of GSS applications: the utilization of appropriate GSS tools to ensure proper task-technology fit; and the effective appropriation of those technologies for improved group decision-making. Indeed, Dennis, Wixom and Vandenberg (2001) have described fit and appropriation as “a set of two overreaching concepts” for most effectively realizing the benefits of GSS capabilities: “While task-technology fit improves outcome *effectiveness*, appropriation support acts to improve the process by improving *efficiency* and *process satisfaction*” (Dennis, et al p.184). Moreover, they assert that the primary contribution of GSS facilitators is providing proper task technology fit, and assisting in the GSS appropriation process, a view contrary to the commonly held assumption that facilitators are primarily concerned with managing group dynamics.

1. The terms GDSS, GSS, and EMS are used interchangeably, depending upon which term was used in a specific study. However, for convenience, and ease of pronunciation, the shorter term, “GSS”, is used frequently when describing group decision support systems, group support systems, or electronic meeting systems outside the context of a specific study.

This study addresses the effectiveness of virtual facilitation (system-directed multi-modal user support) for supporting the GSS appropriation process and structured group decision-making. As such, the major functionality of the automated virtual facilitation application (AFVA) utilized in this research is the recommendation of specific GSS technologies to utilize for the assigned group decision-making tasks, as well as supporting the faithful appropriation of the structured group decision-making heuristic specified for completing the assigned tasks.

Because qualified GSS facilitators are not always readily available, nor affordable, the need for automated systems that are capable of effectively replicating the facilitator function is apparent. Moreover, by systemizing the facilitation process and ensuring its consistent replication, the benefits from GSS use can be more predictable (Briggs et al. 2003).

1.2 Research Overview

A number of key research questions in this area remain unanswered. Several studies have demonstrated that virtual facilitation – or specifically "automated facilitation" – holds the potential for replacing human facilitators. Limayem and DeSanctis (2000) found that automated facilitation could result in higher levels of understanding and improved perceptions of the group decision process. However, their study did not examine the effectiveness of using system-directed facilitation for improving group decision-making performance, nor determine its effectiveness in providing appropriation support. In a follow-up study, Limayem (2003 unpublished manuscript) compared human facilitation with automated facilitation and found that the latter was as effective as human facilitation in improving faithfulness of appropriation. However, his study did not examine its effect on user satisfaction, or on a related measure of GSS appropriation, attitudes towards use.

Wong and Aiken (2003) likewise demonstrated that automated facilitation could be as effective as expert facilitators -- and better than novice-human facilitators -- for idea generation and ranking tasks. However, their study did not consider the effect of using automated facilitation for providing structured decision-making support, or for improving GSS appropriation levels. Likewise, Ho and Antunes (1999) examined the effectiveness of an automated tool for meeting planning, but their results were inconclusive. Chalidabhongse et al. (2002) similarly studied the effects of an intelligent facilitation agent and found that their automated system resulted in greater group participation, more ideas generated, and less group distraction. However, the effects of automated facilitation on intellective tasks and appropriation support were likewise not considered.

Still other studies have proposed integrating expert systems with group support systems but have not empirically examined the effectiveness of such systems. Aiken, Sheng and Vogel (1991) examined potential synergies between intelligent systems and GSS and described a system which would effectively integrate the two technologies, but they did not empirically test their system. Lopez et al. (2002) proposed the possibility of embedding facilitation features in group support systems, but likewise, no empirical study was conducted. Recently, Briggs, DeVreede and Nunamaker (2003) introduced their *thinkLets* concept designed to help systemize the GSS facilitation process, but did not empirically test it.

A number of related studies have examined the impact of facilitation (in comparison to chauffer-driven GSS) on group decision-making effectiveness but have not examined the issue of *virtual* facilitation. In an early study, Dickson and Partridge (1993) examined the efficacy of chauffer-driven GDSS use in comparison to human facilitation. Likewise, Anson and Bostrom (1995) investigated the impact of GSS use with and without facilitators, but did not consider the

issue of automated facilitation. Numerous other studies have examined various aspects of GSS fit, facilitation and/or appropriation (e.g. Wheeler and Valacich 1996, Dennis et al. 2001, Goodhue and Thompson 1995, Griffith et al. 1998,) but did not examine these issues in the context of virtual facilitation (see below). By addressing these apparent gaps in the GSS literature (summarized in Table 1) through the experiment described below, and more fully in Chapter 3, the research described herein is designed to extend our current knowledge in these related areas.

Table 1: Related studies which the present research is designed to expand upon

Study	Primary Focus	Issues Not Investigated
Limayem and DeSanctis (2000) Limayem (2003 unpublished) Wong and Aiken (2003)	Automated facilitation	Appropriation/satisfaction Satisfaction/attitudes Automated facilitation in supporting GSS appropriation
Wheeler and Valacich (1996)	Facilitation, appropriation, PRAST	Automated facilitation
Dennis, Wixom and Vandenberg (2003)	Effects of fit/appropriation (FA) on GSS performance	Automated facilitation; empirical test of FA theory
Zigurs and Buckland (1998)	Task-technology fit theory Fit profiles	Empirical test of GSS fit profiles

The growing popularity of group collaboration systems, and in particular, the use of GSS and similar electronic meeting systems for conducting web-based meetings, such as Microsoft's *Live Meeting* software[2], can be attributable to a number of factors. As organizations become more widely dispersed over larger geographic regions, the disparity between the costs of attending "live" meetings, in comparison to participating in their virtual counterparts, continues to increase dramatically, due primarily to falling bandwidth costs and increasing travel and lodging prices.

2. Microsoft's *Net Meeting* electronic meeting system (EMS) incorporates a number of web-based collaboration tools, including a shared whiteboard and electronic voting features, but not the extensive functionality of more sophisticated group support systems such as GroupSystems (formerly PLEXSYS) and SAMM (Software-Aided Meeting Management), which were initiated at the University of Arizona and the University of Minnesota, respectively, and were among the first group decision support systems developed and used in early GDSS experimental research. The proposed research was conducted using the GroupSystems MeetingRoom GDSS.

Moreover, as managers spend increasing amounts of time attending organizational meetings, the need to ensure meeting productivity continues to become more critical. As a *Wall Street Journal* report illustrates, the costs of attending meetings can be dramatic, with senior and middle managers spending between 11 and 23 hours per week attending meetings, and meeting attendance costs ranging between $20,000 and $46,000 per executive per year. The same *Wharton Center for Applied Research* (CFAR) report also fond that CEO's spend approximately 17 hours per week in meetings, costing approximately $42,500 per year.

In a related study, the University of South Australia determined the cost of organizational meetings in that country totaled to more than $24 billion in 1999, an amount comparable to *$348 billion* per year for U.S businesses, if extrapolated using population figures. In light of the enormous costs of attending organizational meetings, the potential benefits from conducting such meetings more efficiently, through the use of GSS and other technologies, are promising indeed. By increasing meeting productivity only marginally, the resultant cost savings for organizations could be substantial. But how can such efficiencies be achieved consistently?

In spite of their potential for improving meeting efficiency by addressing many of the process losses common to group meetings, GSS systems have not lived up to their expectations. Indeed, Fjermestad and Hiltz (1999) report that a mere 16.6 percent of GSS studies have shown positive effects of the technology in comparison to face-to-face methods, while the most common result was found to be "no difference" in comparing outcomes between groups using GSS and those interacting without GSS (p. 7).

A number of factors can account for such discouraging results. Primarily, many of the inconclusive GSS studies have been conducted using small groups and relatively simple tasks, precisely the combination of variables that have been shown to hold the least potential

for realizing benefits from GSS use. More importantly, a large percentage of the disappointing studies have involved the use of GSS tools which were not properly suited for the assigned task. Because proper task-technology fit is crucial for realizing significant benefits from GSS use, such disappointing results are not totally unexpected. Indeed, in those studies which have exhibited proper fit between the GSS technology and the assigned task, results have generally been encouraging (Fjermestad and Hiltz 1999, Dennis et al. 2001).

Appropriation support, and in particular the role of GSS facilitators in providing such support, is also a critical factor in explaining a significant percentage of the inconclusive GSS results. Indeed, in terms of improving meeting efficiency, Dennis et al. (2001) found that appropriation support (i.e. guidance, facilitation, restrictiveness, and training) was instrumental in achieving both efficiency as well as process satisfaction. But how can appropriation support, and in particular, GSS facilitation be reliably and systematically provided? Research into intelligent systems may provide some insight.

Intelligent systems (applications that contain "a computerized version of human tacit and explicit knowledge…capable of explaining to their human users both the knowledge they contain and the reasoning process they go through" -- Gregor and Benbasat 1999), have demonstrated considerable potential in helping users more effectively appropriate advanced information technologies. Indeed, their common use as components of help functions in popular software applications has made the appropriation process for such software considerably less taxing. On a more complex level, expert systems and other "advice-giving intelligent systems" have proven to be effective in such diverse fields as medicine and finance. Their potential as "explanation facilities" for assisting users in meaningful ways is well documented (Berry and Broadbent 1987, Shortliffe 1976). While the AVFA application

does not meet the strict definition of an intelligent agent per se, future AVFA versions could effectively incorporate intelligent agent features that would qualify it as such.

Research into intelligent systems and, in particular, NSF-funded Human-Computer Interaction (HCI) research has remained at significant levels in recent years, totaling more than $5 million since 1999. The Division of Information and Intelligent Systems (IIS) of the National Science Foundation Directorate for Computer & Information Science & Engineering (CISE) describe Human-Computer Interaction research as follows:

> Research and related education activities fundamental to the design and evaluation of systems that mediate between computers and humans, and which will lead to the creation of tomorrow's exciting new user interface software and technology. The program's ultimate objective is to transform the human-computer interaction experience, so the computer is no longer a distracting focus of attention but rather an invisible tool that empowers the individual user and facilitates natural and productive human-human collaboration. HCI research topics include, but are not limited to: … multi-media and multi-modal interfaces in which combinations of text, graphics, gesture, movement, touch, sound, etc. are used by people and machines to communicate with one another; intelligent interfaces; information visualization; virtual and augmented reality….(NSF Information and Intelligent Systems website)

Some have argued that intelligent systems may be the most significant technical contribution to the effectiveness of GSS use (Crowston and Malone 1988, Johansen 1988). Moreover, a number of researchers have claimed that the utilization of expert systems may hold the potential of transforming GSS from merely “passive agents” that process and present group decision-making information, into “active agents” that enhance group interaction (Aiken et al. 1991, Ellis et al. 1988, Liu Sheng et al. 1989). Aiken, Liu Sheng and Vogel (1991) have asserted that the goal of integrating expert systems with group decision support systems should be in designing systems that facilitate simplified and enhanced group decision-making.

The automated virtual facilitation application (AVFA) used in this research has been designed to simplify and enhance GSS utilization by recommending appropriate GSS tools, and to improve decision quality by increasing the faithful utilization of structured group decision-making activities. In directing GSS tool selection, the virtual facilitation application used in this study is designed to recommend appropriate GSS tools based on the nature of the task to be performed, using the set of fit profiles proposed by Zigurs et al. (1998) and Dennis et al. (2001). In providing appropriation support, the system is designed to provide "heuristic expertise" commonly used for specific types of group-decision-making problems. For the research experiment, the AVFA application uses a multiple-activity group decision-making procedure similar to the five-step heuristic employed by Wheeler and Valacich (1996) which incorporates a number of specific decision-making goals and activities.

To incorporate certain advanced human-computer interaction features, as advocated in the NSF Intelligent Information Systems research summary (i.e. "multi-media and multi-modal interfaces in which combinations of text, graphics, gesture, movement, touch, sound, etc. are used by people and machines to communicate with one another [including] intelligent interfaces; information visualization; virtual and augmented reality…."), the AVFA application is designed to communicate verbally with participants through the use of pre-recorded facilitator scripts, similar to those suggested by Briggs et al. (2003) in order "to replicate the guidance and process restrictiveness comments from a facilitator," as advocated by Wheeler and Valacich (1996).

The virtual facilitation application, as more fully described in Chapter 3, has been designed to test the feasibility of using system-directed facilitation for supporting GSS appropriation and structured group decision-making. Specifically, the AVFA application is

employed in an experiment designed to compare GSS appropriation levels and decision-making effectiveness for groups receiving system-directed facilitation ("AVFA-supported groups") with so-called "chauffer-driven" groups ("conventional GSS groups") and groups interacting without computer support ("unsupported groups").

Methodologically, the experiment conducted for the current study employs a multi-criteria decision-making task (IT Policy Task) to assess the effectiveness of system-directed facilitation on decision-making efficiency and effectiveness under the three approaches. Additionally, the experiment is designed to measure faithfulness of appropriation, attitudes toward use, and user satisfaction under each format, using instruments developed by Chin et al. (1997), Sambamurthy and Chin (1994), and Briggs et al (2003), as detailed in Appendix B.

1.3 Research Questions

The present research seeks to determine whether virtual facilitation can be as effective as conventional facilitation in supporting GDSS appropriation and structured group decision-making. Specifically, the current study is designed to answer the following research questions:

1) Is virtual facilitation as effective as conventional facilitation in supporting GDSS appropriation?

2) Will groups using virtual facilitation be as efficient as conventional GSS groups -- and more efficient than groups interacting without computer-based support?

3) For groups using virtual facilitation, will decision quality be equal to conventional GDSS groups, and greater than those groups interacting without computer-based support?

4) Will groups using virtual facilitation generate as many ideas and alternatives as conventional GDSS groups, and more than unsupported groups?

5) Will user satisfaction be equal for virtual-facilitated groups and conventional GSS groups, and greater than unsupported groups?

While most of these questions remain unanswered, as more fully explained below, the present research framework builds upon several research streams and seminal studies in the GDSS area, namely:

- Limayem and DeSanctis' (2000) study examining the impact of providing automated decisional guidance (i.e. facilitation) in a GDSS environment. While this is perhaps the most closely related study to the present research, it did not address the issue of whether system-directed facilitation is effective in improving user satisfaction, nor did it measure the impact of automated facilitation using the two measures of user appropriation utilized in the present research: faithfulness of appropriation (Chin et al 1997) and attitudes towards use (Sambamurthy and Chin (1994).
- Wheeler and Valacich's (1996) Process Restricted Adaptive Structuration Theory (PRAST) examined the role of facilitation, GSS tools, and training as sources of guidance and restrictiveness in structured group decision making. While their experiment provides the basis for using a structured group decision-making technique (see above) and found that facilitation can increase the faithful use of structured techniques resulting in improved decision quality, their study did not examine the issue of using *system-directed facilitation* to achieve these objectives.
- Dennis, Wixom, and Vandenberg's (2001) *Fit-Appropriation Model* which asserts that task-technology fit, appropriation support, and faithfulness of appropriation are critical factors in GSS outcome effectiveness, process efficiency, and user satisfaction. In spite of its similarity with the present research, Dennis et al. did not address the issue of system-directed facilitation for providing GSS fit and appropriation support.

- Zigurs and Buckland's (1998) theory of task/technology fit (TTF) and group support systems effectiveness and Zigurs et al. (1999) meta-analysis of their TTF theory. While Zigurs et al. developed task-technology "fit profiles," their meta-analysis did not directly test their theory, or utilize it in an automated facilitation context.
- Goodhue and Thompson's (1995) Technology-to-Performance Chain model examined the relationship between task-technology fit, system utilization, and decision-making performance, but did not address the issue of using system-directed facilitation for providing GSS fit and appropriation support.
- Silver (1991) examined three aspects of decisional guidance (when and why to provide it, how to provide it, and the consequences of providing it) and suggested an agenda for researching it. However, his theories were not empirically tested.

Specifically, the present research is designed to fill these apparent gaps in the GSS literature by testing the following hypotheses, as depicted in the Virtual Facilitation Model in Figure 1, and as more fully explained in Chapters 3:

Hypothesis 1: AVFA-supported groups will be equally efficient as conventional GSS groups and more efficient than unsupported groups.

H1A: Conventional GSS groups and AVFA-supported groups will be more efficient in completing their meeting agenda than unsupported groups.

Hypothesis 2: Appropriation levels will be equal for conventional GSS groups and AVFA-supported groups.

H2A: Faithfulness of appropriation will be equal for conventional GSS groups and AVFA-supported groups.

H2B: Attitudes towards use will be equal for conventional GSS groups and AVFA-supported groups.

Hypothesis 3: Decision-making effectiveness will be equal for coventional GSS groups and AVFA-supported groups and greater than unsupported groups:

H3A: Decision quality will be equal for conventional GSS groups and AVFA-supported groups and higher than unsupported groups.

H3B: Conventional GSS groups and AVFA-supported groups will generate an equal number of ideas/alternatives and more ideas/alternatives than unsupported groups.

H3C: Satisfaction with the meeting process will be equal for conventional GSS groups and AVFA-supported groups and higher than for unsupported groups.

H3D: Satisfaction with the meeting outcome will be equal for conventional GSS groups and AVFA-supported groups and higher than for unsupported groups.

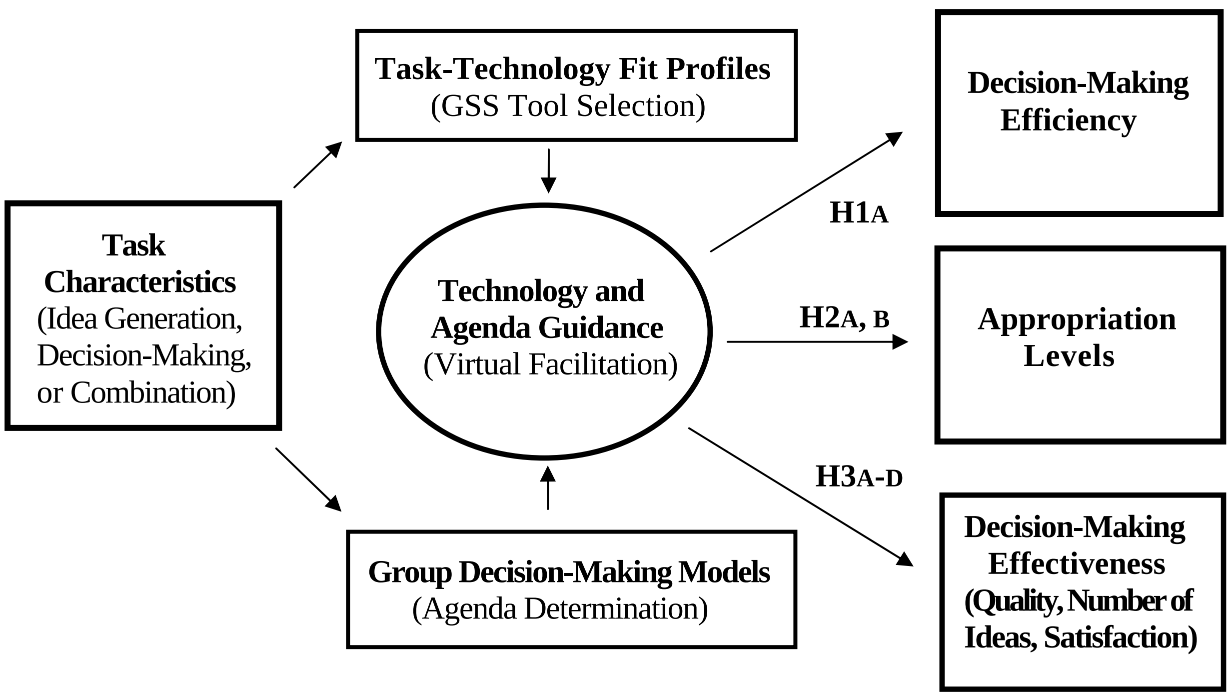

Figure 1: Virtual Facilitation Model

By experimentally testing these hypotheses using the methodology described in Chapter 3, the present research is designed to expand our current knowledge of the effectiveness of virtual facilitation for improving the efficiency of group decision-making; increasing GSS appropriation measures; and improving group decision-making effectiveness.

Before describing the current study's methodology, a review of the GSS literature is necessary. In particular, an examination of two theories on which this study's hypotheses are based will serve to explain the theoretical basis on which the dissertation's hypotheses are formulated, namely: *task-technology fit* and *technology appropriation*. Following a discussion of these theories, a review of the broadly related areas of decisional guidance, expert systems, facilitation, and virtual facilitation is presented.

CHAPTER 2

REVIEW OF THE LITERATURE

2.1 Introduction

In this chapter, the evolution of computer-supported decision-making, decision support systems, and group decision support systems literature is reviewed. Following this overview, three topic areas closely related to the present research are more thoroughly examined, namely: task-technology fit theories, appropriation theories, and the related areas of decisional guidance, expert systems, facilitation and virtual facilitation. Through a comprehensive review of the GSS literature, a variety of studies related to the present research are examined, their implications for the current study are discussed, and apparent gaps in the GSS literature are noted.

As more fully discussed latter in this chapter, one of the most remarkable aspects of the GSS literature is the number of inconsistent research findings reported since the first empirical studies were conducted nearly twenty-five years ago. Indeed, it is the sheer volume of conflicting GSS research findings and anecdotal evidence regarding perceived GSS ineffectiveness that perhaps has contributed to their slow adoption of by organizations. Moreover, it has been only recently that a few general conclusions can be drawn regarding the conditions under which GSS can be expected to yield significant benefits (Fjermestad and Hiltz 1999, Dennis et al. 2001). Of these GSS moderators, perhaps most important is the requirement that a proper *fit* exist between the nature of the group decision-making task and the GSS technology which is employed to address it. Indeed, *task-technology fit* has been cited by a number of authors (e.g. Gallupe and McKeen 1990, Turoff and Hiltz 1993, Goodhue 1998, Dennis and Wixom 2001) as being a key moderator in achieving GSS effectiveness. Likewise, appropriation support has also been

identified as being another critical factor in fully realizing the potential benefits of GSS technologies (Dennis and Wixom 2001). Accordingly, the key research studies relating to each of these areas are the primary focus of this literature review.

Also emphasized in the following review are those studies in the broadly related subject areas of *decisional guidance, expert systems, facilitation, and automated facilitation*. Because these research streams in the GSS literature relate directly to the primary focus of the present research (i.e. virtual facilitation), considerable attention is paid to the research findings in these topic areas. Before delving into these specific studies, however, an historical perspective of computer-supported decision-making, decision support systems, and an overview of the GDSS literature are presented.

2.2 Computer-Supported Decision-Making

Computer-supported decision-making has been studied for nearly a half a century, beginning in earnest with Herbert Simon and Alan Newell's *Heuristic Problem Solving* (1958) which addressed the issue of how computers could be used to solve complex problems through the use of heuristics. Simon and Newel contended that individual judgment is often "bounded," due to the fact that the required information needed to make rational decisions is often unavailable or not fully considered in reaching decisions. Because of the cognitive limitations of human intelligence, as well as various time and cost constraints in reaching optimal decisions, human decision makers must often "satisfice" instead of considering all possible alternative courses of action when making decisions. As a result, Simon and Newell believed computer-supported decision-making could help overcome these limitations. Indeed, the need for decision support systems and group decision support systems were significantly influenced by such cognitive limitations and decision biases.

Kahneman and Tversky (1974) built upon Simon's work by demonstrating how *decision biases* can also affect human judgment. Their *Prospect Theory* (1979) asserted that individuals evaluate gains and losses relative to neutral reference points and that decisions are often based upon how an individual's status quo or *asset position* is affected. Their theory included the isolation effect which asserts that individuals often discard factors shared by all prospects under consideration; a certainty effect which holds that individuals are risk-averse regarding gains (and thus reluctant to forego "sure things" in hopes of potentially winning larger amounts) while risk seeking in situations where losses can be potentially mitigated. Related to this is their concept of framing which suggested that changes in wording can significantly impact decision making by portraying decision outcomes as either gains or losses relative to neutral reference points or status quo positions. As such, one of key contributions of Kahneman and Tversky is their demonstration of how human behavior often deviates from expected-value and expected utility theory, and that "losses loom larger than gains" in decision making. Thaler (1980) demonstrated that framing, or so-called *formulation effects*, could be used intentionally to manipulate the desirability of decision options, as when the credit card industry lobbied for the term "cash discount" instead of the term "credit card surcharge."

Bazerman's seminal text (1985) examined the role of judgment in decision-making and investigated how cognitive biases can affect managerial judgment and decision-making, resulting in *quasi-rational* behavior. He introduced the concept of judgmental heuristics and described how managers use three types of heuristics as a means of simplifying managerial decision-making, although they may not always be aware of doing so. The availability heuristic attributes the likely cause of an event to whatever may be most readily available in

memory. The *representativeness* heuristic looks to previously formed stereotypes to guide decision-making. *Anchoring* uses an initial assessment of something to arrive at its current evaluation, often resulting in systematically biased decision-making. Bazerman reviews thirteen common biases (Table 2) emanating from these heuristics that result in systematic and predictable mistakes in decision-making. He concludes by outlining five strategies for making better decisions, including: acquiring experience and expertise; reducing bias in judgment; taking and outsider's view; using linear models; and adjusting intuitive predictions.

Table 2: Common Biases Emanating from Heuristics. Condensed from Bazerman (2002)

Biases Emanating from the Availability Heuristic

1. Ease of recall – events more easily recalled are judged to be more numerous than others
2. Retrievability – individual memory structure may distort the perceived frequency of events
3. Presumed associations – the probability of two events co-occurring are often overestimated

Biases Emanating from the Representativeness Heuristic

4. Insensitivity to base rates – base rates tend to be ignored if descriptive information is provided
5. Insensitivity to sample size – the role of sample size is frequently ignored in estimating events
6. Misconceptions of chance – a sequence of past events is often used to judge future events
7. Regression to the mean – extreme events tend to regress to the mean on subsequent trials
8. The conjunction fallacy – conjunctions (two events co-occurring) are judged to be more likely than other occurrences of which the conjunction is a subset

Biases Emanating from Anchoring and Adjustment

9. Insufficient anchor adjustment – insufficient adjustments are made from an initial anchor value
10. Conjunctive and disjunctive events bias – conjunctive events are often overestimated
11. Overconfidence – individuals tend to be overconfident of the infallibility of their judgment when answering moderately to extremely difficult questions

General Biases

12. The confirmation trap – individuals tend to seek confirmatory information and fail to search for disconfirmatory evidence
13. Hindsight and the curse of knowledge – individuals tend to overestimate their predictive powers in and fail to ignore information they possess that others do not

A wide range of studies both in and outside of the MIS literature have examined the *group decision-making process* and different methods of carrying-out group decision processes. Holloman and Hendrick (1972) examined the adequacy of six modes of decision-making, including 1) average decisions, 2) leader decisions, 3) committee decisions, 4) majority vote, 5) consensus, and 6) consensus after majority vote. The study found that decision accuracy increases where groups use decision-making procedures which permit the direct participation by as many of the group members as possible.

In a seminal study, Van de Ven and Delbecq (1974) examined the effectiveness of the Nominal, Delphi, and Interacting group decision-making processes. The nominal group technique (NGT), in which face-to-face group members generate their ideas in writing and subsequently discuss such ideas with group members and rank them depending upon specific decision rules; and the Delphi method, in which dispersed group members are polled using questionnaires and feedback, were found to be equally effective and significantly more effective, respectively, than conventional interacting groups. However, because of their different requirements for group member proximity, each group decision-making process is called for in specific meeting situations.

In another formative study of group decision-making, Miner (1979) similarly compared three types of group decision-making approaches, including the nominal process developed by Delbecq and Van De Ven, the Delphi processes originated by Dalkey and Helmer (1963), and the Problem Centered Leadership (PCL) derived from Maier (1952). In brief, the Problem Centered Leadership method is designed to: 1) summarize the problem, 2) provide essential facts, 3) encourage group member participation, 4) restate expressed ideas to more accurately reflect group members positions, 5) ask questions to stimulate problem-

solving behavior, and 6) summarize as required in order to facilitate the discussion, indicate its progress and discuss differences of opinion (p. 84). The study found that the PCL approach achieved higher levels of quality, acceptance, and effectiveness than either the nominal process or Delphi method.

Following Simon and Newell's early work on computer-supported decision-making, a number of early researchers began investigating the then-evolving concept of computer systems designed specifically to facilitate improved decision making and to address the cognitive limitations inherent in reaching optimal decisions. Scott-Morton's *Management Decision Systems* (1971) and Keen and Scott Morton's *Decision Support Systems* (1978) were perhaps the first major books on such information technologies designed to support human decision making. In another widely cited text, Sprague and Carlson (1982) described decision support systems as "interactive computer-based systems that *help* decision makers utilize *data* and *models* to solve *unstructured* problems" (p.4). They proposed three DSS technology levels (Specific DSS, DSS Generators, and DSS Tools) and introduced a DSS "taxonomy of flexibility" based on the amount of adaptability offered by such systems:

F1: Flexibility to Solve – the ability of a Specific DSS to handle a group of related problems in a given problem domain.

F2: Flexibility to Modify – the ability to modify a Specific DSS configuration to handle an expanded set of problems in a given problem space.

F3: Flexibility to Adapt – the ability to adapt to extensive changes requiring a completely different Specific DSS.

F4: Flexibility to Evolve – the ability of DSS "to *evolve* in response to changes in the basic nature of the technology" (p.132-134).

Just as decision support systems were developed to facilitate more effective decision-making by addressing many of the cognitive limitations and biases described above, a similar need existed for comparable systems that could more adequately facilitate decision-making for group settings. The following section describes how such group decision support systems evolved and reviews many of the seminal works in the GDSS area.

2.3 Group Decision Support Systems Historical Overview

As their name suggests, group decision support systems (GDSS) evolved from their DSS counterparts to support group decision-making, initially for face-to-face meetings taking place in so-called decision rooms. Many of the earliest GDSS studies focused on the design, functionality, and anticipated benefits of these emerging information technologies. A number of early laboratory studies examined the effectiveness of such applications in a wide variety of group decision-making scenarios. Steeb and Johnson (1981) used a planning task involving a foreign embassy takeover by a terrorist group to evaluate the effectiveness of computer-supported group decision-making. Lewis (1982) employed an idea generation task for arriving at potential solutions to financial problems at a university. Turoff and Hiltz (1982) used an intellective task involving a group of people attempting to survive in arctic conditions to evaluate the effectiveness of group decision-making systems. DeSanctis and Gallupe's (1987) foundational study of GDSS and their experimental investigation of computer-based support for group problem-finding (1988) were perhaps the most rigorous GDSS studies of their time.

The findings of these formative GDSS studies were equally diverse. Steeb and Johnson (1981), Lewis (1982), Gallupe, DeSanctis, and Dickson (1988), and Zigurs, Poole and DeSanctis (1988) found that decision quality and the number of alternative solutions

generated was greater using GDSS systems, while Ruble (1984) and Beauclair (1987) found no effect on decision quality in using GDSS. Likewise, Turoff and Hiltz (1982) found that consensus was less likely in GDSS supported groups, while Watson, DeSanctis and Poole (1988) found no effect on consensus in using GDSS. Lewis (1982) found that GDSS resulted in reduced individual dominance, while Beauclair (1987), Gallupe et al. (1988), Watson et al. (1988), Jarvenpaa et al. (1988), and Easton (1988) found no such benefits from using GDSS systems. Similarly, a number of these same studies found no significant effect on user satisfaction in using GDSS-based decision-making, while at least two such studies found that GDSS reduced satisfaction with decision outcomes.

The sheer abundance of conflicting GSS studies has puzzled researchers, deterred their more widespread adoption by organizations, and stifled their more passionate advocacy by practitioners. Several of these formative studies have presented cogent explanations for the inconsistencies in prior GDSS research efforts and have offered a number of recommendations for achieving performance improvements from computer-supported group decision-making (e.g. Gallupe and DeSanctis 1988). However, conflicting GSS findings have continued to occur in more recent studies. Several researchers -- Fjermestad and Hiltz (1998), Fjermestad (1998), and Dennis & Wixom (2001) in particular -- have offered insightful explanations as to why group support systems have not provided their expected benefits, pointing mainly to a number of contextual factors, *intervening* factors, and *adaptation* factors affecting the successful outcome of GDSS use.

In their meta-analysis of moderators of group support systems effectiveness, Dennis and Wixom (2001) investigated five moderators of GSS use, including task, tool, group type, group size, and facilitation procedures, in explaining the diverse findings in GSS research.

The results of their analysis supported the majority of their hypotheses that such moderators were indeed significant factors in explaining prior GSS research findings. As discussed below, the authors’ meta-analysis indicated that task, tools, and facilitation (as well as the type and size of the group using the technology) are significant moderators of group support systems performance, and as such, can help explain many of the inconsistencies in prior GDSS research. Before examining these moderators in much greater detail, however, it is necessary to first review some of the formulative literature in the GDSS area, as well as a number of key issues that have been examined by GDSS researchers over the past twenty years.

Perhaps one of the earliest seminal studies in the group decision support systems area was Huber's (1984) formative study examining key issues in the design of group decision support systems. Huber asserts that group decision support systems arise primarily from two key factors: the need for more information sharing in organizations, and the resistance of managers to attending meetings. He posits that the number and nature of tasks supported is positively related to the overall frequency of GDSS use, and that the frequency of GDSS use is positively related to the likelihood of GDSS use for any given task.

Huber advocated an activity-driven design strategy, based on determining the nature of user tasks, and then designing a system best suited to support such tasks:

> Given the innumerable decision-group tasks that an organization might generate how can we use a design strategy that derives system capabilities from knowledge of user tasks?…It is to focus on group activities rather than on group tasks, and to derive the necessary system capabilities from a review of these activities and a consideration of how computing and communications technology might be used to carry them out. In other words, it is to use an *activity-driven* design strategy (p.200).

One of the most significant early studies in the GDSS area, and perhaps one of the most widely cited articles in this body of literature, is DeSanctis and Gallupe's "Foundation for the Study of Group Decision Support Systems" (1987) in which the authors propose a multidimensional taxonomy for organizing GDSS systems and research efforts. Specifically, the authors assert that GDSS design is driven by three factors: the *size* of the group, whether or not there is face-to-face interaction among group members, and the nature of the task which the group is engaged in. The article examines GDSS from an information exchange perspective of group decision-making and theorizes that the effectiveness of GDSS systems are due primarily to their ability to introduce changes in the pattern of communication among group members, as a result of the features of the GDSS technology. Specifically, the authors posit that GDSS systems affect the nature of group member participation, and that such participation will impact both decision quality, as well as outcomes of group meetings. In short, the authors believe that the goal of GDSS systems is to alter the communication process within decision-making groups, and that the more such changes that occur within the communication process as result of adopting the GDSS technology, the more significant the impact will be on the decision-making process, as well as the outcomes of group decisions.

Because of the wide variability in approaches to decision-making by groups, and the need to accommodate a broad range of decision processes, the authors propose three levels of GDSS systems to accommodate various group decision-making processes:

- Level 1 systems are designed to remove communication barriers, provide voting features, and accommodate anonymous input of member ideas to better facilitate information exchange between group members.

- Level 2 systems provide decision models and decision-making techniques designed to reduce uncertainty for group decision-making processes.
- Level 3 systems include features designed to provide expert advice and guidance "for controlling the pattern, timing, or content of information exchange" including Robert's Rules of Order and other features to support the group facilitation process.

Using McGrath's "circumplex model" of group task types, including *generating*, *choosing* and *negotiating* tasks, DeSanctis and Gallupe offer a comprehensive set of example GDSS features to support six task types. In the *generating* area, GDSS systems can be used for both planning and creativity-related tasks. In the *choosing* area, GDSS systems can be designed for both intellective as well as preference related tasks. Finally, in the negotiating area, GSS features can be used to manage cognitive conflict, as well as accommodate mixed motive type tasks. For each of the six task types, the authors provide a number of examples of level one, two, or three systems, and describe a number of possible GDSS support features that each such system might include.

DeSanctis and Gallupe suggest a number of directions that future GSS research should pursue, including: GDSS design, patterns of information exchange, mediating effects of participation, as well as the effects of physical proximity, interpersonal interaction, and group cohesion on GDSS effectiveness. In addition, the authors advocate examining the effects of GDSS on power and influence of group members, and how decision-making effectiveness and user satisfaction should be balanced. In short, should GDSS systems be used primarily to facilitate higher-quality decisions, or used mainly for improving user satisfaction with group decisions?

As a follow-up to their seminal article, Gallupe and DeSanctis (1988) conducted a laboratory experiment to determine the effects of problem complexity on groups using GDSS for group decision-making. Specifically, the study examined the impact of GDSS on decision quality, number of alternatives considered, decision confidence, agreement with the final solution, satisfaction with the decision process, and discussion conflict, by hypothesizing that each of these dependent variables would be favorably impacted in those groups using GSS systems for higher difficulty tasks. For tasks of lower difficulty, no such favorable effects were predicted. The authors found support for each of the study's hypotheses, except for the prediction relating to decision confidence, where GSS use did not result in higher decision confidence among group members, even for tasks of higher difficulty. In finding support for the vast majority of its propositions regarding the importance of task difficulty in GDSS effectiveness, the study emphasizes the critical nature of task difficulty as a moderator when examining the effectiveness of group support systems, a finding that helps explain a large number of studies in which no significant effects were found for groups using GDSS systems.

In another early GSS study, Jarvenpaa, Rao and Huber (1988) examined the impact of computer support for meetings of groups working on unstructured problems. The authors hypothesized that computer-supported group members (groups using electronic blackboards and workstations) would experience more thorough information exchange, would participate more equally, and would experience higher-quality meetings than groups interacting without such support. The study found significant differences between computer-supported groups and conventional groups in most of the dependent variable measures, including meeting

thoroughness, meeting equality, meeting equity, meeting quality, and participant satisfaction; with groups using electronic blackboards reporting the most significant benefits.

In another frequently cited study, Dennis, George, Jessup, Nunamaker and Vogel (1988) proposed the term “electronic meeting systems” (EMS) which the authors claimed were more than traditional group decision support systems, but were designed instead to enable meetings to be conducted “across time and space”; specifically:

> Information technology-based environments that support group meetings, which may be distributed geographically and temporally. The IT environment includes, but is not limited to, distributed facilities, computer hardware and software, audio and video technology, procedures, methodologies, facilitation, and applicable group data. Group tasks include, but are not limited to, communication, planning, idea generation, problem solving, issue discussion, negotiation, conflict resolution, systems analysis and design, and collaborative group activities such as document preparation and sharing (p. 593).

A number of frameworks for studying group decision support systems have been proposed over the last two decades. Dennis et al. presented a model consisting of six variables including: the *characteristics of the group*, the *task* faced by the group, the *context in which the group meeting occurs*, the *presence or absence of an EMS*, the *nature of the group process*, and the *outcomes* of the group meeting that can be measured. Using a taxonomy similar to that proposed by DeSanctis and Gallupe (1987), the authors proposed analyzing GSS systems on the basis of *group size*, *group proximity*, and *time dispersion* (synchronous or asynchronous) and offer detailed explanations of different GSS systems within such a taxonomy. Using the University Of Arizona’s PLEXSYS electronic meeting system (subsequently named GroupSystems) as an example EMS, they predicted that EMS would be able to improve productivity by decreasing the number and duration of organizational meetings and providing other benefits:

At the same time, the number of individuals involved in a particular meeting can increase without affecting the productivity of the meeting since EMS can be designed to successfully support large groups. Finally, EMS makes it possible to broaden the scope of a meeting to include participants from various hierarchical levels, thereby improving organizational communication and facilitating faster approval for decisions (p. 615).

Other frameworks proposed for studying group decision support systems were described in the following studies: Jarke (1986) presented a highly technical framework for studying the communications component of group decision support systems. Jelassi and Beauclair (1987) developed an integrated framework for group decision support systems design in which the behavioral as well as technical aspects of GDSS are examined concurrently. Their framework emphasized the need to examine individual, group, and environmental factors relating to group decision-making, and asserted that problems resulting from group decision-making can be attributed to diffusion of responsibility, loss of "objective self-awareness", striving for group consensus, and group coordination problems. Gray (1987) proposed a framework which included two levels of outputs: primary outcomes (attitudes, consensus levels, etc.) which in turn result in performance outcomes. Pinsoneneault and Kraemer (1989) asserted that GSS support enhances group processes by removing communication barriers, improving task performance, and reinforcing the social values of groups. Poole and DeSanctis (1990) contended that GSS will not alter the nature of group activities but will merely be another set of structures with which they will interact. Hiltz (1991) proposed expanding DeSanctis and Gallupe's GSS model through the addition of an asynchronous level to their proximity dimension. Applegate (1991) proposed a framework which examined the assimilation of GSS in organizations. McGrath and Hollingshead (1994) investigated the interaction between inputs, organizational factors, process variables, and outcomes. Mennecke, Hoffer, and Wynne (1992) proposed a hybrid

framework integrating *meeting inputs* (task, group characteristics, etc.), the *meeting process* (facilitation, GSS support, etc.), and meeting output*s* (performance, perceptions, etc.). Zigurs and Kozar (1994) likewise presented an integrated input-process-output model which focuses on the interrelationships among the process variables. McLeod (1992) presented a meta-analysis which suggests that GSS can result in improved decision quality, greater numbers of decision alternatives and participation, but requiring more time, and resulting in less consensus and satisfaction. Likewise, Benbasat and Lim's (1993) meta-analysis found similar positive and negative effects resulting from GSS use (Fjermestad 1998, p.86-97).

Consolidating these frameworks, Fjermestad proposed his own comprehensive model for examining group support systems which focused on input, process, and output variables. His framework includes an exhaustive set of factors examined in the GSS studies described in the previous paragraph: contextual factors include context-related variables (environment, organizational, and cultural), group-related factors (group characteristics, composition, leadership, member characteristics, meeting structure, initial levels, and group structures), task factors (task type and task characteristics), and technology factors (communications mode, design, process structure, and task support). In the process area, his framework encompasses both intervening factors as well as adaptation factors. Intervening factors include methods, summary variables, organizing concepts, and operating conditions. Adaptation factors include group adaptation processes, process gains and losses, and intermediate role outcomes. Finally, the frameworks' outcome factors include efficiency measures, effectiveness measures, satisfaction measures, consensus measures, and usability measures. Concluding, Fjermestad asserts that these factors can be used to construct a prototheory which predicts the following contingent relationships:

- IF the GSS technology (tools and imbedded structures) is appropriate to the group, tasks, and environmental context;
- AND IF intervening factors are appropriate (such as adequate training, the right experimental design, with the right number of sessions and length);
- AND IF the group's adaptive structuration of the tools and procedures provided is faithful, so that the intended process gains are achieved and process losses avoided;
- THEN the GSS will lead to certain desirable outcomes such as better decisions (Fjermestad p.104).

The virtual facilitation application used in this study posits a similar contingent relationship in which GSS performance is dependent upon both task-technology fit as well as faithful appropriation of the GSS technology.

Rao and Jarvenpaa (1991) proposed a similar contingency model integrating existing theories of communication, minority influence and information processing and asserting that many of the inconsistencies in GSS research are due to the lack of well-thought-out models and frameworks for studying GSS systems. Because GSS studies take place in different environments, use different tasks, and employ different measures to assess the effectiveness of using GSS systems, they often result in a pattern of results indicating no clear cut benefit from using GSS systems. To address this issue the authors propose a contingency model which asserts that theoretical linkages exist among theories of communication, minority influence, and human information processing. The present study asserts that similar theoretical linkages exist between theories of task-technology-fit and appropriation, and employs a similar contingency model, which posits that GSS fit is necessary for achieving the potential benefits of GSS utilization.

Equally important in GSS effectiveness is the issue of information exchange, and how it can be best structured to facilitate improved communication and decision-making. In two related articles, Dennis (1996) investigated the effects of information exchange on group decision-making. In one case, he examined the impact of information exchange with and

without GSS, finding that GSS did not promote greater exchange of information among group members, in comparison to groups not using GSS. In a similar study, Dennis (1996) examined the effects of using group support systems on information exchange and group decision-making in situations in which groups experienced majority/minority splits of opinion within the group. That study found that when distinct majority and minority subgroups were present, groups tended to exchange more information and make better decisions when such groups utilized GSS systems. However, the study also found that groups using GSS tended to take longer to reach decisions than those groups interacting without GSS systems.

In another study of information exchange within groups, Hightower and Sayeed (1996) studied the effects of communication mode on information exchange within groups, and the effects of “pre-discussion conflict” on information exchange in groups using computer mediated communication systems (CMCS) verses those meeting in face-to-face settings. The study found that information exchange was less efficient in groups using computer-mediated communications. However, for groups sharing a greater amount of common information (i.e. pre-discussion preferences), efficient information exchange was less problematic for groups using computer mediated communication systems. Moreover, the study found that where conflicting pre-discussion preferences existed, information exchange improved, confirming the general belief that non-personal conflict among group members can in fact lead to improved information exchange, such as when nominal group techniques are used to introduce a diversity of opinions, or devil's advocacy roles are adopted by group members. By demonstrating that information exchange can be more difficult in computer-mediated settings, the study emphasizes concerns that over-reliance on CMCS can be

problematic, especially when such communication is used extensively in certain group settings, such as with virtual teams and *distributed* group support systems.

While information exchange is a recurring theme in the GSS literature, the question of how individuals and groups effectively exchange information is an issue also addressed in several MIS articles. Daft and Lengel (1986) examined organizational information requirements and proposed a theory of "media richness" to explain the most effective medium of communication. Because organizations process information to manage uncertainty and equivocality, the authors argue that task performance can be improved when the requirements for specific tasks are matched to a specific level of media richness. Specifically, they argue that rich media (e.g. face-to-face meetings) are more appropriate for equivocal tasks in which ambiguity exits, and less rich media (e.g. computer-mediated communication) are more appropriate for tasks in which informational content is incomplete. While the authors limited the testing of their theory to having managers select what they felt was the most effective means of communicating in given situations, they did not specifically test whether richer media was indeed more appropriate for equivocal tasks, or whether less rich media was better suited for tasks lacking specific information – questions which are relevant for selecting the proper communication medium for group decision-making.

Dennis and Kenny (1998) examined the issue media richness theory in the "new media" (e.g. computer mediated and video communication) in an effort to determine the primary factors that could be used to predict specific media performance. The authors hypothesized that decision performance improves as the "multiplicity of informational cues" increase, and that performance improves more for equivocal tasks as informational cues are increased. Their study found that increased multiplicity of cues and immediacy of feedback

did indeed lead to better performance overall, bringing into question a major assertion of media richness theory that matching media to task equivocality will result in improved performance.

Dennis and Valacich (1999) likewise questioned the efficacy of media richness theory by proposing their own theory of *media synchronicity*, which asserts that group communication processes are comprised of two primary processes: conveyance and convergence, and that media performance will be enhanced when the capabilities of specific media are aligned with these processes. Citing a number of studies which questioned the assertions of media richness theory, the authors contend that five media capabilities are more important than the original four dimensions of media richness theory: immediacy of feedback, parallelism, symbol variety, reprocessability, and rehearsability. They contend that the 'best' medium will be dependent upon which of these five dimensions are most important for a given situation, and concluding that attempts to classify the relative 'richness' of media are not productive:

"We believe that the key to effective use of media is to match media capabilities to the fundamental communication processes required to perform the task. Because most tasks require individuals to both convey information and converge on shared meetings, and media that excel at information conveyance are not those that excel at convergence. Thus choosing one single medium for a task may prove less effective than choosing a medium or set of media which the group uses at different times in performing the task, depending on the current communication process (convey or converge). Media switching may be most appropriate (p.8-9).

The present study adopts this approach through its prescribed multiple-activity group decision-making heuristic which prescribes a combination of GSS tools and decision processes for completing the assigned group task. As described more thoroughly in Chapter 3, the group decision-making heuristic employs the process of "media switching", depending upon the current activity of the group decision-making heuristic.

Because of their ability to provide *anonymity* for individuals participating in group decision-making and the importance of this feature in improving member participation, the effects of anonymity for group decision-making have been the focus of a number of research studies in the GSS area. Indeed, equality of participation is often cited as a major benefit of GSS systems, and one in which anonymity plays a primary role. Connolly and Jessup (1990) found that groups working anonymously produced a greater number of original solutions as well as more overall input. Interestingly, where anonymity did *not* exist, the study found that members had higher levels of satisfaction and perceived effectiveness, but generated fewer solutions and had lower levels of member-contributions. In a related study, Jessup and Connolly (1990) found that anonymity tended to reduce behavioral constraints, and caused group members to contribute more freely to the group processes. Pinsoneneault and Heppel (1997) attributed many of the inconsistent findings of group support systems research to the effect of social constraints on group members, including the effects of social evaluation in limiting group members' contributions. Cooper et al. (1998) also examined the effects of anonymity in electronic brainstorming in groups, studying factors that limit the effectiveness of verbal brainstorming.

In a related area, Chidambaram (1996) studied how group support systems can impact group attitudes. Using *social information processing theory*, he argued that intimacy among GSS-supported group members may take longer to develop than among group members interacting without group support systems. His findings support his contention that relational ties among group members participating in a GSS context do indeed develop over time. Zigurs and DeSanctis (1991) also studied how adoption patterns of GSS systems could impact user attitudes. Their results suggest that two patterns of adoption in the use of GSS

systems generally emerge: groups that accept the technology and effectively use it during their meeting processes, and groups that do not use the technology as intended.

A number of authors have examined the issue of collaboration and collaborative group work and how the effectiveness of such collaboration is affected when using computer-based support. George, Easton, Nunamaker and Northcraft (1990), compared collaborative group work with and without computer-based support and found mixed results. Specifically, they reported that group consensus was more likely in manual groups, that the time required to reach decisions was less in manual groups, and that participation was more equal in GDSS groups. The study also found that manual groups with leaders had more equal participation; but that GDSS groups without leaders had more equal participation.

Horton, Rogers and Austin (1991) investigated the impact of face-to-face collaborative technology on group writing. They found that the computer-based collaboration affected the writing process, resulting in less group planning and more work on individual levels than situations in which conventional writing tools were used. They also found that collaborative technology also reduced verbal activities, as well as overall group focus. As such, the collaborative technology was found to have both positive and negative effects on group performance. While the technology did not impact the overall quality of the documents prepared, the study found that it could in fact, enhance the adaptiveness of the writers.

Karan, Kerr, and Murthy (1996) examined the impact of computer support for collaborative decision-making in an auditing context. Their study investigated whether groups using GSS systems to arrive at collaborative decisions outperformed groups interacting without such technologies. Their study examined the so-called "choice-shift"

phenomenon, in which decisions made by interacting groups shift over time. The study found that both anonymous and non-anonymous GSS-mediated communication had no significant impact on choice shift, whereas face-to-face communication resulted in significant choice shifts. Their study also found that GSS communication was more efficient, but that group members' perceived satisfaction levels were not significantly different in groups using GSS technologies than those participating in face-to-face settings.

The specific *mode* of communication for group support system environments have been studied by a number of researchers. Barkhi, Jacob and Pirkul (1999) compared decision-making and processes for groups interacting face-to-face to groups utilizing computer-mediated communication. Their study compared the performance of groups and their leaders using a measure of performance called "the efficient frontier," finding that groups interacting face-to-face outperformed those groups using computer-mediated communication.

Barkhi, Varghese and Pirkul (2002 and 2004) studied the influence of authority structure, incentive structure, and communication mode on GSS use and outcomes by comparing groups meeting face-to-face with groups using distributed group support systems. The study found that *group-based incentive structures*, which are used to encourage cooperation among group members, and *individual-based* incentive structures, which are used to encourage individualistic behavior, are both important in the successful utilization of group support systems and, as such, should be embedded within the GSS structure.

Chidambaram and Jones (1993) examined the impact of communication medium and computer support on the performance of groups in face-to-face and dispersed settings. The study found that EMS could indeed be beneficial in supplementing standard audio

conferencing by providing additional features, resulting in improved communication among group members. The study also found that electronic meeting systems could lead to improved decision-making performance, assuming proper task-technology fit is present, and that effective facilitation is provided, conclusions which support the hypotheses of the present study.

Ocker, Fjermestad and Hiltz (1998) examined the effects of four different modes of communication for group decision-making. Specifically, the study compared face-to-face group meetings with synchronous computer conferencing, asynchronous computer conferencing, and meetings using both face-to-face communication and asynchronous computer conferencing. The study found that both creativity as well as the quality of solutions of groups using combined face-to-face and asynchronous computer conferencing was higher than the other three meeting conditions studied. In addition, groups using the combined methods were found to be more satisfied with the outcome of their decision-making processes. As described above and more fully detailed in chapter 3, the agenda prescribed by the automated virtual facilitation application employs such a combination of face-to-face and asynchronous modes of communication.

A number of researchers have conducted meta-analyses of previous GSS research efforts. Dennis, Nunamaker, and Vogel (1991) compared laboratory and field studies of electronic meeting systems (EMS) in attempting to explain why previous laboratory results varied significantly from field studies. In explaining the factors that affect the use of GSS technology, the authors contend that differences between field and laboratory studies are indicative of different situations existing in each type of study. Specifically, the authors

identified twenty-four differences in organizational contexts, group characteristics, tasks, and EMS environments that help explain such differences.

Fjermestad and Hiltz (1999) examined a number of salient variables impacting group support systems effectiveness in their comprehensive compendium of prior GSS research studies. Of the total 1,582 hypotheses examined, a disappointing majority of the studies found no significant difference between groups utilizing GSS technologies and those interacting without group support systems. Moreover, the percentage of positive results from such studies comparing group support systems to face-to-face interaction accounted for a mere 16.6% of the total studies examined. In a related study, Fjermestad and Hiltz (2000) examined the 54 cases and field studies from 79 published GSS studies and presented characteristics of successful and unsuccessful GSS implementations. Interestingly, the presence (or absence of) a facilitator was first on each list of such characteristics. Other characteristics necessary for successful GSS use included: effective group leadership (verses a dominating or unenthusiastic leader), complex (verses trivial) tasks, and permitting (verses discouraging) verbal and electronic modes of communication. The multi-activity problem-solving heuristic utilized for this research is designed to use both such communication modes.

In a subsequent meta-analysis, Fjermestad (2004) examined the results of 145 studies having the GSS communication mode as the independent variable. His study found that in most cases there was no significant difference between situations in which groups utilized GSS and those interacting in face-to-face meetings. On the encouraging side, his meta-analysis indicated that 29% of the studies found more positive effects for groups using GSS, as compared to groups interacting without GSS systems. Overall, the study suggests that GSS systems can result in better decision quality, higher levels of analytical review, greater

equality of participation, and higher user satisfaction, in comparison to groups interacting without GSS. Moreover, the meta-analysis also suggests that task type, as well as GSS technology can have significant effects on adaptation and outcome factors. In particular, GSS-supported groups taking part in idea generation and brainstorming tasks were found to perform better than groups interacting without GSS support.

These findings likewise provide additional support for a number of earlier studies which found *task* to be a significant moderator of GSS performance. Gallupe and McKeen (1990), for example, found that group support systems effectiveness is determined to a large extent by the type of task for which GSS systems are used. Likewise, Turoff and Hiltz (1993) found that GSS performance is contingent upon the type of task for which a GSS system is used. Goodhue (1998) explains *task technology fit theory* as “the correspondence between information systems functionality and task requirements (which) leads to… positive performance impacts.” Indeed, task-technology fit has been identified as a significant moderator of group support systems effectiveness in a growing number of GSS studies, as discussed in the following section.

2.4 Task-Technology Fit Theories

The roots of task-technology fit theory can be traced to the socio-technical school which studied the relationship between technological and organizational elements in work environments. Beginning with the formative work of Trist and Bamforth (1951) at London's Tavistock institute after World War II, a number of theories regarding the “interconnectedness” of social and technical elements in the workplace have emerged for examining the reciprocal nature of relationships between humans and the technology they employ in the workplace. In studying how “the joint optimization of social and technical

systems” can be best achieved, sociotechnical researchers Emery and Trist (1965) regard improved task performance as a primary means of accomplishing this objective.

As sociotechnical systems that encompass aspects of both social and technical components within organizations, the performance of group support systems is significantly influenced by the *fit* existing between group tasks and the GSS tools used to carry them out. In cases where task technology fit is properly matched, significant performance benefits can result. Conversely, when task-technology fit is inappropriate, the organizational impact from using GSS can be inconsistent at best. As Griffith, Fuller, and Northcraft (1998) explain, “a sociotechnical system approach to GSS acknowledges that organizational and human outcomes can be improved by striving for fit between the social and technical elements of the organization (and creating) a balanced and synergistic relationship” between the human and technological elements of the GSS sociotechnical system (p.20-21).

As this dissertation asserts, and as more fully described in the following sections, the GSS *facilitation* process is critical in helping ensure that group members effectively exploit the capabilities of the GSS technology to achieve this task-technology synergy. Griffith, Fuller, and Northcraft explain the components of GSS sociotechnical systems and the role of facilitators more fully:

> The components of the GSS sociotechnical system include group members, task, technology, and facilitators. Facilitators (both of the technology and/or of the group process), group members participating in the interaction (whether peers or part of a hierarchy), and technology (the group support system hardware and software) interact within the context of the task (e.g., decision-making, information gathering)…Facilitation is a key element to the success of groups and teams in a sociotechnical system. Facilitation helps the participants exploit the capabilities of the technology and the group, in the pursuit of their task (p.21).

While sociotechnical research began with studies of work routines in the coal mining industry, a number of organizational researchers have focused on group meetings, and the

variety of tasks that are designed to accomplish group objectives. Poole et al. (1985) noted the significance of "group task type" by finding that this variable could account for as much as 50% of the variance in group performance. McGrath's (1984) "circumplex model" of group task types was the most significant result of a number of earlier attempts at categorizing group tasks on the basis of decision-related meeting goals. The circumplex model focuses on the purpose of group meetings including *generating* ideas and actions, *choosing* alternatives, and *negotiating* solutions. McGrath's model includes three group tasks purposes and distinct task types, as explained by DeSanctis and Gallupe (1987) in their seminal article on group decision support systems:

Generating ideas and actions –

- Planning tasks require generation of action oriented plans
- Creativity tasks require generation of novel ideas

Choosing alternatives –

- Intellective tasks require selection of the correct alternative
- Preference tasks require selection of an alternative for which there is no objective criterion of correctness

Negotiating solutions –

- Cognitive conflict tasks involve resolution of conflicting viewpoints
- Mixed-motive tasks involve resolution of conflicting motives or interests (p.600)

Adopting McGrath's circumplex model of task types to a GDSS context, DeSanctis and Gallupe (1987) explain how specific GDSS features can be used to facilitate specific group-related tasks:

The contribution of GDSS to GENERATE tasks should be to facilitate input and display ideas from all group members, to speed up the process of idea (or plan) evaluation, and to provide technical support for creative thinking techniques...In the case of CHOOSING tasks, where alternatives are known and in need of evaluation by group members, the objectives of GDSS technology should be to aid in the selection of either the correct solution (in intellective tasks) or the socially preferred solution (for preference tasks)... In

> NEGOTIATING tasks...voting solicitation and summary (Level 1) and stakeholder analysis and resource allocation models (Level 2) may be of use to the group. (pp.601-602).

To illustrate how features of each level of group support systems can be properly matched to specific group tasks, DeSanctis and Gallupe presented a number of example GDSS features required for each of McGrath's six task types. As indicated in Table 3, such features range from technical functions for improving group communications (Level 1 GDSS), to decision-modeling and group decision techniques (Level 2 GDSS). As indicated, Level 3 GDSS are designed primarily to facilitate group meeting processes. The AVFA application for providing system-directed facilitation (Level 3 GDSS) is designed to direct and support such meeting processes.

Jarvenpaa's (1989) seminal paper examining the effects of task demands and graphical format on information processing strategies was one of the earliest MIS studies to empirically examine the effects of task-technology fit on decision-making. The study found that while information presentation format affected decision time and the selection of information acquisition and evaluation choices, the characteristics of the tasks, and the interaction between the presentation format and other task demands were also significant factors in effecting decision time as well as the choice of decision-making strategies. In doing so, Jarvenpaa demonstrated early on that task-technology fit can be a significant factor in the effectiveness of computer supported decision-making.

Cooper and Zmud (1990) incorporated task-technology fit in their research model for studying information technology implementation. Their model asserts that the compatibility between task characteristics and technology characteristics is positively related to IT implementation success. Moreover, in cases where both task and technology complexity is

high, their model posits a negative relationship between such complexity and IT implementation effectiveness, as indicated in Figure 2. The virtual facilitation application utilized in this research is designed to make the utilization of group support systems more effective by ensuring the proper fit between the assigned group tasks and the GSS technology, as more fully described in chapter 3.

Table 3: DeSanctis and Gallupe's "Example GDSS Features to Support Six Task Types"

Task Purpose	Task Type	GDSS Level	*Possible Support Features*
Generating	Planning	Level 1	*Large screen display, graphical aids*
		Level 2	*Planning tools (e.g. PERT)*
			Risk assessment, subjective probability estimation for alternative plans
	Creativity	Level 1	*Anonymous input of ideas; pooling and display of ideas; search facilities to identify common ideas, eliminate duplicates*
		Level 2	*NGT, Brainstorming*
Choosing	Intellective	Level 1	*Data access and display; synthesis and display of rationales for choices*
		Level 2	*Aids to finding the correct answer; e.g. forecasting models, multi-attribute utility models*
		Level 3	*Rule-based discussion emphasizing thorough explanation of logic*
	Preference	Level 1	*Preference weighting and ranking with various schemes for determining the most favored alternative; voting schemes*
		Level 2	*Social judgment tools; automated Delphi*
		Level 3	*Rule-based discussion emphasizing equal time to present opinions*
Negotiating	Cognitive conflict	Level 1	*Summary and display of members opinions* *Using social judgment analysis, each member's judgments are analyzed by the system and then used as feedback to the individual member or the group*
		Level 3	*Automatic mediation; automate Robert's Rules*
	Mixed motive	Level 1 Level2	*Voting solicitation and summary* *Stakeholder analysis*
		Level 3	*Rule base for controlling opinion expression; automatic mediation; automatic Parliamentary procedure*

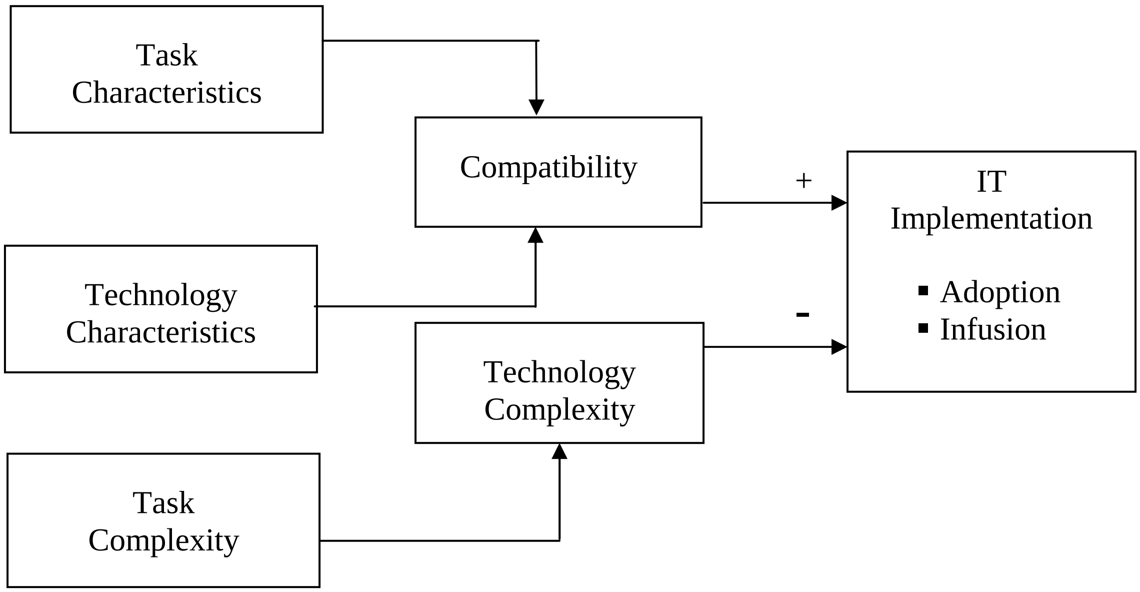

Figure 2: Research Model for Studying Technological Diffusion in IT Implementation (Cooper and Zmud)

Straus and McGrath (1994) examined the interaction of task type and technology on group performance. Specifically, the authors posit that as group tasks require more interdependence among group members, communication media that transmit more "social context cues" will result in better group performance and satisfaction. While they found few differences between computer supported and face-to-face groups in terms of the work quality, face-to-face groups were found to be significantly more productive than computer supported groups for tasks requiring higher levels of coordination among group members. As a result of these and similar findings, the embedded facilitation utilized in this research emphasizes such "social context" cues, specifically by using verbal communication to convey system-directed messages to group members.

Huang and Wei (1997) found that task type was a significant moderator of *group influence* for participants using group support systems. For intellective tasks, their study

found that GSS resulted in less equal influence among group members, while for decision-making tasks, influence was more evenly distributed. In a subsequent study, Huang and Wei (2000) investigated the effects of task type on *group interactions* from an influence perspective. Using a research model derived from McGrath's (1991) Theory of Time, Interaction and Performance (TIP theory), the study concluded that GSS systems could significantly influence group interaction processes, improving group task interactions but somewhat impeding group social interactions.

Lam (1997) studied the effects of group decision support systems and task structures on group communication and decision quality, and whether the structure of tasks will moderate the effects of GDSS. In explaining why GDSS can produce both positive and negative impacts on group decision-making performance, he asserts that GDSS effects are "task-structure-dependent" and that the *decision process* must also be evaluated to determine how decisions are made. The virtual facilitation model contends that GSS effectiveness is contingent upon task-technology fit, and that guidance in the GSS tool selection process is critical for ensuring such fit.

A number of other researchers have proposed their own theories of task- technology fit, and how the interaction of group tasks with GSS technology can significantly improve group decision-making performance. Zigurs and Buckland (1998) provide an extensive review of a number of task-technology theories proposed over the last decade, in addition to proposing their own theory of task-technology fit and group support systems effectiveness, based primarily on the level of task complexity, in which they define *task-technology fit* as "ideal profiles of task/technology alignment". While their theory is *deterministic* in the sense that it prescribes specific GSS features (communication support, process structuring, and

information processing) for different categories of tasks, the authors admit that technology is but one of many factors which influence group behavior patterns, including a myriad of human and institutional factors, as Orlikowski (1992) and DeSanctis and Poole (1994) have argued in earlier works.[3]

Zigurs and Buckland's theory focuses on *organizational* decision-making tasks and defines a *group task* as "the behavior requirements for accomplishing stated goals, via some process, using given information" (p. 316) and includes five task categories based on task complexity, namely: *simple tasks, problem tasks, decision tasks, judgment tasks, and fuzzy tasks*. Likewise, they define *group support systems technology* as "a set of communication, structuring, and information processing tools that are designed to work together to support the accomplishment of group tasks" (p.319). Finally, the authors define task/technology fit as "ideal profiles composed of an internally consistent set of task contingencies and GSS elements that effect group performance."

As proposed by Zigurs and Buckland, this "ideal profile" approach to task-technology fit attempts to establish "viable alignments" of task and technology using the following three-step process to test the propriety of that fit:

1. Identifying distinct task environments
2. Specifying ideal technological support for each task environment
3. Testing the performance effects of task/technology alignments (p. 323)

The automated virtual facilitation application is based on such an approach in which ideal task-technology profiles are used for prescribing appropriate GSS tools for specific group tasks.

3. Complexity is a function of the number of variables, the number of relationships between them, their stochasticity, and time pressure. As such, the "hidden profile" task used in this research is believed to be of moderate complexity. Approximately 2 hours are allowed for completing the task, which should be adequate in relation to the task's complexity. A complete description of the IT Policy Task is provided in chapter 3.

A number of researchers have adopted similar approaches of empirically testing different group decision-making tasks with specific GSS technologies (Clapper et al. 1991, Gopal et al. 1992, Easton et al. 1990, Sia et al. 1996, and Tan et al. 1994). However, the findings of each of these studies were either mixed or inconclusive. As a result, McGrath's circumplex continues to be the most utilized classification scheme for testing task-technology hypotheses; however its prescriptions have yet to be tested systematically across various types of GSS technologies (Zigurs and Buckland, p. 324).

The theory of task technology fit proposed by Zigurs and Buckland asserts that when task/technology fit is appropriate, the result should be an improvement in *group performance*, a construct representing a number of key performance metrics, including: decision quality, process efficiency, group member satisfaction, and post-decision consensus (Fjermestad and Hiltz 1997; Hollingshead and McGrath 1995). Specifically, Zigurs and Buckland's task technology prescriptions recommend the following levels of communication support, process structuring support, and information processing support for the tasks indicated in Table 4:

Table 4: Fit Profiles of Task Categories and Technology Dimensions (Zigurs and Buckland)

	Communication Support Dimension	Process Structuring Dimension	*Information Processing Dimension*
Simple tasks	High	Low	*Low*
Problem tasks	Low	Low	*High*
Decision tasks	Low	High	*High*
Judgment tasks	High	Low	*High*
Fuzzy tasks	High	Medium	*High*

In a follow-up study, Zigurs and Buckland (1999) tested their theory of task-technology fit in a meta-analysis of prior GSS experimental research. Contending that the most likely cause for the often conflicting results of prior studies of GSS effectiveness is the role of group tasks, the authors argue that their theory regarding the fit between task and technology will help explain such conflicting results, as well as help plan future research efforts. Defining task as "the behavior requirements for accomplishing stated goals, via some process, using given information" (Campbell 1988; Zigurs and Buckland 1998), Zigurs and Buckland's theory categorizes task types on the basis of four task dimensions, as indicated in Table 5:

Table 5: Task categories (from Campbell, 1988; Zigurs and Buckland, 1998)

	Simple Tasks	Problem Tasks	Decision Tasks	Judgment Tasks	*Fuzzy Tasks*
Outcome multiplicity	No	No	Yes	No	*Yes*
Solution scheme multiplicity	No	Yes	No	No	*Yes*
Conflicting interdependence	No	Yes or no	Yes or no	Yes or no	*Yes or no*
Solution scheme outcome uncertainty	Not applicable	Low to High	Low to high	Low to high	*Low to high*

Using their definition of fit as "ideal profiles composed of an internally consistent set of task contingencies and GSS elements that affect group performance" (Venkatraman 1989, Zigurs and Buckland 1998) the authors propose the following five propositions:

P1: Simple tasks should result in the best group performance (as defined for the specific task) when using a GSS configuration that emphasizes communication support.

P2: Problem tasks should result in the best group performance (as defined for the specific task) when using a GSS configuration that emphasizes information processing.

P3: Decision tasks should result in the best group performance (as defined for the specific task) when done using a GSS configuration that emphasizes information processing and process structuring.

P4: Judgment tasks should result in the best group performance (as defined for the specific task) when using a GSS configuration that emphasizes communication support and information processing.

P5: Fuzzy tasks should result in the best group performance (as defined for the specific task) when done using a GSS configuration that emphasizes communication support and information processing, and moderate process structuring (p.37 – emphasis added).

Using a coding scheme developed by the authors to categorize task types on the basis of the four task dimensions (outcome multiplicity, solution scheme multiplicity, conflicting interdependence, and solution scheme outcome uncertainty), and a theoretically-based scheme to a classify GSS technologies; the results of their meta-analysis were generally consistent with the prescribed fit profiles. In general, when the GSS and group task were matched using the theoretical fit profile, GSS-supported groups typically performed better than groups not using GSS. Similarly, where GSS technology and task were not properly matched, GSS supported groups performed either worse or virtually the same is not supported groups. The GSS technology selection guidance provided by the automated virtual facilitation application is based upon using fit profiles similar to those presented by Zigurs et al.

Goodhue also conducted a number of studies in the area of task-technology fit and its impact on individual performance. Specifically, Goodhue (1988, 1995) and Goodhue and Thompson (1995) have used the theory of task- technology fit (TTF) as a basis for evaluating information systems effectiveness. Specifically, Goodhue's theory of task-technology fit examines "the correspondence between information systems functionality and task

requirements" and its effect on user evaluations and performance impacts of organizational information systems:

> The heart of the task technology fit model is the assumption that information systems give value by being instrumental in some task or collection of tasks and that users will reflect this in their evaluation of the systems. Thus, the strongest link between information systems and performance impacts will be due to a correspondence between task needs and systems functionality (task technology fit)… As task needs (or the abilities of the users) change, the "best" type of information system will change as well (Goodhue 1998, p. 107).

Defining task-technology fit as "the degree to which a technology assists an individual in performing his or her portfolio of tasks" and "the correspondence between task requirements, individual abilities, and the functionality of technology", Goodhue and Thompson (1995) assert that "information systems will have a positive impact on performance only when there is a correspondence between their functionality and the task requirements of users." Likewise, they assert that "as the gap between the requirements of the task and the functionalities of the technology widens, TTF is reduced" (p. 214-218).

Moreover, the authors assert that task technology fit will also have a significant impact on system utilization:

> Not only does high TTF increase the likelihood of utilization, but it also increases the performance impact of the system regardless of why it is utilized. At any given level of utilization, a system with higher TTF will lead to better performance since it more closely meets the task needs of the individual (p. 218).

Goodhue and Thompson's "Technology-to-Performance Chain" (TPC) posits that for information technology to have positive impacts on individual performance, not only must the technology be utilized, but the technology must also be a good fit with the task that it supports. Their study found evidence that performance impacts are indeed a function of both task-technology fit and utilization, and not utilization alone, as depicted in Figure 3. The present research framework adopts a similar view by positing that the GSS technology

utilized by group members must be properly aligned with the prescribed task in order to effectively exploit the group support system

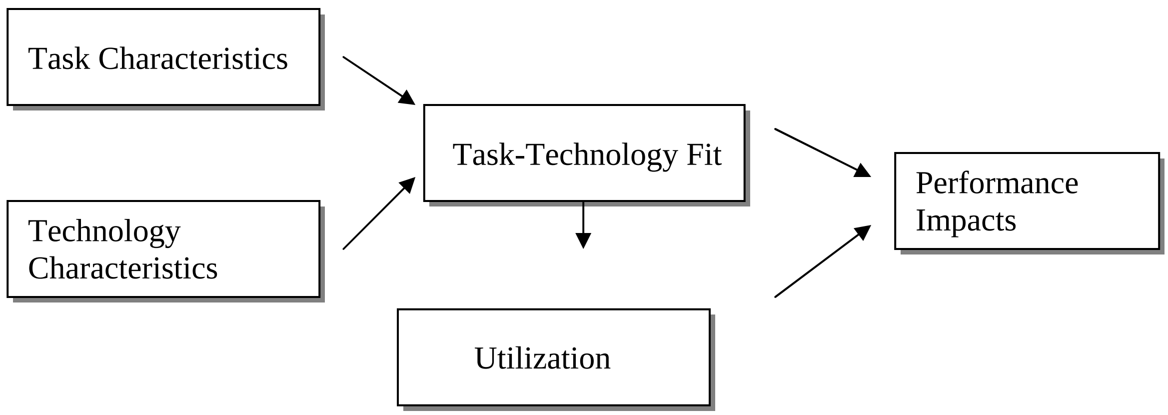

Figure 3: Goodhue and Thompson's "Technology-to-Performance" Chain

While Goodhue and Thompson argued that performance impacts are contingent upon the characteristics of the technology and the tasks for which they are used, Dennis, Wixom, and Vandenberg (2001) also contend that outcome effectiveness can be improved by properly fitting GSS tools to specific tasks. Adopting DeSanctis and Gallupe's (1987) view that GSS tools can impact not only the nature of information exchange, but also the manner in which groups perform their tasks; Dennis et al. employ a taxonomy similar to Zigurs and Buckland to classify the types of support that GSS systems can provide, namely: *communication support*, *information processing support*, and *process structure*. They describe how task-technology fit can improve group performance:

When a GSS is configured to match the ideal profile for a task, then a fit exists between the GSS and the task, and performance should improve. Conversely, performance should be reduced when the GSS configuration does not match the ideal profile for the given task (p. 171).

Using Dennis and Valacich's (1999) Media Synchronicity Theory (MST) which focuses on the fit between GSS communication features and specific task requirements, Dennis, Wixom and Vandenberg propose three "ideal GSS profiles" to achieve optimum task technology fit. Media Synchronicity Theory advocates "pure electronic communication" for tasks in which group members need to convey information such as generating ideas or alternatives, since it permits parallel communication. Conversely, MST contends that verbal communication is most appropriate for tasks requiring group members to converge on "the meaning of information or a course of action" because it provides instant feedback. Most significantly, MST contends that the majority of decision making tasks will require *both* the conveyance of information *and* the convergence upon a selected course of action (p. 171*).* The current study adopts a similar approach, by using ideal fit profiles as the basis for providing GSS technology guidance in the automated virtual facilitation application.

Dennis et al. contend that it is also important to fit GSS support features to specific tasks. As Zigurs and Buckland argue, simple tasks do not require any processing support. In contrast, decision-making tasks ("single or multi-criteria intellective tasks, judgment tasks with no correct answer, and 'fuzzy tasks' such as sense-making") require information processing support since such tests require group members "to develop a shared understanding of criteria and alternatives and to reach a consensus on which alternative is best" (p. 171).

Accordingly, the following "ideal GSS profiles" are recommended by Dennis, Wixom, and Vandenberg for optimum task-technology fit:

- Generation tasks – require electronic communication

- Decision-making tasks – require a combination of electronic and verbal communication and information processing support
- Combination tasks (i.e. tasks requiring both the generation of ideas/alternatives as well as a decision-making choice) – require electronic communication for generation subtasks, and both electronic and verbal communication with information processing support for choice subtasks

As described more fully in the following chapter, Dennis et al's "ideal GSS profiles" are used in conjunction with the fit profiles advocated by Zigurs and Buckland to form the basis for the GSS technology guidance system designed for specifying appropriate GSS tools for assigned group decision-making tasks.

Just as task-technology fit is imperative for realizing the potential benefits of GSS systems, effective appropriation of the technology is necessary for ensuring the effective utilization of the group support system. The following chapter examines a number of theories relating to technology appropriation and reviews some of the seminal studies in the GSS appropriation area.

2.5 Appropriation Theories

While task-technology fit theory asserts that the effectiveness of GSS technology is contingent upon the match existing between a given technology and the specific task for which it is used, theories of *appropriation* examine how individuals or groups effectively utilize advanced information technologies to carry out their assigned tasks. Two theories, in particular, incorporate the concept of appropriation to examine the role of advanced information technologies in effecting organizational change, and how appropriation mediators can be used to influence the successful utilization of such technologies: *Adaptive*

Structuration Theory (AST) and Process Restricted Adaptive Structuration Theory (PRAST), respectively. In brief, Adaptive Structuration Theory is a framework for examining organizational change resulting from the utilization of advanced information technologies. As a "specific instantiation" of AST, Process Restricted Adaptive Structuration Theory posits that facilitation, GSS configuration, and training act as appropriation mediators "through the forces of guidance and restrictiveness to influence specific procedural dimensions of the social interaction process, and ultimately, decision outcomes." (Wheeler and Valacich p.432).

In their seminal work, DeSanctis and Poole (1994) proposed adaptive structuration theory for studying organizational change resulting from using *advanced information technologies* -- "technologies that enable multiparty participation in organizational activities through sophisticated information management" -- including GDSS, which is used to illustrate the major principles of AST. Similarly, Wheeler and Valacich (1996) used Process Restrictive Adaptive Structuration Theory (PRAST) to explain how the appropriation process can be affected by *process structure,* as discussed below.

Two schools of thought have examined the role information technology in organizational change, and DeSanctis and Poole have blended each school's perspectives on technology and organizational change in formulating their theory of adaptive structuration. Specifically, the Decision-Making School, which employs a positivist approach to research using relatively static models of behavior, argues that technologies such as GDSS will produce favorable outcomes in and of themselves, or that desired outcomes are ultimately contingent upon technology. This engineering or technocentric view holds that technology "contains inherent power to shape human cognition and behavior." In contrast, the

Institutional School adopts an interpretive approach to research, focusing on social structure and using non-deterministic models, exemplified by theorists such as Giddens, whose structuration theory was a significant influence on AST. Institutionalists argue that technology is not the determining factor in organizational change, but instead focus on the role of human interaction in examining the impact of advanced information technologies.

DeSanctis and Poole explain the need for adopting approaches from both schools in studying the impact of advanced information technologies on organizational change:

> The purely institutional approach underplays the role of technology in organizational change. A more complete view would account for the power of social practices without ignoring the potency of advanced technologies for shaping interaction and thus bringing about organization change. Such a view would integrate assumptions from the decision-making and institutional schools and apply both positivist and interpretive this research approaches (p. 124).

A third view, the *"social technology"* perspective argues that social practices moderate the effects of technology on behavior, as with sociotechnical theories which assert that the effects of technology are contingent upon the degree to which social and technical structures are "jointly optimized." Likewise, structuration theory (Giddens 1979) is used to explain the adoption of computing and other technologies by organizations. Adaptive structuration theory extends such structuration models of technology-induced change to examine "the mutual influence of technology and social processes". Indeed, the interplay between advanced technologies and organizational work processes is a central focus of adaptive structuration theory:

> "Adaptation of technology structures by organizational actors is a key factor in organizational change… there is an interplay between the types of structures that are inherent in advanced technologies (and, hence, anticipated by designers and sponsors) and the structures that emerge in human action as people interact with these technologies" (p.122).

The manner in which such technologies are adapted by groups is crucial to achieving the desired outcomes of the technology, and this process of adaptation or *appropriation* is evidence of a group's effective utilization of the technology. When the utilization of the technology is consistent with its "spirit" -- that is, when it is used as its designers intended, the appropriation is deemed faithful. When its utilization is not consistent with its intended use, the appropriation is considered unfaithful.

DeSanctis and Poole assert that the appropriation process -- as well as proper task-fit -- is critical to achieving the desired outcomes of advanced information technologies:

> Given AIT and other sources of social structure…and ideal appropriation processes, and decision processes that fit the task at hand, then desired outcomes of AIT will result (p. 131).

Such a process would seem to be consistent with the emergent perspective of causal agency described by Markus and Robey (1988) which asserts that outcomes of information technology "emerge unpredictably from complex social interactions." As so-called "web" models suggest, information technology is "an ensemble of equipment, applications, and techniques that carry social meanings." Markus and Robey describe the dynamic nature of emergent models and their inherent complexity:

> By refusing to acknowledge a dominant cause of change, emergent models differ qualitatively from the deterministic causal arguments of the two (technological and organizational) imperatives. Prediction in the emergent perspective requires detailed understanding of dynamic organizational processes in addition to knowledge about the intentions of actors and the features of information technology. This added complexity makes emergent models difficult to construct (Markus and Robey, p.589).

Likewise, the appropriation process described by DeSanctis and Poole would seem to be consistent with the process theories described by Markus and Robey which recognize the complexity of causal relationships, and specifically the "complex indeterminant interactions" between technological antecedents and organizational outcomes. By encompassing the

proposition that advanced information technologies may *or may not* result in organizational change, process theories give implicit recognition to the importance of technology adaptation processes such as appropriation, as DeSanctis and Poole have argued. Indeed, they assert that structuration models are salient due to the fact that they focus on “the interplay between technology and the social process of technology use” and illustrate how “multiple outcomes” can result from the utilization of the same technology (DeSanctis and Poole, p.142).

The IS implementation literature can likewise be instructive in better understanding the appropriation process. Specifically, Cooper and Zmud (1990) addressed the issue of organizational appropriation of information technology in their seminal study of the IT implementation process. Based in part on Lewin’s (1952) change model, and Kwon and Zmud’s (1987) stage model of IT implementation, the authors’ “technological diffusion” approach proposes that the IT implementation process occurs in six distinct stages, comprised of processes and products, in which organizational members gradually adopt information technologies and incorporate them into their normal work routines. Beginning with the *initiation* phase in which an organization seeks out IT solutions for existing organizational problems and/or opportunities, negotiations then ensue to obtain organizational backing for acquisition of the IT application (*adoption* phase). In the *adaptation* phase, the IT application is developed and installed, and organizational members are trained to use the new application. During the *acceptance* phase, organizational members are “induced to commit” to usage of the application, resulting eventually in employing the technology in their organizational work. Subsequently, in the *routinization* phase, usage of IT application is encouraged as “a normal activity…and the organization’s governance systems are adjusted to account for the IT application.” Finally in the *infusion* stage, the

organization is able to achieve improved effectiveness by using the application. But how can the appropriation process be effectively measured?

Poole and DeSanctis (1992) assert that appropriations can be measured in one of three ways:

From a global perspective, appropriations may be *faithful* (the technology is used in a manner consistent with its general intent) or *unfaithful*. *Attitudes toward use* (e.g. beliefs about ease-of-use or usefulness) may be favorable or unfavorable. Finally, *consensus on appropriation*, (the extent to which group members agree about how to use a technology) may be high or low (Salisbury et al., p.92.).

Likewise, Gopal et al. used attitudes towards use as their measure of appropriation (i.e. “the vehicle that reflected the stability of each group's appropriation process”). Two attitude constructs, level of comfort and degree of respect were defined by Poole and DeSanctis. Sambamurthy (1989) advocated the use of challenge as another measure of appropriation. Perceived usefulness and perceived ease of use (Davis 1989) were also employed as measures of appropriation, as was perceived compatibility (Moore 1989).

Gopal et al. found that the GSS process was significantly influenced by attitudes prevailing prior to GSS use, and that in all cases, user attitudes were significantly more important in predicting GSS outcomes than either task or technology. Interestingly,, the authors believe that AST can provide insight into “the complexities of interaction between technology, groups, and tasks that make the varied outcomes of GSS use so hard to understand”. By demonstrating the significance of the appropriation process in achieving desired AIT outcomes, the study established the effectiveness of adaptive structuration theory for examining the complexities of GSS use. As more fully explained below, and in the following chapter, the present study’s methodology relies upon two significant measures of appropriation to assess the effectiveness of providing system-directed facilitation.

Because the appropriation process is critical in achieving the desired outcomes of advanced information technologies, any structures designed to ensure that the utilization of such technologies is consistent with their intended use would appear promising for helping achieve desired AIT outcomes. Such appropriation mediators are intended to "selectively bias the social interaction process toward faithful use of heuristic structures" are the focus of Wheeler and Valacich's (1996) Process Restricted Adaptive Structuration Theory (PRAST), and form the theoretical basis for several of this dissertation's hypotheses.

As "a specific instantiation of AST," Process Restrictive Adaptive Structuration Theory is designed to examine the roles of facilitation, GSS configuration, and training as appropriation mediators, and to study how they affect "specific procedural dimensions of the social interaction process, and ultimately, decision outcomes" (p.432). Wheeler and Valacich posit that the presence of appropriation mediators will increase a group's faithful use of a heuristic, and the faithful use of heuristics should improve decision quality (p. 437). Specifically, appropriation mediators "act through guidance and process restrictiveness to signal groups with what to do next and to limit groups' options among the procedural dimensions." As such, appropriation mediators may be able to bias a group's procedural choices in favor of faithful use of the heuristics' structures (Wheeler and Valacich, p. 435).

Two forms of software-directed user support, process guidance and process restrictiveness, are crucial in understanding how appropriation mediators can be used to influence advanced technology utilization. Silver (1991) described process guidance as "how a decision support system enlightens or sways its users as they structure …their decision process" In the context of appropriation, its purpose is "to lead a group through procedural obstacles in faithfully using a heuristic's structures" (Wheeler and Valacich 1996). In

comparison, *process restrictiveness* is defined as "the degree to which and the manner in which a decision support system limits a user's decision-making processes to a subset of all possible processes" (Silver 1990) and is designed "to prevent both the unfaithful uses of a heuristic's structure and the choosing of alternative structures" (Wheeler and Valacich, p. 433). For maximum effectiveness, the authors posit that guidance and restrictiveness must be able to interact with GSS users in the same communication mode that the group employs for its information exchanges (p. 434). In accordance with this, and as more fully described in the following chapter, the automated facilitation application used for this research was designed to communicate with group members through audio channels, as well as through user monitors, and the shared GroupSystems monitor.

Wheeler and Valacich contend that guidance and restrictiveness act to influence a group's decision process by their effect on six procedural dimensions:

1. The sequence of activities (e.g. the order in which GSS features are used)
2. The pace of communication activities (e.g. the amount of time spent on different tasks)
3. The content of the communication messages (e.g. faithful or unfaithful with the current activity of the heuristic
4. The communication mode (e.g. verbal, gestural, or computer-mediated)
5. Vigilance of engagement in the activity (e.g. the degree of critical thinking, challenging assertions, proposing novel ideas, etc.)
6. Selection of process support structures (e.g. brainstorming tool, voting tool)

(Wheeler and Valacich, p. 434)

They assert that facilitation, configuration of the GSS, and *training* act as appropriation mediators in guiding and restricting appropriation choices relating to these six procedural dimensions by systematically influencing a group's choice and use of structures in a manner that represents faithful appropriation of a heuristic's objectives. As such, appropriation mediators permit meeting designers to create guidance and process restrictiveness, and are either active or passive. Active mediators "intervene to direct or limit

a group's procedural choices in the same communication mode in which those choices are carried out," and include the meeting facilitation process as carried out by the facilitator. Passive mediators cannot effectively intervene or limit procedural choices in the same communication mode(s) used by group members, and include GSS and training. While a GSS provides a "visually persistent" form of passive guidance and restrictiveness, training must be recalled by group members (p.435).

Dennis, Wixom, and Vandenberg (2001) also examined the significance of appropriation – and appropriation support – on GSS performance in their meta-analysis of group support systems performance. Their Fit-Appropriation Model asserts that task-technology fit, appropriation support, and faithfulness of appropriation are critical factors in GSS outcome effectiveness, process efficiency, and user satisfaction. Using Adaptive Structuration Theory to explain the GSS appropriation process, they describe why appropriation is critical to GSS performance outcomes:

> A group's ultimate performance depends upon what capabilities are appropriated by the group, and whether the appropriation is faithful or unfaithful. As groups appropriate GSS capabilities, they begin to learn which appropriations are successful and which are not, leading to the repetition of some appropriations from which habitual norms for GSS use gradually emerge (p.172).

By integrating task-technology theories with the theory of appropriation, as posited by AST and PRAST, Dennis et al. propose a model which would appear to effectively explain the factors necessary for effective GSS performance, and one which provides the theoretical foundation for the model employed for this research. Specifically, the virtual facilitation model likewise asserts that both task-technology fit and faithfulness of appropriation are necessary factors for achieving GSS effectiveness. However, the virtual

facilitation model additionally examines the effectiveness of system-directed facilitation in providing appropriation support and in improving group decision-making performance.

Because appropriation is a critical construct of adaptive structuration theory, and "proper measurement is critical to the advancement of theory" (Blalock 1979), Chin, Gopal, and Salisbury (1997) developed an instrument designed to measure "the extent to which users of an advanced information technology believe they have appropriated its structures faithfully." Accordingly, in developing their scale to measure the faithfulness of appropriation, Chin et al. attempted to "tap into the faithfulness construct enough to provide insights into the appropriation process" (p.365). As DeSanctis and Poole 1994 observed, the objective of such an undertaking should be in "describing the appropriation process with sufficient refinement so that we can gain a meaningful (though not perfect) insight into the connection between technology and action" (DeSanctis and Poole 1994, p.141).

Chin et al. contend that the appropriation process is influenced by three factors:

Appropriations are characterized by faithfulness (the extent to which structures provided to a group are used in a manner consistent with the spirit of the EMS)", consensus (the extent of the agreement among group members on how the EMS should be used), and attitude (the views about using the EMS held by group members.)(p.345)

The model developed by Chin et al. posits that faithfulness of appropriation will have a direct effect on user satisfaction due to the fact that users who accept the appropriateness of the EMS method and its ability to assist them in achieving their objectives "may be expected to be satisfied with the method" (p358). As anticipated, the authors indeed found that user assessments of the "appropriateness" of their EMS use "strongly influences their subsequent satisfaction with the EMS." (p. 363)

Using structural equation modeling, the authors confirmed the convergent, discriminant, and nomological validity of their instrument, which was comprised of the following specific items:

1. The developers of [the technology] would disagree with how I used it.
2. I probably used [the technology] improperly.
3. The original developers of [the technology] would view my use of it as inappropriate
4. I failed to use [the technology] as it should be used
5. I did not use [the technology] in the most appropriate fashion (p. 365).

While task-technology fit and faithfulness of appropriation are generally accepted as being significant moderators of GSS effectiveness, the GSS facilitation process is increasingly recognized as being an equally critical component in achieving performance gains in the utilization of group support systems. The following section examines several concepts closely related to GSS facilitation which are critical in understanding how system-directed facilitation can be structured to more effectively provide GSS process guidance.

2.6 Decisional Guidance

Whereas appropriation theories focus on "the manner in which structures are adapted by a group for its own use" through the structuration process (Gopal et al. 1993), *decisional guidance* is related to how decision support systems "enlighten or sway users as they structure and execute their decision-making processes" (Silver 1991). As such, decisional guidance can be thought of as one way in which the appropriation process is expedited to fully exploit a decision support system's functional capabilities, or as Silver describes: "just as a DSS supports the judgments required enroute to making decisions, decisional guidance can support the judgments required in the course of operating the DSS" (Silver 1991, p.106).

The concept of decisional guidance for computer-based decision support was advanced by Silver (1991) in his explanation of *when and why* decisional guidance should be provided,

how system designers can build decisional guidance into DSS, and what the *effects* of providing it are. Limayem (1992) defined guidance in a GSS context as “the enrichment of decision models with cues that direct decision makers toward successful structuring and execution of model components.” As such, guidance can inform groups as to what to do next (forward guidance), help groups resolve problems from prior activities (backward guidance), or in the case of preventive guidance, prevent disruptions that obstruct progress in group decision-making (Limayem 1992).

In contrast to the concept of guidance is what Silver defines as *process restrictiveness*, or “the degree to which and the manner in which a decision support system limits the user’s decision making processes to a subset of all possible processes” (1990, p. 53). Within the context of GSS, Poole and DeSanctis (1992) stated that restrictiveness can be defined as “the extent that the heuristic limits or channels the groups’ use of the resources inherent in the heuristic” (p.132).

A number of key definitions inherent in the concept of decisional guidance are the following:

- “Mechanical guidance” is designed to assist users with the mechanics of an operating system’s features, whereas decisional guidance is provided to help users choose among a system’s information processing capabilities.
- “Inadvertent” decisional guidance is an “unintended consequence” of the system’s design, while “deliberate” guidance is intentionally incorporated within a system.
- “Suggestive guidance” is designed to make “judgmental recommendations (what the user should do), whereas “informative guidance” is designed to provide “pertinent

information that enlightens the decision maker's judgment, without suggesting how to act."

- Guidance for structuring the decision-making process is designed to help users choose operators (e.g. choice rules, forecasting techniques, or solution generators), while decisional guidance for executing a process affects how decision makers carry out "the evaluative and predictive judgments necessary when executing the chosen operators." (Silver 1991 p.107)

Informative guidance is presented "in a unified and readily accessible form" that might otherwise need to be searched for sequentially. While informative guidance can reduce the "availability", "selected perception", and "confirmation" biases that can occur when decision makers do not adequately assess all relevant information, it can potentially result in other biases relating to "order effects" or an over-reliance on the informative guidance instead of using other available information (Silver 1990, p.120).

Silver asserts that decisional guidance should be provided when users need to make *discretionary judgments*, which is dependent upon how much discretion the system allows its users:

In general, the more restrictive a DSS, the less the opportunity for providing guidance. Consequently, the interaction between restrictiveness and guidance leads to a design trade-off: For each judgmental opportunity, the designer must decide whether to restrict the decision-making process, to guide it, or do neither" (Silver p.108).

Likewise, the decision to provide decisional guidance is primarily based on a desire to create a DSS that is more supportive and that assists users in exercising their judgment as they interact with the system:

As the frequency, complexity, and importance of the judgments demanded from them increase, decision makers may require – or, at least, desire – computer-based facilities that provide the meta-support for the judgments they must make. The greater the needs of

decision makers for this added support, the greater the motivation for providing the guidance (Silver p.109).

Thus, the need for decisional guidance is dependent upon both the complexity of the DSS system, as well as the users' perceptions of the decision-making task. As such, "novices" will require more decisional guidance than seasoned users, as will situations in which the task is relatively unstructured, or less defined than those tasks having well-defined objectives. The decision to provide user guidance, however, must be weighed against the possibility of overloading users with information, or in fact making the system more complex with an excessive amount of guidance mechanisms. Moreover, the guidance system should avoid directing users to a specific decision, but should instead attempt to influence how users reach a decision (Silver, pp. 108-109)

In building guidance into a DSS, Silver presents a three-dimensional typology encompassing targets, forms and modes. *Targets* relate to which aspects of decision making the guidance addresses: either structuring or executing the decision-making process. *Forms* pertain to what the guidance offers decision makers that might inform or influence them: suggestive guidance or informative guidance. Modes relate to how the guidance mechanism works (predefined, dynamic or participative). Predefined mechanisms are "a set of recommendations or informational displays" that the system designer embeds into the system. Dynamic mechanisms are those that employ user-supplied information obtained through queries or recent user behavior to suggest behavior or display information. Lastly, participative guidance mechanisms "facilitate users' deriving their own recommendations or defining for themselves the information they need" by allowing users to significantly participate in determining the content of the guidance that they receive (Silver, p.111)

The decisional guidance application employed for this research (as described in the "research framework" section) utilizes a combination of these mechanisms to address a number of research questions, similar to those suggested by Silver, namely:

- Do decision makers prefer a system that provides decisional guidance? (e.g. do users prefer receiving guidance for using the GSS system as intended, or do they prefer a GSS that is merely "chauffer driven?")
- Does decisional guidance affect how much time the decision maker spends using a system?
- Does guidance make a system easier to use?
- When does decisional guidance improve decision-making performance and when does it degrade it? (Silver, p.119)

DSS design features can be structured to either directly influence how decisions should be made (directed change) or to provide users with a number of alternative capabilities from which to choose in their decision-making activities (non-directed change). A number of design strategies exist for doing so, ranging from highly restrictive DSS, to minimally restrictive DSS. In his earlier (1990) study on directed and non-directed change, Silver presents a broad set of objectives for determining the appropriate level of system restrictiveness (p. 57), as shown in Table 6:

Parikh, Fazlollahi, and Verma (2001) conducted an empirical evaluation of the effectiveness of decisional guidance in terms of four evaluation criteria: decision quality, user satisfaction, user learning, and decision-making efficiency. Their study compared systems using decisional guidance with systems having no guidance, informative versus suggestive decisional guidance, and predefined versus dynamic decisional guidance.

Table 6: Objectives for Determining the Appropriate Level of System Restrictiveness (Silver, 1990)

Objectives Favoring Greater Restrictiveness	*Objectives Favoring Lesser Restrictiveness*
▪ Promoting Use ▪ Prescription - Of a Normative Approach - For Coordination / Consistency	▪ *Promoting use* ▪ *Providing a Broad Repertoire of Decision Support Tools*
▪ Proscription	▪ *Supporting Multiple or Changing Decision-Making Environments*
▪ Providing Structure to the Process	▪ *Promoting Creativity*
▪ Fostering Structured Learning	▪ *Fostering Exploratory Learning*

The study found that *deliberate decisional guidance* (i.e. decisional guidance intentionally designed and built into a DSS by the designer) was more effective for each of the four criteria, while *suggestive guidance* (i.e. guidance which provides recommendations as to what to do, and the reasoning why such recommendations are suggested) was found to be more effective in improving decision quality and user satisfaction. *Informative guidance* (i.e. guidance which provides users "unbiased, pertinent information about the problem domain, but which requires users to form a judgment about what to do from the available information") was found to be more effective in improving user learning about a particular problem domain, while *dynamic guidance* (i.e. guidance which provides "real-time help in identifying and customizing guidance to meet individual user's current needs) was found to be more effective than *predefined guidance* (i.e. guidance which is "static and less customized, giving different users under different situations with different tasks the same canned guidance") in improving decision quality and user learning. The study also found that suggestive guidance and dynamic guidance resulted in reduced decision time (Parikh, et

al., pp.303-310). The AVFA application for automating the GSS facilitation process incorporates both suggestive and informative decisional guidance. While dynamic guidance was not used in the present research, it could be included in future versions of the automated virtual facilitation application.

Barkhi (2002) investigated the effects of decisional guidance and problem-modeling on group decision-making. His findings indicated that groups using group support systems with problem-modeling tools generated more diverse solutions and achieved higher task performance levels than GDSS-supported groups not using such problem-modeling tools. As predicted, groups using problem modeling tools were found to be less efficient in terms of the time required to reach decisions, as well as the number of messages required for groups to converge on a final solution. In addition, user confidence in the group's solution and was found to be not be significantly different between both groups. In light of these findings, Barkhi recommends that future research efforts investigate how problem modeling tools can be effectively incorporated in the design of next-generation group decision support systems.

One such example of incorporating advanced decisional guidance features into group decision support systems was carried out by Limayem and DeSanctis (2000). In perhaps the most comprehensive studies of its kind, the authors investigated incorporating *intelligent agents* for providing software-directed system explanations. In doing so, they asserted that the utilization of decisional guidance for multi-criteria decision-making (MCDM) using GDSS should have three primary objectives:

> 1) enhancing user understanding of the model inputs, processes, and outputs
> 2) to improve decision outcomes by helping the group to navigate through the complex choices associated with MCDM modeling and
> 3) to generate more positive perceptions on the part of users about their decision processes, decision results, and the MCDM. Technology (p.388)

Prior research has suggested that two interdependent types of support are needed for groups using GDSS for multi-criteria decision-making: *cognitive support* to provide explanations about how to develop and apply MCDM models, and *group interaction support* that determines the timing for initiating system explanations throughout the group decision-making process. Limayem and DeSanctis assert that both capabilities must be implemented in tandem in order to achieve meaningful results, and that both must be operationalized into the GDSS interface. (p.388):

> Cognitive feedback draws attention to judgment inconsistencies and illustrates their causes, enables decision makers to understand their judgments and reduce their commitment to incorrect analysis, and helps decision makers to shape an adequate model of the decision-making process…*Feedforward* is the process of providing explanations prior to performing each step in the model building process. Feedforward provides explanations of MCDM procedures in advance of their use and be operationalized as a set of heuristics for task performance. Feedforward is thought to attenuate cognitive strain by providing decision makers with information that otherwise would have been learned through feedback (p.388).

Limayem and DeSanctis detail a number of support needs for multi-criteria decision-making using GDSS, guidance capabilities, and their study's implementation approach for providing automated decisional guidance (p.391). While the virtual facilitation application was designed for mult-activity group decision making tasks and includes only the *feedforward* functionality summarizing the current, prior, and subsequent steps (but not the *automated detection* functionality of Limayem and DeSanctis' application), their application's functionality is instructive and could conceivably be incorporated into future versions of the virtual facilitation application:

Table 7: Support requirements for automating mult-criteria decisional guidance, and implementation approaches (Limayem and DeSanctis)

Support Needs	Guidance Capabilities	*Implementation*
Support for group cognition Cognitive Feedback	Information about preference selections and MCDM structure; identification of consistencies and inconsistencies in judgment	*Automated detection of uncompleted steps (e.g. missing entries of individual or group judgments); detection of wide variations in individual judgments on criteria or alternatives; flagging of points of variations with visual indicators on model input and output screens*
Feedforward	Information about each step in the MCDM modeling task prior to its performance	*Screens that summarize a current MCDM step in which the group is engaged; addition of status windows identifying each step and the subsequent step; visual tracking of group progress through the MCDM model*
Support for group interaction Normal Breakpoints	Shifts from one step in the MCDM to another; determining how output from one step should be used as input to the next	*Feedforward is triggered when a normal breakpoint occurs*
Delay Breakpoints	Holding patterns wherein the group recycles a specific step the model; determining when to repeat a step and when to move forward	*Cognitive feedback is triggered when a delay breakpoints occurs*
Disruption Breakpoints	Periods of conflict or uncertainty about how to use or interpret model components or outputs; interpreting model results and determining how to proceed	*Both feedforward and cognitive feedback are triggered when a disruption break occurs*

The authors found significant support for their hypotheses that groups receiving automated guidance will achieve greater model understanding than groups receiving no guidance; and that groups receiving automated guidance will have more positive perceptions of the group decision process and outcomes than group receiving no guidance. As predicted, groups receiving automated guidance required significantly longer time to reach their decisions than groups receiving no guidance. Finally, groups receiving automated guidance

were not found to achieve significantly higher consensus or confidence levels for their decisions than groups receiving no guidance.

By finding support for software-directed interventions to support group interaction and decision-making, the previous study demonstrated the potential for employing intelligent assistance for enhancing the effectiveness of multi-criteria group decision-making, and the feasibility of using automated facilitation for the multi-activity group decision making task utilized for this research. While the title of Limayem and DeSanctis' study used the term "decisional guidance", a follow-up study using the same application used the term "automated facilitation" to describe the identical concept. Indeed, these terms are sometimes used synonymously, and are sometimes associated with advanced information technologies referred to as *expert systems*, an area of the MIS literature that is reviewed in the following section.

2.7 Expert Systems

The concept of decisional guidance is broadly related to the functionality of *expert systems* (ES) in that each is designed to guide the user in some fashion. But where *decisional guidance* relates to how (DSS) systems "enlighten or sway users as they structure and execute their decision-making processes" (Silver 1991), *expert systems* are tools designed to simulate human experts within a specific domain. As such, expert systems are artificial intelligence tools that support decision making using a knowledge base and inference techniques. While decisional guidance can provide procedures explaining *how to solve problems* and *why* a certain solution is recommended, in order to assist groups in their decision-making processes, expert systems can replicate a human adviser (i.e. group facilitator) and can potentially replace them.

Turban and Watson (1986) examined various issues relating to integrating decision support systems and expert systems, and presented two frameworks for integrating DSS and expert systems: ES integration into DSS components, and ES as an additional component of a decision support system. Among the benefits resulting from combining expert systems and decision support systems, are the following, as summarized by Turban:

- Assistance in selecting decision models
- Providing judgmental elements to models
- Providing heuristics
- Providing explanations
- Providing terms familiar to user
- Acting as a tutor
- Providing intelligent advice
- Adding explanation capabilities
- Expanding computerization of the decision-making process (Turban et al. p.124)

By replicating the manager-consultant-computer process, as advocated by Goul et al. (1984), an integrated DSS/ES can be designed to query users to determine the general category of a problem, the exact nature of a problem, and finally, suggest an appropriate model for solving the problem. By using expert systems as "consultants" to determine what to do in specific problem-solving situations, the complexity of using GDSS for group decision-making activities can be significantly reduced. Similar applications of integrating DSS and expert systems can include in the provision of explanation capabilities to the DSS that allow users to follow the reasoning behind specific recommendations. By using terms that are familiar to the user as well as by providing a tutoring to users, such integrated systems can significantly reduce the cognitive load placed on users of GDSS.

Also related to the concept of decisional guidance and expert systems is the concept of *cognitive feedback*, or feedback about an individual or collective decision-making process which is "provided interactively as an integral part of the individual and group processes"

(Sengupta and Te'eni, 1993). In their study investigating cognitive feedback for improving control and convergence in computer supported group decision-making, cognitive feedback was found to increase cognitive control, resulting in uniformly high levels of cognitive control over time. Additionally, cognitive feedback was found to result in increased levels and degrees of collective control for group decision making. As hypothesized, groups receiving cognitive feedback were found to formulate group decision rules more frequently than groups not receiving cognitive feedback.

Dhaliwal and Benbasat (1996) proposed a model based on cognitive learning theories explaining the reasons and theoretical basis for providing system explanations for the facilitating user learning, and a two-part framework and for examining the use of knowledge-based system (KBS) explanations. Specifically, the authors pose the following questions:

1) What theoretical justification is there for KBS to provide explanations?
2) Is there a coherent theoretical basis for the various types of explanations that KBS should provide?
3) What factors influence the use of explanations?
4) What are the effects of the use of explanations? (p.343)

Hayes and Reddy (1983) assert that explanations are needed for three principal reasons: explanations *clarify* particular intentions; explanations are intended to *teach*; and explanations are used to *convince*. Although clarifying, teaching and convincing can indeed increase the understanding of information systems users receiving the explanations, the question of whether such explanations actually result in better decision-making remains unclear (Dhaliwal and Benbasat, p.345).

Dhaliwal and Benbasat contend that only *task information* is effective in promoting learning, and, as such, it forms the "coherent theoretical basis" for the various types of explanations that KBS should provide, including the "explanations provision model" they

propose. Moreover, the authors contend that three possible *explanations provision strategies* exist for designing knowledge-based systems: feedforward only, feedback only, or both feedforward and feedback. The following definitions of explanations are provided by the authors:

Table 8: Definitions of Knowledge-based System Explanations (Dhaliwal and Benbasat)

Feedforward Why explanations justify the importance of, and the need for, input information to be used or a procedure that is to be performed.

Feedforward How explanations detail the manner in which input information is to be used or procedures are to be performed

Feedforward Strategic explanations clarify the overall manner in which input information to be users organize to structured, and specify the manner in which each input sheet to be used fits into the overall plan of assessment that is to be performed.

Feedback Why explanations justify the importance, and clarify the implications, of a particular conclusion that is reached by the system

Feedback How explanations present a trace of the evaluations performed an intermediate conferences made in getting to a particular conclusion.

Feedback Strategic explanations clarify the overall goal structure used by system to reach a particular conclusion, and specify the manner in which each particular assessment leading to the conclusion fits into the overall plan of assessments that were performed. (Dhaliwal and Benbasat, p.352)

The authors use MYCIN, one of the earliest expert systems, to illustrate the use of feedforward and feedback explanations. For example, "why" explanations in MYCIN were feedforward and presented information explaining why a particular question was being asked of a user. "How" explanations provided information regarding the basis on which a specific conclusion was reached. Although no strategic explanations were provided by MYCIN, later

versions (NEOMYCIN) provided such explanations using a combination of feedforward and feedback (Dhaliwal and Benbasat p.352):

Table 9: MYCIN Explanation Provision Strategies for KBS Explanations (Dhaliwal and Benbasat)

Type of Explanation	Explanation Provision Strategy
Why	Feedforward
How	Feedback
Strategic	Feedforward/Feedback

The automated facilitation application provides various feedforward and feedback explanations designed to explain *why* a group decision-making procedure and/or GSS tool is being used and *how* the previous decision-making activity has influenced the current activity and/or GSS tool. As predicted in the System-Directed facilitation Model, the provision of such explanations should lead to improved user understanding of the decision-making process, resulting in improved user satisfaction, in comparison to groups not receiving such explanations.

In a related study, Gregor and Benbasat (1999) examine the nature of explanations from intelligent systems by attempting to answer three critical questions regarding the importance of explanations from knowledge-based (expert) systems:

1. Do users of intelligent systems want explanations? Why are explanations needed?
2. What benefits arise from the use of explanations? What kinds of benefits?
3. What types of explanations should be provided? (p.499)

Gregor and Benbasat developed a number of propositions regarding the nature and use of system-initiated explanations by drawing from three theoretical areas: cognitive *effort perspective*, *cognitive learning theory*, and *Toulmin's model of argumentation*, as well as a number of empirical studies supporting their assertions.

The *cognitive effort theory*, or cost benefit principle, is based on the assumption that effort is an important factor in strategy selection, and contends that system users will not exert significant effort to access and read explanations unless the expected benefit of doing so is perceived to exceed the cost of the required effort. This is what Carroll and McKendree (1987) referred to as the *Production Paradox*, or "learning versus working", epitomized by the conflict existing between learning and working in the workplace: "*Learning is inhibited by lack of time and working is inhibited by lack of knowledge*" (p.506). Gregor and Benbasat present four propositions derived from the *cognitive effort* perspective and the indicated empirical studies:

P1: Explanations will be used when the user perceives an expectation failure or perceives an anomaly (Dhaliwal 1983, Mao and Benbasat 1996, Ye 1995)

P2: Explanations will be used more when the user has a goal of long-term learning (that is, learning that transfers to a non-KBS context) (Gregor 1996).

P3: Explanations will be used when the user lacks knowledge needed so he or she can contribute to problem-solving. The knowledge could be terminology knowledge or knowledge of a problem-solving procedure (Everett 1994, Gregor 1996, Mao 1995)

P4: Explanations that require less cognitive effort to access and assimilate will be used more and will be more effective with respect to performance, learning or user perceptions. The types of explanations for which this effect is expected include:

(1) automatic (always present) explanations (Everett 1994, Moffett 1989)

(2) hypertext accessible explanations (Gault 1994, Mao 1995)

(3) intelligent explanations (given to user automatically when system judges necessary) (no empirical studies found)

(4) case-specific rather than generic explanations (Berry and Broadbent, 1987, Dhaliwal 1993) (Gregor and Benbasat pp.506-514)

As discussed more fully in the following chapter, the automated virtual facilitation application provides explanations to participants who lack significant knowledge regarding the GSS system and the group decision-making processes that will be employed in the experiment. Likewise, by virtue of their audio-based delivery, provision of the explanations is

designed to require minimum cognitive effort to assess and assimilate. Although the virtual facilitation model is not designed to specifically test these assumptions, usage of the system's explanations is anticipated to be positively effected by their presentation format and the knowledge-level of participants.

Gregor and Benbasat draw upon *cognitive learning theory* as the basis for four propositions relating to the *outcomes* of explanation use. As such, cognitive theory is used to explain impacts on dependent variables of explanation use, including accuracy or effectiveness, and speed or efficiency. A number of researchers have used theories of learning due to expected relationships between explanations and learning. Cognitive learning theory is based on the concept of short-term and long-term memory, and the manner in which knowledge is organized. Cognitive information processing distinguishes between *declarative knowledge* (knowledge of facts: "knowing that"), and *procedural knowledge* (knowledge of a skill: "knowing how") (Gregor and Benbasat, pp. 509-510)

P5: Use of explanations improves the performance achieved with a KBS as an aid (De Greef and Neerincx, 1995, Dhaliwal 1993, Gregor 1996, Mao 1995, Wognum 1990)

P6: Use of explanations aids learning (transfer of knowledge to non-KBS context) (De Greef and Neerincx, 1995, Eining 1988, Everett 1994, Gault 1994, Gregor 1996, Moffett 1989, Murphy 1990)

P7: Novices will use explanations more for learning (short and long-term) than experts (Mao 1995)

P8: Experts will use explanations more for resolving anomalies (disagreement) and for verification that novices (Mao 1995, Ye 1990) (pp.510-512).

Toulmin's *Model of Argumentation* (1958) forms the basis of Gregor and Benbasat's final proposition relating to the question of what type of explanations should be provided. In general, Toulmin's model of argumentation asserts that strong and well-founded arguments are more convincing than weak or baseless arguments. Consequently, explanations that

conform to Toulmin's model should be more persuasive since they contain elements found in convincing “human-human arguments”. As such, they should result in greater trust, agreement, satisfaction, and acceptance (p. 512):

> P9: Use of explanations conforming to Toulmin's model (justification explanations) will give rise to more positive user perceptions of a KBS and other explanations (trace and strategic explanations) (Everett 1994, Ye 1990) (pp.512-513)

In conformity with these findings, all explanations provided by the virtual facilitation application attempt to be “strong and well founded” in an effort to improve user trust, agreement, satisfaction, and acceptance of such explanations. By providing such explanations, the system-directed facilitation is designed to provide improved user support in their utilization of the GSS. The nature of such facilitative support and the manner in which it is provided is described more fully in the following section.

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2.8 Facilitation

Also broadly related to the concept of decisional guidance is what Dickson, Partridge, and Robinson (1993) originally termed facilitative support, or “the manner in which GDSS users are supported in their utilization of group decision support systems.” However, while decisional guidance is primarily related to how inanimate decision support systems (DSS) “enlighten or sway users as they structure and execute their decision-making processes” (Silver 1991), facilitative support, and the more general term “facilitation,” generally refers to the use of “facilitators” whose function is to direct group members regarding which GDSS features to use, as well as when to use them (Dickson et al., p.173).

As described above, Limayem and DeSanctis and others (Ho and Antunes 1999; Chalidabhongse et al. 2002; Lopez, Booker, Shkarayeva, Briggs, and Nunamaker 2002; Nunamaker and Zhao 2002; Briggs, De Vreede and Nunamaker, 2003; Wong and Aiken

2003) have expanded the concept of facilitation to include the use of "automated facilitation mechanisms" and "intelligent facilitation agents." Indeed, the terms "decisional guidance" and "automated facilitation" are sometimes used interchangeably to describe such software-directed group support and intervention mechanisms (e.g. Limayem and DeSanctis 2000 and Limayem 2003).

Griffith et al. (1998) describe the facilitator's role as one of "improving a group's communication and information flow…to enhance the manner in which a group makes decisions without making those decisions *for* the group" (p.20). Nunamaker et al (1997) list four functions normally provided by GSS meeting facilitators:

1. Providing technical support by initiating and terminating specific software tools and functions and guiding the group through the technical aspects necessary to work on the task.
2. Chairing the meeting, maintaining the agenda, and assessing the need for agenda changes.
3. Working with the group to highlight the principal meeting objectives and developing an agenda to accomplish them
4. Providing organizational continuity by setting ground rules for interaction, enforcing protocols and norms, maintaining the group memory repository, and acting as champion/sponsor (p.192-193).

The automated virtual facilitation application is designed to provide these four facilitator functions in providing GSS fit and appropriation support. As described more fully in the following chapter, the application is envisioned to provide technical support by offering a simplified tool selection interface, maintaining the agenda, highlighting principal meeting objectives, setting initial ground rules for interaction, and enforcing protocols through both audio and visual messaging.

In a survey of forty-five experienced GSS facilitators, Bostrom et al. (1996) found that planning and designing a meeting agenda was significantly more important

than all other facilitator functions. Other significant contributions of facilitators included matching GSS tools to the assigned task, adapting the meeting agenda is needed, clarifying meeting goals and agenda items; remaining focused on the outcome; and creating an open environment for anticipation. Traditional facilitator functions relating to managing group dynamics, such as building rapport and managing conflict were found to be significantly less important facilitator functions. The virtual facilitation application focuses primarily on planning and directing the meeting agenda, which will be dictated principally by Wheeler and Valacich's five-step multiple activity heuristic.

In his definitive work on facilitators and their role in developing group effectiveness, Schwarz (1994) describes how facilitators can help improve the way that groups identify and solve problems and make better decisions by improving the manner in which group members work together. As he explains, facilitators can assume one of two roles. In basic facilitation, the facilitator guides the group in reaching an effective decision using the appropriate group process. In developmental facilitation, the facilitator teaches group members how to carry out specific processes for future problem-solving:

Table 10: Basic and Developmental Facilitation (Schwarz, p. 7)

Characteristic	Basic Facilitation	Developmental Facilitation
Group objective	Solve a substantive problem	Solve a substantive problem while learning to improve its process
Facilitator role	• Help group temporarily improve its process • Take primary responsibility for managing the group's process	• Help group permanently improve its process • Share responsibility for managing the group's process

Schwarz' approach to facilitation is based on three values: "valid information, free and informed choice, and internal commitment to those choices" (p.8). As opposed to changing group members' behaviors, he argues that the role of facilitators is to provide information to enable group members to decide *whether* to change their behavior, and if they choose to do so, to help them learn *how* to change (p.8). Schwarz asserts that for groups to become more effective, facilitators need to understand which factors contribute to group effectiveness, which factors detract from it, and how such factors can interact, in impacting group effectiveness, using a model built largely on the work of Hackman (1987) and Sundstrom, DeMeuse and Futrell (1990):

While Schwarz does not directly address the role the facilitator in the context of group support systems, his intimate knowledge of the group facilitation process, including his considerable experience in facilitating a number of diverse groups, offers valuable insights into the successful integration of group facilitation theory and practice.

Because the manner in which group members are facilitated during their utilization of a GDSS will have a "profound effect" on the outcome of GDSS use (Dickson et al., p.174) the most effective mode of providing GSS support is of critical importance. Specifically, the need for GDSS facilitation arises from two problems that must be addressed for groups using a GDSS system for the first time, namely:

1. GDSS users must "overcome the mystique" of using a new and unknown technology, and

2. "A sound problem-solving process" used by the group in its GDSS interaction, including the application of the GDSS technology, must be provided (Dickson et al., p. 174).

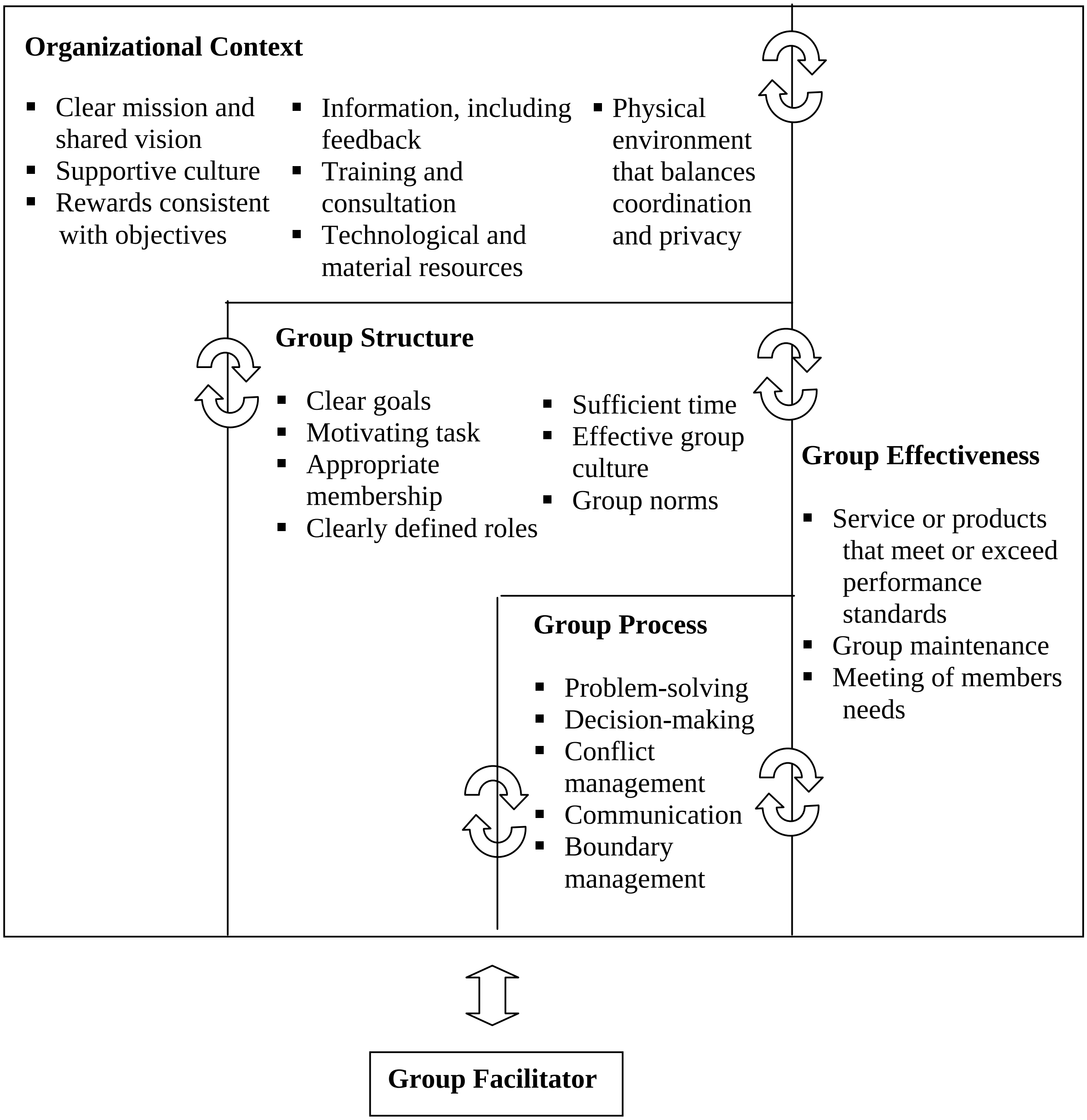

Figure 4: Group Effectiveness Model (Schwarz 1994)

Dickson et al. introduced the following terminology to describe three distinct facilitator-related support modes:

- User-driven support (no facilitative support) – all GDSS features and functions are available at each user workstation for members to use in any way and in any order they wish in performing a group task, after a brief training session.

- Task facilitative suppo*rt* (facilitator-driven support) – a person who is not a member of the group is utilized to direct group members "on what GDSS features to use, when to use them, and how to use them" … (and) influences *how* the group uses the technology".

- Operational facilitative support (chauffer-driven support) – at the direction of the group, a "chauffer" merely implements features of the GDSS system for the group, but does not affect the group process. (Dickson et al., pp.174-175)

As discussed in the following chapter, the automated virtual facilitation application was designed to provide task facilitative support, focusing primarily on which GSS tools to use, in addition to when and how to use them. The research framework is designed to evaluate the effectiveness of groups having such facilitation, in comparison to groups having operational facilitative support (chauffer-driven support) only.

Such "chauffer-driven" support is similar in nature to what Maier and Maier (1957) described as *free discussion* techniques, in which a leader poses a problem, then conducts the group discussion "in a permissive manner without making value judgments, but merely helps the group reach agreement on a solution" (p. 320). In comparison, the *developmental* technique for group discussion involves a leader who "breaks the problem into parts so that each part of the problem is discussed separately before the final decision is made" (Dickson, et al, p. 180). Maier and Maier found that the "developmental" approach was more effective

than the “free” discussion approach in improving decision quality. In contrast, DeSanctis et al. (1989) found that restrictiveness did not lead to improved group consensus, and that excessive restrictiveness may indeed result in groups losing their “sense of ownership and control over the technology,” resulting in lower levels of consensus.

In comparing facilitator-driven support to chauffer driven support, Dickson et al. found support for their hypothesis that chauffer-driven groups (“technology-aided, non-prescriptive process”) will achieve greater post-meeting consensus than facilitator groups, and that no significant differences exists between individual facilitators in implementing a particular GDSS support mode.” According to the authors:

> “Facilitated groups were uncomfortable with the imposition of structure in the decision process (because) facilitation is a complex process and, unless properly employed, can fail to achieve its expected benefits. The evidence suggests that facilitation, to be effective, must be richer and more flexible than employed in this study (Dickson et al., p.191).

As more fully described in the following section, the virtual facilitation application attempts to maintain the meeting agenda without being overly restrictive by requiring all group members to proceed to the next step in the multi-step decision-making process, thus granting each group member a veto power on proceeding to the next step in order to foster a more democratic decision-making process and one which helps ensure greater equality of participation.

This approach would appear to be in line with Silver’s (1990) assertions that high levels of restrictiveness and decisional guidance, as in the case of certain facilitator-driven groups, may be inappropriate to promote *change* in group consensus. In such instances, Dickson et al. assert that systems allowing greater flexibility by utilizing “minimally restrictive GDSS” having low levels of decisional guidance are preferable (p. 191). The

multiple-activity group decision-making procedure recommended as the basis for providing decisional guidance is believed to offer such flexibility.

In an early study of group facilitation, George, Dennis, and Nunamaker (1992) compared facilitated and non-facilitated groups using electronic meeting systems and found no significant differences between the groups in terms of alternatives generated, decision quality, satisfaction levels, or ability to reach consensus. Anson, Bostrom and Wynne (1995) investigated the effects of human facilitation on group performance, group cohesion, and group interaction processes in group decision-making situations. Their study found that facilitated groups achieved improvements in group performance, interaction processes and group cohesion levels. Moreover, facilitation combined with GSS utilization, were found to enhance the effectiveness of group cohesion and group decision making processes. As such, facilitation was deemed critical in improving GSS effectiveness, especially for first-time users, and in situations where less restrictive GSS tools are used. Moreover, the quality of facilitation is believed to be a significant factor in improving group decision-making outcomes. Indeed, facilitators lacking proper skills may have minimal effects on improving outcomes. Thus, training and experience are critical in developing facilitator skills. As discussed in the following chapter, the quality of the facilitation process will be rated by the participants following the experiment, in addition to obtaining a number of other measures, including the faithfulness of and consensus on appropriation.

In a formulative study, and one which forms the basis for this dissertation's methodology, Wheeler and Valacich (1996) examined the effects of facilitation, GSS configuration, and training as mediators in the effective use of structured group decision techniques. Drawing on DeSanctis and Poole's (1994) structuration theory, the authors use the

term *process restrictiveness* (i.e. “the manner of limiting a group’s interaction to the activities, sequences, and philosophies specified by a heuristic.” p.430) to formulate their *Process Restricted Adaptive Structuration Theory)*.

The authors assert that the efficacy of guidance and process restrictiveness is dependent upon the ability of a system to ascertain and influence a group decision processes through three primary moods: *verbal*, *gestural*, and *computer mediated*. For optimal effects, guidance and restrictiveness should direct a group's decision processes using the same communication mode as the group's primary information exchange mode (p.434). Accordingly, the virtual facilitation application uses both audio and visual channels to direct the facilitation process.

Wheeler and Valacich contend that guidance and process restrictiveness affect a group's decision process through their impact on six procedural dimensions:

1. The *sequence* of activities (e.g., choosing to generate ideas and then evaluate, or engaging in concurrent generation of evaluation, etc.)
2. The *pace* of the communication activities (i.e. how much time spent generating ideas and discussing a vote before transitioning to another activity)
3. The *content* of the communication messages e.g. faithful or unfaithful with current activity of the heuristic, such as generating solution criteria, etc.
4. The *communication mode* (e.g. verbal, gestural, or computer mediated)
5. *Vigilance* of engagement in the activity (e.g. degree of critical thinking and exploring assumptions, challenging assertions, proposing novel ideas, etc.)
6. Selection of *process support structures* (e.g. flip charts, brainstorming tool, voting tool, etc. (p.434).

Appropriation mediators (facilitation, GSS configuration, and training) provide the means by which guidance and process restrictiveness can be invoked. *Active* mediators can intervene directly in the same communication mode as a group is employing at the current time, while passive mediators cannot. As such, GSS configuration and training are considered passive mediators, while facilitation can be either active or passive.

Wheeler and Valacich hypothesize that the presence of appropriation mediators will increase a group's faithful use of a heuristic. Specifically, facilitated groups, trained groups, and groups employing level 2 GSS configurations, were predicted to more closely follow a heuristic's structure (activities, sequences) than non-facilitated groups, or groups that have not been properly trained, or those not using configured GSS. In line with these propositions, facilitation was found to have the largest effect of the mediators, primarily due to its active nature, while both GSS configuration and training also improved faithful GSS use, though to a somewhat smaller degree. Moreover, groups using activities and sequences suggested by the heuristic were found to make better decisions than groups not using such sequences. Furthermore, groups deviating significantly from the heuristic's prescribed activities were found to have lower quality decisions than those groups more closely following the heuristic's structures. The authors attribute the significant influence of facilitation to the ability of the facilitator to discern in real-time the conformance of a group's procedural activities in comparison to the prescribed structures of the heuristic, as well as the ability to communicate in the same mode as the group's procedural deliberations. Accordingly, the authors recommend choosing an *active* mediator whenever possible in order to more effectively guide a group's interaction process towards faithful use of the GSS. As described above, and more fully in the following chapter, the virtual facilitation application uses pre-scripted audio messages to actively communicate with group members.

Griffith, Fuller, and Northcraft (1998) employ a sociotechnical approach in investigating intended and unintended effects of facilitator influence. The authors assert that facilitation is a critical element in the success of groups within sociotechnical systems due to the fact that facilitation is designed to help group members "exploit the capabilities of the

technology and their group, in the pursuit of their task (p.21). As such, the facilitator's role is critical to the objective of a sociotechnical system approach of fining "the social and technological arrangement that meets both the needs of the [group members]…and organizational goals (Pasmore and Sherwood 1978, p.41). Moreover, facilitation needs to be a impartial, in order that group decisions are determined by the group members, in order that they feel committed to the meeting's outcome (Griffith p.23).

Griffith et al. assert that the facilitator's ability to influence a group's decision making process is a function and of the facilitator's power, both "legitimate" and "expert". However, as a result of the power that facilitators wield, the ability of facilitators to influence meeting outcomes may result in certain unintended effects:

"The paradox of facilitation is that facilitators are supposed to influence without being influential (p.27). As such, GSS facilitators must strike a balance between enhancing the effectiveness of group processes and influencing the group towards the facilitator's own objectives or agendas. Indeed, the authors posit that facilitator influence is likely to be intentional what facilitators have agendas conflicting with a group's agenda.

Griffith et al. propose the following guidelines for achieving more effective facilitation:

1. Facilitators need to acknowledge and understand the sources of influence that they control.
2. Facilitators need to be trained to facilitate in a way that minimizes unintentional influence.
3. Standards need to exist which spell out the obligations of facilitators with respect to the use of their influence (p.30).

Miranda and Bostrom (1999) studied the impact of process and content facilitation on meeting outcomes. *Process facilitation* (i.e. "the provision of procedural structure and general support to groups through the meeting process," including such functions as

encouraging the group to follow agendas, discouraging criticism, promoting equal participation, and assisting with task structuring) was found to have a positive impact on meeting processes. Content facilitation (i.e. "interventions that relate directly to the problem being discussed," such as offering insights, opinions, or interpretations of facts or events of the specific problem being addressed) was found to have a negative impact on meeting processes. The study also found that meeting processes have a strong positive impact on user satisfaction levels but no corresponding impact on overall quality. The virtual facilitation application is designed to provide process facilitation only.

Dennis, Wixom, and Vandenberg (2001) examined the impact of the role of facilitation (in addition to guidance, restrictiveness, and appropriation training) in providing process support for group decision-making. Their Fit-Appropriation Model (FAM) of GSS performance asserts that task technology fit is necessary but not sufficient for improving GSS performance. Their theory asserts that without proper appropriation support, group decision-making performance is not likely to improve, in spite of having the proper task technology fit:

Task-technology fit is necessary, but not sufficient, for good performance; without support in appropriating the GSS (assuming the group has no habitual routines for using the GSS for the task) performances is less likely to improve…We hypothesize that performance will be improved when there is a task technology fit and when appropriation support is provided compared to situations in which there is no task technology fit with or without appropriation support (p.175).

As such, the authors' Fit-Appropriation Model proposes "a set of the two overreaching concepts" (fit and appropriation) for most effectively realizing the benefits of GSS capabilities: "While task-technology fit improves outcome effectiveness, appropriation support acts to improve the process by improving efficiency and process satisfaction." Indeed, the authors assert that the primary contribution of a GSS facilitator is providing

proper task technology fit, as well as assisting in the appropriation process, (as opposed to the commonly held assumption of primarily managing group dynamics). For these reasons, the authors' Fit-Appropriation Model forms the basis of a number of the propositions put forth in this dissertation, and is the basis for the application's focus on providing GSS fit and appropriation support, as discussed above and in the following chapter.

Several earlier studies reported similar findings in terms of the importance of facilitator functions. Dickson, Limayem, Partridge, and DeSanctis (1996) found the following *task interventions* to be the most important facilitator roles (in order of importance):

- structuring group activities
- guiding the agenda
- clarifying and rephrasing issues
- keeping discussions on topic
- reformulating questions or problems
- summarizing
- testing agreement among participants
- identifying decisions (de Vreede and Niederman 2002, p.2)

The following interactional interventions were found to be most significant by Dickson et al. (in order of importance):

- equalizing participation of participants
- identifying communication problems
- soliciting feedback
- managing conflict
- providing and aiding groups emotional client (de Vreede and Niederman, p.2)

Clawson and Bostrom (1996) likewise found similar facilitator functions and qualities to be most significant (in order of importance):

- planning and designing the meeting
- listening to, clarifying, and integrating information
- demonstrating flexibility
- keeping group outcomes focused
- creating and reinforcing an open, positive and participated environment
- selecting and preparing appropriate technology

- directing and managing the meeting
- developing and asking the right questions
- promoting ownership and encouraging group responsibility
- building rapport and relationships
- demonstrating self-awareness and self-expression
- managing conflict and negative emotions constructively
- encouraging/supporting multiple perspectives
- understanding technology in its capabilities
- creating comfort with and promoting understanding of the technology and technology outputs
- presenting information to group (de Vreede and Niederman, p.2)

As more fully discussed in the following chapter, the most important of these facilitator functions were incorporated in the virtual facilitation application.

DeVreede and Niederman (2002) addressed the question of what effective GSS facilitation consists of through a qualitative inquiry of group participants' perceptions. Through interviews of 133 participants of GSS meetings, the following clusters and categories emerged as being significant functions of facilitators (*not* in order of importance):

- workshop design (preparation of scripts, choosing meeting accommodations)
- required knowledge (technical GSS knowledge, content knowledge, knowledge of group processes/dynamics)
- setting the stage (introduction/explanation of meeting process and rules, introduction/explanation of GSS technology, introduction/explanation of meeting topic)
- being available (being available/approachable)
- human qualities and attributes (self projections, social skills)
- being sensitive/building rapport (building rapport with the problem owner, being sensitive to the group)
- intermediate results (explaining, resuming, interpreting group output and giving feedback)
- directing (motivating/stimulating the group, giving free rein/tightening the reins, bringing the group to results, leading the group in its discussions in general)
- guarding (guarding the discussion focus, time management)
- script evaluation/modification in designing processors (structuring discussions, process adaptivity)
- being sensitive to results (being sensitive to the meeting content/topic, respecting the group results)
- aftercare (de Vreede and Niederman, p.5)

The application employed for this research was designed to provide a number of such process facilitation functions, including introductory remarks, explanation of meeting processes, meeting agenda management, and reporting results of each phase of the multi-step decision-making process. Using both pre-recorded audio scripts of explanations and answers to frequently asked questions, as well as through visual messaging to individual members, or the entire group through the shared whiteboard, the virtual facilitation application was structured to replicate those functions of human facilitators which have been found to be the most important facilitation functions. As a number of studies have shown, such *system-directed facilitation* can be effective in improving key GSS performance metrics, as discussed in the following section.

2.9 System-Directed Facilitation

Because of the breadth and variety of skills that a facilitator must bring to the table, a growing number of studies have examined the feasibility of automating the facilitation function by embedding specific facilitator tasks within the GSS system (Stodolsky 1981, Aiken, Sheng and Vogel 1991, Reagan-Cirincione 1992, Ho and Antunes 1999, Nunamaker and Zhao 2002, Lopez et al. 2002, Briggs, DeVreede and Nunamaker 2003, Wong and Aiken 2003). Such *system-directed* facilitation holds considerable promise as a means of enabling individuals lacking adequate facilitation experience to more effectively manage GSS-supported group meetings, and could ultimately result in completely automating the GSS facilitation process, as several studies have proposed (Limayem and DeSanctis 2000, Chalidabhongse et al. 2002, Limayem 2003). If the most important facilitator functions are indeed fitting GSS capabilities to the assigned group task and assisting participants in successfully appropriating the GSS technology, as Dennis, Wixom, and Vandenberg have asserted (2001, p.186), then additional

research efforts exploring how such system-directed facilitation can be more effectively provided would appear fruitful.

Aiken, Sheng and Vogel (1991) presented a modeling and research framework for integrating expert systems with GSS, and suggested a number of potential solutions for automating the facilitator function, including:

1. Automated monitoring facilities -- systems designed to keep track of the frequency of comments generated by participants and intelligent agents to initiate reminders if member participation levels are inadequate.
2. Automated parliamentary procedures -- systems designed to structure discussions for greater efficiency, productivity and quality.
3. Automated counselors-- systems designed to provide advice on selecting appropriate group support tools.
4. Automated "facilitator's assistants" -- using input regarding which GDSS tools are to be used (item 3) and their duration times, such systems could determine the necessary sequence of steps to conduct a group session.
5. Automated retrieval agents - designed to provide retrieval of ancillary online information to augment members' recollection of relevant information (pp.78-79).

Aiken et al. propose the use of automated systems incorporating characteristics of Model Management Systems (MMS) to support GSS tool selection as a means of optimizing the choice of particular GDSS technologies for a given task:

Integrating an ES with a GDSS model base allows even novice group facilitators to select the appropriate tools and procedures for a group work session. This integration will allow the GDSS to provide a sufficient number of tools and adequate support to achieve a critical threshold necessary for a high frequency of use, which in turn, is necessary for a successful GDSS (p.85).

Reagan-Cirincione (1992) proposed combining an external facilitator, a decision model, and information technology as a means of improving the accuracy of group cognitive judgment by using an iterative "estimate-feedback-talk" procedure incorporating three distinct phases:

1) Initial specification of decision models and decision-making criteria by individual members, and subsequently, by the group as a whole ("estimate" phase)
2) Displaying the results of individual and group decisions ("feedback" phase)
3) Facilitated group discussion ("talk" phase)

Reagan-Cirincione cites a number of different perspectives on the role of external facilitators in group decision-making: Keltner (1990) believed that their function is to ensure that all group members are able to fully participate in the decision-making process, and that the process is not dominated by a minority of group members. Ackermann (1990) asserted that external facilitators could help support cognitive processing by providing the group a structure in which to operate. As such, he believed that facilitators could enable the group to match specific modeling techniques to assigned group tasks more easily. Eden, Jones and Sims (1983) believed that external facilitators could be used to improve a group's cognitive judgment by encouraging discussion of differences in group members' perspectives, reviewing the objectives of a particular task, and identifying inconsistencies among group members' perspectives. Kayser (1990) stated that facilitators could help the group "free itself from internal obstacles or difficulties so that they more efficiently the effectively pursue the achievement of its desired outcomes (p.12-13).

Reagan-Cirincione states that the *model building* process can be used to create "a common bond that encourages teamwork and, ultimately, allows convergence on a consensus judgment" (p.234). Phillips (1988) believed that by providing a shared language that group members can utilize collectively, a decision model can help group members structure their thinking about a specific problem, a view similar to Eils and John (1980):

> The model enables the group to decompose the problem into its constituent parts. Discussion centers on the appropriate use of pieces of information -- their relative importance and their functional relations to the unknown parameter to be judged -- as a means to improve the cognitive processing in which group is engaged (Reagan-Cirincione, p.234).

Lastly, information technology can be used to provide "synergy and stimulation" to the group in carrying out its decision-making tasks:

Members can concentrate their attention on the projected images from the computer, so that everyone has access to exactly the same information during discussion. The computer also plays a critical role by providing feedback to the group about the implications of their judgments. As a result, communication of individual differences stays more focused, saving group time for more thorough exploration of *why* such differences in perspective exists (Reagan-Cirincione, p.234).

The study found that interacting groups performed significantly better in cognitive judgment tasks than any individual group member when facilitated by the system-directed “estimate-feedback-talk” process utilizing decision modeling and information technology to carry out the facilitation process.

Ho and Antunes (1999) developed a tool to assist electronic facilitation of decision-making groups in order to address two problems inherent in using electronic facilitation: a limited support for managing planning activities, and difficulties in carrying out remote facilitation. Their Facilitation Tool was designed to guide the entire GDSS planning process, ranging from high-level planning assistance through the selection and configuration of specific GDSS tools properly fitted to the specific group decision-making task. Their Facilitation tool was also capable of handling remote facilitation, including the provision of three types of group interventions to facilitate the decision-making process: “steer and focus group participants, analyze and understand issues, and moderate conflicting or chaotic situations” (p.9). While their Facilitation Tool offers a number of features not included in such GDSS applications as GroupSystems, significant empirical testing of their facilitation application was not conducted in the study.

As discussed in the previous section, Limayem and DeSanctis (2000) examined the effectiveness of providing *decisional guidance* (i.e. “automated facilitation”) for multi-criteria decision-making (MCDM) in groups. Their approach for automating the

facilitation function involved providing system explanations at specific breakpoints in the decision-making process, designed to improve user understanding of the decision models. Building on Silver's (1990) concept of decisional guidance, their *automated decision guidance* was formulated to enhance decision models with cues directing decision makers to achieve better structure and execution of a decision model's components.

In a follow-up study, Limayem (2003) compared human and *automated facilitation* in the GDSS context and found that automated facilitation was as effective as human facilitation in terms of encouraging the faithfulness of appropriation of the GDSS technology. Limayem and DeSanctis (2000) defined automated facilitation as "the enrichment of a GDSS with cues that guide decision makers towards successful structuring and execution of the decision-making process." Similar to human facilitation, it consists of providing the group *decisional guidance* "in order to help them achieve their own outcomes" (Limayem, 2003 p.3).

Limayem uses AST theory to explain how facilitation can be instrumental in affecting group interactions and outcomes. By regarding faithfulness of appropriation (FAO) of the GDSS technology as a major determinant of its effectiveness in decision outcomes, Limayem's research model posits that facilitation is instrumental in achieving faithful appropriation. Specifically, facilitators (either human or automated) can help a group successfully appropriate GDSS structures by guiding group members in using the GDSS system in conformity with its intended use, as well as by fostering positive attitudes among group members regarding the use of the GDSS technology. Moreover, as Wheeler and Valacich (1966) have demonstrated, by faithfully appropriating the GDSS

technology, groups can achieve significantly improved meeting outcomes and participant perceptions (p.4).

The following procedure was used by human facilitators to guide the group through its agenda of completing the “Foundation Task” involving the allocation of financial resources among six competing projects:

1. Defining a list of criteria to evaluate projects
2. weighing the criteria in order of importance
3. evaluating the alternatives against the criteria
4. calculating scoring based on the criteria weights and ratings
5. allocating dollar amounts the projects (p.5)

The automated facilitation process included the following functions:

1. Explaining the purpose of the model and its major steps.
2. Summarizing the current, previous, and subsequent steps: Upon choosing an option from the allocation menu, a screen summarized the previous steps, and explained the purpose of the selected option.
3. Status display: A status window displayed the current step as well as the next step to be performed
4. Highlighting group inconsistencies: If inconsistencies were detected by the system (e.g. wide disparities in group members rankings of alternatives), a message was displayed on the public screen prompting group members to clarify the meaning of those criteria or alternatives having high disparities among group members.
5. Explaining system output to group members: graphs and tables were presented to group members to better understand the model’s recommendations.

The study found that automated facilitation was as effective in enhancing group performance as human facilitators, and demonstrated the importance of faithfulness of appropriation in successfully exploiting GDSS technology. To achieve such benefits, the study advocates that automated facilitation applications communicate to users how they can more faithfully appropriate the system (i.e. use the GDSS in conformity with the *spirit* of the technology, as intended by the system’s developers). Moreover, Limayem suggests that the “interplay” between the GDSS *structural features* and the *spirit* of the GDSS technology, as well as “the cognitive perceptions of the user on the facilitation process” are significant

factors in enhancing the faithfulness of appropriation, and ultimately, in achieving significant improvements in group decision-making effectiveness. The virtual facilitation application likewise attempts to improve faithfulness of appropriation by suggesting how GSS use might conform more to its intended use.

Lopez, Booker, Shkarayeva, Briggs, and Nunamaker (2002) investigated the possibility of embedding facilitation capabilities in group support systems to more effectively manage distributed group behavior:

> We propose the concept of embedded facilitation in which we implant intelligent agent based behavioral indicators into GSS systems to serve as the "eyes and ears" of the facilitator, and where, based on these indicators, either automated repeatable processes are launched or thinkLets are suggested to the facilitator from which to select and launch… Embedded facilitation would reduce the need for the facilitator to fully understand intervention techniques... in dramatically alter the way virtual teams interact (p. 1).

By embedding specific tools and integrating processes to support group behavior and carry out routine group meeting tasks, the system envisioned by the authors would enable virtually any user to manage group collaboration processes with a minimum amount of facilitation training. Lopez et al. assert that such an embedded facilitation system would need to include the following components:

- tools to manage processes such as time
- tools to support the convergence process
- tools to monitor participant behavior
- tools to provide guidance to the group leader to a group in reaching consensus
- features to enhance *team building* (a task which the authors feel is "essential to the establishment of goal congruence")
- an integrated set of tools supported by toolbars, on-screen monitoring indicators, menus and a virtual mentor (p. 2-4).

The authors proposed a system having the following capabilities:

1. Virtual team monitoring - through the use of natural languages, content analysis, and parsers, the system could determine user activity levels, user behavior, and commonality of user comments.

2. Automated facilitator interventions - using automated messaging systems to communicate with users based on unusual patterns of participation.
3. ThinkLets utilization (i.e. pre-scripted dialogues designed to assist the facilitator in more effectively communicating in certain envisioned situations. See Briggs et al. below).
4. Improved facilitator console design – a redesigned console that would better assist individuals in carrying out the following facilitation skills:
   - encouraging participation
   - clarifying and integrating information
   - keeping the group focused
   - creating and reinforcing an open, positive, and participative environment
   - building rapport and relationship
   - managing conflict and negative emotions constructively
   - directing and managing the meetings and creating comfort with technology (Lopez et al. p. 7)

The virtual facilitation application was designed to provide such facilitator functions, as more fully described in the following chapter.

Wong and Aiken (2003) examined the possibility of replacing human facilitators in distributed meeting environments. Their automated facilitator application included in automated individual comment monitor which was designed to encourage meeting participants to participate more frequently and to notify the facilitator if participation rates fall below a predetermined threshold, based on the particular GSS tool being used, its planned duration, participants' GSS experience and typing speeds, in addition to any other parameters which were specified prior to the meeting taking place. The *automated system operator* was designed to start and stop specific programs, to notify group members regarding approaching the end points for a meeting phase, as well as performing other administrative tasks normally handled by the facilitator.

The study found no significant differences in *perceived satisfaction levels* between groups using automated facilitators and those having expert facilitators. In terms of *ease of use*, groups having expert facilitators found their systems easiest to use, followed by group's

using automated facilitators and then by groups having novice facilitators, although no significant differences existed between groups using automated facilitators and those having either expert facilitators. In terms of the *number of ideas contributed* per subject, no significant differences were found between expert-led and "automated" groups. Significant differences were, however, found between automated and novice-led groups, and between expert and novice-led groups. Finally, there was no significant difference between expert-led groups and "automated" groups in the area of performing routine administrative tasks. By finding that automated facilitation can be as equally effective as expert facilitators in terms of perceived satisfaction levels, ease-of-use, and number of ideas generated, the study demonstrated the potential which automated facilitation holds for supplanting human facilitators with system-directed facilitation. While the present study focuses on decision-making in a face-to-face environment, the automated virtual facilitation application could be readily adopted for web-based group meetings.

Briggs, DeVreede and Nunamaker (2003) investigated the feasibility of using "repeatable collaborative processes" in the facilitation of group meetings through the use of *thinkLets*, which the authors define as "the smallest unit of intellectual capital required to create one repeatable, predictable pattern of collaboration among people working toward a goal" (p.46) As such, thinkLets are designed to provide "explicit, scripted prompts" for communicating with a group or its members during meetings, and to provide guidance to facilitators for reaching decisions based on a group's behavior patterns. Accordingly, each thinkLet is uniquely identified and is designed to create a specific pattern of collaboration among group members (e.g. divergence thinkLets, consensus building thinkLets, etc.).

The authors use the term collaboration engineering to denote “an approach for the design and deployment of collaborative technologies and collaborative processes to support mission-critical tasks,” and specify three requirements for successfully executing collaboration engineering efforts:

1. GSS-related facilitation skills must be packaged in such a way that the *conceptual load for practitioners is reduced significantly*.
2. GSS-related facilitation skills need to be packaged in such a way that *different practitioners using the same packaging will get similar, predictable results from their groups*.
3. Collaboration engineers must find ways to package GSS-related facilitation skills in such a way that packages can be *reused* to enable short development times for new processes (Briggs et al. p.46)

Briggs et al. identify five general patterns of collaboration which comprise five broad thinkLet categories:

1. Diverge: to move from a state of having fewer concepts to a state of having more concepts.
2. Converge: to move from a state having many concepts to a state having a focus on, and understanding of, the few worthy of further attention.
3. Organize: to move from less to more understanding of the relationships among concepts.
4. Evaluate: to move from less to more understanding of the possible consequences of concepts.
5. Build consensus: to move from having less to having more agreement on courses of action (p.47-48)

ThinkLets are comprised of three components, and are defined in terms of the tool utilized, its configuration, and a script for facilitators to use in its execution:

- Tool -- the specific version of the specific hardware and software technology used to create a pattern of collaboration.
- Configuration -- the specifics of how the hardware and software were configured to create a pattern of collaboration.
- Script -- the sequence of events and instructions given to the group to create the pattern of collaboration.

Because the thinkLets concept permits the “packaging” of specific facilitation skills in a manner that can easily be transferred to practitioners, the authors contend that

they represent “efficient and effective building blocks to create repeatable processes” that can be reliably replicated by practitioners not possessing the facilitation skills necessary to effectively lead GSS-supported meetings. As such, they can be critical components in applications designed to automate the facilitation function.

As online collaboration and distributed decision making become more widespread, an increasing number of studies have examined the issue of distributed facilitation, and the possibility of using intelligent agents and other system-directed interventions to assist in directing “virtual meetings” and web-based collaboration efforts. Indeed, the growing trend towards the utilization of web-based software applications to enable improved collaboration within organizations (e.g. Microsoft’s NetMeeting) has emphasized the need for improved methods of facilitating distributed meetings and so-called “web conferencing”.

One of the earliest studies in this area was conducted by Niederman (1993) in his investigation of facilitation issues in distributed group support systems. The study focused primarily on the concerns of facilitators in moving from face-to-face to distributed environments, and the anticipated benefits of doing so. By far, the biggest concern regarding distributed facilitation was the fear that nonverbal cues would be absent. Likewise, the belief that coordination and control would be more difficult, and that conflicts would be harder to resolve, were also mentioned. Interestingly, many of the technology-related concerns that facilitators had regarding migrating to distributed environments turned out to be not applicable, with the advances that have occurred in distributed collaboration, and in particular, the proliferation of web-based conferencing.

Mittleman, Briggs and Nunamaker (1999) compiled a collection of the best practices in facilitating virtual meetings based on their initial experience in facilitating

meetings in distributed environments. Their research data was collected through observations of participants during distributed meetings, interviews with participants after the meetings, and discussions, debriefing, and reflections among meeting participants and facilitators. The results of their study are presented in Table 11.

Romano, Briggs, Nunamaker and Mittleman (1999) examined the roles of facilitators and participants in distributed GSS meetings. Their study addressed the following three research questions:

- What changes in GSS group processes will be required to support collaboration for groups distributed along the dimensions of time, space, and technology?
- How do the roles of facilitators, group leaders, and participants in distributed settings change from those in face-to-face settings?
- What other factors are important in distributed GSS sessions that are not important in face-to-face sessions? (p. 2)

Romano et al. present a number of different dimensions of facilitator roles as developed by Clawson and Bostrom (1993) in their study of GroupWare facilitation. Their study found 1,444 different characteristics of effective and ineffective behavior of facilitators, resulting in 16 different dimensions:

1. Promotes ownership and encourages group responsibility
2. Demonstrates self-awareness and self-expression
3. Appropriates, selects and prepares technology
4. Listens to, clarifies, and integrates information
5. Develops and asks the right questions
6. Keeps group focused on outcomes life task
7. Creates comfort with and promotes understanding of the technology and technology outputs
8. Creates and reinforces an open, positive and participative environment
9. Actively builds rapport and relationship
10. Presents information to group
11. Demonstrates flexibility
12. Plans and designs the process
13. Manages conflict and negative emotions constructively
14. Understands technology and the capabilities
15. Encourages / supports multiple perspectives
16. Directs and manages the secession or project (Romano et al., p.3)

Table 11: Lessons Learned and Best Practices for Facilitating Virtual Meetings (article excerpts from Mittleman, Briggs and Nunamaker, p. 4-15)

Lessons Learned	*Best Practices*
1. It is harder to follow a meeting process from a distance	• *Make the pre-meeting plan as explicit as possible* • *Engage vested interests in advance to confirm their participation* • *Create a scoreboard for the meetings agenda and use check marks to focus participants on the topic at hand* • *Focus transitions - moving from one process stage to another should be complete and explicit* • *Enunciate interim goals using a prioritized set of action items*
2. People don't get feedback when working over a distance	• *Explicit facilitated feedback* • *Frequent process checks* • *Encourage use of back channels for feedback*
3. People forget who is at a distributed meetings	• *Reflect users names when facilitating* • *Remind participants who is at the meeting* • *Distribute photos and short biographies*
4. It is harder to build a team over a distance	• *Achieve very clear, unambiguous goals for the team* • *Have kick-off meetings face-to-face* • *Engage in distributed breaks*
5. Network connections are unpredictable	• *Assume a technology learning curve* • *Have a fallback plan* • *Have on-call technical support* • *Establish a re-bootstrap mechanism* • *Download a process map to each participant*
6. It is difficult to sort out multiple communication channels	• *Introduce new technology only on an as- needed basis* • *Separate task and process channels* • *Use video only during process stages where it is beneficial* • *Focus video on artifacts rather than talking heads when appropriate* • *Use process support tools to focus group attention on specific information*
7. There is an art to using audio and video channels in a distributed meeting	• *Engage in a dialog rather than give a briefing* • *Engage in a dialog with someone you know* • *Stay close to the microphone* • *Shift focus among the different sites*
8. It is harder to converge over a distance	• *Tightly structure the convergence process* • *Hold frequent process checks* • *Use ad hoc teams to negotiate compromise solutions* • *Develop a team dictionary and place it on line*
9. Different time virtual meetings are different then same time virtual meetings	• *Make sure participants perceive different vested interests in the task* • *Make sure there is no easier way to accomplish the task* • *Make sure that users know that management values the output of the task* • *Correspond in advance with each participant directly to confirm their participation* • *Begin each different time project with a same time different place GSS meeting* • *In every tool you use, create an extra place for team members to engage in back channel communication to the facilitator* • *Participant instructions must be vastly more explicit than would be*

Romano et al. developed a process for distributed facilitation comprised of eight rules of thumb for engaging participants and maintaining their involvement in the process:

1. Select a task in which participants have high vested interests
2. Establish a champion with clout and vested interest
3. Explicitly verify that the task cannot be accomplished more easily by another method
4. Facilitators must directly contact all participants to confirm their commitment to participate
5. Each distributed project should kick off with a same time different place voice-and-GSS online activity
6. Two deliverables of the kick off session should be an explicit prioritized set of action items for asynchronous participation, and a firm schedule for the next synchronous interaction.
7. Participant instructions must be vastly more explicit than would be necessary for synchronous sessions.
8. Every GSS session should include a separate process channel monitored by the facilitator (Romano et al., p.11)

While the present study's experiment was conducted in a face-to-face setting, many of the rules of thumb and "lessons learned" for distributed facilitation can be readily applied to meetings occurring in a single location, and was useful in designing the virtual facilitation application's specific functionality.

McQuaid et al. (2000) also identified a number of "lessons learned" for facilitating virtual meetings and arrived at a similar set of "best practices" for conducting online collaboration. They proposed the use of a virtual reality toolset designed to reduce cognitive load on participants by using symbols to represent various objects within a group meeting environment. Using virtual reality markup language (VRML), McQuaid and his eight associates developed and tested a prototype virtual reality environment using on-screen avatars employing participant-directed facial expressions for "happiness, sadness, puzzlement, and anger and related body positioning, as well as other appearance shortcuts" (p.8).

Chalidabhongse et al. (2002) developed and tested an intelligent facilitation agent (IFA) to facilitate distributed group meetings through a web-based discussion system. The system's facilitation capabilities are derived from "the power of asking questions" combined with an "information extraction agent" designed to support group discussion. The intelligent facilitation application relies primarily on the use of decision markup language (DCSML) which classifies data from a discussion into the XML format.

As the authors describe it, DCSML is used "to provide the structure for extracting key decisions factors from a group conversation" (p.358). The facilitation agent analyzes information within the DCSML structure using the information extraction agent to determine if any available information is relevant in supporting the group's decision-making process.

The study found that their intelligent facilitation agent resulted in higher numbers of ideas generated, higher levels of discussion participation, greater access to supporting information for decision-making, and lower distraction levels among group participants. Using its collection of technologies from the domains of natural language processing, data mining, intelligent agents, and management science, the intelligent facilitation agent was found to significantly enhance group discussion efficiency, and may be proven beneficial in future efforts at automating the distributed facilitation process.

While the AVFA application did not include features specifically designed for distributed facilitation, those features which are adaptable to face-to-face meeting will be incorporated in present and future versions. As previously discussed, the application does not include technologies enabling automated monitoring of meeting dialogues, such as DCSML, but instead communicates with users

through pre-scripted audio and visual messages. The specific design of the AVFA application and the experiment's methodology are covered in the following chapter.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter describes the methodology employed in conducting the present research, including the assigned group decision-making task, experiment participants, research variables, and procedures used to carry out the experimental research. Beginning with a description of the automated facilitation application used in conducting the experiment, the chapter contains a description of the research design, treatment groups, and the key procedural details of the experiment. Following that, the study's hypotheses are presented, together with the dependent variables and research instruments utilized to conduct the research. Finally, the grading process used to assess the task solutions recommended by the research participants is presented. Prior to that however, a brief recap of the salient issues impacting the present research will be helpful.

The studies reviewed in the previous chapter have demonstrated the feasibility of using automated facilitation and other forms of system-directed decisional guidance to effectively replicate the functions of human facilitators. Indeed, a number of studies have shown that automated facilitation can be equally as effective as human facilitators in providing GSS support. Yet only one unpublished study (Limayem 2003) has investigated the impact of automated facilitation on the GSS appropriation process and, specifically, on the faithfulness of appropriation. However, that study did not examine the effectiveness of using automated facilitation to support structured group decision-making.

As described in the previous chapter, Wheeler and Valacich (1996) investigated the use of facilitation (as well as GSS configuration and training) to "directively" affect group decision making by using a five-step multiple activity group decision-making heuristic

designed to guide groups in identifying an assigned task's primary objective, for choosing evaluation criteria, and for selecting a solution. The study found that of the three appropriation mediators, facilitation was particularly effective in increasing the faithful use of the heuristic, and also that a heuristic's faithful use could improve decision quality. Indeed, facilitation was found to be the only mediator capable of consistently restricting the heuristic's activities and sequences in all communication modes. As a result, Wheeler and Valacich concluded that "even a weak and relatively structured form of facilitation" can be effective in increasing both heuristic use and decision quality (p.445-447).

The Wheeler and Valacich study, however, did not address the effectiveness of using *system-directed facilitatio*n for providing task-technology fit or appropriation support. Indeed, the authors recommended that future research efforts consider "embedding facilitation-like expertise" into the GSS system, including "audio messages that replicate the guidance and process restrictiveness comments from a facilitator" (p.447). The present study was designed to do precisely that, in order to test the effectiveness of this approach. By examining the effectiveness of virtual facilitation to support the GSS appropriation process and structured group decision-making, the research plan described in this chapter has been designed to examine many of the same issues that Wheeler and Valacich investigated, but in an *automated-facilitation* context. As also discussed in the previous chapters, the present research likewise expands upon Dennis, Wixom, and Vandenberg's study investigating the relationship between GSS appropriation and decision-making effectiveness.

Because of the central role of system-directed facilitation in expanding upon these previous studies, the effectiveness of virtual facilitation is the primary focus of this research. By demonstrating whether virtual facilitation can be effective in supporting GSS

appropriation and structured group decision-making, in comparison to traditional GSS groups and unsupported groups, the present research is designed to contribute to our knowledge of the viability of virtual facilitation for effectively appropriating advanced information technologies and supporting structured group decision-making.

3.2 Automated Virtual Facilitation Application

The automated virtual facilitation application (AVFA) is a multi-modal application for prescribing GSS tools to ensure proper task-technology fit, and providing appropriation support for more effectively utilizing the underlying GSS technology. The AVFA application is used in the present research to investigate the effectiveness of virtual facilitation in comparison to conventional facilitation and unsupported group decision-making to determine whether virtual facilitation can be as effective as conventional facilitation in the areas of appropriation, efficiency, and effectiveness.

As previously discussed, the AVFA application is based primarily on operationalizing a multiple-activity group decision-making heuristic, similar to the one utilized by Wheeler and Valacich in their 1996 study. Indeed, the research design described in this chapter is to a large degree adapted from that study, including the incorporation of a hidden-profile task similar to the *School of Business Policy Task* (Wheeler and Mennecke, 1992) utilized in that study. Specifically, the automated facilitation application is intended to guide subjects in faithfully following the structured group decision-making heuristic, the sequence of which provides the basic structure of the AVFA software application. As recommended by the authors, a key extension of the present study is to test an *automated* version of a multiple activity group decision-making heuristic:

GSS researchers should consider how GSSs can move beyond providing *process support* structures to *process enabling cues* to promote vigilance in information processing. One example would be embedding facilitation-like expertise into the system itself. At present, we are likely many years away from machine intelligence capable of reproducing and applying the expertise of a skilled facilitator…future GSSs with multimedia workstations might include audio messages that replicate the guidance and process restrictiveness comments from a facilitator…The GSS could periodically make announcements…(which) could be triggered via simple timers…The results of this experiment more strongly support the effects of active audio verses passive on-screen text (Wheeler and Valacich, p.447).

The AVFA application was designed to recommend GSS tools for the sequenced activities of the six-step heuristic by operationalizing the GSS fit profiles advocated by Zigurs and Buckland (1999) and Dennis and Valacich (1999).

The multi-activity group decision-making heuristic used by Wheeler and Valacich (1996) and the problem-solving model presented by Schwarz (1994) incorporate findings from the behavioral literature regarding how heuristic structures can assist groups in overcoming common obstacles to effective decision-making, including separating divergent (idea generation) and convergent (choice) phases of group activity, and writing-out an agreed upon problem statement before working on a solution (Wheeler and Valacich, p.438). Specifically, the problem-solving model used in the present research incorporates the following two major goals and six sequenced activities:

Table 12: Two-step, multiple-activity group decision-making heuristic: Adapted from Schwarz (1994) and Wheeler and Valacich (1996)

Major Goals	Sequenced Activities
1) Problem identification	Problem statement brainstorming (EB) Problem statement rating (Vote) Problem statement drafting
2) Solution recommendation	Solution brainstorming (EB) Solution rating (Vote) Solution drafting (Rate)
GSS Tool Abbreviations: EB = Electronic Brainstorming Tool, Vote = Voting Tool,	

The agenda activities prescribed by the AVFA application require the use of group decision support system features that correspond to the primary tools of the *GroupSystems* meeting support software housed in LSU's DECIDE Boardroom. GroupSystems, an outgrowth of its predecessor PLEXSYS (see page 4) is a complex, chauffer-driven "meeting room" group decision support system designed for so-called "decision room" or "meeting rooms" in which groups are gathered to brainstorm and decide upon specific issues. Group decision-making tasks such as generating "problem statements" are carried out by using the GroupSystems *Electronic Brainstorming* Tool (EB).

The AVFA software was designed to establish the meeting's agenda by specifying the specific sequence of group decision-making activities to be followed, and to specify the GSS tools to be used in carrying out each prescribed activity, including an explanation of how each tool should be used. Such *process restrictiveness* was a major focus in Wheeler and Valacich's study and their Process Restricted Adaptive Structuration Theory (PRAST) previously reviewed. In that study, the human facilitator was a "verbal version" of the printed heuristic, with the additional responsibility to "actively recognize when the group's communication exchanges deviated from the heuristic." By verbally commenting when a group attempted to unfaithfully appropriate the heuristic ("remember, the purpose of this activity is to generate problem statements, not solutions") the facilitator provided restrictiveness, but did not provide guidance pertaining to the meeting's pace or "vigilance."

While the AVFA software does not provide additional feedback regarding the meeting's pace or "vigilance," nor is it capable of recognizing deviations from the suggested decision-making activities, it is a *computerized version* of the group decision-making heuristic designed to replicate the general explanations regarding the GSS, as well as to

provide introductory comments that normally would be made by a human facilitator explaining how to use the GroupSystems application.

The AVFA software is designed to convey information pertaining to the heuristic's current goal and activity on user monitors and through audio channels. Specifically, after pre-recorded introductory scripts are played at the beginning of the experiment, a listing of each of the heuristic's activities are displayed on participants' monitors in the format shown in Figure 5 below.

Agenda activities are selected by clicking on the relevant hyperlink. Upon doing so, a pre-recorded audio message is played providing instructions for that activity, including a brief explanation of how to use the specified tool for the activity and important reminders regarding that activity's requirements. Group members have the ability to re-play a specific activity's instructions by re-clicking its hyperlink. Likewise, recorded scripts can be terminated by clicking the "current activity completed" hyperlink. In addition to transmitting audio messages to users' headphones, the AVFA application presents a summary of the current activity's instructions within the AVFA browser (see Appendix E).

Typical problems and questions regarding the use of the GroupSystems tools are addressed by a series of "frequently asked questions" (FAQ) hyperlinks, accessible at the bottom of the AVFA screen. In addition, a series of FAQs has been specifically designed to assist a designated team leader of each group, who is assigned specific tasks normally handled by the decision room facilitator or GSS "chauffer" (e.g. initiating GSS tools and transferring brainstorming results to the voting tool). Because the experiment was designed to test the ability of GroupSystems users to effectively utilize the GDSS software without assistance from human facilitators, no assistance was given to the AVFA-supported groups by the researchers after the experiment began.

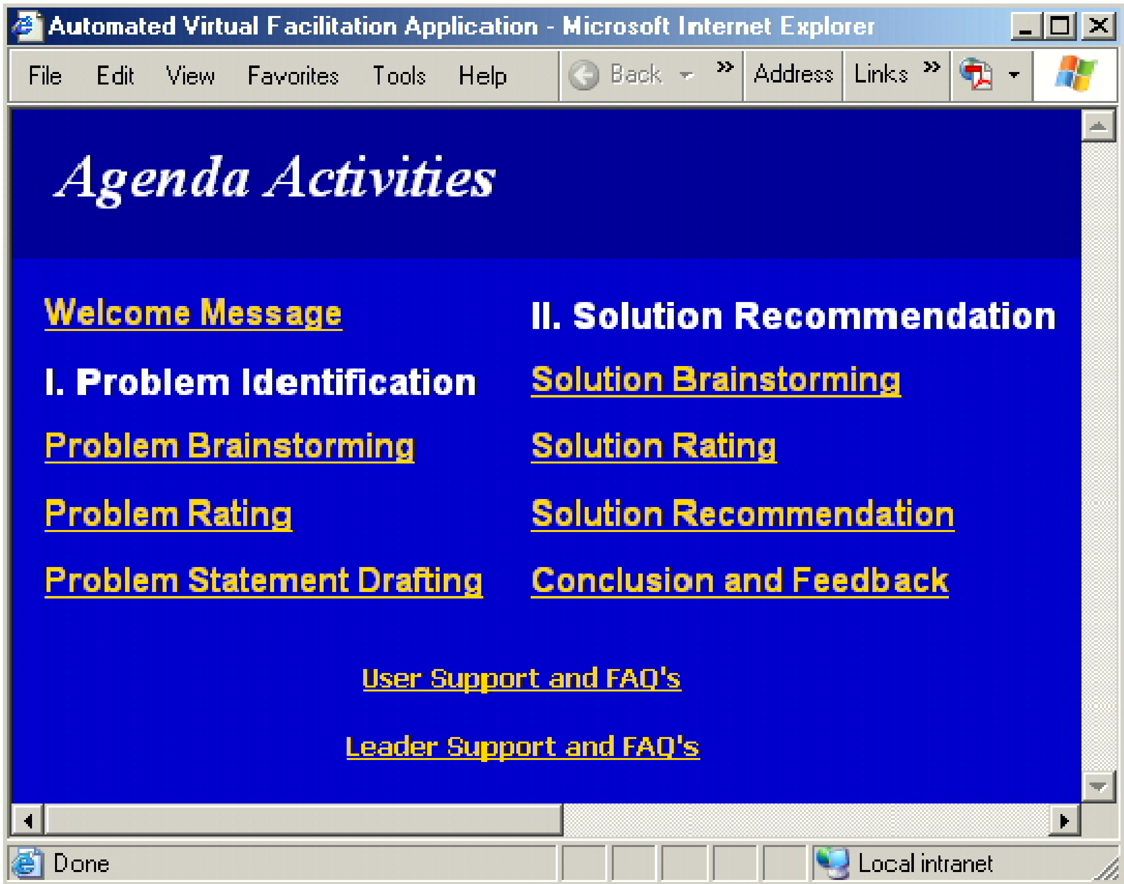

Figure 5: Automated Virtual Facilitation Application (AVFA) application interface

Pre-defined ThinkLets (Briggs 2003) and excerpts from Schwarz's problem-solving model (1994) were used as a basis for composing the pre-recorded audio scripts incorporated in the AVFA application. Upon completion of all of the activities of the six-step structured group decision-making heuristic, the AVFA application requests each subject to complete a questionnaire (Appendix B), the framework for which is described in the following sections.

3.3 Research Design

The present research is designed to examine the effectiveness of using automated facilitation for supporting the GSS appropriation process and structured group decision-making. To investigate this, a controlled laboratory experiment was designed to compare groups using the automated facilitation application (AVFA-supported groups) to groups using the GroupSystems GDSS in the conventional manner ("conventional GSS groups") and groups interacting without any computer support ("unsupported groups"). A hidden-profile task designed to compare GDSS appropriation levels, user satisfaction, and decision-making efficiency and effectiveness is utilized in the experiment using auditors, accountants, and IT security professionals as participants. The "IT Policy Task" (see below) is used to simulate an information systems audit by using a case study in which a three-person audit team is required to identify as many IT security-related problems as possible, and to formulate recommendations to address those problems. Different information is provided in each of the three case study roles, requiring effective information sharing among team members to successfully complete the assigned tasks

3.3.1 Independent Variables

The manner in which the GDSS users were supported in their utilization of the group decision support system (i.e. facilitative support) was the experiment's independent variable for examining whether virtual facilitation can be as effective as conventional GSS facilitation

in supporting GSS appropriation and structured group decision-making. As noted above and summarized in Table 13, three treatment groups (“conventional GSS groups,” “unsupported groups,” and “AVFA-supported groups”) were used to conduct the experiment. One-third of the three-person groups (“conventional GSS groups”) used the GSS in the conventional manner, with no open communication among group members, and with the same level of user instruction and facilitation that is normally provided in a conventional GSS setting. One-third of the groups (“unsupported groups”) were required to complete the hidden-profile task using manual methods, including a printed version of the group decision-making heuristic that comprises the screen content of the AVFA application. Lastly, the AVFA-supported groups were required to complete the hidden-profile task using the same agenda as conventional GSS groups and unsupported groups, but were allowed to interact openly, with facilitative support provided by the AVFA software. To test the ability of the AVFA software to autonomously direct the groups’ activities, no human assistance was provided to the AVFA-supported groups after the experiment began.

To assure uniformity of the content of the facilitative support provided to each of the three treatment groups, an identical script was read to each treatment group (see Appendix F). While the entire pre-recorded script was read to the conventional GSS groups and unsupported groups before the experiment began, the AVFA-supported groups interactively controlled the reading of the facilitation script by clicking on hyperlinks representing each agenda activity. The content of the unsupported groups’ script was amended slightly by changing the term “group decision support system” to “group decision-making heuristic.”

Table 13: Summary of treatment group requirements and key procedural details

Treatment Group	Requirements	Key Procedural Details
Conventional GSS Groups	**Required to use the GSS in the conventional manner with no open communication and be facilitated in the traditional GSS manner. Required to solve the hidden-profile task with the same agenda and tools as the AVFA-supported groups.**	1. An agenda is provided and is mandatory. 2. The AVFA script is played (with minor edits where necessary) before the groups begin completing their assigned tasks. 3. The major problems identified and the solutions proposed are written down by group members in order for participants to eliminate duplicate and very similar items.
Unsupported Groups (Manual Solution Groups)	**Required to complete the hidden-profile task using conventional methods with no GSS technology and no facilitation. A group decision-making heuristic with the same activities as the computer-supported groups (but in manual form) is provided and is mandatory.**	1. Do not use any GSS technology to complete the hidden-profile task. 2. An agenda ("decision-making heuristic") is provided is mandatory. Forms are provided to record brainstorming items and for ranking purposes. 3. No facilitation is provided by a GSS leader. 4. The AVFA script (edited to remove references to GSS tools) is played before the experiment begins. 5. The major problems identified and the solutions proposed are written down and submitted by all group members in order for participants to be able to refer to the ranked problems (with duplicate items eliminated) during the solution-generating phase.
AVFA-Facilitated Groups	**Required to complete the hidden-profile task with the same agenda as the traditional GSS groups but allowed to interact openly. Facilitated in the same manner as the unsupported teams (i.e. no human facilitator is used). Guidance is provided by the AVFA software.**	1. Groups use an automated facilitation system and not a human facilitator. 2. An agenda is provided and is mandatory. 3. Questions and problems are resolved within each group through in-group discussion or by using FAQ user-support and leader-support hyperlinks. 4. No facilitation help is available from the GSS leader in order to test the ability of AVFA groups to perform autonomously. 5. The major problems identified and the solutions proposed are written down by group members in order for participants to be able to refer to the ranked problems (with duplicate items eliminated) during the solution-generating phase.

3.3.2 GSS Technology

The experiment was conducted using the GroupSystems *Meeting Room* meeting management software located in the LSU DECIDE Boardroom. The GroupSystems tools used were the *electronic brainstorming* tool and the *voting* tool. The voting tool used the “slider” option which permits team members to assign a rating of between 1 and 10 to brainstorming items based upon their perceived significance.

3.3.3 Task

The assigned group decision-making task (“IT Policy Task”) is based on the COBIT case study “TIBO” published by the IT Governance Institute and used by permission. COBIT (Control Objectives for Information and Related Technology) is a set of internationally recognized standards for ensuring adequate control over information technology and are fundamental guidelines for addressing many of the IT control weaknesses that were presented in the case study. The assigned task involved identifying and ranking IT control weaknesses and subsequently proposing a formal recommendation to address the problems that were identified.

In adapting the TIBO case for the present research, TIBO case information was apportioned among three distinct roles for the three-person teams used in the experiment. In addition to receiving unique information, each team member also received the same background information relating to the case.

The *IT Policy Task* (Appendix A) is a *hidden profile* task patterned on the *School of Business Policy Task* developed by Wheeler and Mennecke (1992). Hidden-profile tasks are designed to distribute unique information among group members and are believed to more accurately simulate real world situations in which relevant information for completing a task

is known only by specific group members. A hidden-profile task requires all group members to participate and share information in order for the group to identify the pertinent problems and to develop a feasible solution. In structuring group decision-making experiments as hidden-profile tasks, "free riding" by one or more participants will deprive the group of information critical to identifying problems and formulating appropriate solutions. Likewise, a hidden-profile task does not state the specific problem for the group to solve, as is common with many tasks used in experimental research (Wheeler and Valacich, p.438). Indeed, multiple problems relating to IT security issues are disclosed in the IT Policy Task.

In a fashion similar to the *School of Business Policy Task*, group members in the current study were required to identify the specific IT security-related problems existing in an audit engagement and to arrive at a formal recommendation from the information uniquely held by them in their assigned group roles (audit partner, IS auditor, and internal control auditor). All groups received the same instructions and task objective. Likewise, all groups were told repeatedly that recommended solutions should be based on at least two criteria: *the solution's feasibility,* and *a solution's ability to solve as many problems as possible*. As detailed below, these criteria are the basis for evaluating the quality of each team's formal recommendations.

3.3.4 Participants

As detailed in Appendix C and summarized in Table 14, participants for the current study consisted of accountants, auditors, and IT security professionals in government, industry, and public practice, including CPAs, CIAs (certified internal auditors) and CISAs (certified information systems auditors). Participants received eight hours of continuing professional education (CPE) credit for attending a day-long seminar entitled "Using COBIT for

Complying with the Sarbanes-Oxley Section 404 Provisions," (see Appendix G) which was designed to cover many of the same IT security issues and information systems control objectives that were pertinent to developing appropriate recommendations for the assigned hidden profile task described in the previous section.

Table 14: Summary of participants by occupation

Occupation	Percentage of Total Participants
Certified Public Accountants	27.9%
Certified Internal Auditors / Internal Auditors	48.8%
IT Security Personnel	11.6%
Corporate Accountants and Controllers	11.6%

To conduct the experiment, 90 participants were recruited to comprise thirty *three-person* groups planned for the experiment (ten "conventional GSS" groups, ten "unsupported" groups, and ten "AVFA-supported" groups). Due to a number of no-shows each day, the final number of participants was less than originally anticipated, as detailed in Table 14 below. Also, because the number of participants on two of the days was not an exact multiple of three, a small number of two-person groups were used on those days. Such two-person groups were not assigned the "audit partner" role of the case study, which contains significantly less IT security-related information than the other two auditor roles, as detailed in Appendix A, which presents the actual information apportioned to each of the three auditor roles. As a result of the minimal amount of task-related content apportioned to the "audit manager" role of the IT Policy Task, the absence of this role in the two-person groups is not believed to be a significant factor in the successful completion of the assigned group tasks by such groups.

Table 15: Summary of treatment group participants by group size

Treatment Group	Total Participants	Number of 3-Person Groups	Number of 2-Person Groups	Total Number Of Groups
Conventional GSS Groups	23	7	1	8
Unsupported Groups	24	8	0	8
AVFA-Supported Groups	22	6	2	8
Totals	69	21	3	24

Table 16 presents the statistical power for the group-level samples detailed in Table 15 for conventional groups vs. unsupported groups, and AVFA groups vs. unsupported groups. Statistical power was found to be .477 for comparing AVFA groups and unsupported groups in hypothesis 3B -- the lone hypothesis supported by the data -- in which the dependent variable *problems identified* was examined. Statistical power for participant-level variables was found to range between .619 and .995 for each of the dependent measures that were studied.

Finally, it should be noted that in comparison to the pilot study conducted prior to the actual experiment, in which graduate students were used as participants, the recruited professionals demonstrated a significantly more conscientious approach to completing the assigned group tasks throughout the experiment. As result, the initial decision to use professionals as participants instead of students, as is typical in most research projects, is believed to be a critical factor in this study.

Table 16: Statistical Power for Group-Level Variable "Problems Identified"

	Means (Std. Deviations) for Dependent Measures		
	Conventional Groups	Unsupported Groups	AVFA-supported Groups
Problems Identified	15 (5.95)	5.25 (3.01)	10.57 (4.54)
Sample Size- Groups	8	8	8
Alpha Level	.05	.05	.05
Power (for comparing conventional and AVFA groups to unsupported groups)	.974		.831

3.3.5 Procedures

Participants were assigned to individual groups based upon their previous information systems auditing experience, as reported during the registration period prior to the seminars. Participants were then randomly assigned to one of the three roles of the hypothetical three-person "audit team" employed to investigate IT security issues.

Treatment group assignment was based upon the day the seminar was conducted (day one of the seminars tested conventional GSS groups; day two tested unsupported groups; and day three tested AVFA-supported groups). After participants were assigned to groups and then randomly assigned to one of the three auditor roles, each day's participants were read an identical series of introductory remarks, and were then read a series of instructions specifically tailored to each treatment group.

On the first day, "conventional GSS" groups were instructed to complete their assigned group decision-making tasks using the GroupSystems GSS in the conventional manner and were reminded of the importance that no conversation take place during the course of the experiment. They were further instructed to raise their hand to request assistance from a researcher if they encountered difficulties in using the GroupSystems GSS. To replicate the introductory discourse that takes place before normal DECIDE Boardroom meetings, the Boardroom Executive Director presented the normal introductory information regarding the GroupSystems software that is typically given to participants before beginning their use of the GroupSystems application, including:

- How agenda activities are initiated
- How brainstorming results are transferred
- How voting results can be viewed

On the second day, “unsupported” groups were instructed on how to complete their assigned group tasks. Participants were informed that they would be completing their assigned group decision-making tasks without any computer support, and that in doing so they would be using a *group decision-making heuristic* which they would need to follow as closely as possible. In completing their assigned task, they were instructed to submit two items: a listing of the most important problems that their group identified in the case study, and a set of recommendations to address the problems that they identified. They were also instructed that their entire group must take part in identifying the problems that they had uncovered in the case study, and in deciding upon which of the problems were deemed most important. Likewise, they were reminded that their entire group should take part in recommending solutions to address these problems, and in determining which recommendations were the most critical. All team members were provided worksheets for problem and solution brainstorming.

On the third day, AVFA-supported groups were instructed on the required procedures before beginning the experiment. Participants were informed as to how the AVFA application is used, including the process of clicking an agenda item’s hyperlink to hear that agenda item’s instructions and subsequently completing the assigned tasks that were explained in the pre-recorded instructions. AVFA-supported groups were also informed that they would not be allowed to ask researchers or other groups for assistance, and that any problems that might occur would need to be resolved within their own group, or by using the User FAQs, or the Leader FAQ’s that were accessible through the AVFA software’s homepage. Participants who had been assigned the “audit partner” role were designated as the team leader for each group. As such, they were required to perform the GSS management tasks that are normally

carried out by the GroupSystems facilitator or "chauffer" (e.g. initiating GSS tool usage, transferring brainstorming results to the voting tool).

3.3.6 Hypotheses

As noted, the experiment was designed to assess the effectiveness of virtual facilitation for supporting GSS appropriation and structured group decision-making, in comparison to conventionally facilitated groups and unsupported groups. As presented in Figure 6, the virtual facilitation model posits that the assigned task characteristics will indicate established task-technology fit profiles (Zigurs and Buckland, 1999; Dennis and Valacich, 1999) and appropriate group problem-solving models (Briggs, DeVreede Nunamaker 2003). These, in turn, will dictate appropriate GSS tools and group decision-making procedures ("meeting agendas") to be employed in addressing assigned group decision-making tasks. Through this process, virtual facilitation is posited to result in efficiency levels, appropriation measures, and decision-making performance metrics that are equal to those achieved through conventional facilitation, and greater than those achieved by unsupported groups. As such, the virtual facilitation model regards task-technology fit as a necessary, though not sufficient prerequisite for effective GSS performance. Accordingly, as presented in Chapter 1, the following hypotheses are posited:

HYPOTHESIS 1: AVFA-supported groups will be equally efficient as conventional GSS groups and more efficient than unsupported groups.

H1A: Conventional GSS groups and AVFA-supported groups will be more efficient in completing their meeting agenda than unsupported groups.

HYPOTHESIS 2: Appropriation levels will be equal for conventional GSS groups and AVFA-supported groups

H2A: Faithfulness of appropriation will be equal for conventional GSS groups and AVFA-supported groups

H2B: Attitudes towards use will be equal for conventional GSS groups and AVFA-supported groups

HYPOTHESIS 3: Decision-making effectiveness will be equal for conventional GSS groups and AVFA-supported groups and greater than unsupported groups:

H3A: Decision quality will be equal for conventional GSS groups and AVFA-supported groups and higher than unsupported groups.

H3B: Conventional GSS groups and AVFA-supported groups will generate an equal number of ideas/alternatives and more ideas/alternatives than unsupported groups.

H3C: Satisfaction with the meeting process will be equal for conventional GSS groups and AVFA-supported groups and higher than for unsupported groups.

H3D: Satisfaction with the meeting outcome will be equal for conventional GSS groups and AVFA-supported groups and higher than for unsupported groups.

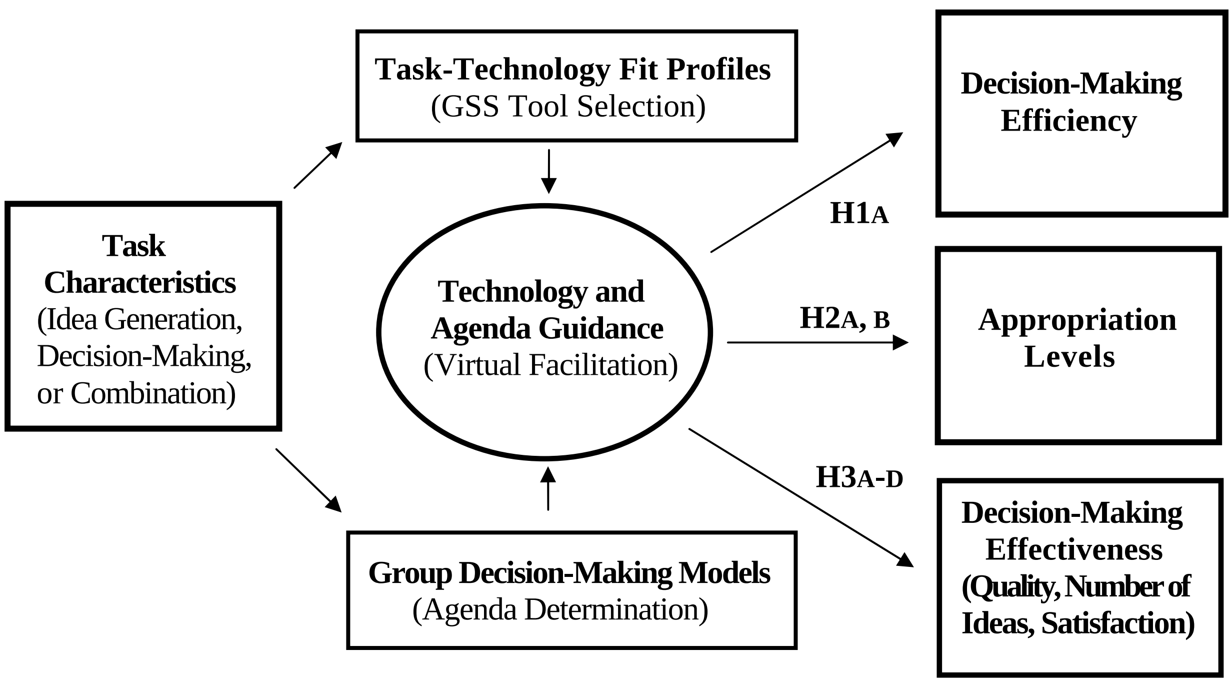

Figure 6: Virtual Facilitation Model

3.3.7 Dependent Variables

Table 17 summarizes the dependent variables used for measuring the effectiveness of virtual facilitation in supporting GSS appropriation and structured group decision-making. Decision-making efficiency, decision quality, and the number of ideas and alternatives suggested by group members were used to measure *group-level* performance. Appropriation measures (faithfulness of appropriation and attitudes towards use) and user satisfaction metrics were used to measure *participant-level* variables obtained through questionnaires. Section 3.39 provides detailed descriptions of how each dependent variable was measured.

Table 17: Dependent variables used to measure effectiveness of virtual facilitation

HYP.	Dependent Variable	Operationalized Measure
H1A	Efficiency	Time required to complete the meeting agenda
H2A	Faithfulness of appropriation	Chin, Gopal and Salisbury (1997) scale to measure faithfulness of appropriation
H2B	Attitudes Towards Use	Sambamurthy and Chin (1994) scales to measure attitudes toward GDSS designs (perceived ease of use, perceived usefulness, and extensiveness of use)
H3A	Decision quality	Wheeler and Valacich's (1996) approach in which each group's solution is scored on two indices: degree to which solution solves multiple problems (*breadth*); and extent to which solution is *feasible* (scale of 0 to 100 points each).
H3B	Number of ideas/alternatives	Total problems identified and solutions recommended by each group
H3C	Satisfaction with meeting process	Briggs et al. (2003) A Theory and Measurement of Meeting Satisfaction post-session questionnaire
H3D	Satisfaction with meeting outcome	Briggs et al. (2003) A Theory and Measurement of Meeting Satisfaction post-session questionnaire

3.3.8 Instruments

The instruments used for this research are Chin, Gopal and Salisbury's (1997) scale to measure *faithfulness of appropriation*; Sambamurthy and Chin's (1994) scales to measure attitudes toward group decision support systems designs (perceived ease of use, perceived usefulness, and extensiveness of use), all of which are used to measure individual perceptions

regarding appropriation of the group decision support system. Briggs, de Vreede and Reinig's (2003) instruments are employed to measure satisfaction with the meeting process and satisfaction with the meeting outcome, both of which are used in part for measuring overall decision-making effectiveness. Appendix B includes each of the instruments used to obtain participant feedback, as well as the Likert scoring system used to quantify questionnaire results.

3.3.9 Scoring and Statistical Analysis

Scoring for group-level dependent variables (efficiency, problems identified, solutions recommended, and decision quality) was determined as follows: Decision-making *efficiency* (Hypothesis 1A) was determined by the total minutes required to complete the entire meeting agenda. Timing for all treatment groups started immediately before each group listened to pre-recorded scripts describing the assigned group task and the GSS tools to be used, and prior to participants reading the case study. Conventional GSS groups and unsupported groups were played the entire script prior to reading the case study, while AVFA-supported groups listened to portions of the script before beginning an activity described in that particular script. Timing of each group ended when the formal recommendation was completed and the group entered the time shown on their monitor's clock.

The *number of problems identified* and *solutions recommended* (Hypothesis 3B) was determined by the number of such items submitted by each group for problem identification and solution recommendations. To evaluate the *quality* of the recommendations submitted by each group (Hypothesis 3A), an approach similar to that used by Wheeler and Valacich (1996) was adopted. Under that approach, each group's recommended solution was scored on two distinct criteria which participants were informed of on several occasions: the degree to which a recommended solution addresses multiple problems presented in the case study

(breadth); and the extent to which the recommended solution is *feasible*. Both indices were scored by three graders on a scale of 0 to 100 points each, with the score on each index combined to arrive at a composite index for decision quality of between 0 and 200. Finally, each recommendation's three scores are averaged to arrive at a final score for decision quality for each recommendation.

As detailed in Appendix B, data for the *participant-level* dependent variables was obtained through the questionnaires described in section 3.38 and included in Appendix B. Scoring for participant-level dependent variables was determined by adding the Likert score for each questionnaire item and obtaining a composite score for each dependent measure, using the seven-point scales provided for each of the four research instruments utilized.

All statistical analyses were conducted using the Independent-Samples t-test which compares mean scores of two groups on a given dependent variables. Levene's Test was used to test equality of variances for all dependent variables, the results of which are shown in Table 19. Where Levene's Test indicated homogeneous variances for the dependent variables tested (Levene significance level > .05), reported t-Test results are those based on the assumption of equal variances. Where Levene Tests indicated non-homogeneous variances, (Levene significance level < .05), reported t-test results are those based on the assumption of unequal variances.

For each hypothesis, mean scores for the relevant dependent variable were compared among the applicable treatment groups. Based on the structure of the study's hypotheses (dependent measures will be equal for conventional GSS groups and AVFA-supported groups), the primary analysis for each hypothesis consists of a comparison between conventional GSS groups and AVFA-supported groups to determine whether dependent variables for each group are in fact equal. A secondary analysis was performed comparing conventional GSS groups and AVFA-

supported with unsupported groups to determine whether computer-supported groups performed better than unsupported groups for each of the dependent variables examined. Unsupported groups were not included in comparisons of dependent variables representing appropriation measures.

The Independent Samples t-test formula used in comparisons among treatment groups is shown below, where the x-bar terms represent mean values of the relevant dependent variable for the applicable treatment groups. The statistical analyses that were performed are summarized in Table 18.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}}$$

Table 18: Statistical analyses performed using Independent Samples t-tests

<table>
<tr><th>Dependent Variable</th><th>Primary Comparison</th><th>Secondary Comparisons</th></tr>
<tr><td>Efficiency</td><td rowspan="11">AVFA-Supported Groups
vs.
Conventional GSS Groups</td><td rowspan="6">AVFA-Supported Group vs. Unsupported Groups

Conventional GSS Groups vs. Unsupported Groups</td></tr>
<tr><td>Decision Quality</td></tr>
<tr><td>Problems Identified</td></tr>
<tr><td>Solutions Recommended</td></tr>
<tr><td>Satisfaction with Meeting Process</td></tr>
<tr><td>Satisfaction with Meeting Outcome</td></tr>
<tr><td>Faithfulness of Appropriation</td><td rowspan="5">N/A [4]</td></tr>
<tr><td>Perceived Ease of Use</td></tr>
<tr><td>Perceived Usefulness</td></tr>
<tr><td>Extensiveness of Use</td></tr>
<tr><td>Attitude Towards Use (Composite)</td></tr>
</table>

Through this comparative approach, the study's primary research question (*can virtual facilitation be as effective as conventional facilitation in supporting GDSS appropriation and structured group decision-making)* is effectively addressed: The results of the comparative analysis are presented in chapter 4.

4. Unsupported groups were not included in comparisons of dependent variables representing appropriation measures, due to the fact that such measures are related to the utilization of advanced information technologies, which were not used by the unsupported groups in completing their assigned group decision-making tasks.

CHAPTER 4

RESULTS

4.1 Introduction

Presented in this chapter are the results of the experiment conducted to determine the effectiveness of virtual facilitation in supporting GSS appropriation and structured group decision making. Specifically, the effects of virtual facilitation on efficiency, appropriation levels and effectiveness, in comparison to conventional GSS groups and unsupported groups are presented, with each of the relevant hypotheses addressed throughout the chapter.

Effects on decision-making efficiency are addressed in Hypothesis 1A, while effects on appropriation levels (faithfulness of appropriation and attitudes towards use) are addressed in Hypotheses 2A and 2B. Decision-making effectiveness (decision quality, number of ideas/alternatives generated, satisfaction with the meeting process, and satisfaction with the meeting outcome) are addressed in Hypotheses 3A through 3D respectively. Hypotheses relating to group-level measures (efficiency, number of ideas/alternatives generated, and decision quality) are addressed first, while hypotheses relating to participant-level measures (faithfulness of appropriation, user attitudes, and satisfaction levels) are addressed in latter sections. Following that, a qualitative analysis is included in which participant's responses to questions regarding the GroupSystems and AVFA software are presented. In the final section, analysis of video tapes of the experiment is discussed.

4.2 Statistical Analysis

Prior to performing the quantitative analyses described below, the statistical assumptions underlying the analytical tests were verified. The assumption of independence was satisfied by the random assignment of participants to teams and then to

one of the three assigned auditor roles in the group decision-making task. While each team was intentionally balanced in terms of IS audit experience by assigning participants to teams on the basis terms of prior information systems auditing experience, assignment of participants to individual teams and to auditor roles within the teams was on a purely random basis.

The assumption of normality was tested using the Kolmogorov-Smirnov and Shapiro-Wilk Tests of Normality. As indicated in Table 19, significance levels for all variables tested exceeded the .05 critical value for significance levels, resulting in the assumption of normality being satisfied for each of the twelve dependent variables examined in the study.

Table 19: Kolmogorov-Smirnov and Shapiro-Wilk Tests of Normality

Dependent Variable	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Efficiency	0.109	22	0.2	0.975	22	0.823
Decision Quality	0.137	22	0.2	0.965	22	0.591
Number of Problems Identified	0.116	22	0.2	0.928	22	0.11
Number of Solutions Recommended	0.159	22	0.153	0.934	22	0.147
Faithfulness of Appropriation	0.111	22	0.2	0.964	22	0.572
Perceived Ease of Use	0.114	22	0.2	0.958	22	0.45
Perceived Usefulness	0.115	22	0.2	0.951	22	0.331
Extensiveness of Use	0.124	22	0.2	0.955	22	0.398
Attitudes Towards Use (Composite)	0.152	22	0.2	0.926	22	0.104
Satisfaction with Meeting Process	0.147	22	0.2	0.933	22	0.144
Satisfaction with Meeting Outcome	0.157	22	0.169	0.935	22	0.155
AVFA Favorability Rating	0.118	22	0.2	0.987	22	0.988

Homogeneity of variance was the final assumption tested. Levene's Test for Equality of Variances was performed for each of the dependent variables using the treatment group comparisons specified in the hypotheses. Where Levene's Test indicated homogeneous variances (Levene significance level > .05), reported t-test results are those based on the assumption of equal variances. Where Levene Tests indicate non-homogeneous variances, (Levene significance level < .05), reported t-test results are those based on the assumption of unequal variances. Levene's Test results are shown in Table 20.

Table 20: Results of Levene's Test for Equality of Variances

Dependent Variable	AVFA Groups vs. Conventional Groups Sig.	AVFA Groups vs. Unsupported Groups Sig.	Conventional vs. Unsupported Groups Sig.
Efficiency	0.238	0.625	0.412
Decision Quality	0.028	0.695	0.131
Number of Problems	0.304	0.272	0.032
Number of Solutions	0.885	0.036	0.058
Faithfulness of Appropriation	0.208	0.016	0.138
Perceived Ease of Use	0.095	0.006	0.261
Perceived Usefulness	0.759	0.118	0.067
Extensiveness of Use	0.427	0.331	0.744
Attitudes Towards Use (Composite)	0.413	0.185	0.630
Satisfaction with Meeting Process	0.812	0.007	0.006
Satisfaction with Meeting Outcome	0.992	0.536	0.545

4.2.1 Analysis of Group-Level Performance

This section presents results of Independent Samples t-tests of *group-level* performance measures, namely: efficiency, decision quality, and ideas/alternatives generated. In each analysis, the primary comparison is between AVFA-supported groups and conventional GSS groups. Secondary comparisons shown are between AVFA groups and unsupported groups, as well as between conventional GSS groups and unsupported groups.

Table 21 presents Independent Samples t-test results of comparisons among treatment groups for the dependent variable *decision-making efficiency*. Column one specifies the treatment groups compared in Table 21, and in all such tables presented in this chapter. Column two of Table 21 presents the average number of minutes required to complete the assigned meeting agenda for conventional GSS groups, unsupported groups, and AVFA-supported groups. Column three presents standard deviations for the dependent variable data presented in column two. Column four shows the significance levels (p-values) of the Independent Samples t-test that was conducted in comparing conventional GSS groups and AVFA-supported groups. Finally, column five shows significance levels of t-test comparisons between conventional GSS groups and unsupported groups on the top row of the column, as well as significance levels of t-test comparisons between AVFA-supported groups and unsupported groups on the bottom row of the column.

As indicated in Table 21, AVFA-supported groups required more time than both conventional GSS groups and unsupported groups. However, differences between conventional GSS groups and AVFA-supported groups were not found to be significant ($p= .096$) in the Independent-Samples t-test conducted. Efficiency levels for conventional

GSS groups and unsupported groups were likewise not significantly different (p=.931), nor were efficiency levels for AFVA-supported groups and unsupported groups significantly different (p= .127).

Thus, while AVFA-supported groups were not significantly different from conventional GSS groups in efficiency ratings, as posited in Hypothesis 1A, AVFA-supported groups were less efficient than unsupported groups. Accordingly, Hypothesis 1A (Conventional GSS groups and AVFA-supported groups will be more efficient in completing their meeting agenda than unsupported groups) was not supported by the experiment's results.

Table 21: Efficiency of Groups in Completing Meeting Agenda

<table>
<tr><th>Treatment Group</th><th>Mean Time Required to Complete Agenda (Minutes)</th><th>Standard Deviation</th><th>Sig. (2-tailed) Conventional GSS Groups vs. AVFA Groups</th><th>Sig. (2-tailed) Conventional Groups and AVFA Groups vs. Unsupported Groups</th></tr>
<tr><td>Conventional GSS Groups</td><td>108.6</td><td>21.3</td><td rowspan="3">.096</td><td rowspan="2">.931</td></tr>
<tr><td>Unsupported Groups</td><td>109.6</td><td>23.9</td></tr>
<tr><td>AVFA-Supported Groups</td><td>131.0</td><td>26.9</td><td>.127</td></tr>
</table>

The second dependent variable examined in the present study was the *quality* of the recommendation submitted by each of the conventional GSS groups, unsupported groups, and AVFA-supported groups. As previously noted, decision quality was evaluated on the basis of the recommendation's *breadth* (number of problems that the recommendation would effectively address) and *feasibility* (ability to effectively implement a proposed recommendation). As in the Wheeler and Valacich (1996) study, a score of 0 to 100 was

assigned for each decision quality component, for a maximum score of 200 points for each team's submitted recommendation.

In tests of inter-rater reliability, scoring profiles for the three graders employed to evaluate the submitted recommendations (two Louisiana State University Accounting faculty members and an Accounting PhD candidate) were found to be significantly correlated, as indicated in Table 22. In the Reliability Analysis performed using the two-way mixed effect model, the single measure Intraclass Correlation Coefficient was found to be .7119 (p = .0000), indicating a highly significant level of agreement among the three graders in evaluating the decision quality of each team's submitted recommendation. While correlations between raters ranged between .5711 and .8691, as shown in the correlation matrix, single measure and average measure intraclass correlation were .7119 and .8812 respectively, confirming the high degree of correlation among the three raters.

Table 22: Reliability Analysis

	Mean Score	Std Dev	Cases
Scorer 1	129.6364	38.5086	22.0
Scorer 2	148.8636	34.2585	22.0
Scorer 3	136.6591	26.6222	22.0

Correlation Matrix

	Scorer 1	Scorer 2	Scorer 3
Scorer 1	1.0000		
Scorer 2	.5711	1.0000	
Scorer 3	.8290	.8691	1.0000

Intraclass Correlation Coefficient

Two-Way Mixed Effect Model (Consistency Definition):
People Effect Random, Measure Effect Fixed
Single Measure Intraclass Correlation = .7119*
F = 8.4145 DF = (21, 42.0) Sig. =.0000 (Test Value = .0000)
Average Measure Intraclass Correlation = .8812**
F = 8.4145 DF = (21, 42.0) Sig. =.0000 (Test Value = .0000)

As indicated in Table 23, conventional GSS groups and AVFA-supported groups were statistically comparable in decision quality. The average decision quality for conventional GSS groups was found to be 148.8, while the average decision quality for unsupported groups and AVFA-supported groups were 133.6 and 128.1, respectively. AVFA-supported groups scored lower in decision quality than conventional GSS groups, though not significantly (p=.145). Likewise, AVFA-supported groups also scored lower than unsupported groups. Accordingly, Hypothesis H3A (decision quality will be equal for conventional GSS groups and AVFA-supported groups and higher than unsupported groups) was not supported by the experiment's results.

Table 23: Decision Quality of Team Recommendations

Treatment Group	Mean Decision Quality Score	Standard Deviation	Sig. (2-tailed) Conventional GSS Groups vs. AVFA Groups	Sig. (2-tailed) Conventional Groups and AVFA Groups vs. Unsupported Groups
Conventional GSS Groups	148.8	12.9	.145	.238
Unsupported Groups	133.6	30.2		
AVFA-Supported Groups	128.1	31.3		.737

As indicated in Table 24 and 25, conventional GSS groups and AVFA-supported groups submitted significantly more problems and solutions than unsupported groups. Table 24 shows that conventional GSS groups and AVFA-supported groups submitted an average of 15 and 10.6 problems respectively. Though the average number of problems submitted by conventional GSS groups and AVFA-supported groups were not significantly different (p=.134), both groups submitted significantly more problems than unsupported groups who

submitted an average of only 5.2 problems per group. Likewise, while conventional GSS groups submitted slightly more solutions than AVFA-supported groups (9.4 vs. 8.9), the disparity between both groups was not statistically significant. Accordingly, Hypothesis 3B (conventional GSS groups and AVFA-supported groups will generate an equal number of ideas/alternatives and more ideas/alternatives than unsupported groups) was supported by the findings.

Table 24: Average Number of Problems Identified by Treatment Groups

Treatment Group	Mean Number of Problems Identified	Standard Deviation	Sig. (2-tailed) Conventional GSS Groups vs. AVFA Groups	Sig. (2-tailed) Conventional Groups and AVFA Groups vs. Unsupported Groups
Conventional GSS Groups	15.0	5.95	.134	.002
Unsupported Groups	5.2	3.01		
AVFA-Supported Groups	10.6	4.54		.018

Table 25: Average Number of Solutions Recommended by Treatment Groups

Treatment Group	Mean Number of Solutions Recommended	Standard Deviation	Sig. (2-tailed) Conventional GSS Groups vs. AVFA Groups	Sig. (2-tailed) Conventional Groups and AVFA Groups vs. Unsupported Groups
Conventional GSS Groups	9.4	3.70	.782	.001
Unsupported Groups	3.7	1.58		
AVFA-Supported Groups	8.9	3.34		.006

In spite of only Hypotheses 3B being supported in the analysis of group-level hypotheses, AVFA-supported groups were found to be not significantly different from conventional GSS groups for each of the three *group-level* dependent variables examined: efficiency, decision quality, and number of ideas/alternatives generated – thus supporting this study's contention that virtual facilitation can be as effective as conventional facilitation in supporting structured group decision making. *Participant-level* measures are analyzed in the following section.

4.2.2 Analysis of Participant-Level Responses

In this section, results of the statistical analyses examining *participant-level* dependent variables are presented. As in the previous section, all analyses were conducted using independent-samples t-tests comparing AVFA-supported groups with conventional GSS groups as the primary focus. In the secondary comparison, AVFA groups are compared with unsupported groups, and conventional GSS groups are likewise compared with unsupported groups.

Because appropriation measures relate specifically to the effective *utilization of* and *attitudes towards* advanced information technologies, t-test comparisons for appropriation measures were conducted only between conventional GSS groups and AVFA-supported groups, and do not include comparisons with unsupported groups.

As previously noted, Hypothesis 2 posits that appropriation levels will be equal for conventional GSS group members and AVFA-supported group members. However, as Tables 26 indicates, faithfulness of appropriation (FOA) levels were significantly lower for AVFA-supported groups than for conventional GSS groups ($p=.020$). Accordingly, hypothesis H2A (faithfulness of appropriation measures will be equal for conventional GSS

group members and AVFA-supported group members) was not supported by the experiment's results.

Table 26: Faithfulness of Appropriation

Treatment Group	Mean Faithfulness of Appropriation Score	Standard Deviation	Sig. (2-tailed) Conventional GSS Groups vs. AVFA Groups
Conventional GSS Groups	27.7	5.83	.020
AVFA-Supported Groups	22.8	7.71	

In other measures of appropriation, AVFA-supported group members were likewise found to score lower than conventional GSS group members. As indicated in Table 27, AVFA-supported groups were found to score significantly lower in *perceived ease of use* measures than conventional GSS group members (p=.023).

Table 27: Perceived Ease of Use

Treatment Group	Mean Perceived Ease of Use Score	Standard Deviation	Sig. (2-tailed) Conventional GSS Groups vs. AVFA Groups
Conventional GSS Groups	25.0	5.90	.023
AVFA-Supported Groups	20.2	7.71	

Conversely, *perceived usefulness* scores were found to be lower for conventional GSS group members than for AVFA-supported group members, though not significantly (p=.093), as indicated in Table 28.

Table 28: Perceived Usefulness

Treatment Group	Mean Perceived Usefulness Score	Standard Deviation	Sig. (2-tailed) Conventional GSS Groups vs. AVFA Groups
Conventional GSS Groups	16.65	4.73	.093
AVFA-Supported Groups	19.00	4.43	

In the final component measure of the "attitudes towards use" composite score, *extensiveness of use* scores were found to be virtually identical for both conventional group members and AVFA-supported group members (p=.912)

Table 29: Extensiveness of Use

Treatment Group	Mean Extensiveness of Use Score	Standard Deviation	Sig. (2-tailed) Conventional GSS Groups vs. AVFA Groups
Conventional GSS Groups	18.48	5.57	.912
AVFA-Supported Groups	18.32	3.83	

When combined, the three component measures (perceived usefulness, perceived ease of use, and extensiveness of use) form a composite measure of GSS appropriation representing *attitudes towards use* of the GSS application. As indicated in Table 30, conventional GSS group members and AVFA-supported group members were found to be not significantly different (p=.496) for this composite measure of GSS appropriation. Accordingly, Hypothesis

H2B (attitudes towards use will be equal for conventional GSS group members and AVFA-supported group members) was supported by the data, as indicated in Table 30.

Table 30: Attitudes Towards Use (Composite Score)

Treatment Group	Mean Attitudes Towards Use Score	Standard Deviation	Sig. (2-tailed) Conventional GSS Groups vs. AVFA Groups
Conventional GSS Groups	60.17	12.50	.496
AVFA-Supported Groups	57.55	13.19	

Hypotheses 3C and 3D relate to participants' satisfaction with the meeting's process and outcome, positing that conventional GSS and AVFA-supported group members will be equally satisfied with the meeting's process, and will also be more satisfied than unsupported groups. Scores for satisfaction with the meeting's process were calculated by adding the individual item Likert scores in the Briggs et al. post-session questionnaire, as shown on pages 180 and 181.

While conventional GSS and AVFA-supported group members were found to be equally satisfied with the meeting process in the t-tests performed (p=.421), unsupported group members were found to be significantly more satisfied with the meeting's process, as indicated in Table 31. Accordingly, Hypothesis 3C (satisfaction with the meeting process will be equal for conventional GSS group members and AVFA-supported group members and higher than for unsupported group members) was not supported by the data.

Table 31: Satisfaction with Meeting Process

Treatment Group	Mean Satisfaction with Meeting Process Score	Standard Deviation	Sig. (2-tailed) Conventional GSS Groups vs. AVFA Groups	Sig. (2-tailed) Conventional Groups and AVFA Groups vs. Unsupported Groups
Conventional GSS Groups	23.6	6.75	.421	.000
Unsupported Groups	30.5	3.82		
AVFA-Supported Groups	25.3	7.36		.006

Satisfaction with the meeting's outcome was posited in Hypothesis 3D. As indicated in Table 32, satisfaction levels were not significantly different for conventional GSS group members and AVFA-supported group members (p=.829). However, members of both groups were found to be less satisfied with the meeting's outcome than were unsupported group members, as indicated in Table 32. Accordingly, Hypothesis 3D (satisfaction with the meeting outcome will be equal for conventional GSS group members and AVFA-supported group members and higher than for unsupported group members) was not supported by the data.

Table 32: Satisfaction with Meeting Outcome

Treatment Group	Mean Satisfaction with Meeting Outcome Score	Standard Deviation	Sig. (2-tailed) Conventional GSS Groups vs. AVFA Groups	Sig. (2-tailed) Conventional Groups and AVFA Groups vs. Unsupported Groups
Conventional GSS Groups	24.3	6.63	.829	.037
Unsupported Groups	28.7	7.36		
AVFA-Supported Groups	24.7	6.44		.058

As summarized in Table 33, conventional GSS groups and AVFA-supported groups were found to be not significantly different in all *summary* dependent measures, with the exception of faithfulness of appropriation. Unsupported groups were found to be higher than both conventional GSS groups and AVFA-supported groups in satisfaction levels.

Table 33: Summary of Quantitative Analysis

Hypothesis	Outcome	Actual Effect
1A: Efficiency - Conventional and AVFA-supported groups equally efficient, and more efficient than unsupported groups	Not supported	No significant difference in efficiency levels of groups.
2A: Faithfulness of Appropriation - Faithfulness of appropriation equal for conventional and AVFA-supported groups	Not supported	AVFA groups lower than conventional groups in faithfulness of appropriation
2B: Attitudes Towards Use (composite) No significant difference between conventional GSS groups and AVFA-supported groups	Supported	
3A: Decision Quality – Higher decision quality for conventional and AVFA-supported groups than for unsupported groups	Not Supported	All groups equivalent in decision quality
3B: Number of Ideas and Alternatives Conventional and AVFA-supported groups will generate more ideas than unsupported groups	Supported	
3C: Satisfaction with Meeting Process Conventional and AVFA-supported groups will be more satisfied than unsupported groups	Not supported	Conventional and AVFA groups equally satisfied but less satisfied than unsupported groups
3D: Satisfaction with Meeting Outcome Conventional and AVFA-supported groups will be more satisfied than unsupported groups	Not supported	Conventional and AVFA groups equally satisfied but less satisfied than unsupported groups

In spite of the statistical results failing to support all but two of the study's hypotheses, the quantitative results generally support the contention that virtual facilitation can be as effective as conventional facilitation in supporting GSS appropriation and structured group decision-making.

The following sections present a supplemental analysis designed to further evaluate the effectiveness of virtual facilitation. Using feedback from the research participants

obtained through a post-session questionnaire, the supplemental analysis presented below is designed to further assess the effectiveness of the AVFA application and the GroupSystems GDSS to determine whether virtual facilitation can be as effective as conventional facilitation in supporting GDSS appropriation and structured group decision-making.

4.3 Supplemental Analysis

Presented in the following section is a review of the questionnaire responses received from participants who were present when the virtual facilitation application was tested on the final day of the experiment. Following that section, a discussion of the observed behavior patterns of the research participants completing their assigned decision-making tasks is presented, based on an analysis of the video tapes recorded throughout the three days of the experiment.

4.3.1 Questionnaire Responses

In a post-session questionnaire e-mailed to AVFA-supported group members in the week after the experiment, the following six questions were asked of participants:

1. What were the biggest problems that you encountered in using the GroupSystems software?
2. What problems did you encounter in using the automated facilitation system?
3. How could the GroupSystems software be made easier to use?
4. How could the automated facilitation application be more effective?
5. Were the FAQs used in the facilitation application helpful, and did you utilize them much?
6. Were there any questions that you had in using the GroupSystems software that were not covered in the FAQ's?

Many of the problems reported by participants relating to their use of the GroupSystems application were related to the system's inherent complexity and the fact that it is perceived as being not very user-friendly or intuitive. Comments such as the

following were fairly typical of problems encountered by respondents in using the GroupSystems software:

- "It didn't seem to be very user friendly. It took a while to figure out how to get things accomplished."
- "Rigid rules, workflow, and icons were not intuitive"
- "Just not user friendly, even a very experienced person in our group had difficulty. Too many steps to go through for the leader to let the group in, we were kicked off one time trying to record scores and never determined how it happened. Could not get back to our answers easily when time to score"
- "It was difficult to move around in the program and find what you wanted."
- "Maneuvering around in it" (was the biggest problem)
- "When typing/entering a problem (and solution for that matter), the system would 'jump' you to another page, thus requiring you to navigate back to the page where you were entering your problems. That was annoying."
- "Unable to delete something (problem/solution) that was entered (prior to submitting the whole list to the 'Leader')"

The "user-friendly" issue was perhaps the one overriding factor adversely impacting users in effectively appropriating the GroupSystems GDSS software. Due to the lack of a simple and intuitive user interface, the GroupSystems software did not allow participants to readily determine how to correctly use the GDSS application. Moreover, because the GroupSystems software was designed primarily as a "chauffeur-driven" system, in which a GDSS leader is available to answer questions, address user problems, and guide group members in properly using the software, attempts at using it as an "end-user" application without such "live" support proved problematic.

Because the AVFA-supported groups were not given any assistance after the experiment began, the complexity of the GroupSystems GDSS was exacerbated to a large

degree. Indeed, relatively simple issues that arose in using the GroupSystems software that would normally be resolved in moments with the assistance of a trained GDSS leader, required minutes to resolve, through either trial and error, or by referring to the "frequently asked questions" (FAQ's) that were provided to address contemplated problems. When unique problems arose which were not addressed by the FAQs, or when participants failed to refer to them for problems that arose, the result was generally several minutes of inactivity, in which users attempted to work around obstacles prohibiting their effective utilization of the GDSS system. Had the GroupSystems software been more readily adaptable to end-user navigation and control, the time required by AVFA-supported groups to complete their assigned tasks would likely have been significantly less.

The rigid rules and work flow also were significant obstacles in the effective utilization of the GDSS software. Because the GroupSystems application often requires specific keystrokes and other strict procedural requirements, any deviations from the required sequence of keystrokes results in error messages or a stoppage in the operation of the program. Likewise, rigid work flow requirements imposed by the GroupSystems software often prohibit operation of the application in any manner other than what is specifically required. Indeed, even minor deviations form the GroupSystems workflow requirements often resulted in the system failing to function at all. Contributing to these problems was a lack of intuitive icons which accurately describe the functionality represented. When combined, these deficiencies proved to be a significant hindrance to users more effectively appropriating the GroupSystems software.

As further evidence of this complexity, participants who had previous experience in using electronic meeting systems had considerable difficulty in utilizing the GroupSystems

software. In particular, cumbersome requirements for admitting users and for completing assigned tasks proved particularly burdensome to participants. Complaints that the GDSS software required too many steps to go through to perform relatively simple functions were indicative of excessively rigid operating requirements of the GroupSystems application. Incidents of groups being prematurely terminated in completing assigned tasks were further evidence of the difficulties encountered by participants. In particular, transferring brainstorming results to the voting tool proved to be an especially challenging task for AVFA-supported groups. Because no assistance was provided by the researchers for completing this task, data was either lost or significant delays occurred due to the complexity of transferring results from one GroupSystems process to a subsequent one. In addition, participants were often unsure of what may have transpired after experiencing a malfunction of the system, resulting in increased levels of frustration and inefficiency.

Effective navigation within the GroupSystems software also proved to be problematic. Incidents of participants experiencing difficulties in navigating from brainstorming tools to voting tools, and vie versa, were further evidence of an overall lack of user-friendliness of the GroupSystems GDSS. Problems in locating specific GSS tools were also reported by participants, resulting in lower efficiencies in completing assigned group tasks, and significant obstacles in effectively appropriating the software.

Incidents of participants being inadvertently transferred to another screen were also reported. Because such malfunctions would require participants to navigate back to their original location, the time required to complete the assigned tasks was significantly impacted. Perhaps more importantly, user frustration resulting from such occurrences led to considerable frustration among users who were required to navigate back to their original position, and re-

enter data that was previously completed. Finally, complaints that participants were unable to delete brainstorming items once they had been entered, was further evidence of the inflexibility of the GroupSystems GDSS.

The questionnaire responses thus support the contention that the inherent complexity of the GroupSystems software may well have been a significant factor in the research results presented in the preceding section. Specifically, due to the complexity of the GroupSystems software, effective appropriation of the GDSS application by participants appears to have been significantly impacted. As a result, it is highly likely that faithfulness of appropriation, attitudes towards use, and satisfaction with the meeting process were adversely impacted by the complexity of the GroupSystems software.

Problems encountered by participants in using the automated virtual facilitation application were primarily related to difficulties in navigating between the AVFA application and the GroupSystems application, as well as a perceived shortage of FAQ's for unanticipated problems encountered in using the GroupSystems software. Following are some of the comments received from participants regarding these issues:

- "Moving between the two programs was difficult"
- "Cumbersome moving back and forth between two applications"
- "Commands were not universal with programs normally operated. Alternating between systems did not terminate the instructions; they could only be terminated by clicking the command to end the instructions."
- "Did not have sufficient answers to issues."
- "No indication of where you are in the process (what you had already completed and what there was left to do). I found the long narrative format of the FAQs cumbersome and time consuming to read."
- "Other than the FAQ being insufficient, none"

While navigation between the GroupSystems application and AVFA software required users to click the appropriate application button at the bottom of their screens, as is required to move between any Windows applications, the lack of a more integrated mechanism for doing so resulted in increased inefficiency among some users. Also, alternating between applications did not terminate the current AVFA audio track, resulting in the instructions for a previous task being read while users were attempting to perform subsequent tasks.

A lack of FAQ answers to unanticipated questions also proved to be a problem for certain participants. Although all problems were attempted to be addressed in formulating the FAQ's, the numerous difficulties in operating the GroupSystems application created a much greater need for a significantly expanded range of solutions to potential GroupSystems problems. Because many of the problems encountered by participants in using the GroupSystems software were unanticipated, a number of additional areas should have been addressed in both the User FAQ's and Leader FAQs that were provided.

Another functionality which should be addressed in future versions of AVFA software is the ability to signify the current agenda activity, as well as those activities that have been previously completed. While the application was designed to do this through by using a different color for visited hyperlinks (completed agenda activities), a more obvious means of designating completed activities, current activities, as well as uncompleted activities should be devised. One possible solution would be the use of a check-mark icon to indicate completed items, and a similar icon to designate the current agenda activity.

The somewhat lengthy FAQ explanations were also cited as being problematic by at least one participant. Likewise, the auditory explanations provided by the AVFA software

were perceived by some participants as being too verbose. While users could terminate audio instructions by clicking the “current activity completed” button, efforts should be made to make the FAQ’s and audio instructions more concise.

As with the GroupSystems GDSS deficiencies discussed above, the AVFA navigation issues and the perceived shortage of FAQ’s likely impacted the effective appropriation of the GroupSystems GDSS. As a result, it is also likely that such deficiencies adversely impacted participants’ attitudes towards the GroupSystems software and AVFA application, as well as their overall satisfaction with the meeting’s process.

Participants offered a number of suggestions regarding how the GroupSystems software might be made easier to use, ranging from improved functionality and additional features to a more user-friendly and intuitive interface:

- “Need search features, easier duplication removal, better instructions, demo features to indicate how to perform - professionals do not have time to waste on how to figure out a system - it has to be easy so they can focus on the issues at hand rather than the software.”
- “Allow more flexible editing to any info anytime.”
- “Analysis of feedback from all participants and making the results available to participants.”
- “Resolve user "unfriendly" issues

Issues relating to enhanced functionality were one of the primary areas which participants mentioned as being necessary for the GroupSystems GDSS application to be more effective and user-friendly. In particular, search capabilities that would permit users to more easily locate help resources and other required information were cited as being particularly necessary. Due to the excessive time that users required in attempting to determine how specific GDSS tools functioned, enhanced search features would likely be

considerably effective in reducing the time required to complete group decision-making tasks.

Similar features designed to improve efficiency levels in utilizing the GroupSystems GDSS were also mentioned as being needed. Due to significant difficulties that team members encountered in deleting items from brainstorming and voting lists, improved procedures for eliminating such items would likely result in significant improvements in both GDSS appropriation and user satisfaction levels. In particular, the removal of duplicate items from brainstorming results is a particularly important area in need of improvement. By permitting users to more easily consolidate duplicate or similar brainstorming ideas and alternatives, the effectiveness of the GroupSystems work flow could be significantly enhanced.

Efficiency levels could also be substantially improved by including demonstrations illustrating how to utilize specific GSS tools and perform required tasks. This could be particularly beneficial where human facilitators are not present, as is the case with the AVFA application. By using a sequence of screenshots demonstrating how the brainstorming and voting tools are used, the need for human assistance to resolve problems in using these tools could be significantly reduced. Due to the fact that professionals cannot afford to waste time attempting to figure out how to use a new software applications, features designed to better facilitate rapid training of GDSS users would likely be particularly effective in improving efficiency levels. Moreover, because professionals utilizing GDSS applications need to focus on the meeting's agenda items, rather than learning how to utilize the software, any system-directed improvements for more effectively training users could result in significantly higher GDSS appropriation and user satisfaction.

The ability to more effectively monitor input from group members could likewise result in improved decision-making effectiveness. In particular, features designed to monitor responses from group members and submit screen prompts and/or audio messages to group members who are not adequately participating could result in significant improvements in participation levels among team members. This would appear to be a relatively easy improvement to add in future AVFA software versions, and one which could be significantly effective in improving participation levels in group-decision-making settings.

Finally, and perhaps most importantly, any improvements intended to enhance the user-friendliness of the GroupSystems GDSS would likely be particularly helpful in improving GDSS appropriation levels and group decision-making effectiveness. Indeed, it is likely that a much simpler and intuitive GDSS user interface may well have resulted in significantly different research findings. Due to the considerable complexity of the GroupSystems software, it is very likely that appropriation measures and user satisfaction levels would have been significantly higher in using a less restrictive GDSS application that offered many of the features just described.

A number of similar suggestions were also made regarding how the AVFA software might be improved. Many participants believed that the AVFA software should be more tightly integrated with the GroupSystems application. Other respondents felt that additional FAQ's and more extensive instructions would be beneficial in enhancing the AVFA software, as the following responses indicate:

- "Integrate with GroupSystems, (add) search features, more topics, help feature, and demo features as they relate to GroupSystems; have used similar systems but more sophisticated. Would consider using this software again as it did help with the trial."

- “Physically integrate in the GroupSystems so that you don't switch back and forth.”

- “Generally more automated directions.... possibly some GUI pop-ups after each task is completed with guidance on how to proceed.”

- “Being able to navigate more easily; clearly defined buttons and instructions.”

- “If the systems could be more integrated to work together more easily, it would be much better.”

- “Expand the FAQ and instruction areas.”

- “The FAQs were helpful, but the long narrative format was not easy to follow. Bulleted list are much less intimidating and easier to follow, especially when you are reading from a monitor.”

- “Visual demonstrations” (are needed)

- “More detail on each step (and) examples” (are needed)

- “Should have instructions specifically for the leader.”

- “Documentation should not be long verbose wording. Better to have quick phrases w/pictures & brief examples. Or would be good to have search function & table of contents with key functions which would take you to the specific documentation topic. Otherwise, user has to read through paragraph after paragraph. Remember the old saying, "Pictures are worth 1,000 words" and the KISS "keep it simple" rule.”

- “In the documentation, also include a picture of the icons next to its name.”

- “Needs search features and easier pop up screens - need to be interactive with GroupSystems software.”

- “I think an online demo would really help.”

- “Make the FAQs and instruction a little more in depth. Answer a wider range of questions.”

More effective integration of the AVFA application with the underlying GDSS was a recurring suggestion offered by respondents for improving the virtual facilitation software. Indeed, a highly integrated application, or perhaps a single unified system in which the

virtual facilitation functionality is contained within the GDSS system itself, would likely be a significantly more effective solution for automating the facilitation process than would two distinct systems. Because the current AVFA configuration requires constant navigation between both applications, a facilitation application designed as an integral component of the standard GDSS Help Menu would likely result in substantial improvements in the AVFA application's effectiveness.

Likewise, the addition of support features designed to occur automatically, such as pop-up windows for notifying users of required actions, would likely be a highly effective means of integrating the facilitation function into the GDSS application. Icons could also be incorporated into the standard GDSS toolbar for requesting online demos and screen-shots explaining required user actions, or for initiating audio tracks to provide detailed explanations of the current agenda activity's objectives and requirements. Similarly, expanded search features for locating specific facilitation resources could likewise be integrated into the GDSS software.

In addition to more effectively integrating the facilitation application with the GDSS software, respondents again suggested expanding the existing FAQ's to encompass a wider array of help topics. In providing answers to FAQ's however, opinions were split between being more concise in answering FAQ's and making FAQ explanations more in-depth. While differences of opinion existed on the scope of FAQ explanations, one recommendation for improving the AVFA application's effectiveness through adherence to the KISS principle would appear to be an effective guideline for designing any software improvements.

Based on the questionnaire responses received, it would thus appear that significant opportunities exist for improving the AVFA application's effectiveness and its integration with the underlying GDSS software. It is also highly likely that such software enhancements would result in significant improvements in both GDSS appropriation and user satisfaction.

Participants submitted a number of insightful comments regarding their use of the FAQs in utilizing the GroupSystems software. While the FAQs were utilized by most of the participants, several problems appear to have occurred immediately following their use. In certain instances participants again reported difficulties in navigating within the GroupSystems application to implement the FAQ guidance:

- "FAQs were helpful and used almost all of them."
- "We utilized them, but had trouble going to the other program to implement."

Some participants felt that the FAQ wording was excessive and contributed to their frustration in attempting to determine how to utilize the GroupSystems GDSS, while others did not need to refer to the FAQs once they began getting acclimated with the software.

- "I used the FAQs some but found the verbose wording more frustrating than helpful. If I can't find an answer quickly, I start trying things and clicking buttons until I make it work. Then I want flexibility to correct/change anything entered."
- "Although I reviewed the FAQ's, I did not have a need to refer to them once we started moving through the process."

A number of respondents were unable to locate solutions to problems that were encountered when using the GroupSystems software. Whether such solutions were in fact available, or were not readily accessible due to the lack of a search function remains unclear. However, the need for an effective means of locating user support content is apparent. While the facilitation application's FAQs addressed a wide range of issues and potential

roadblocks that were known to exist with the GroupSystems software (see Appendix E), a more comprehensive collections of answers to potential problems would likely alleviate a significant number of difficulties in using any GDSS application. In spite of this, the FAQ's that were provided appear to have been helpful overall:

- "Somewhat helpful. I referred to the FAQs a few times, but it did not cover the issue/problem noted in #2 (how to stop the unwanted 'jumping' to the next page)."

- "They weren't extremely helpful. It did help a little, but we had plenty of questions that weren't answered."

- "The FAQs were OK. I used them a couple of times but not too much. Yes, we used them, and they were helpful."

In at least one instance, the FAQs designed to provide assistance to group leaders appeared to address an issue that was preventing group members from participating in the brainstorming activity.

- "I used one FAQ to determine why the Group Leader's invitation to participate was not being received by the Team Members. After informing the Group Leader of the (FAQ) answer received, the team members received the invitation to participate. Not sure if the problem was with the application or the Group Leader."

Here again, its appears that significant opportunities exist for improving the virtual facilitation application, especially in the area of the application's user support. By making the system's FAQs and overall user support more effective, it is quite likely that both GDSS appropriation levels and user satisfaction could be significantly improved.

The final AVFA questionnaire item related to whether any unique problems arose which were not addressed by the FAQ's. While respondents stated that the FAQ's adequately addressed problems encountered in using the GroupSystems software, a number of participants claimed that their particular issues were not addressed by the FAQs that

were provided in the AVFA application -- or that the information was not easily accessible. Demo features were again recommended as being a possible solution for providing more effective help than FAQ’s:

- “We could generally find answers, but again trying to go back to the GroupSystems to implement was extremely difficult.”
- “There was some confusion about voting methods, but they were addressed in the FAQ's.”
- “Yes, there were several issues. I did not document them, but was frustrated that the information was not available. It needs to have complete demo capacity for GroupSystems and a search feature.”
- “I have been using Microsoft Live Meeting for over a year and feel that product is a little more user-friendly than GroupSystems. I think effective use of GroupSystems would certainly be enhanced by a demo (actually online would be much better) prior to actual use, as in our situation last week.”
- “Yes. It didn't go into too much detail in answers.”
- “Probably not, however, I only used the FAQ's once. I instead tried different commands and looked for feedback.”

By providing more extensive FAQs, more effective search capabilities for accessing user support, and online demonstrations for explaining how specific GDSS tools are used, future versions of the AVFA application could be significantly improved. As more fully discussed in the final chapter, it is highly likely that GDSS appropriation, user satisfaction, and the overall effectiveness of the virtual facilitation application could be significantly improved by including such enhancements in future AVFA versions.

4.3.2 Behavioral Analysis

This section presents an analysis of participant behavior observed through a review of video tapes recorded during the three days of the experiment. While detailed accounts of

each group's decision-making processes are not possible, due to the fact that only two cameras were used to record the approximate eight groups each day, general descriptions of participant behavior within each treatment group are presented, including how each of the three groups differed in their approaches to completing the assigned group task.

As noted, conventional GSS groups were tested on the first day and all participants were instructed to not converse with members of their teams throughout the experiment, and that assistance in resolving GSS problems and other issues was to be provided by the researchers. For the most part, participants followed the required ground rules, raising their hands to obtain assistance for GroupSystems problems and issues relating to interpreting the procedural instructions that were handed out. On a few occasions, participants were observed asking team members questions regarding how to perform certain functions of the GroupSystems application, as opposed to discussing the assigned group decision-making task. In general, participants adopted a business-like approach to completing the agenda items and, overall, appeared diligent in completing their assigned tasks. In all, probably ten requests for assistance were made during the first day's experiment, with the majority of such issues relating to specific procedural details.

As reflected in the quantitative results for GDSS appropriation and user satisfaction, conventional groups appeared to have some difficulty in effectively utilizing the GroupSystems software. Because of its complexity and lack of user-friendly functionality, conventional group members exhibited signs of frustration in attempting to effectively utilize the GroupSystems software. In particular, several groups appeared to be noticeably puzzled in trying to get the software to perform the required tasks, re-affirming the contention that the GroupSystems complexity may have significantly impacted the GDSS appropriation and user

satisfaction quantitative results. Indeed, the frustration exhibited by several groups in working with the GroupSystems software appears to re-affirm many of the statistical findings reported in the previous sections.

On the experiment's second day, participants were required to complete their assigned group decision-making task without GSS support, and were additionally required to use a printed version of the group decision-making heuristic that forms the basic algorithm of the AVFA software. Participants were also given problem and solution brainstorming forms to assist them in their assigned tasks. Observation of the recorded video revealed that participants adopted a business-like approach to completing their assigned agenda items and appeared to be genuinely concerned with effectively solving their task. Participants were observed devoting a significant amount of time to discussing the relevant issues of the case and re-reading different sections of the case study to ascertain the factual details presented in the case study. In some teams, a clear group leader evolved and appeared to be directing the group's activities. In other groups, there appeared to be more a more democratic approach in which all group members took an active part in directing the meeting process. Overall, most teams appeared to be conscientious in their completion of the agenda items, with very few if any teams revealing a lackadaisical approach to the assigned problem-solving tasks.

On the final day, participants used the AVFA software for completing their assigned group decision-making tasks. To test the viability of using the AVFA software in place of a human facilitator, participants were not allowed to request assistance from the researchers, and were required to effectively utilize the GroupSystems software and resolve any problem-solving issues within their individual groups. Only on one occasion was assistance given to a group whose GroupSystems folders had not been properly configured to the "AVFA" folder

group, and as such, the previous “conventional” group’s brainstorming items appeared within their GroupSystems “note pad.” Once this issue was resolved, all groups were able to complete the assigned agenda utilizing the GroupSystems software without any outside assistance.

The video tapes did reveal that most groups encountered significant difficulties in effectively utilizing the GroupSystems application, due to its inherent complexity, and its intended usage as a human-directed application. While most groups exhibited an evenly-balanced approach to learning the required procedures to properly use the GroupSystems software, de facto leaders who assumed control of the GSS learning process emerged in several groups. In most cases, these participants turned out to be those with previous experience in using an electronic meeting system, or those whose technical abilities permitted them to more readily learn the GroupSystems intricacies.

Because the GroupSystems application was perceived by most participants as being not very user friendly, as documented in the preceding section, the observed difficulties that participants encountered are certainly understandable, although not completely anticipated. Indeed, few if any groups were able to proceed through their assigned GSS-based tasks without encountering various roadblocks. In most instances, such obstacles were overcome by a trial-and-error approach, in which groups tried different methods of getting the GroupSystems application to function properly until the correct procedure was discovered, a process which resulted in considerable frustration and consternation among participants.

The observed difficulties in effectively utilizing the GroupSystems software would seem to bolster the contention that the GroupSystems’ complexity was a significant factor in the lower than expected GDSS appropriation and user satisfaction measures for the AVFA-

supported groups. Indeed, it is likely that the GroupSystems complexity had a direct bearing on its users’ lower appropriation measures and satisfaction levels than the unsupported group members. As recommended in the final chapter, future research efforts should be directed towards employing a GDSS system which is less complex and more easily adaptable to effective utilization by end-users.

CHAPTER 5

SUMMARY AND CONCLUSIONS

5.1 Introduction

A summary of the current research is presented in this chapter. Beginning with an overview of the research findings, the feasibility of utilizing virtual facilitation for supporting GSS appropriation of advanced information technologies is discussed next. Following that, the limitations of the current research are discussed. Finally, directions for future research are proposed.

5.2 Research Overview

The current research studied the effectiveness of using virtual facilitation for supporting GSS appropriation and structured group decision-making. Specifically, the feasibility of using an automated facilitation application was studied to determine its effects on efficiency, appropriation levels, and decision-making effectiveness (decision quality, number of ideas generated, and user satisfaction) in comparison to groups guided by human facilitators ("conventional GSS groups"), and groups interacting without computer support ("unsupported groups"). An experiment was conducted over a three-day period in which auditors, accountants, and IT security professionals were employed to test the three group decision-making approaches in a hidden-profile task designed to simulate an information systems audit engagement. Participants were required to share information in order to identify the IT security problems existing within a banking firm, and to then formulate a formal recommendation to address the problems identified.

Performance measures were recorded at both the group-level and participant-level. To evaluate group-level performance, decision quality was evaluated on the basis of the feasibility and breadth of team recommendations. Decision-making efficiency was evaluated on the basis of the

total time required to complete the assigned group tasks. Lastly, team performance was evaluated on the as the number of problems identified in the case study and solutions recommended to address the problems. Participant responses were obtained through questionnaires designed to gauge GSS appropriation levels (faithfulness of appropriation and attitudes towards use) as well as satisfaction with the meeting process and with the meeting's outcome.

As discussed in Chapter 4 and summarized again in Table 34, the research found that AVFA-supported groups were not significantly different from conventional GSS groups in every summary measure except faithfulness of appropriation. However, both AVFA-supported groups and conventional GSS groups scored no better than unsupported groups in the majority of variables studied, contrary to a number of the study's hypotheses.

Table 34: Summary of Research Results

Hypothesis	Outcome	Actual Effect
1A: Efficiency - Conventional and AVFA-supported groups equally efficient, and more efficient than unsupported groups	Not supported	No significant difference in efficiency levels of groups.
2A: Faithfulness of Appropriation - Faithfulness of appropriation equal for conventional and AVFA-supported groups	Not supported	AVFA groups lower than conventional groups in faithfulness of appropriation
2B: Attitudes Towards Use (composite) No significant difference between conventional GSS groups and AVFA-supported groups	Supported	
3A: Decision Quality – Higher decision quality for conventional and AVFA-supported groups than for unsupported groups	Not Supported	All groups equivalent in decision quality
3B: Number of Ideas and Alternatives Conventional and AVFA-supported groups will generate more ideas than unsupported groups	Supported	
3C: Satisfaction with Meeting Process Conventional and AVFA-supported groups will be more satisfied than unsupported groups	Not supported	Conventional and AVFA groups equally satisfied but less satisfied than unsupported groups
3D: Satisfaction with Meeting Outcome Conventional and AVFA-supported groups will be more satisfied than unsupported groups	Not supported	Conventional and AVFA groups equally satisfied but less satisfied than unsupported groups

While the results from this research were for the most part unanticipated, they can be explained to a large degree through a closer analysis of the data. Indeed, in spite of the vast majority of the study's hypotheses not being supported, the results support the contention that virtual facilitation can be at least as effective as conventional facilitation in supporting structured group decision-making. In measures of decision-making efficiency, decision quality, number of ideas and alternatives suggested, and user satisfaction, no significant differences were found to exist between groups using automated facilitation and groups using conventional facilitation. Moreover, while faithfulness of appropriation measures were lower for AVFA-supported groups than for conventional GSS groups, no significant differences were found in the other appropriation measure tested, *attitudes towards GDSS use*.

Equally important, the inherent complexity of the GroupSystems GSS software is believed to have been a major factor in the unsupported groups scoring higher than conventional-GSS groups and AVFA-supported groups in the area of appropriation and user satisfaction. As the post-session questionnaire revealed, a significant number of participants found the GroupSystems software to be difficult to operate and not user-friendly. Because of its complexity and rigid operating requirements, the GroupSystems software is believed to have been a significant contributing factor in the research findings. Indeed, had the experiment been conducted using a more user-friendly electronic meeting system, such as Microsoft's Live Meeting EMS, the results could have been far different. In spite of this, the overall findings sustain the contention that virtual facilitation can be as effective as human facilitation in supporting structured group decision-making and affecting attitudes towards GDSS use.

5.3 Implications for Virtual Facilitation Applications

Based on these findings, a number of implications for future utilization of virtual facilitation systems are apparent. Because the AVFA-supported groups were found to score equal to conventional GSS groups in the area of efficiency, decision quality, user satisfaction, and brainstorming effectiveness (number of ideas and alternatives suggested), systems capable of autonomously facilitating users of advanced information technologies would seem to hold the potential for eventually replacing their human counterparts. Indeed, because the AVFA software utilized in this research study was an admittedly rudimentary application designed solely for testing the feasibility of virtual facilitation, more sophisticated virtual facilitation systems would seem to hold far greater potential for performing at least as well as human facilitators in instructing and acclimating users in the utilization of advanced information technologies.

Although the results of this research sustain the feasibility of using virtual facilitation for supporting the appropriation of advanced IT applications, a number of caveats need to be addressed in order for such an approach to be effective. One such issue relates to the breadth of user support provided by the virtual facilitation application. While the AVFA application provided FAQs for anticipated questions for a number of contingencies, several participants noted that the FAQ's did not address the specific problems that they wished to resolve. Attempts at automating user facilitation should thus focus on addressing as many scenarios as possible in order to provide answers to any number of problem situations that might arise in using the supported software. While there may be rare occasions where totally unexpected problems arise for which user assistance is necessary, normal and recurring problems in using the system should be anticipated and addressed within the automated user support

system. Such inclusive coverage can be achieved through extensive user testing of the supported software and through observation of user difficulties in utilizing it, focusing on those issues that require outside assistance to resolve.

Another recurring issue noted by participants -- and one which has significant implications for future virtual facilitation use -- relates to more closely integrating virtual facilitation applications with the software they are designed to support. Specifically, by more tightly integrating virtual facilitation applications with the supported software, the use of automated facilitation systems can be greatly simplified. Other implications for future use relate to incorporating search features to enable more easy access to user support resources, and incorporating pop-up windows, voice prompts, and other active feedback features designed to respond after specific tasks are completed, and to advise users of additional actions required for completing the next phase of an assigned task. By incorporating such *active-feedback* features into future virtual facilitation applications, their utility could be significantly improved and their adoption could become considerably more widespread.

Finally, auditory feedback designed to communicate with users would also appear to hold significant promise for facilitating the AIT appropriation process. Indeed, such non-conventional computer-to-human communication perhaps holds as much potential for future virtual facilitation applications as any automated facilitation feature. While the voice communication provided by the AVFA application was simplistic, the research results would appear to demonstrate the viability of using this approach for facilitating the appropriation of advanced information technologies. Indeed, the increasing pervasiveness of voice communication features in an expanding range of electronic devices is compelling evidence of the significant viability of this method for communicating with users of such devices.

5.4 Limitations of the Research

Several limitations of the current research study should be noted. Perhaps the most significant limitation was the relatively small number of groups tested over the three-day period. Although a total of ninety participants were recruited for the anticipated thirty *three-person* groups (10 conventional GSS groups, 10 unsupported groups, and 10 AVFA-supported groups), several no-shows each day caused the total number of groups to be slightly less than originally intended (see Chapter 3 for a detailed recap of daily participants). As a result, the number of groups was less than what would be desired to ensure sufficient statistical power for conducting such an experiment. Unfortunately, due to the difficulty of recruiting auditors, accountants, and IT security professionals for experimental research, attempts at recruiting sufficient numbers of such professionals will always be problematic. However, in comparison to the customary alternative of utilizing students as research subjects, the limitations resulting from the study's smaller sample size would seem to be preferable to the lack of generalizability and realism that inevitably occurs when student subjects are used.

While the number of groups was less than ideal for the *group* variables tested (efficiency, decision-quality, and number of ideas and alternatives generated), the number of participants for testing *individual* measures (GDSS appropriation and satisfaction measures) was more than sufficient to assure adequate statistical power.

Another limitation of the research was related to the GroupSystems GSS software. Because of the inherent complexity of the software, the attempt to autonomously facilitate groups using it was problematic. Indeed, had the supported software been of a more user-friendly nature (and designed for use without the assistance of a human facilitator acting as

the GSS chauffer), the study's results may have been vastly different. In spite of this, the research findings still support the study's contention that virtual facilitation can be equally as effective as conventional facilitation for supporting structured group decision-making and affecting attitudes towards GDSS use.

Finally, the issue of generalizability and realism is somewhat of a concern, in spite of using auditors, accountants, and IT professionals as the experiment's subjects. While the IT Policy Task attempted to simulate an actual information systems audit, differences between the simulated audit and an actual IS audit will no doubt exist. Likewise, information-sharing among audit team members within a much shorter time frame than would normally exist in an actual audit environment would also tend to somewhat limit the realism and generalizability of this research study. In spite of these limitations, the experiment is still believed to have sufficiently simulated an information systems audit in order to draw reasonable conclusions from the study's findings.

5.5 Directions for Future Research

This research studied the effectiveness of virtual facilitation for supporting GDSS appropriation and structured group decision-making. The experiment compared conventional GDSS groups with unsupported groups, and groups facilitated with an automated virtual facilitation application (AVFA). Accountants, auditors, and IT security professionals participated in an experiment employing a hidden-profile task in which unique information relating to a hypothetical information systems security audit was shared among group members in order to identify problems existing within the case study and to formulate recommendations as to how such problems should be addressed. Participants were evaluated on the basis of their group's performance (efficiency, number of problems identified and

solutions recommended, and decision quality) as well as their individual scores in the areas of GSS appropriation (faithfulness of appropriation and attitudes towards their GSS use, including perceived ease of use, perceived usefulness, and extensiveness of use). The findings from this study point to several issues that should be addressed in future research efforts.

First, the issue of the GroupSystems software complexity should be addressed. As previously noted, participants found the GroupSystems GDSS to be exceedingly rigid in terms of procedural requirements. Because the GroupSystems GDSS is a sophisticated software application designed primarily to be used in a chauffer-driven "decision-room" environment in which a human facilitator guides a single group through its decision-making activities, it is not the ideal application for which to test the viability of virtual facilitation for supporting GDSS appropriation and structured group decision-making for a number of small groups acting autonomously. As such, future research efforts should utilize a less rigid system having a more intuitive user interface, and one which is significantly more user-friendly in terms of operating autonomously.

Secondly, an improved virtual facilitation application should be developed for use in future research efforts. Although the AVFA software was a simplified application designed for testing the viability of virtual facilitation in comparison to conventional GDSS facilitation, it was lacking in certain key features. As noted above, the AVFA software should incorporate a number of more advanced feedback features, most notably, a significantly more interactive and responsive mode of operation. While the AVFA software was designed to introduce users to each of the scheduled agenda activities and to briefly instruct them on how the GSS tools should be used, through pre-recorded audio messages

and screen-prompts, it did not incorporate any active feedback functionality. Future versions of the AVFA software should incorporate features which would communicate with users upon their completion of agenda items, as well as prompt them for more input if they are not participating adequately. As such, future applications would be of a more *intelligent* nature, designed to interactively communicate with users through voice prompts and other means. Finally, future AVFA versions should also be integrated within the supported software application, as opposed to operating as a separate system.

In the area of experimental design, future research efforts should focus on comparing only AVFA-supported groups and conventional GSS groups to more clearly examine the question of whether virtual facilitation can be equally as effective as human facilitation. While the results from the current study regarding unsupported groups vs. GSS-supported groups were informative in terms of examining the viability of using group support systems in auditing environments, the issue of unsupported groups is not directly related to the central question comparing virtual facilitation with conventional facilitation.

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APPENDIX A

IT POLICY TASK

Texas Interstate Banking Corporation

To: Michael Andrus, CPA
Anders, Andrus & Company

From: James Marshall, CEO

Re: Information Technology Policy Recommendation

As a result of a number of complaints that have been received about the effects of our current IT policies, we have asked your firm to advise us regarding these policies.

With this in mind, your committee's task is to evaluate all of the information that your audit team has uncovered. You should identify the problems that exist and advise us on revising our IT policy to address those problems. After deliberating on this issue, please submit a concise written statement of your recommendations to me.

You should consider each committee members' viewpoints and knowledge in formulating your recommendation. A form is provided on the last page on which you can place your responses.

Following is a summary of the findings that your team has uncovered.

Texas Interstate Banking Corp. Findings*

Texas Interstate Banking Corp. (TIBCO) CEO James Marshall recently met with Director of Information Technology (IT) Steven DeHart regarding TIBCO's IT control environment. At that time, Marshall informed DeHart that the Texas Banking Commissioner was currently working on a formal complaint against TIBCO for its NetBanking services. The Commissioner informed TIBCO that it received over 40 customer complaints over the prior two months.

Discussions with TIBCO personnel have established that there has been significant dissatisfaction with the IT staff for the quality of work of the IT outsourcing firm. In addition, there has been considerable friction between the retail banking division and the IT staff, due to the fact that the outsourcing decision had been made by the IT staff solely on its own. DeHart has claimed that this decision was made in good faith due to the retail banking management team's frustration about their inability to compete in the web-banking market.

When TIBCO's NetBanking first went into operation, things had gone fairly well. There were initially only a small volume of users (5 percent of the total retail customer base). However, after six months, when the number of users grew, problems began with the quality of the service delivery, such as:

- Response time was unsatisfactory
- Customers could access the system only during specific times of the day
- Occasionally, transactions were not processed or were processed erroneously.

As a result, TIBCO's help desk has received an increasing number of queries and complaints. Until now, these problems have not escalated beyond the operational level where they have been solved by the IT staff and retail banking management.

TIBCO Company Profile

Your firm's largest client, Texas Interstate Banking Corp. is a moderate-sized financial institution (total assets = $1.5 billion) with the following characteristics:

- Its core business competencies include retail banking—saving accounts, checking accounts, loans, credit cards and personal banking—as well as performing clearing and settlement services for the other banks in the region. One of its strengths has been the personal attention provided to customers by account managers in the personal banking group.
- It is downsizing its physical branch network while aggressively pursuing e-banking business.
- It is starting to acquire outside IT services (outsourced or joint ventured).
- It has gone through several local mergers and as a result has a complex environment with shared IT services that are difficult to integrate.
- It is process-oriented with an emerging culture of stakeholder inclusion but with no formal strategy and a tendency to shift priorities after long debates between stakeholders.
- It is competing in a market in which a number of changes have taken place, including an increased presence of building societies (savings and loans) and international banks. New products being introduced by competitors—including higher savings interest rates—are attractive to customers. In addition, electronic financial services with 24/7 access are becoming ubiquitous.
- It possesses a steady customer base and revenues, and increasing acquisitions to this point, but the effects of increased competition are being felt ever more strongly. There is concern over the loss of market share as well as compressed profit margins.
- It is aware of indicators that the regulators are getting concerned about systemic risk, as TIBCO provides payment and settlement services to other banking institutions.

The headquarters is home to approximately 600 employees. Nationwide, the corporation employs approximately 9,000 people, of which 450 are in IT. IT services are critical to all 600 headquarters employees.

In your discussions with other firm partners regarding TIBCO's situation, they have mentioned the relevance of the Sarbanes-Oxley provisions regarding internal control, and specifically the COBIT guidelines (Control Objectives for Information and Related Technologies) and the ISO/IEC 17799 standards for information security practices.

Role 1: Audit Partner
Organizational Entities

Board of Directors

The TIBCO board of directors has the following attributes:
• The chairman of the board is not involved with the company on a daily basis.
• It is composed of both internal and external members, with the majority of audit committee members being external directors.
• The members are technically literate, but they are risk-conscious and interested in what “others” do.

Executive Committee

The TIBCO Executive Committee has the following attributes:
• It wields strong influence on the board, but needs the co-operation of external board directors.
• It is focused on achieving monetary results, and is somewhat risk-taking.
• It consists of a chief executive officer (CEO), chief financial officer (CFO), chief operating officer (COO) and a business executive. The COO oversees IT as part of his duties.
• Control is not high on the priority list, but it will listen to audit and will push for recommendation implementation.
• It recently pushed for development of the web banking systems of the bank.

Business Strategy Group

The TIBCO strategy group has the following attributes:
• It reports to the business executive and is not technologically inclined.
• Major priorities on its list are customer relationship management and the CRM project.
• It has recently gone through a major downsizing exercise, reducing the branch offices by 50 percent.
• Is has benchmarked IT cost in the enterprise’s business sector and found TIBCO’s own IT to be more expensive than the competition.
• It wants positive net present value (NPV) on major IT infrastructure investments.

The current strategic initiatives are:
• Closing low-performing branches (almost complete)
• Creating a web-based banking system (NetBanking) to unload the demand for services at branch offices (in-progress)
• Developing CRM capabilities to create opportunities to cross-sell banking services (project initiated)

Retail Banking Division

TIBCO retail banking executives are:
• Becoming IT-literate and are a bit jealous of IT getting their budgets while they have had to downsize and IT has not
• Claiming they need increased remote connectivity and automated workflow solutions to be effective in a downsized branch network
• Complaining about throughput of, and support for, core systems and are pushing for rebuilding the near-obsolete core systems
• Connecting more and more e-customers even if they do not bring in immediate income, while stressing the operational and support systems.

Role 2: Internal Control Auditor

Standards and Procedures

TIBCO's IT procedures are developed in-house, and vary in quality and conformance from area to area within the IT group. IT strategy development is relatively informal; it is based on management discussion and documented via management meeting notes, rather than determined by a prescribed process or any standard format. IT would like more guidance from the business and the executive management, but strategic decisions are made on a project-by-project basis.

The IT organization is fairly traditional, with a systems development team, an operations team and a system and technology team. The management team consists of a manager for each of the three groups, plus the head of the department. System developments have been undertaken mostly in-house, based on the mainframe, with a system development life cycle (SDLC) methodology that was acquired some years ago and has been adjusted to suit the bank. In recent years these methods have been found to be outdated and too slow to undertake. However, they at least have ensured reasonable documentation of systems. There is little experience in acquiring packaged solutions. Only a few of the in-house team have any experience with client-server systems, and none have any web development experience.

Operations are well organized with good discipline and tight procedures. Generally, all work is treated as high priority. There are shifts covering operations 24 hours a day, with a small overnight team that handles mostly batch processing. Internal service level agreements are defined in technical terms and are really service level statements setting, for example, availability targets and capacity requirements for the network. There is a small internal help desk, which is mostly used for occasional user queries and password resets.

Security

TIBCO's security is based on a long-standing procedure, which is based on a traditional mainframe security administration system. The workstations are diskless. The simple but not up-to-date security policy states general responsibilities and the importance of privacy and security of banking data. IT has hardened servers, firewalls, strong encryption and a VPN. There is a small security administration group that supports security maintenance and handles new employees, terminations, and changes to access rights. There is no dedicated security manager, although a security administrator is responsible for the allocation and management of privileges. Because of business and technology pressures, people tend to be lax about security rules. Security is still addressed in a reactive mode, and the bank has sought *ad hoc* outside assistance, advice and third-party offerings. Prior to this point, the general opinion has been that there have been few issues to worry about.

Role 3: Information Systems Auditor
TIBCO Information Technology Environment

IT Coordination Committee

TIBCO's IT coordination committee involves a mix of IT and user managers. It meets monthly and is primarily concerned with the oversight of existing and future developments. It reports quarterly to the business strategy group. It has had little involvement with the We-BOP development because of the outsourced nature of its development and operation.

IT Management

TIBCO's IT director and his management team are:

- Highly technical and want to make a mark in e-business, specifically through the web-enabled banking operations project, which they support strongly
- Concerned about the aging network, which may run out of capacity as a result of the move to e-banking
- Fully supportive of tight controls over IT
- In agreement that more co-operation is needed with the business strategy group, which generally supports IT management project priorities but does not always agree on what should be done first
- Firmly believe that the current core systems can support the business for several more years, and are getting cranky when core systems rebuilding is brought up.

IT Teams

The TIBCO IT teams are:

- Highly qualified professionals with a strong quality focus; they have put strong project control and performance measurement in place. However, the latter is too detailed and used only at the local level.
- Constantly diverted by change management issues as a result of many changes to the applications and infrastructure
- Concerned about rapid change, especially the outsourcing and business-promoted projects that are not always commercially successful and take resources away from needed infrastructure investments, such as the new IT network to increase connectivity and standardize solutions
- Concerned with the increase in maintenance problems and decrease in available skills relative to the core systems and are actually becoming increasingly frustrated.

Technology

Overall, TIBCO's networking infrastructure is getting older and strained. Only senior managers have laptops. The PC network platform involves Windows servers utilized for file and print services, communication services and gateway services. PC workstations are running Windows. Remote connectivity is to be introduced based on features available in IT-Net. Mainframe access is granted by a security administration system. UNIX security is provided by the host operating system; no proprietary security tools are used. Firewalls are installed and managed by the IT-Net supplier, as a managed service.

We believe the problems existing in this case are the following. (List each problem on a separate line. Please do not include duplicate or very similar items):

Our exact recommendation for addressing these problems is the following. (List each recommendation on a separate line. Please do not include duplicate are very similar items):

Suggested Solutions to the IT Policy Task

General Answers

Some general issues that need to be emphasized in the answers provided by the participants:

• The strategy is not clear to all parties, and there is a difference of opinion on priorities.
• There are major issues with change management as a result of the many changes.
• The enterprise is barely at maturity level 2 for information security.
• There is no co-ordination and a lack of communication.

Be aware that maturity level 2 is built into the case (reference to process DS5's maturity model). Its characteristics are:

• Responsibilities and accountabilities for IT security are assigned to an IT security administrator with no management authority, reporting to the database supervisor.
• Security awareness is fragmented and limited.
• IT security information is generated, but rarely analyzed.
• Security solutions tend to respond reactively to IT security incidents and by adopting third-party offerings, without addressing the specific needs of the organization.
• Security policies are being developed, but inadequate skills and tools are still being used.
• IT security reporting is incomplete, misleading or not pertinent

Expected Answers on Security

The security risks are:
• There appears to be a lack of management (board, audit committee) concern with security.
• Security is under-resourced.
• There is no IT security plan.
• Policies are based in the mainframe era and should be strengthened for new technologies, such as laptops and virtual disk drives.
• Responsibilities and accountabilities for IT security are assigned to an IT security administrator with no management authority, reporting to the database supervisor.
b. Recommend some good practices to better mitigate the risks. Some good risk-mitigation practices are:
• Implementing ISO17799
• Using COBIT process DS5

APPENDIX B

RESEARCH INSTRUMENTS AND SCORING

Independent Variable: Group Decision-Making Support (SUPPORT)
1= Conventional GSS Groups
2= Unsupported Groups (Manual Solution Groups)
3= AVFA-Supported Groups

Dependent Variable 1: Decision-Making Efficiency (EFFICIEN)
Total Score = number of minutes required to submit formal recommendation

Dependent Variable 2: Number of Problems Identified (NUMPROB) Duplicate and very similar items not counted

Dependent Variable 3: Number of Solutions Proposed (NUMSOL) Duplicate and very similar items not counted

Dependent Variable 4: Decision Quality (QUALITY) Score equal to average evaluation of each group's formal recommendation. Using Wheeler Valacich (1996) approach, each group's formal recommendation is scored on two indices: *degree to which the solution solves multiple problems*; and *extent to which the solution is feasible* (scale of 0 to 100 points each: minimum = 0, maximum = 200)

Dependent Variable 5: Faithfulness of Appropriation (FOA)

Variables 6, 7, 8 and 9: Attitudes Toward Use

Dependent Variable 6: Perceived Ease of Use (PEU)

Dependent Variable 7: Perceived Usefulness (PU)

Dependent Variable 8: Extensiveness of Use (EOU)

Dependent Variable 9: Composite Score for Attitude Measures (ATTITUDE)

Dependent Variable 10: Satisfaction with Meeting Process (PROSAT):

Dependent Variable 11: Satisfaction with Meeting Outcome (OUTSAT):

Dependent Variable 12: AVFA Favorability Rating (AVFAFAV)

Dependent Variable 5: Faithfulness of Appropriation (FOA)

FOA1. The developers of the EMS would probably be shocked at how our group used the system.

___ I would strongly disagree	7
___ I would quite disagree	6
___ I would slightly disagree	5
___ I would neither agree nor disagree	4
___ I would slightly agree	3
___ I would quite agree	2
___ I would strongly agree	1

FOA2. Our group probably used the EMS improperly.

___ I would strongly disagree	7
___ I would quite disagree	6
___ I would slightly disagree	5
___ I would neither agree nor disagree	4
___ I would slightly agree	3
___ I would quite agree	2
___ I would strongly agree	1

FOA3. The original developers of the EMS would view our group's use of the system as inappropriate.

___ I would strongly disagree	7
___ I would quite disagree	6
___ I would slightly disagree	5
___ I would neither agree nor disagree	4
___ I would slightly agree	3
___ I would quite agree	2
___ I would strongly agree	1

FOA4. Our group failed to use the EMS as it should have been used.

___ I would strongly disagree	7
___ I would quite disagree	6
___ I would slightly disagree	5
___ I would neither agree nor disagree	4
___ I would slightly agree	3
___ I would quite agree	2
___ I would strongly agree	1

FOA5. We did not use the EMS in the appropriate fashion. Ideally we should have used the EMS in a different way.

___ I would strongly disagree	7
___ I would quite disagree	6
___ I would slightly disagree	5
___ I would neither agree nor disagree	4
___ I would slightly agree	3
___ I would quite agree	2
___ I would strongly agree	1

Dependent Variable 6: Perceived Ease of Use (PEU)

EASOFUSE

PEU1: I felt frustrated by the GroupSystems group decision support system (GDSS)

___ I would strongly disagree	7
___ I would quite disagree	6
___ I would slightly disagree	5
___ I would neither agree nor disagree	4
___ I would slightly agree	3
___ I would quite agree	2
___ I would strongly agree	1

PEU2: Using the GroupSystems GDSS was fun

___ I would strongly disagree	1
___ I would quite disagree	2
___ I would slightly disagree	3
___ I would neither agree nor disagree	4
___ I would slightly agree	5
___ I would quite agree	6
___ I would strongly agree	7

PEU3: While using the GroupSystems GDSS, I felt comfortable

___ I would strongly disagree	1
___ I would quite disagree	2
___ I would slightly disagree	3
___ I would neither agree nor disagree	4
___ I would slightly agree	5
___ I would quite agree	6
___ I would strongly agree	7

PEU4: I enjoyed using the GroupSystems GDSS.

___ I would strongly disagree	1
___ I would quite disagree	2
___ I would slightly disagree	3
___ I would neither agree nor disagree	4
___ I would slightly agree	5
___ I would quite agree	6
___ I would strongly agree	7

PEU5: On the whole, I felt very comfortable using the GroupSystems GDSS and would be willing to use it again.

___ I would strongly disagree	1
___ I would quite disagree	2
___ I would slightly disagree	3
___ I would neither agree nor disagree	4
___ I would slightly agree	5
___ I would quite agree	6
___ I would strongly agree	7

Minimum PEU Score = 5
Minimum PEU Score = 35

Dependent Variable 7: Perceived Usefulness (PU)

PU1: I am not in favor of computer-aided meetings, because it is just another step toward depersonalization of meetings.

___ I would strongly disagree	7
___ I would quite disagree	6
___ I would slightly disagree	5
___ I would neither agree nor disagree	4
___ I would slightly agree	3
___ I would quite agree	2
___ I would strongly agree	1

PU2: Using a computer system for meetings seems like a good idea to me.

___ I would strongly disagree	1
___ I would quite disagree	2
___ I would slightly disagree	3
___ I would neither agree nor disagree	4
___ I would slightly agree	5
___ I would quite agree	6
___ I would strongly agree	7

PU3: Even otherwise interesting meetings might be boring when conducted with computer-mediated support.

___ I would strongly disagree	7
___ I would quite disagree	6
___ I would slightly disagree	5
___ I would neither agree nor disagree	4
___ I would slightly agree	3
___ I would quite agree	2
___ I would strongly agree	1

PU4: The GroupSystems GDSS was more of a hindrance in the process of our meeting.

___ I would strongly disagree	7
___ I would quite disagree	6
___ I would slightly disagree	5
___ I would neither agree nor disagree	4
___ I would slightly agree	3
___ I would quite agree	2
___ I would strongly agree	1

Minimum PU Score = 4
Minimum PU Score = 28

Dependent Variable 8: Extensiveness of Use (EOU)

EOU1: I did not feel that the GroupSystems GDSS played a major roll in our meeting activities.

___ I would strongly disagree	7
___ I would quite disagree	6
___ I would slightly disagree	5
___ I would neither agree nor disagree	4
___ I would slightly agree	3
___ I would quite agree	2
___ I would strongly agree	1

EOU2: On the whole, I learned enough about the GroupSystems GDSS and used it extensively during the meeting.

___ I would strongly disagree	1
___ I would quite disagree	2
___ I would slightly disagree	3
___ I would neither agree nor disagree	4
___ I would slightly agree	5
___ I would quite agree	6
___ I would strongly agree	7

EOU3: I think that the GroupSystems GDSS enabled us to gain a better perspective on the various issues than would have been possible without the use of the system.
___ I would strongly disagree 1
___ I would quite disagree 2
___ I would slightly disagree 3
___ I would neither agree nor disagree 4
___ I would slightly agree 5
___ I would quite agree 6
___ I would strongly agree 7

EOU4: Most members of my group used the GroupSystems GDSS extensively to support various phases of the meeting.
___ I would strongly disagree 1
___ I would quite disagree 2
___ I would slightly disagree 3
___ I would neither agree nor disagree 4
___ I would slightly agree 5
___ I would quite agree 6
___ I would strongly agree 7

Minimum EXTENSIV Score = 4
Maximum EXTENSIV Score = 28

Dependent Variable 9: Satisfaction with Meeting Process (PROSAT):

PROSAT1: I feel satisfied with the way in which today's meeting was conducted.

___ I would strongly disagree 1
___ I would quite disagree 2
___ I would slightly disagree 3
___ I would neither agree nor disagree 4
___ I would slightly agree 5
___ I would quite agree 6
___ I would strongly agree 7

PROSAT2: I feel good about today's meeting process.
___ I would strongly disagree 1
___ I would quite disagree 2
___ I would slightly disagree 3
___ I would neither agree nor disagree 4
___ I would slightly agree 5
___ I would quite agree 6
___ I would strongly agree 7

PROSAT3: I liked the way the meeting progressed today.

___ I would strongly disagree	1
___ I would quite disagree	2
___ I would slightly disagree	3
___ I would neither agree nor disagree	4
___ I would slightly agree	5
___ I would quite agree	6
___ I would strongly agree	7

PROSAT4: I feel satisfied with the procedures used in today's meeting.

___ I would strongly disagree	1
___ I would quite disagree	2
___ I would slightly disagree	3
___ I would neither agree nor disagree	4
___ I would slightly agree	5
___ I would quite agree	6
___ I would strongly agree	7

PROSAT5: I feel satisfied about the way we carried out the activities in today's meeting.

___ I would strongly disagree	1
___ I would quite disagree	2
___ I would slightly disagree	3
___ I would neither agree nor disagree	4
___ I would slightly agree	5
___ I would quite agree	6
___ I would strongly agree	7

Minimum PROSATIS Score = 5
Maximum PROSATIS Score = 35

Dependent Variable 10: Satisfaction with Meeting Outcome (OUTSAT):

OUTSAT1: I liked the outcome of today's meeting.

___ I would strongly disagree	1
___ I would quite disagree	2
___ I would slightly disagree	3
___ I would neither agree nor disagree	4
___ I would slightly agree	5
___ I would quite agree	6
___ I would strongly agree	7

OUTSAT2: I feel satisfied with the things we achieved in today's meeting.

___ I would strongly disagree	1
___ I would quite disagree	2
___ I would slightly disagree	3
___ I would neither agree nor disagree	4
___ I would slightly agree	5
___ I would quite agree	6
___ I would strongly agree	7

OUTSAT3: When the meeting was finally over, I felt satisfied with the results.

___ I would strongly disagree	1
___ I would quite disagree	2
___ I would slightly disagree	3
___ I would neither agree nor disagree	4
___ I would slightly agree	5
___ I would quite agree	6
___ I would strongly agree	7

OUTSAT4: Our accomplishments today give me a feeling of satisfaction.

___ I would strongly disagree	1
___ I would quite disagree	2
___ I would slightly disagree	3
___ I would neither agree nor disagree	4
___ I would slightly agree	5
___ I would quite agree	6
___ I would strongly agree	7

OUTSAT5: I am happy with the results of today's meeting.

___ I would strongly disagree	1
___ I would quite disagree	2
___ I would slightly disagree	3
___ I would neither agree nor disagree	4
___ I would slightly agree	5
___ I would quite agree	6
___ I would strongly agree	7

Dependent Variable 11: AVFA Favorability Rating (AVFAFAV)

Minimum OUTSATIS Score = 5
Maximum OUTSATIS Score = 35

AVFA1: I enjoyed using the Automated Virtual Facilitation Application (AVFA).

___	I would strongly disagree	1
___	I would quite disagree	2
___	I would slightly disagree	3
___	I would neither agree nor disagree	4
___	I would slightly agree	5
___	I would quite agree	6
___	I would strongly agree	7

AVFA2: On the whole, I felt very comfortable using the automated facilitation system and would like to use it again.

___	I would strongly disagree	1
___	I would quite disagree	2
___	I would slightly disagree	3
___	I would neither agree nor disagree	4
___	I would slightly agree	5
___	I would quite agree	6
___	I would strongly agree	7

AVFA3: The automated facilitation system was more of a hindrance in the process of our meeting.

___	I would strongly disagree	7
___	I would quite disagree	6
___	I would slightly disagree	5
___	I would neither agree nor disagree	4
___	I would slightly agree	3
___	I would quite agree	2
___	I would strongly agree	1

AVFA4: I think that the automated facilitation system enabled us to gain a better perspective on using the GroupSystems EMS than would have been possible without the use of the system.

___	I would strongly disagree	1
___	I would quite disagree	2
___	I would slightly disagree	3
___	I would neither agree nor disagree	4
___	I would slightly agree	5
___	I would quite agree	6
___	I would strongly agree	7

AVFA5: I would recommend using the automated facilitation system again.

___	I would strongly disagree	1
___	I would quite disagree	2
___	I would slightly disagree	3
___	I would neither agree nor disagree	4
___	I would slightly agree	5
___	I would quite agree	6
___	I would strongly agree	7

Minimum AVFAFAV Score = 5
Maximum AVFAFA Score = 35

APPENDIX C

PARTICIPANTS

Senior Internal Auditor
Cleco Support Group LLC

Assistant Director of Internal Audit
Southern University System

Auditor
DHHS/OIG/OAS (Dept of Health and Human Services)

Auditor Supervisor
Teachers' Retirement System of Louisiana

Auditor III
Teachers' Retirement System of Louisiana

Sarbanes Oxley Program Specialist
Albemarle Corp.

CPA
Albemarle Corp.

CPA, Director of Internal Audit
Louisiana Department of Education

CIA (Certified Internal Auditor), Audit Supervisor
Louisiana Department of Education

Staff Auditor
Louisiana Department of Education

Staff Auditor
Louisiana Department of Education

Auditor
Louisiana Dept of Transportation and Development

Auditor
Department of Transportation & Development

Senior Internal Auditor
LSU Health Sciences Center

CISA
Director of Information Technology Division
Office of Legislative Auditor
State Of Louisiana

VP - Corporate Controller
EDGEN

CPA

CPA, Sr. Auditor
Cleco Internal Audit Staff

CIA, CISA (Certified Information Systems Auditor)
Internal Auditors with LSUHSC-NO
Office of Compliance Programs

CGFM (Certified Government Financial Manager)
Internal Auditors with LSUHSC-NO
Office of Compliance Programs

Audit Manager
Louisiana Department of Labor

Director of External Reporting
Edgen Corporation

CPA
Director, Office Audit and Discovery
Louisiana Department of Revenue

CPA, PhD
LSU Accounting Department
Assistant Professor, Accounting Information Systems

CPA, CISSP (Certified Information Systems Security Professional), CISA, MCSE-Security (Microsoft Certified Systems Engineer – Security)
State Systems Data Manager,
Office of the Legislative Auditor

CPA, CISA
Sr. IS Auditor
Louisiana Legislative Auditor

CISSP, CISA
Information Security Officer
Franciscan Missionaries of Our Lady Health System

CPA
Internal Audit Manager
Louisiana Community & Technical College System

CPA, CFE (Certified Fraud Examiner), Auditor
La. Community & Technical College System
CPA, CFE
Louisiana Community and Technical College System

CPA
Audit Supervisor
Louisiana Dept of Transportation and Development (DOTD)

Auditor, DOTD
Auditor III, DOTD

Audit Director
Louisiana Office of Student Financial Assistance

Project Accountant
Energy & Chemical and Maintenance Division
The Shaw Group
Former Manager
Office of Statewide Reporting and Accounting Policy (OSRAP)

Systems Manager
Office of Statewide Reporting and Accounting Policy (OSRAP)

Auditor
DOTD

Audit Supervisor
Division of Education Finance

MBA, CIA
LCTCS Internal Auditor

Internal Auditor
Louisiana Department of Wildlife & Fisheries

CISA
Internal Audit Division
Louisiana Department of Revenue

CPA

Project Manager
Lamar Advertising MIS

Director of Systems and Development
Lamar Advertising

Internal Auditor
IberiaBank

Internal Audit Manager
IberiaBank

Louisiana Legislative Auditor
Staff II IT Auditor

CIA
Amedisys

CPA, CISA
Internal Audit Louisiana Community & Technical College System

CISA
Internal Audit Division
Louisiana Department of Revenue

Assistant Professor
LSU Accounting Department
Assistant Professor, Accounting Information Systems

CPA, CISA, CISSP, CIA
Director IT Audit
Blue Cross Blue Shield of Louisiana

CISA, CIA, MCSE, CCNA (Cisco Certified Network Associate)
Senior IT Auditor
Louisiana Legislative Auditor

CPA

CPA, FLMI (Fellow, Life Management Institute)
Controller, Guaranty Group

CPA, CIA
Assistant Director, Post Processing Services
Division
Louisiana Department of Revenue

Corporate Controller
H&E Equipment Services LLC

CPA, CIA
Internal Audit Manager
Louisiana Workmen's Compensation Corporation

Assistant Secretary
Group One Tax Administration
Louisiana Department of Revenue

Internal Auditor
University of New Orleans

IT Audit Manager,
Louisiana Lottery

Auditor Supervisor
Louisiana Office of Student Financial Assistance

Senior Staff Auditor
Louisiana Office of Student Financial Assistance

CPA
Carleton & Company, CPA

Senior Accountant,
H&E Equipment Services, LLC

Senior Auditor
Southern University Board and System

Staff Auditor
Southern University Board and System

Controller
Lion Copolymer, LLC

CPA
ABMB Engineers, Inc.

Accounting Manager

CPA Sole Practitioner

Auditor
Office of Legislative Auditor

Director of Internal Audit
University of Louisiana System

IT Compliance Manager
Offshore Logistics Inc

CIA
SAIC (Science Applications International Corporation) / Entergy
Financial Info Systems

Auditor 3
La. DOTD

Chief Information Security Officer
Office of Information Technology
State of Louisiana

CPA, CISA, CISM (Certified Information Security Manager)
Director of Internal Audit
Apria Health Care

Director of Internal Audit
Southern University Board and System

CPA
IT Security Dept, Baton Rouge
Albemarle Corporation

APPENDIX D

IT POLICY RECOMMENDATIONS

1. Company should develop a long-term strategic plan for hardware infrastructure and the organizational structure. Include goals and objectives.
2. The company should develop and/or amend a comprehensive set of policies and procedures to included appropriate review of complaints.
3. Perform an audit of controls in the application and develop controls to prevent and detect transaction errors.
4. Review IT‘s performance measurement tool to make more effective.
5. Update security policy in detail.
6. Top management should foster an environment to increase communication between IT and retail banking.

1. Develop system architecture and processing standards.
2. Appoint a task force to develop a strategic plan for transforming from physical to e-banking to be voted on by Board of Directors
3. IT should be an integral part of the merger/acquisition team
4. Mergers causing compatibility addressed by strategic plan
5. Looming regulatory oversight intervention needs a task force to identify which regulations are problematic and recommend to the board cost efficiency of compliance
6. Develop a formal process to respond to stakeholders/customer suggestions/complaints
7. IT outsourcing should be addressed in the policies and procedures developed from the strategic plan
8. Elevate IT in the management decision process
9. Priorities should be addressed in the strategic plan
10. Recommendations for repair of system degradation needs to be addressed by IT staff

1. Conduct security IT audits
2. Write strategic plan
3. Perform risk assessments
4. Address ineffective or inefficient IT processes
5. Hire qualified and experienced staff
6. Align IT strategy with business strategy
7. Develop business continuity plan
8. Develop critical success factors and key performance indicators
9. Increase communication between business strategy group and IT group
10. Increase review processes of net banking operations
11. Expand the responsibilities of the IT coordination committee
12. Expand IT committee to oversee outsourcing

1. Hold joint meetings to discuss goals/vision
2. Develop organization-wide strategic plan
3. Realign processes with strategic plan
4. Implement 24/7 access with adequate security
5. Outsource complete security review
6. Established performance/accountability factors
7. Use automated workflow tools
8. Track performance of IP outsourced firms
9. Implement continuous audit technique
10. Develop standard IT policy
11. Hire additional temp staff as needed
12. Increase staff training
13. Hire external consultants as needed
14. Use software to track customer service/helpdesk
15. Train IT staff and Board
16. Regular meetings with staff - boost morale and increase communication

1. A conversion process should be followed to integrate systems
2. Outsource an architecture review to ensure systems are scalable for future e-business solutions
3. All systems should be stress tested and capacity tested prior to implementation. The current web app should be tested in a test environment to find the point of failure
4. Business and IT should develop a strategy and objectives. IT should base their strategy and objectives off of corporate strategy and objectives. They should also get executive management approval.
5. A change management process should be developed and adopted
6. Escalation procedures for the help desk should be developed
7. Service-level agreements should be developed for helpdesk
8. Adopt procedures for preventive maintenance checks of software/hardware
9. IT management should be trained in change management
10. Service level agreements should be included in IT outsourced contract
11. Develop a formal process for selecting systems
12. Realistic performance measures
13. IT should be trained to view clients as customers

1. A formal strategy / long-term vision and should be created by the IT group and reviewed and approved by upper management.
2. Regular meetings should be held between members of the IT group and management in order to properly communicate changes and priorities
3. A centralized security administration function should be established and an enterprise-wide security software solution should be implemented. Administrators should be well trained. The new end user process should be well communicated to end-users with a top-down approach
4. Business decisions should be made by top management with a cost-benefit analysis on possible changes/solutions. Decisions should be fully communicated to ensure priorities and are in the line.
5. Documentation of system processes and controls. Management should consider internal audits of the processes
6. Change management process should be developed. Should be specific and address infrastructure changes to accommodate the growing company.
7. Tone at the top should go to “controls” focused.
8. Procedures to monitor outsourcing firm

1. Develop IT strategic plan
2. Develop/implement IT control framework
3. Develop overall strategic plan
4. Review sufficiency of IT infrastructure
5. Adopt COBIT
6. Review responsibilities of IT coordination committee
7. Review helpdesk data and develop solutions to prevent future problems

1. In IT steering committee should include functional users as well as IT staff, and should develop a strategic IT plan, set priorities, direct outsourcing, and monitor progress.
2. Assign responsibility, authority, and accountability to specific individuals to address specific problem areas

1. Enhancer upgrade IT core banking system
2. Rebuild, not patch, existing systems
3. Upgraded system must include sufficient upgrade for projected future growth
4. Going forward, the business strategy group must have one committee with the empowerment to make final decision over the IT team and IT management group
5. Create a formalized IT strategic plan that contains IT direction, risk identification, appreciation for an internal customer needs, and certify IT Department members
6. Enhance Internet banking speed and ensure IT management has identified root causes of posting errors, enhance speed and ensure banking services are available 24/7.
7. Designate a chief security officer. Update security policy, then enforce.

1. Stop and assess systems and procedures -- where to go and how to get their
2. Update technology
3. Train current employees or hire a qualified personnel
4. Putting security procedures in place for access to information systems
5. Appoint full-time IT manager and security manager
6. Evaluate and do customer survey to improve on customer service procedures
7. Resolve people/staff/team problems/conflicts. Implement a coming together team-building process to resolve conflicts/resentments/anger/frustrations. Develop a "we're all in this together" attitude. Evaluate customer satisfaction and make appropriate changes. Put security measures in place at all levels.

1. Streamline IT operations inclusive of all users/stakeholders
2. Hire a CIO and compliance officer and include them in the executive committee. CIO responsibilities will include security.
3. Develop a strategic planning committee with representatives from all departments and divisions to develop long-term and short-term business strategies / objectives.

1. Develop and implement a strategic IT plan to include the following:
a) Identify how IT is to be integrated into overall business strategy
b) Develop short-term and long-term IT goals including
1) Infrastructure needs and upgrade plans
2) Personnel skills needs and upgrade plans
c) Establish leadership, authority and responsibility of the IT coordination committee to assume appropriate levels of user input into IT decision-making processes

2. Due to the lack of necessary skills and knowledge in-house, a qualified consultant should be engaged to:
a) Reevaluate the capabilities of the net banking services provider in terms of
1) Scalability - the ability of the Company to handle ever-growing transaction volumes
2) Reliability - the ability of the Company to accurately and timely process transactions
3) Availability - the Company possesses the necessary infrastructure and redundancy to issue or access at agreed-upon levels
b) Re-negotiate service-level agreements with outsourcing company to ensure that the items in number one above are maintained at agreed-upon levels

Note to #2: in the long-term internal skills should be developed in accordance with recommendations #1 to allow the SLA's identified in #2 to be monitored internally

1. Executives, Board of Directors should set out mission statement, goals for Company, strategic vision and, management accountability -- communicate to everybody
2. Team to address immediately problems with Internet banking, including all stakeholders: retail banking, IT, outsourcing
• processing controls/erroneous transactions
• Problem resolution /escalation process
• Availability issues/24 x 7
• Capacity issues/response time
3. Company sets strategic plan for what we want to accomplish
4. Consolidate IT systems - standardized to support strategic direction
• Hardware, software, systems, policy, procedure
• evaluate IT skills sets on hand and study feasibility of retaining and retraining some or all of current IT, or outsource some or all
• Corporate security policy - procedures and awareness of roles and responsibilities defined and educate employees on what their roles are
5. Explore profit-sharing incentives for employees and for outsource companies - if we do we will all get a piece of the pie
6. Audit committee needs own charter that says they have oversight, management had responsibility and audit to has responsibility for monitoring and evaluating, and there needs to be communication for internal controls

1. The recommendation and for the infrastructure/security problems listed is to first hire a security officer to address the security issues listed and immediately investigate the errors in transaction processing. Also, to investigate potential network acquisitions to address the aging network issues, transaction issues, response time, and customer access.
2. The solution for strategic planning issues is for management to develop a strategic plan and a clear vision for the company to be proactive, not reactive, in following objectives, such as following the e-banking objective. Management must also develop a monitoring system for their outsourcing project and develop policy and procedures that are consistent with the Company.
3. Final recommendation and for the human resources problems is to resolve the friction between IT and retail staff through conflict resolution with training the staff. Management should organize training for IT staff for change and open communication lines for questions and comments for those resistant to change and hire experienced personnel to monitor inexperienced staff.

1. Adopt a formal strategic plan including executives from all departments within the Corporation. Long-term and short-term goals should be identified.
2. Review IT infrastructure to evaluate IT resources and skills sets, hardware, software, communications, networking and security and prioritize issues discovered
3. Formalize the procedures for defining and monitoring the service-level agreements internally and with third parties. Expand scope of internal IT SLA's with incident management and formal escalation
4. Adopt a centralized formal security policy that encompasses all systems and is managed centrally. Adopt a security awareness program

1. IT should involve end users prior to outsourcing
2. Create a core group who is responsible for presenting solutions to complaints
3. Create an audit section to review transactions on a timely basis
4. Try to centralize IT processes for all locations
5. invest more money in IT infrastructure

1. Establish short-term and long-term goals/objectives
2. Create a committee to evaluate system requirements -- current and long-term
3. Create steering committee to prioritize projects and manage resources
4. Document IT organizational structure and define responsibilities
5. Develop monitoring and reporting system that determines appropriate factors to monitor and report the results to the appropriate level of management so that corrective action can be taken timely

1. Develop an internal auditing committee/department to keep the focus away from the bottom line. Also perhaps change bonus and performance evaluations to be based on other categories and not end result
2. Board of Directors needs to fully engage Sarbanes-Oxley concepts in their daily operations
3. Engage IT and business in the decision-making process on both sides. Make sure that the meetings and task forces involve correct people from both sides. Perform cross-team evaluations and act on “issue” items
4. Audit committee needs to actively engage IT and business sides on internal control concepts. Analyzing the processes in implementing controls will improve overall business/IT environment.
5. Board of Directors should meet with the business and IT process owners to understand what the current issues are, the positive factors. Basically engage in an in-depth understanding to assist in facilitation of priorities, especially if the Company may be exposed to lawsuits or banking commission penalties

6. Process should be developed to ensure that all problems flow up the chain in order to find solutions agreed-upon by the appropriate management. That way, all solutions will take into account all departments
7. There should be a formal security manager position. This person should lead an effort in establishing and integrating security policies and procedures
8. An effort should be made on IT side to permanently fixed problems versus temporary patch. This can be in a form of identifying the problems as permanent fixes and putting certain procedures in place to ensure that the fixes are implemented and that problems are eliminated (collect resolution metrics)
9. Evaluate change management process in place. Are there adequate development, test, deployment, and post-deployment procedures in place? Are they well executed? Evaluate business process software used to see whether there are any gaps between what needs to be achieved on the business side versus software functionality.
10. The firm based to increase communication among business personnel so they can have an understanding of why cuts are made in some places and not in others. Also bring both businesses and IT personnel together to create a more cohesive team.
11. Begin testing the current online system in order to determine as many problems with this as possible.
12. Evaluate the system for existing processes and risks associated with these processes. Perform ranking and develop priority ranking. Implement priority identification by working cases/ issues based on the priority matrix.
13. Conduct cross-training for IT in the areas of businesses they serve. Can have brown bag lunches where they invite customers to talk about their processes the same can be done for the customers as well.
14. User access for the customers need to be changed to 24/7 access to facilitate more customer satisfaction. Bottom line will decrease as the customers become dissatisfied and more move to other banks. The purpose is to increase their customers. The more customers that do not have access to their accounts, the more likely they will move somewhere that day will be able to.

1. Define the IT organization and relationships
2. Define a strategic IT plan
3. Communicate management aims and direction
4. Manage performance and capacity
5. Develop and implement a systems development lifecycle methodology (manage projects)
6. Manage problems and incidents
7. Define and manage service levels
8. Assess risks
9. Assess internal control adequacy
10. Identify automated solutions

1. Establish checks and balances when processing transactions to reduce errors or irregularities
2. Ensure that any outstanding agreements have performance measurements which if not met enable TIBCO to terminate this agreement
3. Develop a master IT plan with input and support from all business units
4. Develop an IT steering committee with individuals from across the organization, all with equal representations
5. Incorporate testing plan and scenarios into any system modifications
6. Review and recommendation regarding condition of IT infrastructure
7. Modify Web banking for customers to access any time of the day
8. Establish security standards, designate a security manager, and outline his/her duties and responsibilities
9. Create an internal feedback mechanism so that feedback can be provided to on IT performance. Ensure that internal staffs' continued employment is tied to this performance
10. Instead of "let them come in and we will build it" move to a "build it and they will come" mentality

1. Retail banking should be encouraged to abandon obsolete systems in favor of more efficient technology
2. Personnel requirements for IT requiring a certain level of experience for each technical area of IT
3. Chairman should increase level of involvement in the Company activities
4. All members should be encouraged to work towards the achievement of all the Company's goals, not just monetary goals
5. Must develop a monitoring plan of third-party contract performance
6. Third-party contracts should be really written to ensure that all levels of responsibility, performance measures, and ownership are clearly defined
7. Management should developed a company-wide IT strategic plan in line with the business' goals
8. Internal control should be stressed as something to be taken seriously
9. Management should establish a continuous training plan
10. Standard internal service agreements should be developed requiring inclusion of all services to be performed and a method to evaluate compliance
11. A system of checks and balances should be enforced in order to diminish the possibility of one person or group gaining too much influence.

1. Develop a comprehensive IT strategic plan
2. Steering committee of the of the of
3. Acquire and assess necessary resources for
4. Evaluate outsourcing
5. Manage firewall in-house
6. Better communications, including stakeholder involvement
7. Management buy-in and commitment to plans

APPENDIX E

AVFA SCREEN CONTENT

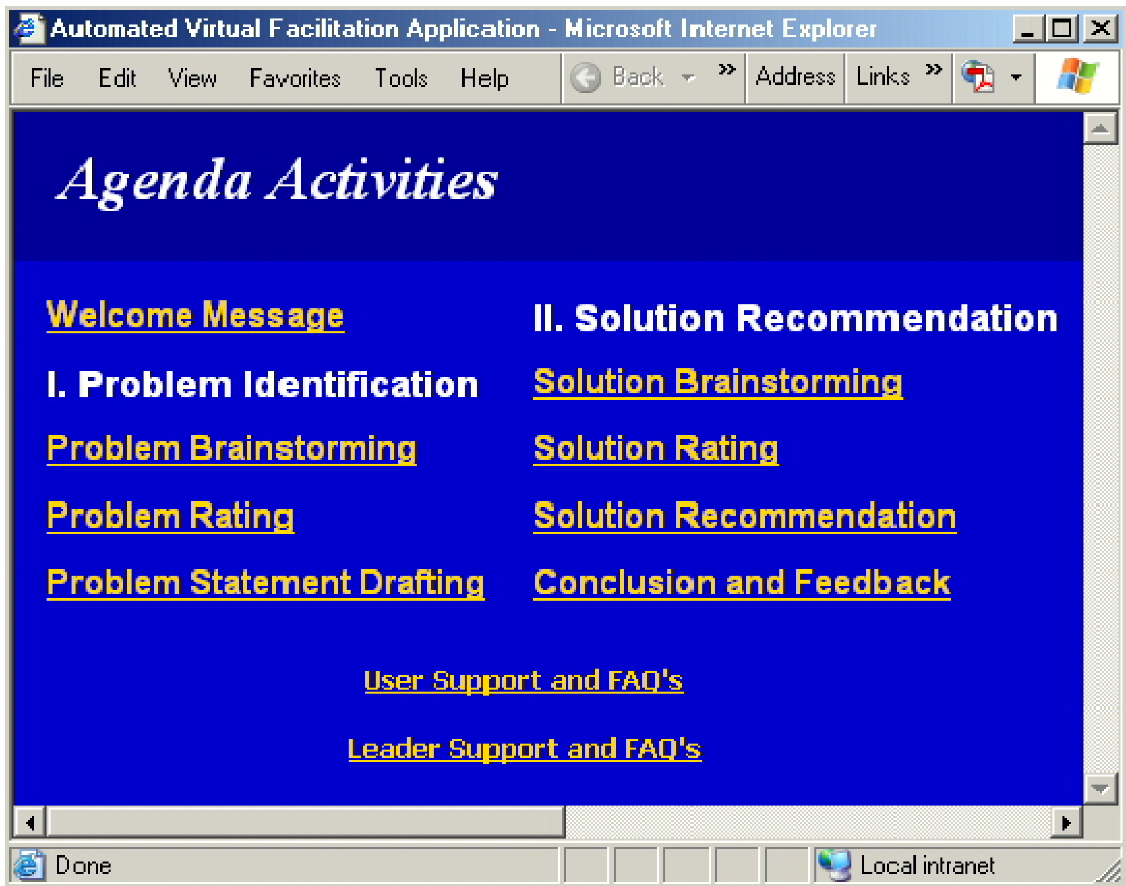

Figure 7: AVFA Screen

Welcome Message

- To receive guidance for a specific agenda activity, click on that activity's hyperlink.
- Click the "Current Activity Completed" hyperlink for instructions on another agenda activity.
- Click the hyperlink below when the welcome message has finished.

Problem Brainstorming

1. Type in a brief description of a problem, and then press the "Submit" button (or the F9 key) to submit it.
2. Repeat this process for each problem that you wish to submit.
3. After submitting all of the problems you wish to submit, click the "Pause" button.
4. When all team members have finished submitting their problems, the team leader should transfer the brainstorming results to the subsequent "Problem Rating" agenda activity.

Problem Rating

1. Use the slider control next to each problem statement to rate a problem's significance.
2. Assign higher scores to those problems that you feel are most significant, and lower ratings to those problems that you believe are not as important.
3. After rating each problem, click the "cast ballot" icon.

Problem Statement Drafting

1. Write down all of the problems that your group has identified in the order that was agreed upon by your group.
2. Identify as many problems as possible, but do not include duplicate items, or problems that are very closely related.
3. Each team member should write down the problems on their own forms, as you will need to refer to this listing for proposing solutions, and submit them when you are finished

Solution Brainstorming

1. Type in a brief description of the solution that you are proposing, then press the "Submit" button (or the F9 key) to submit it.
2. Repeat this process for each solution you wish to submit.
3. After submitting all your solutions, click the Pause button.
4. After all team members have finished submitting their solutions; the team leader should transfer the brainstorming results to the subsequent "Solution Rating" agenda activity.

Solution Rating

1. Use the slider next to each solution to rate its effectiveness in being able to solve the problems that have been identified.
2. Assign a higher rating to those solutions that you feel would be most effective, and assign a lower rating to those solutions that you feel would not be as effective.
3. After rating each solution, click the "Cast Ballot" icon.

Solution Recommendation

1. Write down all of the solutions that your group has agreed upon in the order of their importance, on the form attached to the case study.
2. Submit as many solutions as possible, but do not include duplicate items, or solutions that are very closely related.
3. Each team member should write down the problems on their own forms
4. Be sure to indicate the time that you finish.

Conclusion and Feedback

Thank you for your participation in this research. Please complete the questionnaire that has been given to you and hand it in to a researcher when you are asked to submit it.

User Support and FAQs

How do I switch back and forth between the GroupSystems and AVFA applications? Click the GroupSystems or AFVA button on the bottom of your screen, as you would do to move between two Windows applications, or press the "Alt" and "Tab" keys to toggle back and forth between the two applications.

How do I go to the next agenda activity in GroupSystems?
Double-click the "Agenda" button at the top of your GroupSystems Window to display the Agenda Activities, then double-click the agenda item you would like to go to. The team leader must have initiated a new activity in order to be able to go to a new agenda activity. This can be done only when everyone has clicked the "Pause" button after entering all of your brainstorming items.

Why can't I see the agenda in Group Systems?
Sometimes the Agenda window might be hidden by another GroupSystems window. To see the Agenda window, close any windows that might be on top of it by clicking the "X" box in the upper right corner, as you would normally do when using Windows applications. If the Agenda window is still not visible with all of the GroupSystems windows closed, double-click the Agenda button (icon) on the GroupSystems toolbar to re-open the Agenda window, or on the "Window" menu, select "Agenda".

How do we transfer the Brainstorming results to the Voting activity? The team leader should click the "Shift Data to Another Tool" icon (the icon with two circular arrows). This will bring up the "Shift Activity" dialog box. The team leader should select "Existing Activity" and choose "Problem Voting" if you have just finished problem brainstorming. Select "Solution Voting" if you have just finished solution brainstorming.

How do we remove duplicate or very similar brainstorming items?
This must be done on a manual basis when using the Brainstorming tool. If two or more brainstorming items are very similar, they should (theoretically) be rated almost identically during the voting phase. When you submit your group's final problems or solutions, you should omit duplicate items, and just include one problem or solution description for items that are very similar.

How do I get the slider control to appear on the voting page?
The leader must click the "select voting method for ballot" icon (slider icon) after he has transferred the brainstorming results to the voting tool for the slider controls to appear on the voting page (for a more detailed description, refer to the "Leader Support and FAQs".

How can I display the voting results?
To display the voting results, click on the "bar graph" icon on the GroupSystems toolbar after all team members have cast their votes.

What does the green arrow icon on the GroupSystems toolbar do?
The green arrow icon is used by the leader to start an agenda process, such as brainstorming or voting.

Leader Support and FAQs

Why is a leader needed, and what does a leader do in GroupSystems?
A leader is needed to direct the activities of the group in its decision-making activities. The leader must be a member of the group when the facilitation process (i.e. group leadership process) is automated. In such cases, a team member will instruct the GroupSystems software when to begin and end certain processes, such as Brainstorming or Voting

How does the leader start the Brainstorming tool?
To start the Brainstorming tool (and many other tools) the leader needs to click the green arrow icon ("Start Participants in this Activity" icon). This will open the "Start Participants"

After brainstorming, what does the leader need to do?
After all team members have finished submitting their brainstorming items and have clicked the "Pause" button, the leader will need to transfer the brainstorming results to the next agenda activity (e.g. problem rating) so that all team members can vote on all of the items that were submitted during the brainstorming process.

I don't see the "Pause" button at the bottom of the brainstorming screen. The leader may not have a "Pause" button to click after he is finished submitting his brainstorming items. Instead, he should click the "Close" button to register the end of his brainstorming.

How does the leader transfer the brainstorming results to the voting tool? To transfer the brainstorming results to the voting tool (e.g. "problem brainstorming" to "problem rating") the leader must click the circular arrow icon ("shift data to another activity" icon). This will open the "Shift Activity" dialog box. The leader should select "Existing Agenda Activity" and "Problem Voting" and then click OK to transfer the problem brainstorming results to the "Problem Voting" (i.e. problem rating) activity. Next, the leader must specify the voting method to be used by clicking the "slider" icon ("select voting method for ballot" icon). Next, the leader should select "10-point scale" as the voting method, and then click OK. At this point, all of the team members should be able to vote on all of the items that were submitted during the brainstorming process

How does the team leader direct the voting process?
After the team leader has selected the voting method, as described above, all team members should have a listing of all of the brainstorming items on their screens with a slider button next to each, and should be able to begin voting. If this is not the case, the leader may need to click the green "start participants in this activity" icon to permit voting to begin.

After voting, what does the leader need to do?
The leader should make sure that all team members have clicked the "cast ballot" icon to register the ratings that they have assigned to the brainstorming items after they have finished rating them.

Once all team members have cast their ballots, what does the leader need to do?
After all members' votes have been cast, the leader and all team members should be able to click the "View Results" icon (bar graph icon) to display the voting results.

W**hat does the team leader do with the voting results?**
The voting results are used to prepare the required submissions for problem identification and solution recommendations. In submitting their problem listings and solution recommendations, duplicate or very similar problems should be eliminated or consolidated before writing down all of the problems that will be included in your formal report. Likewise, all team members should eliminate duplicate or very similar solutions before submitting their formal solution recommendations.

APPENDIX F

AVFA AUDIO SCRIPT

Welcome to LSU's DECIDE Boardroom. Thanks for your participation in this research. Your efforts will assist us in studying computer-supported group decision-making

Today you will be working as a member of a team in solving problems identified in a hypothetical case study. You will be using our GroupSystems collaboration software which is designed to facilitate more effective group decision-making.

Your group will be asked to recommend a solution that they think will best address the problems presented in the case study.

Each person in your group has been assigned a specific role, and will have slightly different information contained in their packet. The information you receive will need to be shared with the rest of the group in order to effectively solve the problems presented in the case study.

At the end of today's session you will be asked to write a formal recommendation. Your goal is to identify and solve any and all of the problems that are presented in this case study.

You will now be given a copy of the case study. After you have finished reading it, please click the "Current Activity Completed" button. After all team members have finished reading the case and are ready to proceed to the next activity, click the "Begin Next Activity" button. Please repeat this sequence after each of today's agenda items, in order to interactively control the meeting's pace. Feel free to spend as much -- or as little -- time as you care to on each of the scheduled activities.

As previously mentioned, your group will be preparing a formal recommendation stating which specific actions are needed in order to address the problems that you have learned about in the case study. You will be recommending a set of solutions that solve as many problems as possible. Please be sure that all of your recommendations are based on at least two criteria: Feasibility, and the number of problems they will solve. The more feasible or practical a solution is, and the more problems it solves, the better its quality is deemed to be. Also, try to solve as many problems as you can, but be sure to solve the biggest problems first. .

We'll now use the group collaboration software to generate "problem statements." A problem statement is a clear definition of the problems that you are attempting to resolve. You will be using the Electronic Brainstorming tool to help generate as many potential solutions to a problem as possible.

To use the brainstorming tool, simply type in what you perceive the problems to be. Please include only one problem in each statement. And don't worry about proper grammar. A simple description of the problem will suffice. After typing in your problem statement, press the F9 key to submit each statement.

Remember, all of your statements will be anonymous. Please submit as many problem statements as you can. When you've finished, click the "current activity completed" button at the bottom of your screen.

After all of the problem statements have been submitted, you should discuss and clarify each of them, and eliminate any duplicate items. You may begin submitting your problem statements now.

The next activity is designed to reduce the number of problem statements for consideration. To do so, you'll be using the Voting tool. Simply use the slider on the side of each statement to register your vote. A score of 10 signifies that the statement correctly defines a major problem. Lower scores indicate that the statement does not define an actual problem, or merely defines a very minor problem.

You can begin voting as soon as the voting tool appears on your monitor. Once you have completed voting, click the 'activity completed" button at the bottom of your screen.

Now that you've focused on the most significant problems, the next item on our agenda is to compose a formal problem statement that identifies all of the relevant problems that need to be addressed. After agreeing upon its content, have a team member write it down.

Now that you've formulated a problem statement, you should now try to identify what the root causes of the problems might be. Using the Brainstorming tool, list as many potential causes as possible for the problems that have been identified. As before, please enter each cause separately, pressing the F9 button after each one

So far, you've identified the existing problems and their possible causes. Now it's time to think of some of those solutions. Using the Brainstorming tool, please submit as many possible solutions as you can to the problems that you've identified.

Our current activity is designed to reduce the number of potential solutions. To do so, we'll be using the Voting tool once again. As before, simply use the slider button to register which suggestions you prefer (giving those a higher vote), and assigning a lower score to those solutions which you feel would not effectively solve the problems. You can begin voting as soon as the Voting tool appears on your screen.

Our agenda now requires you to prepare a formal recommendation that will effectively address the issues specified in the problem statement, using the criteria that were agreed upon earlier.

Remember, you will be recommending a set of solutions that are designed to solve as many problems as possible. In addition to any other criteria that may have been used, your recommendations should be based on their feasibility, as well as the number of problems that they can help solve. Remember, the more feasible or practical a solution is, and the more problems it solves, the better its quality is deemed to be. Finally, in drafting your recommendation, be sure to address the biggest problems first.

When your team has agreed on the content of your recommendation, have a team member write it on a piece of paper and turn it in to one of the researchers.

Thank you for your participation in this research. We now need you to give us some feedback regarding the technology that was used today. Since your evaluations will be completed individually, you can proceed to all of the subsequent activities at your own pace. Simply click the “Next Activity” button to proceed to the evaluation form. Because this is the probably the most important part of this research, please try to be as accurate as you can in providing your answers to the following questions. Thanks again for your help.

APPENDIX G

SEMINAR FLYER

Using COBIT for Complying with the Sarbanes-Oxley Section 404 Provisions

Section 404 of Sarbanes-Oxley requires management to establish adequate internal controls and assess their effectiveness on an annual basis. COBIT (Control Objectives for Information and Related Technology) has become the internationally recognized standard for ensuring adequate control over information technology and can help ensure compliance with Sarbanes-Oxley's internal control objectives.

- **Presents an overview of the COBIT standards and examines how they can be used to help ensure compliance with the Section 404 provisions of Sarbanes-Oxley.**
- **A case study is presented in which seminar participants take part in addressing information systems security issues, including the use of collaboration technologies for group decision-making in an LSU Department of Information Systems and Decision Sciences research project.**

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- January 18
- January 19

All seminars are 8:30 a.m. - 5:00 p.m. Seating is limited to 30 per seminar. Lunch and refreshments will be provided.

Please register by Monday January 9

To register, email Harold Lagroue, CPA at hlagroue@yahoo.com and specify your preferred seminar date and level of COBIT and IS auditing experience.

LSU

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APPENDIX H

DATA SET

GROUP-LEVEL DATA

SUPPORT	MINUTES	NUMPROB	NUMSOLUT	QUALITY
1	115	9	6	143.3
1	123	17	10	148.3
1	115	19	10	NULL
1	108	22	16	138.3
1	115	22	13	158.3
1	121	13	8	148.3
1	115	12	7	171.7
1	57	6	5	133.3
2	110	7	2	75.0
2	76	4	4	141.7
2	100	10	6	145.0
2	130	3	3	108.3
2	145	2	2	166.7
2	101	9	6	165.0
2	130	3	3	130.0
2	85	4	4	136.7
3	145	8	5	91.7
3	164	6	5	108.3
3	162	18	14	181.7
3	110	5	10	115.0
3	93	13	10	153.3
3	117	12	11	138.3
3	126	12	7	108.3

PARTICIPANT-LEVEL DATA

SUPPORT	FOA	PEU	PU	EOU	ATTITUDE	PROSAT	OUTSAT	AVFAFAV
1	24	30	21	24	75	30	30	
1	35	26	14	25	65	30	30	
1	35	30	17	22	69	28	21	
1	30	29	21	23	73	30	30	
1	23	21	16	20	57	26	26	
1	26	20	11	18	49	26	25	
1	35	24	27	25	76	26	22	
1	35	29	17	16	62	25	33	
1	32	26	21	24	71	31	30	
1	35	31	12	17	60	10	12	
1	35	31	13	16	60	24	25	
1	28	18	15	18	51	20	25	
1	27	26	15	19	60	27	23	
1	22	12	10	15	37	24	15	
1	20	21	10	15	46	15	16	
1	20	12	19	0	31	30	28	
1	23	27	14	14	55	15	24	
1	20	33	15	14	62	11	33	
1	18	25	21	16	62	25	27	
1	30	30	21	19	70	21	26	
1	26	31	26	27	84	30	16	
1	26	19	13	20	52	11	10	
1	33	25	14	18	57	28	32	
2	35	26	23	23	72	30	30	
2	28	30	24	0	54	26	22	
2	32	25	24	23	72	35	34	
2	32	27	25	27	79	33	34	
2	31	28	19	23	70	30	31	
2	20	29	26	20	75	33	32	
2	33	30	24	24	78	30	30	
2	29	35	22	20	77	35	35	
2	33	30	21	23	74	24	0	
2	35	35	24	27	86	35	35	
2	32	25	14	0	39	27	29	
2	29	26	21	21	68	30	30	
2	32	34	28	28	90	34	33	
2	35	30	25	24	79	35	35	
2	22	26	23	21	70	30	30	
2	35	25	26	25	76	31	29	
2	34	32	24	24	80	30	30	
2	24	28	24	24	76	30	30	
2	24	13	15	17	45	19	17	
2	26	22	18	23	63	30	29	
2	30	30	22	19	71	30	25	
2	22	24	24	18	66	30	30	
2	30	32	20	25	77	31	31	

2	24	33	25	22	80	35	28	

SUPPORT	FOA	PEU	PU	EOU	ATTITUDE	PROSAT	OUTSAT	AVFAFAV
3	30	25	16	20	61	25	25	24
3	5	9	18	15	42	22	25	16
3	35	25	22	20	67	35	31	26
3	18	15	17	14	46	5	15	17
3	20	18	15	16	49	26	24	20
3	10	11	21	13	45	30	25	18
3	18	16	16	14	46	24	18	16
3	25	11	13	18	42	19	22	21
3	18	9	25	22	56	23	24	24
3	30	27	21	18	66	23	15	28
3	26	35	25	22	82	35	34	32
3	19	12	22	13	47	25	25	10
3	15	16	14	11	41	18	21	18
3	22	18	18	19	55	21	20	23
3	16	17	13	17	47	35	31	23
3	33	31	20	24	75	30	30	30
3	20	32	28	24	84	32	35	35
3	25	24	26	18	68	20	15	24
3	30	29	19	24	72	30	30	24
3	26	24	20	20	64	30	30	28
3	29	19	13	20	52	33	33	26
3	32	22	16	21	59	16	16	14

APPENDIX I

SPSS OUTPUT FOR EQUALITY OF MEANS TESTS

Group Statistics

	SUPPORT	N	Mean	Std. Deviation	Std. Error Mean
EFFICIEN	Conventional Groups	8	108.63	21.340	7.545
	AVFA-Supported Groups	7	131.00	26.932	10.179
QUALITY	Conventional Groups	7	148.786	12.8835	4.8695
	AVFA-Supported Groups	7	128.086	31.3387	11.8449
NUMPROB	Conventional Groups	8	15.00	5.952	2.104
	AVFA-Supported Groups	7	10.57	4.541	1.716
NUMSOLUT	Conventional Groups	8	9.38	3.701	1.308
	AVFA-Supported Groups	7	8.86	3.338	1.262

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
EFFICIEN	Equal variances assumed	1.530	.238	-1.795	13	.096	-22.38	12.464	-49.302	4.552
	Equal variances not assumed			-1.766	11.443	.104	-22.38	12.671	-50.132	5.382
QUALITY	Equal variances assumed	6.254	.028	1.616	12	.132	20.700	12.8068	-7.2036	48.6036
	Equal variances not assumed			1.616	7.972	.145	20.700	12.8068	-8.8508	50.2508
NUMPROB	Equal variances assumed	1.144	.304	1.600	13	.134	4.43	2.767	-1.550	10.407
	Equal variances not assumed			1.631	12.801	.127	4.43	2.716	-1.447	10.304
NUMSOLUT	Equal variances assumed	.022	.885	.283	13	.782	.52	1.831	-3.438	4.474
	Equal variances not assumed			.285	12.979	.780	.52	1.818	-3.410	4.445

Group Statistics

	SUPPORT	N	Mean	Std. Deviation	Std. Error Mean
EFFICIEN	Conventional Groups	8	108.63	21.340	7.545
	Unsupported Groups	8	109.63	23.862	8.437
QUALITY	Conventional Groups	7	148.786	12.8835	4.8695
	Unsupported Groups	8	133.550	30.1751	10.6685
NUMPROB	Conventional Groups	8	15.00	5.952	2.104
	Unsupported Groups	8	5.25	3.012	1.065
NUMSOLUT	Conventional Groups	8	9.38	3.701	1.308
	Unsupported Groups	8	3.75	1.581	.559

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
EFFICIEN	Equal variances assumed	.714	.412	-.088	14	.931	-1.00	11.318	-25.275	23.275
	Equal variances not assumed			-.088	13.829	.931	-1.00	11.318	-25.303	23.303
QUALITY	Equal variances assumed	2.597	.131	1.236	13	.238	15.236	12.3226	-11.3857	41.8571
	Equal variances not assumed			1.299	9.728	.224	15.236	11.7273	-10.9937	41.4651
NUMPROB	Equal variances assumed	5.642	.032	4.134	14	.001	9.75	2.358	4.692	14.808
	Equal variances not assumed			4.134	10.364	.002	9.75	2.358	4.520	14.980
NUMSOLUT	Equal variances assumed	4.255	.058	3.953	14	.001	5.63	1.423	2.573	8.677
	Equal variances not assumed			3.953	9.473	.003	5.63	1.423	2.431	8.819

Group Statistics

	SUPPORT	N	Mean	Std. Deviation	Std. Error Mean
EFFICIEN	AVFA-Supported Groups	7	131.00	26.932	10.179
	Unsupported Groups	8	109.63	23.862	8.437
QUALITY	AVFA-Supported Groups	7	128.086	31.3387	11.8449
	Unsupported Groups	8	133.550	30.1751	10.6685
NUMPROB	AVFA-Supported Groups	7	10.57	4.541	1.716
	Unsupported Groups	8	5.25	3.012	1.065
NUMSOLUT	AVFA-Supported Groups	7	8.86	3.338	1.262
	Unsupported Groups	8	3.75	1.581	.559

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
EFFICIEN	Equal variances assumed	.251	.625	1.631	13	.127	21.38	13.107	-6.941	49.691
	Equal variances not assumed			1.617	12.157	.132	21.38	13.221	-7.390	50.140
QUALITY	Equal variances assumed	.161	.695	-.344	13	.737	-5.464	15.8979	-39.8096	28.8810
	Equal variances not assumed			-.343	12.585	.737	-5.464	15.9411	-40.0189	29.0903
NUMPROB	Equal variances assumed	1.314	.272	2.709	13	.018	5.32	1.964	1.078	9.564
	Equal variances not assumed			2.635	10.212	.025	5.32	2.020	.834	9.809
NUMSOLUT	Equal variances assumed	5.484	.036	3.874	13	.002	5.11	1.318	2.259	7.955
	Equal variances not assumed			3.701	8.312	.006	5.11	1.380	1.946	8.269

Group Statistics

	Support Provided	N	Mean	Std. Deviation	Std. Error Mean
Faithfulness of Appropriation	Conventional GSS Groups	23	27.74	5.833	1.216
	AVFA-Supported Groups	22	22.82	7.713	1.644
Perceived Ease of Use	Conventional GSS Groups	23	25.04	5.904	1.231
	AVFA-Supported Groups	22	20.23	7.709	1.643
Perceived Usefulness	Conventional GSS Groups	23	16.65	4.735	.987
	AVFA-Supported Groups	22	19.00	4.429	.944
Extensiveness of Use	Conventional GSS Groups	23	18.48	5.575	1.162
	AVFA-Supported Groups	22	18.32	3.835	.818
Attitude Towards Use	Conventional GSS Groups	23	60.17	12.503	2.607
	AVFA-Supported Groups	22	57.55	13.190	2.812
Satisfaction with Meeting Process	Conventional GSS Groups	23	23.61	6.747	1.407
	AVFA-Supported Groups	22	25.32	7.357	1.569
Satisfaction with Meeting Outcome	Conventional GSS Groups	23	24.30	6.629	1.382
	AVFA-Supported Groups	22	24.73	6.445	1.374

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Faithfulness of Appropriation	Equal variances assumed	1.635	.208	2.421	43	.020	4.92	2.033	.822	9.020
	Equal variances not assumed			2.406	39.092	.021	4.92	2.045	.784	9.058
Perceived Ease of Use	Equal variances assumed	2.914	.095	2.359	43	.023	4.82	2.041	.699	8.933
	Equal variances not assumed			2.345	39.353	.024	4.82	2.053	.664	8.969
Perceived Usefulness	Equal variances assumed	.096	.759	-1.716	43	.093	-2.35	1.368	-5.107	.412
	Equal variances not assumed			-1.719	42.981	.093	-2.35	1.366	-5.103	.407
Extensiveness of Use	Equal variances assumed	.642	.427	.112	43	.912	.16	1.433	-2.729	3.049
	Equal variances not assumed			.113	39.119	.911	.16	1.421	-2.714	3.034
Attitude Towards Use	Equal variances assumed	.683	.413	.686	43	.496	2.63	3.830	-5.096	10.352
	Equal variances not assumed			.685	42.584	.497	2.63	3.835	-5.107	10.364
Satisfaction with Meeting Process	Equal variances assumed	.057	.812	-.813	43	.421	-1.71	2.103	-5.950	2.531
	Equal variances not assumed			-.811	42.267	.422	-1.71	2.107	-5.961	2.542
Satisfaction with Meeting Outcome	Equal variances assumed	.000	.992	-.217	43	.829	-.42	1.950	-4.356	3.510
	Equal variances not assumed			-.217	42.987	.829	-.42	1.949	-4.354	3.508

Group Statistics

	Support Provided	N	Mean	Std. Deviation	Std. Error Mean
Faithfulness of Appropriation	Conventional GSS Groups	23	27.74	5.833	1.216
	Unsupported Groups	24	29.46	4.672	.954
Perceived Ease of Use	Conventional GSS Groups	23	25.04	5.904	1.231
	Unsupported Groups	24	28.13	4.794	.979
Perceived Usefulness	Conventional GSS Groups	23	16.65	4.735	.987
	Unsupported Groups	24	22.54	3.375	.689
Extensiveness of Use	Conventional GSS Groups	23	18.48	5.575	1.162
	Unsupported Groups	24	20.88	6.986	1.426
Attitude Towards Use	Conventional GSS Groups	23	60.17	12.503	2.607
	Unsupported Groups	24	71.54	11.714	2.391
Satisfaction with Meeting Process	Conventional GSS Groups	23	23.61	6.747	1.407
	Unsupported Groups	24	30.54	3.822	.780
Satisfaction with Meeting Outcome	Conventional GSS Groups	23	24.30	6.629	1.382
	Unsupported Groups	24	28.71	7.363	1.503

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Faithfulness of Appropriation	Equal variances assumed	2.283	.138	-1.118	45	.270	-1.72	1.538	-4.817	1.379
	Equal variances not assumed			-1.112	42.133	.272	-1.72	1.545	-4.838	1.399
Perceived Ease of Use	Equal variances assumed	1.296	.261	-1.968	45	.055	-3.08	1.566	-6.235	.072
	Equal variances not assumed			-1.959	42.394	.057	-3.08	1.573	-6.254	.091
Perceived Usefulness	Equal variances assumed	3.512	.067	-4.927	45	.000	-5.89	1.195	-8.297	-3.482
	Equal variances not assumed			-4.892	39.647	.000	-5.89	1.204	-8.323	-3.456
Extensiveness of Use	Equal variances assumed	.108	.744	-1.296	45	.201	-2.40	1.849	-6.120	1.327
	Equal variances not assumed			-1.303	43.596	.200	-2.40	1.840	-6.106	1.312
Attitude Towards Use	Equal variances assumed	.235	.630	-3.218	45	.002	-11.37	3.533	-18.483	-4.253
	Equal variances not assumed			-3.213	44.476	.002	-11.37	3.538	-18.495	-4.240
Satisfaction with Meeting Process	Equal variances assumed	8.230	.006	-4.358	45	.000	-6.93	1.591	-10.137	-3.729
	Equal variances not assumed			-4.310	34.491	.000	-6.93	1.609	-10.200	-3.665
Satisfaction with Meeting Outcome	Equal variances assumed	.372	.545	-2.152	45	.037	-4.40	2.047	-8.526	-.282
	Equal variances not assumed			-2.157	44.832	.036	-4.40	2.042	-8.517	-.291

Group Statistics

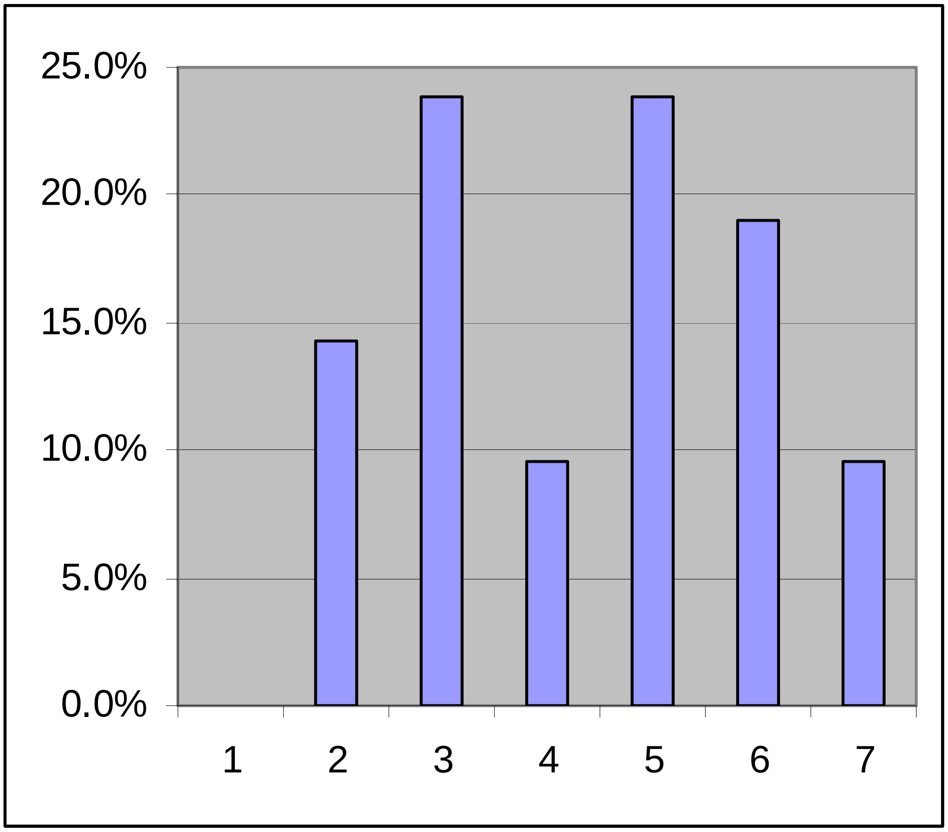
	Support Provided	N	Mean	Std. Deviation	Std. Error Mean
Faithfulness of Appropriation	AVFA-Supported Groups	22	22.82	7.713	1.644
	Unsupported Groups	24	29.46	4.672	.954
Perceived Ease of Use	AVFA-Supported Groups	22	20.23	7.709	1.643
	Unsupported Groups	24	28.13	4.794	.979
Perceived Usefulness	AVFA-Supported Groups	22	19.00	4.429	.944
	Unsupported Groups	24	22.54	3.375	.689
Extensiveness of Use	AVFA-Supported Groups	22	18.32	3.835	.818
	Unsupported Groups	24	20.88	6.986	1.426
Attitude Towards Use	AVFA-Supported Groups	22	57.55	13.190	2.812
	Unsupported Groups	24	71.54	11.714	2.391
Satisfaction with Meeting Process	AVFA-Supported Groups	22	25.32	7.357	1.569
	Unsupported Groups	24	30.54	3.822	.780
Satisfaction with Meeting Outcome	AVFA-Supported Groups	22	24.73	6.445	1.374
	Unsupported Groups	24	28.71	7.363	1.503

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Faithfulness of Appropriation	Equal variances assumed	6.238	.016	-3.566	44	.001	-6.64	1.862	-10.393	-2.887
	Equal variances not assumed			-3.493	33.989	.001	-6.64	1.901	-10.503	-2.777
Perceived Ease of Use	Equal variances assumed	8.299	.006	-4.211	44	.000	-7.90	1.875	-11.678	-4.118
	Equal variances not assumed			-4.129	34.564	.000	-7.90	1.913	-11.783	-4.013
Perceived Usefulness	Equal variances assumed	2.548	.118	-3.066	44	.004	-3.54	1.155	-5.870	-1.214
	Equal variances not assumed			-3.030	39.170	.004	-3.54	1.169	-5.906	-1.178
Extensiveness of Use	Equal variances assumed	.966	.331	-1.519	44	.136	-2.56	1.684	-5.950	.836
	Equal variances not assumed			-1.555	36.306	.129	-2.56	1.644	-5.890	.776
Attitude Towards Use	Equal variances assumed	1.812	.185	-3.812	44	.000	-14.00	3.672	-21.396	-6.596
	Equal variances not assumed			-3.792	42.201	.000	-14.00	3.691	-21.444	-6.548
Satisfaction with Meeting Process	Equal variances assumed	8.128	.007	-3.059	44	.004	-5.22	1.708	-8.665	-1.782
	Equal variances not assumed			-2.982	30.945	.006	-5.22	1.752	-8.797	-1.650
Satisfaction with Meeting Outcome	Equal variances assumed	.388	.536	-1.943	44	.058	-3.98	2.048	-8.110	.147
	Equal variances not assumed			-1.955	43.915	.057	-3.98	2.036	-8.086	.123

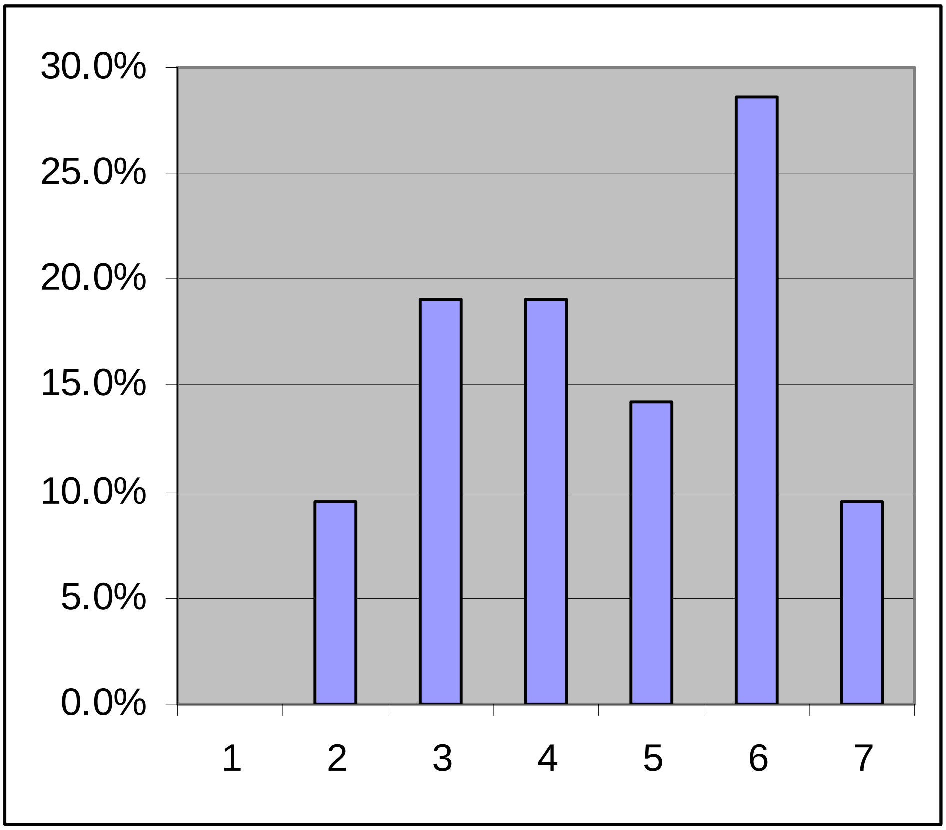
APPENDIX J

AVFA QUESTIONNAIRE RESPONSES



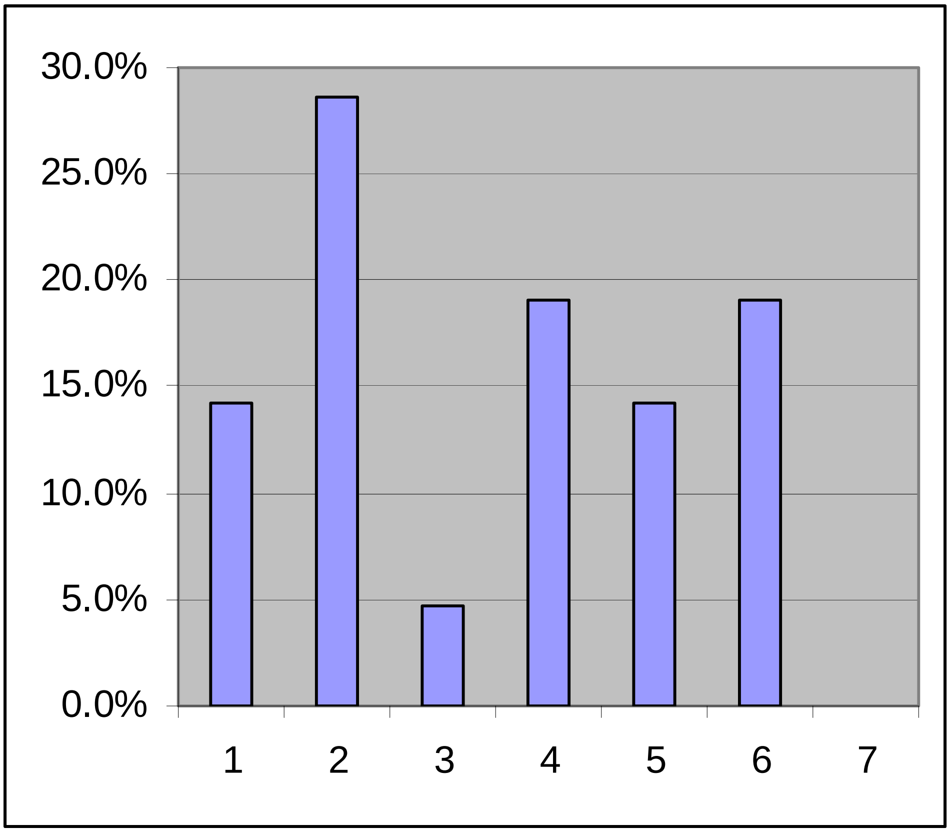
I enjoyed using the Automated Virtual Facilitation Application (AVFA).

1. I would strongly disagree
2. I would quite disagree
3. I would slightly disagree
4. I would neither agree nor disagree
5. I would slightly agree
6. I would quite agree
7. I would strongly agree



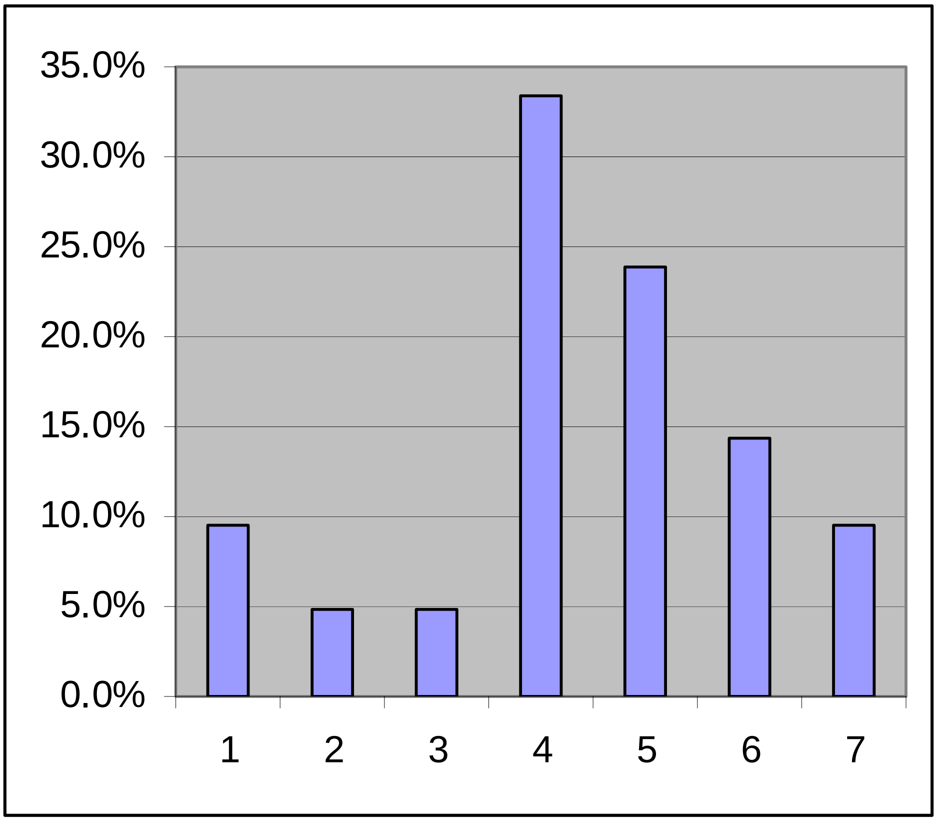
On the whole, I felt very comfortable using the automated facilitation system and would like to use it again.

1. I would strongly disagree
2. I would quite disagree
3. I would slightly disagree
4. I would neither agree nor disagree
5. I would slightly agree
6. I would quite agree
7. I would strongly agree



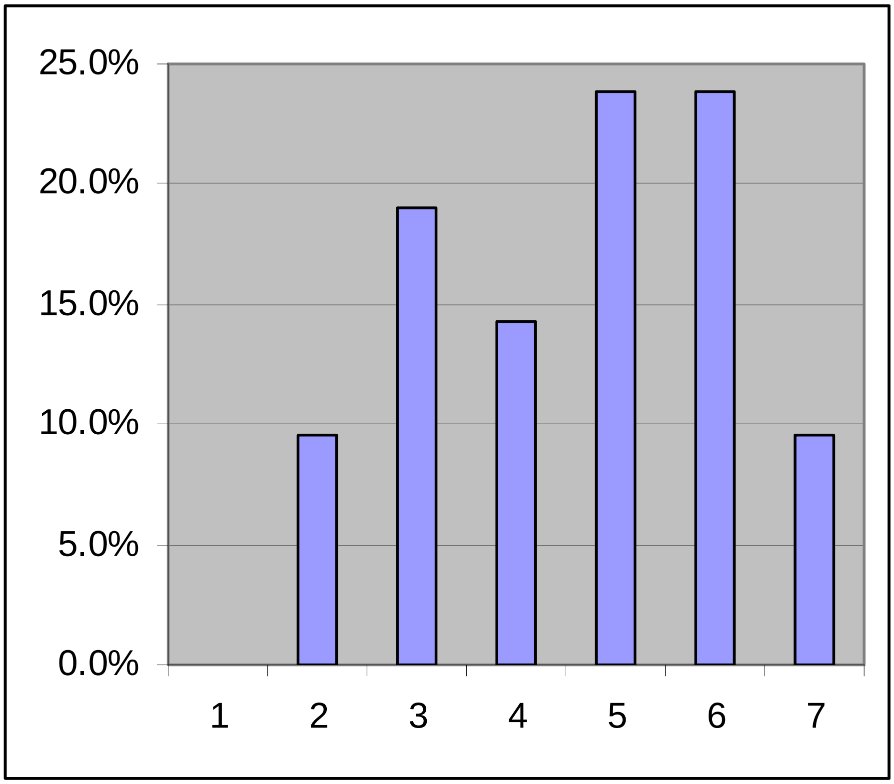
The automated facilitation system was more of a hindrance in the process of our meeting.

1. I would strongly disagree
2. I would quite disagree
3. I would slightly disagree
4. I would neither agree nor disagree
5. I would slightly agree
6. I would quite agree
7. I would strongly agree



I think that the automated facilitation system enabled us to gain a better perspective on using the GroupSystems EMS than would have been possible without the use of the system.

1. I would strongly disagree
2. I would quite disagree
3. I would slightly disagree
4. I would neither agree nor disagree
5. I would slightly agree
6. I would quite agree
7. I would strongly agree



I would recommend using the automated facilitation system again.

1. I would strongly disagree
2. I would quite disagree
3. I would slightly disagree
4. I would neither agree nor disagree
5. I would slightly agree
6. I would quite agree
7. I would strongly agree

VITA

Harold J. Lagroue III received a Bachelor of Arts degree in political science from the Tulane University College of Arts and Sciences in 1974, and a Master of Business Administration degree from the Tulane University Graduate School of Business Administration in 1976. He later received a Master of Science degree in Information Systems and Decision Sciences from Louisiana State University in 2002 and successfully defended his doctoral dissertation in the Department of Information Systems and Decision Sciences in May of 2006. Since 1980 he has practiced as a certified public accountant in Lafayette, Louisiana. He has served as an adjunct professor in the Departments of Accounting and Management Information Systems (formerly Business Systems Analysis and Technology) in the B.I. Moody III College of Business Administration at the University of Louisiana at Lafayette. He currently resides in Lafayette where he serves as a board member of The Moody Company.