9-1998

Effects of Group Support Systems on United States Air Force Strategic Planning Efforts

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EFFECTS OF GROUP SUPPORT SYSTEMS ON UNITED STATES AIR FORCE STRATEGIC PLANNING EFFORTS

THESIS

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AFIT/GIS/LAS/98S-1

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THESIS

Presented to the Faculty of the Graduate School of Logistics and Acquisition Management of the Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Information Systems Management

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September 1998

Acknowledgments

I would like to express my sincere appreciation to my thesis advisor Major Michael Morris for his oversight and guidance throughout my time here. Also thanks go out to my sponsor and reader, Captain Cassie Barlow. Her enthusiasm and advice, as well as her provision of essential data was the real foundation for this effort. Additionally, Captain David Hillman and 1st Lieutenant BrIan Munoz were invaluable in keeping me sane day-to-day. All of their support, insight, and suggestions were essential to the completion of this thesis and were certainly appreciated.

I am also indebted to each and every faculty member that has had the dubious pleasure of having me as a student. Each of their efforts is, in some small degree, evident in this work and most appreciated. One member, though, stands out in his contribution to this effort. I would like to express my appreciation to Dr. Guy Shane for his easy going attitude and willingness to minutely explain the subtleties of statistical analysis. Without him, this thesis would be less rigorous and certainly shorter.

Most importantly, I would like to express my heartfelt appreciation to my wife, Zoe, whose unwavering love, sensitive understanding, and, above all, self sacrifice have allowed me to focus on my studies during the last eighteen months. I would also like to thank the love and distraction of both my daughter, Jessica, and my son Matthew, for keeping me in tune with the really important things in life. Without all of their support, this journey would have been a whole lot tougher, and a lot less meaningful.

Bryan K. Hasty

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Abstract

Strategic planning at an Air Force wing is a team based activity that offers many advantages to the Air Force. But, it is clear there are still questions about how to properly conduct strategic planning to produce the highest quality plans in the most effective and efficient manner. To answer this question, the Air Force created a research project aimed at discovering new methods to improve strategic planning at Air Force wing levels using a computer-mediated communication system. The research project's goal is to apply collaborative processes and technologies, such as Group Support Systems (GSS), to improve the quality of the strategic planning process. This thesis validated the measurement instruments and analyzed the data from one of those studies. The thorough evaluation of the measurement instruments led to validated scales that could be valuable for future use. The analysis shows a significant increase in overall plan quality, and increased participant satisfaction with both the process employed and the product created when the groups used a GSS instead of traditional face-to-face methods. These results lend support to the continued fielding of such systems to support the decision making process for these types of problems.

EFFECTS OF GROUP SUPPORT SYSTEMS ON UNITED STATES AIR FORCE STRATEGIC PLANNING EFFORTS

I. Introduction

Background

Trying to make the federal government more efficient and effective is oxymoronic to some, but the Government Performance Review Act (GPRA) passed in 1993 requires agencies to better measure their performance in terms of results rather than dollars spent. However, even getting the agencies to comply with the first phase of the GPRA, which first requires them to develop acceptable strategic plans, has become a monumental task (Lovelace and Young, 1995). Under the GPRA, federal agencies must submit five-year plans to Congress and the White House that include specific goals and objectives. By law, each agency's five-year plan must include: a mission statement; goals and objectives; specifics on how goals and objectives will be achieved; an explanation of how performance goals relate to general goals; factors that could affect achievement of goals and objectives; a description of evaluations used in setting goals and a schedule for future evaluations.

Strategic Planning in the Department of Defense

Strategic planning in the post-Cold War era has proven to be exceptionally problematic. The multitude of constantly changing national and international tensions that were generally ignored because they were overshadowed by the east-west confrontation of the Cold War now combine to create a world filled with diverse challenges to U.S.

interests (Managing Change, 1992). Equally disturbing is the fact that these challenges are not as clearly defined and easily articulated as the monolithic Soviet threat (Lovelace and Young, 1995). The inherent stability the Cold War provided in U.S. strategic planning is now missing. This missing stability changes the old list of basic elements needed in a strategic military plan to a new list headed with a need for flexibility and closely followed by integration of action plans (Lovelace and Young, 1995).

United States Air Force Strategic Planning

Strategic planning is performed throughout the U.S. Air Force. It is used as a core leadership decision making process to determine the focus and direction of all component wings. The strategic planning process is a vital element in the distribution and allocation of scarce resources. Each wing in the U.S. Air Force's Air Combat Command is required to produce an annual strategic plan (Murdock, 1997). The current process is extremely time consuming, taking three to four months to complete at most wings (Adkins, Nunamaker, Shearer, Simcox, and Romero, 1998).

Strategic planning at an Air Force wing is a team based activity that is critical to mission success. Using a squadron team to develop a strategic plan offers many advantages to the Air Force. The team based process allows for sharing of critical information, generating ideas, making decisions, reviewing the effects of the decisions, and developing commitment to the strategic plan produced (Murdock, 1997). These decision making groups, though, are social entities which require the effective coordination of time and resources. Their goal is to determine the optimal solution to the

presented issues which confront them within the time frame each member can contribute (Adkins, Nunamaker, Shearer, Simcox, and Romero, 1998).

Problem Statement

The main challenge for most senior wing leadership is how to produce a product that is both meaningful and useful for the wing. Commitment to an unusable product is a hopeless endeavor, insupportable by senior leadership. A second important challenge is how to accomplish this effort in a reasonable amount of time. Air Force strategic planning teams need to meet and engage in focused planning efforts which effectively coordinate time and resources to produce an optimal solution.

Research Focus

It is clear that there are still questions about how to properly go about strategic planning. Oft asked questions about strategic planning include how to go about it in the most effective and efficient manner. To answer this question, the Air Force has commissioned several research studies. One such project was created to research methods of improving the Air Force's strategic planning at Air Force wing levels using a computer-mediated communication system as a tool. The research project's goal is to apply collaborative processes and technologies to improve the quality of the strategic planning process for the Air Force. The current phase is designed to produce a computer-mediated strategic planning process which optimizes the application of group support system technology and group facilitation. The group support system in use is a suite of team-based decision software tools that shorten the cycle time for strategic planning, problem solving, and other processes, such as voting and prioritizing alternatives. This

thesis will evaluate the efforts of the Air Force research project to improve strategic planning at Air Force wing level using a computer-mediated communication group support system.

II. Literature Review

Introduction

According to a Business Week special edition, "change can [no longer] be an occasional episode in the life of a corporation. Companies with rigid structures will be swept away. Corporate cultures that can adapt will survive and thrive..." (Managing Change, 1992:62). Flexibility—as well as the related constructs of speed, adaptability, and change—has been touted as a key tenet of the "paradigm for the postmodern manager" (Byrne, 1992:62). To yield positive results, change and flexibility necessitate prior effective strategic planning (Mintzberg, 1997:25). However, researchers have not yet conclusively determined why some planning efforts are more successful than others in meeting the challenge to plan strategically.

Strategy

Strategy is the term used to describe how a business will accomplish its mission. It is the path selected to stay competitive in a market. A strategy is needed when the potential actions or responses of intelligent opponents can seriously affect the endeavor's outcome (Mintzberg and Quinn, 1983:6).

The well-known management strategist Henry Mintzberg has proposed four reasons why organizations need strategies. They are to:

1. Set direction. Organizations need strategy to set direction for themselves and to outsmart competitors, or at least enable themselves to maneuver through threatening environments (Mintzberg, 1987:25). Organizations set their pace based on their capabilities and the actions of competitors.

2. Focus Effort. Strategy is needed to focus effort and promote coordination of activity (Mintzberg, 1987:26). Strategy provides the common purpose for all members of the organization so they can work together towards that same purpose.

3. Define the Organization. Strategy serves not only to direct the attention of the members of the organization, but also to give the organization meaning for them as well as outsiders (Mintzberg, 1987:27). In this sense, strategy defines the organization's reason for being. It tells customers, shareholders, and employees why the firm is in business and what the firm can do for them.

4. Provide Consistency. Strategy reduces uncertainty, provides consistency, and promotes efficiency (Mintzberg, 1987:29). Strategy gives structure to the organization and outlines the function of the firm and its employees.

An organization establishes its strategy to capitalize on its strengths and the weaknesses of its opponents. This strategy provides the stability needed for an organization to survive and thrive in its environment.

Strategic Planning

Strategic planning is a process which organizations use to prepare for the future and is the foundation for establishing the organization's competitive strategy. It is the plan the organization follows to keep or gain a competitive edge in their environment. Strategic planning involves the analysis of the environment, its present competitive strategy, and the establishment of the vision and mission statements which define the organization's quest for success.

Peter Drucker calls strategic planing a continuous process of making present entrepreneurial (risk-taking) decisions systematically with the greatest knowledge of their futurity, organizing systematically the efforts needed to carry out these decisions, and measuring the results of these decisions against the expectations through organized, systematic feedback (Drucker, 1973:125).

This planning is constantly updated to reflect the organization's ever changing environment, it's competitive processes, and risk taking. At times, an organization must take risks to try new methods. Presently, strategic planning is no longer a luxury – it's a necessity for organizations that want to survive and prosper (French, 1993:37-38).

Strategic Planning in Government

Strategic planning in government agencies is slightly different than in private industries. Government agencies are affected by periodic leadership turnover, separation of power and checks and balances, and the lack of a profit motive (Moskow, 1978:27-31). Leadership can change every four years with the election of a new president who may have different goals and objectives than the current administration. A plan developed during one administration may not survive to be realized in the successive. Moskow states that in the corporate world, managers have a much longer relationship with an organization, and often the present Chief Executive Officer chooses and grooms the successor (Moskow, 1978:32).

The Constitution of the United States created a set of checks and balances which does not allow the President to solely enact his own policies. Instead all policies must be approved by Congress and, when challenged, be judged legal by the court systems. Plans

must continually be reviewed to reflect these realities. Congressional disapproval and critical public opinion can end a program before any real progress can be made.

Finally, the major difference between planning in government agencies and private enterprises is the lack of a governmental profit motive. A program can be judged a success or failure purely based on its acceptance by the public or congressional advocates. Though there are difficulties in the implementation of strategic planning in government, "better planning leads to more rational decision making and better government policies and programs" (Moskow, 1978:58).

The Government Performance and Results Act. Public Law No 103-62, the Government Performance and Results Act of 1993, was enacted to "improve the efficiency and effectiveness of Federal programs by establishing a system to set goals for program performance and to measure results" (Senate Report No 103-58, 1993:328). The law established requirements for Federal agencies to develop strategic plans, performance plans, and performance measures. According to the act, strategic plans must include a detailed mission statement, and present the long-term goals and resources needed to meet the goals. The performance plans must show what annual action plans need to be accomplished at each level in order for the higher level to meet its own goals. The strategic plans should also describe the measures and means to verify and validate their measures (Senate Report No 103-58, 1993:341). Finally, the annual performance reports will review the progress of the agency in meeting its goals. These reports will provide the feedback to all managers, policy makers, and the public on what was actually accomplished over the past year (Senate Report No 103-58, 1993:342).

Department of Defense Strategic Planning

Strategic planning is a challenging, but necessary, endeavor for any organization, small or large. For the U.S. Department of Defense (DoD) it is a solemn responsibility to the Nation. President Eisenhower said in 1958, "No military task is of greater importance than the development of strategic plans which relate our revolutionary new weapons and force deployments to national security objectives" (Eisenhower, 1958). In spite of its attention to strategic planning, DoD has not enjoyed great success in this area. For example, a congressional staff report characterized DoD's strategic planning as haphazard at best. It specifically stated that "Inattention to strategic planning has led to numerous deficiencies, including a lack of clarity of DoD's strategic goals" (Senate Staff Report, 1985). They concluded that the stated goals are vague and ambiguous. In an organization as large as DoD, the clear articulation of overall strategic goals can play an important role in achieving a coordinated effort toward these goals by the various components and individuals within them. Clarity of goals can enhance unity and integration. DoD loses the benefit of this unifying mechanism through its failure to clarify its strategic goals. To correct this problem and other strategic planning deficiencies, DoD needs to establish and maintain a well-designed and highly interactive strategic planning process" (Senate Staff Report, 1985).

Following up on this staff finding, Congress, in the Goldwater-Nichols Department of Defense Reorganization Act of 1986 (GNA), mandated a hierarchical process for strategic direction, strategic planning, and contingency planning for the U.S. Armed Forces (Goldwater-Nichols Act, 1986). This process was designed to improve

strategic planning by harmonizing strategic direction and planning with the development of defense programs that would enable DoD to achieve its strategic goals. It was also designed to integrate the strategic and operational planning conducted by the combatant Commanders-in-Chiefs (CINCs). To these ends, the Chairman of the Joint Chiefs of Staff (CJCS) was assigned key and specific responsibilities. Since passage of the GNA, which is now codified in Title 10, United States Code (10 USC), the JCS and then the Chairman have developed, implemented, and revised specific processes for fulfilling most of these statutory responsibilities.

Enactment of the GNA notwithstanding, a recent study concluded that the strategic planning currently conducted by the Joint Staff, on behalf of the Chairman, does not adequately establish and specify strategic objectives nor does it integrate and establish priorities for them. In short, current strategic planning for the U.S. Armed Forces is of limited use in planning for future military capabilities and integrating the planning conducted by the CINCs. It should ensure that both of these efforts conform to national military and security objectives. Equally disturbing, it does not provide sufficient underlying rationale for the review of service functions nor does it provide unequivocal and compelling bases for the development and implementation of joint doctrine (Lovelace and Young, 1995).

Strategic Planning and Performance

Steiner (1972) argued for the importance of strategic planning, providing insight into overcoming the barriers and biases associated with planning failures. However, research by Steiner and others is founded in the critical assumption that planning is

important. The literature is inundated with the apparent advantages of planning, most notably its ability to improve the fit between the organization and its external environment (Godiwalla, Meinhart, and Warde, 1981). Others have argued that planning aids in the identification of future marketing threats and opportunities, elicits an objective view of managerial problems, creates a framework for internal communication, promotes forward thinking, and encourages a favorable attitude to change (Loasby, 1976; Stern, 1966; Wilson, 1973). Further, there are intrinsic benefits that accrue as a result of the planning process (Greenley, 1986).

Langley (1988) also provided support for the benefits of planning, identifying four roles of formal strategic planning. In the public relations role, formal strategic planning is intended to impress or influence outsiders. The information role provides input for management decisions. The group therapy role is intended to increase organizational commitment through the involvement of people at all levels of the organization in strategic planning. Finally, the direction and control role is fulfilled when plans serve to guide future decisions and activities toward some consistent ends.

According to Roach and Allen (1983), the strategic planning process is the product of the best minds inside and outside the corporation. The process considers future implications of current decisions, adjusts plans to the emerging environment, manages the business processes analytically, and links, directs, and controls complex enterprises through a practical, working management system. This process plays a vital role in firm performance (Roach and Allen, 1983).

Cartwright (1987) suggested that effective planning is not as rational and analytical as it has been portrayed in the literature. He argues for the lost art (rather than science) of planning. He contends that planning is both a generic activity whose success determinants are partially independent of the area in which it is applied, and an area where judgment, intuition, and creativity are still important.

Schwenk and Shrader (1993) conducted a meta-analysis of fourteen studies on formal strategic planning and performance. They concluded that strategic planning promotes long-range thinking, reduces the focus on operational details, and provides a structured means for identifying and evaluating strategic alternatives. Since this was the first review that clearly demonstrated the planning-performance link across studies, it strengthened the case for recommending the use of strategic planning in all firms, regardless of size.

Sinha (1990) empirically established some kind of a planning-performance linkage. Sinha examined 1087 decisions made by 129 Fortune 500 firms between 1982 and 1986. He concluded that characteristics of the decisions accounted for 15 percent of the variance in data and therefore should be regarded as important determinants of the contribution planning makes to decision making. However, Sinha concedes that the quality of planning is critical to the relationship (1990:487-491).

Computer-mediated Strategic Planning

A computer-mediated strategic planning process is supposed to help reduce the constraints associated with bringing a large group of people together to collaborate. Specifically, Group Support Systems (GSS) are technology designed to directly impact

and change the behavior of groups to improve group effectiveness, efficiency and satisfaction (Nunamaker, Dennis, Valacich, Vogel, and George, 1991). GSSs have been designed to reduce the effects of the barriers to ideal group decision making (Briggs, 1998). According to Valacich, Dennis, and Nunamaker (1992), "a group support system (GSS), is described as an environment that contains a series of networked computer workstations that enable groups to meet face-to-face, with a computer-supported electronic communication channel used to support or replace verbal communication" (1992: 49-50). When a GSS is applied to group decision making, ideas can be exchanged between group members and organized into distinct categories. These categories can then be analyzed by group members exchanging information through electronic file folders. Consensus can be developed between group members utilizing the GSS, and the data can be used and reviewed in future meetings or exported to a superior or expert for critique or approval.

Group Support Systems are in wide use today and are likely to be even more widely used in the future to allow geographically separated people to work together through computer networks. GSSs are being used with increasing frequency in a variety of organizations (Brashers, Adkins, and Meyers, 1994; Nunamaker, Briggs, Mittleman, Vogel, and Balthazard, 1997; Vogel, Martz, Nunamaker, Grohowski, and McGoff, 1990) where computer technology has been a vehicle for change. A GSS can have critical impacts on group interaction especially in overcoming barriers that influence group decision making. For example, research has shown that in a face-to-face group meeting, 20% of the people do 80% of the talking because some group members are shy, of lesser

status, intimidated, or too polite (Kirkpatrick, 1992). This lack of participation among group members may lead to lower overall productivity, or less critical evaluation of ideas. In an environment using a GSS, anonymous computer-mediated communication provides the opportunity for all group members to participate equally (Nunamaker, Dennis, Valacich, Vogel, and George, 1991). Equal participation has the potential to improve the quality of interaction and perhaps to provide opportunity for more critical discussion of decision alternatives (Brashers, Adkins, and Meyers, 1994; Jessup and Valacich, 1993). Thus, people who have used GSSs claim that these meetings are more effective than face-to-face interactions for group planning, problem solving, decision making, and group interaction (Dennis, Heminger, Nunamaker, and Vogel, 1990; Vogel, Martz, Nunamaker, Grohowski, and McGoff, 1990).

Effectiveness of GSS

GSS research has looked at several kinds of variables, including measures of effectiveness and efficiency. The first dimension reflects a goal-centered approach to assessing organizational effectiveness. The goal attainment measure is primarily concerned with the specific end results normally anticipated from a planning session. The second dimension follows the tradition of earlier studies that sought to examine the impact of GSS use on time to complete complicated planning tasks.

Attempts to understand the group processes that occur during computer supported sessions have relied on previous research of face-to-face groups. During a GSS session, each member can act as a lone problem solver and exert efforts on only one aspect of the problem. To incorporate this ability into the previous research requires studying both the

individual and the group problem solving process and how they are coordinated by the GSS (Turoff, Hiltz, Bahgat, and Rana, 1993).

While GSS implementations are on-going, understanding of their proper usage is still not clear. GSSs have been applied to many different types of problems with mixed results. While several studies quote current periodicals as claiming dramatic improvements by using a GSS, no study claimed to have found previous research with such conclusions, nor reported any dramatic results of their own. It should be noted that even though sales of GSS software are increasing and many corporations are rushing to implement them, much of the empirical evidence is confined to laboratory experimental conditions and case studies, with few field studies available at this time. Overall, however, researchers agree that meetings requiring decision-making are more effective when employing a GSS (Adkins, Nunamaker, Shearer, Simcox, and Romero, 1997; Jarvenpaa Rao, and Huber, 1988:649; Lam, 1997:194, Vogel, Martz, Nunamaker, Grohowski and McGoff, 1990:42). The measure of effectiveness, though, varies with the research.

GSS and Quality

One of the most widely researched measures of GSS effectiveness has been the quality of the decision made. For example, in a study applying a GSS to problem finding tasks, group decision quality was found to be statistically higher in GSS supported groups (Gallupe and DeSanctis, 1988). The experimental task was to find the underlying problem in a crisis situation. By manipulating the task difficulty, the authors attempted to determine how a GSS would affect group decision making for problem finding tasks of

varying difficulty. They reported that the use of a GSS increased the number of alternatives considered and improved the decision quality for problem solving tasks, especially in the higher difficulty task. Dennis and others (1990) also performed a comprehensive review of GSS literature and found that several studies show that GSS use leads to better quality decisions (Dennis, George, Jessup, Nunamaker, and Vogel, 1988:602). These and other studies have supported the finding that GSS use allows organizations to develop better, higher quality solutions to problems and make higher quality decisions (Cullen, 1997:49; Dennis, Heminger, Nunamaker, Vogel, 1990:113; Jarvenpaa, Rao, and Huber, 1988:658; Lam, 1997:204; Nunamaker, Briggs, Mittleman, Vogel, and Balthazard, 1996:171). These results led to the formation of Proposition 1.

Proposition 1: *Higher quality action plans will be produced by groups employing GSS than by traditional Face-to-Face groups.*

GSS and Satisfaction

Another commonly used research measure of GSS use has been satisfaction. While the results of these studies has been mixed, especially early in the history of GSS research, a recent meta-analysis of 29 studies comparing GSS supported versus non-supported group work, revealed that GSS use improves satisfaction with the meeting process and confidence in the decision reached (Anson, Bostrum, and Wynne, 1995:190-191). A possible explanation of the mixed results is the prevalence of laboratory studies early in GSS research efforts (Nunamaker, Briggs, Mittleman, Vogel, and Balthazard, 1997). The use of a GSS in organizations was producing positive effects not modeled in the lab because real groups do not perform in a void, but rather in an organizational

context. This context drives the attitudes and behaviors in group meetings (Nunamaker, Briggs, Mittleman, Vogel, and Balthazard, 1997). Much of the work that followed used field studies which, in contrast to the earlier work, reported positive reactions and results from GSS use (Dennis and Gallupe, 1993).

But, even in these studies the use of the satisfaction measure is not consistent. Several studies measure the satisfaction with the decision making process while others measure the satisfaction or commitment to the decision reached (Anson, Bostrum, and Wynne, 1995; Nunamaker, Briggs, Mittleman, Vogel, and Balthazard, 1997). Only recently have efforts been made to separate these measures and study the performance of GSS supported groups in a more rigorous fashion (Dennis and Gallupe, 1993:64).

One possible explanation for the increase in satisfaction is that the ability for meeting participants to work and communicate in parallel prohibits any one member of the group from dominating or controlling the group's discussions (Tyran, Dennis, Vogel, and Nunamaker, 1992:317). Since each member has equal access to the communications channels, domination is eliminated and free expression is available (Pinsonneault and Heppel, 1997:89). Another possibility is that the anonymity of the inputs prevents higher ranking members from dominating the meeting while allowing shy members to remain separate from their statements (Pinsonneault and Heppel, 1997:89). The differences in power, position or status are equalized due to anonymity leading to a reduction in personality conflicts and an increase in satisfaction with the meeting process (Talbott, 1995:117). As stated before, this equality of participation has been found to improve the quality of interaction (Brashers, Adkins, and Meyers, 1994; Jessup and Valacich, 1993).

Valacich, 1993). Thus, people who have used GSS claim that these meetings are more satisfying than face-to-face for group interaction (Dennis, Heminger, Nunamaker, and Vogel, 1990; Vogel, Martz, Nunamaker, Grohowski, and McGoff, 1990). This type of increase in satisfaction would seem most readily identified as satisfaction with the process of decision making and is addressed as such here. These results led to the formation of Proposition 2.

Proposition 2: *Groups employing GSS will report a higher satisfaction with the decision process than traditional Face-to-Face groups.*

In another study researching the effects of various computer supports for groups working on unstructured problems, the GSS groups produced mixed results for quality, but higher satisfaction (Jarvenpaa, Rao, and Huber, 1988). Groups of software engineers were asked to work on a software design problem. The main focus of the exercise was the gathering of ideas and the reaching of consensus. Some groups experienced increased idea generation, more thorough discussions of the ideas, and better quality performance than their traditional counterparts, while other teams did not (Jarvenpaa, Rao, and Huber, 1988). But, noteworthy in this article is the result that the GSS supported members reported a higher satisfaction with their solutions than did their non-supported counterparts. This type of increase in satisfaction would seem most readily identified as satisfaction with the decision reached and is addressed as such here.

These results lead to the formation of Proposition 3.

Proposition 3: *Groups employing GSS will report a higher satisfaction with the action plan produced than traditional Face-to-Face groups.*

GSS and Efficiency

A widely used research variable in GSS studies has been efficiency. The interaction of task type and technology on group performance and member reactions was examined by Straus and McGrath. They examined the impact computer-mediated and face-to-face communications have on group performance. They investigated the differences between computer-mediated and face-to-face groups when performing idea-generation, intellective, and judgment tasks. They argued that "different tasks vary in how much social context information their effective execution requires" (Straus and McGrath, 1994: 88). The authors found from their experiments that, in general, when looking at judgment tasks, face-to-face groups will be more productive and superior in performance when compared to computer-mediated groups (Straus and McGrath, 1994: 94). However, the authors note that computer-mediated groups are more appropriate for intellective and idea-generation tasks, particularly when productivity is a priority or time is at a premium (Straus and McGrath, 1994: 95). Before closing their article, the authors reiterate what several previous studies have concluded, stating "it also is important to recognize that group work may involve multiple processes....The results of this study imply that different media are more or less appropriate to the different phases of a group project" (Straus and McGrath, 1994: 95). Therefore, depending on the need for social context cues, face-to-face communication may or may not be more appropriate.

As found in several of the studies reported above, one of the main benefits of a GSS is that it generates a large amount of specific and detailed information in a relatively short amount of time. The GSS allows the group members to work simultaneously and

generate parallel input, which increases the speed of idea generation and information sharing (Briggs, Nunamaker, and Sprague 1997:9). Thus, the total number of ideas generated is increased, compared to conventional meetings (Aiken, Vanjani, and Krosp, 1995:39). Furthermore, a GSS incorporates structure into the decision-making process (Dennis, George, Jessup, Nunamaker, and Vogel, 1988:593; Lam, 1997:194). It tends to focus the group's problem-solving efforts and process (Briggs, Nunamaker, and Sprague, 1997:7). Consequently, a GSS enhances overall group productivity (Aiken, Vanjani, and Krosp, 1995:38).

A review of eight case studies of companies using various levels of computer support to generate strategic plans shows similar results (Tyran, Dennis, Vogel, and Nunamaker, 1992). The groups studied had a GSS available, but were not compelled to use it. In general, the article reports that the best results came when the groups used the GSS to generate ideas, solicit managerial input, and identify key issues. But, it was noted that the GSS was not typically used to resolve differences. Most of the groups studied followed the same pattern of GSS usage. First, they would use the GSS to collect and organize ideas and managerial inputs, then the group would disperse into departmental subgroups. Finally, they would reconvene to present and discuss plans. Post process surveys showed that the members felt the GSS helped their group generate ideas, identify the key ideas, and significantly decrease the time needed to come to a decision (Tyran, Dennis, Vogel, and Nunamaker, 1992).

These results lead to the formation of Proposition 4.

Proposition 4: *Groups employing GSS will complete the action plan development process faster than traditional Face-to-Face groups.*

III. Methodology

Introduction

To investigate how humans react differently between computer mediated and face-to-face decision making groups, and specifically whether a GSS would support better strategic planning, a sponsor interested in this line of research was located at Wright-Patterson Air Force Base's Air Force Research Laboratory, AFRL/HESS. The laboratory already had a number of research projects underway in this area. Upon meeting with the sponsor, an existing data set was identified that needed to be evaluated in depth, based on a cursory analysis which had been completed previously by the University of Arizona. There were indications that the original data set allowed for additional analysis since no correlations were reported, and one of the measurement instruments purported to measure two different constructs was reported with only one alpha level. We both felt the previous report could be improved with a more in-depth background literature review to lend stronger theoretical support for the project's approach. Additionally, further statistical analysis of the collected data was both possible and necessary to better understand the impact of the study. The data set came from a research project case study in strategic planning done at the 366th Wing, Mountain Home Air Force Base, Idaho. At the 366th Wing there is a Wing Command and five group level units: Wing Staff (WG), Operations Group (OG), Logistics Group (LG), Support Group (SPTG), and Medical Group (MDG). Each group is responsible for a number of squadrons and there are a total of 24 squadrons in the 366th Wing.

Original Procedure

A facilitated methodology for the strategic planning effort was established using the senior leadership at the Air Force's 366th Wing at Mountain Home Air Force Base, Idaho. A facilitator worked with several strategic planning groups on the base including the 366th Wing command, three group level organizations (OG, LG, SPTG), the 366th Wing staff, and seven squadrons. These efforts were completed using computer-supported strategic planning methods and a group support system called Group Support System (GSS) that was developed at the University of Arizona. Quality questionnaires were also administered to all of the participants in each squadron. Data was collected from all squadrons, both those using traditional, face-to-face methods and those using computer-supported strategic planning methods. All squadron action plans were evaluated by a panel of seven Quality Improvement experts selected from other bases using a six item quality scale.

The computer-supported strategic planning session started with a discussion of the function of mission and vision statements followed by a review of the previous year's mission and vision statements in parallel with the other participants. Then the group turned its efforts to authoring new mission and vision statements. Finally, nominal group techniques and anonymous voting were used to select the final statements for the Wing.

After these initial efforts, the Wing Command brainstormed ideas for Wing goals using the mission and vision statements developed in the initial efforts as a guide. Anonymous voting on the goals followed by refinement of the highest rated goals resulted in a final list of goals, which were then used as the basis for development of

Wing objectives. The Wing's goals were arranged in a hierarchical tree structure so those objectives that supported each goal could be generated in parallel.

A similar process was used at the Group Level for their strategic planning sessions. The tree structure of Wing goals and objectives was used by the Group staff members for each of the Groups to develop targets in parallel. These targets were then refined as needed before the group moved on to the next objective.

The Squadron Level action planning sessions for each of the seven squadrons utilizing the GSS followed a systematic process. First, the participants reviewed the definition and function of an action plan. This was followed by a discussion of the action plan template. The group then proceeded to review the Wing and Group goals, objectives, and targets, which led to the development potential action plans, once more in parallel. Finally, the generated action plans were compared to evaluative criteria.

The definition for action plans was a link between day-to-day work place activities and the vision, mission, goals, and objectives of the Wing. The teams were presented the criteria that the action plans developed should be simple and easy to apply while still meeting the needs of the squadron. The action plans also have to be focused on those day-to-day processes that can be measured, analyzed, and improved. The ideal design of the action plans are such that they were implementable, acceptable, and attainable. The action plan template used included a description, metric, milestone, success criteria, responsible authority, resource identification, and feedback mechanism.

Sample

There were 226 participants from the 366th Wing. At the squadron level there were 139 participants (Males = 105, Females = 21, No Answer = 13). The mean age of the squadron participants was 35.4 with a range of 21 to 56 years of age. The majority of the squadron participants had participated in one or less computer supported meetings (N=107). Representatives from 22 of 24 squadrons participated in the research project. Seven squadrons (N=92) used computer- supported strategic planning methods and 17 squadrons (N=47) used traditional face-to-face strategic planning methods. A panel of seven Quality Improvement officers from other Air Force bases was used to review each squadron's action plans. The reviewers had a mean of 20.1 years of service in the Air Force and a mean of 2.96 years working on strategic planning.

Dependent Variables

A six item quality questionnaire (see Appendix A) was created for the expert reviewers to evaluate each squadron's action plans. The reviewers' questionnaire asked one question each on the quality of the action plans, achievability, buy-in, how well the action plans addressed the targets, and how clearly the plans would be measured. A 26 item satisfaction questionnaire was administered to measure the participant's satisfaction with the strategic planning process and commitment to the strategic plans produced. The questionnaire for the Non-GSS supported groups is in Appendix B, while the survey administered to the GSS participants is in Appendix C. The time needed to complete each squadron's action plan was measured via a questionnaire for the traditional groups and actual measurement for those who were GSS supported.

Analysis Procedure

The new analysis started with a validation of the evaluator responses looking for bias in results. Reviewers showing a significant bias were eliminated from further analysis. After examining the reviewers, a factor analysis to validate all measurement scales was done, followed by a scale reliability calculation to determine the value of the scale. All factor correlations were calculated and reported. Following the factor analysis of the reviewer scale, t-tests were used to statistically determine if there was a qualitative difference between the strategic action plans generated by the GSS groups as compared to the traditional face-to-face groups.

Analysis of the participant scale also began with a factor analysis and scale reliability test. All factor correlations were calculated and reported. After that, t-tests were performed to statistically determine if there was a difference in identified factors between the two groups, GSS and Non-GSS supported groups. After determining if there were differences between the quality of product created by the two groups, those identified factors were used in a linear regression within each group to see if they predicted the expert's quality assessment.

IV. Analysis

Original Analysis

The original results reported that the squadrons which used Group Support Systems (GSS) to develop strategic plans developed higher quality strategic plans than those squadrons that did not use the GSS ($t(7)=3.47$, $p<.05$). There was no significant difference in the commitment to implementation variable between the GSS and the non-GSS squadrons reported in the initial analysis. Furthermore, the original report stated that the squadrons that used computer-supported strategic planning were more satisfied with the strategic planning process than those squadrons that used traditional strategic planning ($t(137)=-2.28$, $p<.05$). And finally, the original authors reported that the strategic planning process took an average of 17.7 hours for squadrons that did not use the GSS, but less than 8 hours for those squadrons that used the GSS.

Aligning the Measurement Scales

The surveys given to the two participant groups, face-to-face and GSS supported were slightly different in nature. The non-GSS group scale had an additional question asking if the participant would use an electronic meeting system for strategic planning if they had the opportunity. Eliminating this question allowed the two scales to be evaluated for measurement factors as one 26 item scale.

Evaluating the Experts

With such a low number of experts ($n = 7$), great care should be taken to ensure no one expert can sway the evaluation of a squadron's action plan significantly. This expert bias may be common in this instance. Since the action plans are produced from

such a diverse selection of squadrons, evaluating them becomes a difficult chore, as each must be looked at from the point of view of the operating squadron. An expert in logistics, for instance, may judge other logistic squadron action plans harsher since the expert is knowledgeable not only in strategic planning, but the specific task domain for such a squadron as well. Without knowing the complete histories of each expert, it is nearly impossible to determine if such a bias occurred. An analysis of the number of times an expert chose a particular rating, though, will show if they were generally hard or easy raters. This may lead to the elimination of an expert seen to be "overly harsh" or "overly easy." The number of times each expert chose each of the seven possible ratings is shown in Table 1.

Table 1. Expert Rating Selection Frequencies

	Rating Values						
	1	2	3	4	5	6	7
Expert 1	91	18	7	4	0	0	0
Expert 2	0	5	19	18	54	24	0
Expert 3	19	13	26	19	23	18	2
Expert 4	0	2	7	21	42	36	12
Expert 5	17	4	11	46	38	3	1
Expert 6	5	20	23	28	27	14	3
Expert 7	1	7	17	17	38	32	8

As can be clearly seen, there is sufficient evidence to eliminate Expert 1 as a biased evaluator of the action plans. Of the possible 120 ratings given by this expert, the lowest rating, a value of one, was chosen 91 times, or over 75.8 percent of the time. No other expert used any one rating more than 45 percent of the time (Expert 2 with rating

value 5). Thus, Expert 1 was considered an "outlier" and his ratings were eliminated from any further analysis.

The elimination of the one expert shifted the reviewer demographics. The panel now consisted of six Quality Improvement officers with a mean of 20.8 years of service in the Air Force and a mean of 3.16 years working on strategic planning.

Scale Item Correlations

Scale correlation matrices show the degree to which the questions on the scale correlate with one another. As such, it is essentially a measure of the reliability of the instrument to accurately measure a construct (Cronbach, 1971). For a scale that measures only one construct, one would expect the questions to be highly correlated, that is if a respondent selected a high rating on question one, then the same respondent would be expected to select a high rating on all of the other questions. The expert scale in this study shows this very phenomenon. The scale correlation matrix for the expert rating scale is shown in Table 2.

Table 2. Expert Scale Correlation Matrix:

	Q1	Q2	Q3	Q4	Q5	Q6
Q1	1.0000					
Q2	0.2112	1.0000				
Q3	0.1275	0.4777	1.0000			
Q4	0.1961	0.3094	0.4754	1.0000		
Q5	0.2048	0.2851	0.3325	0.3855	1.0000	
Q6	0.3611	0.3855	0.4574	0.5183	0.5040	1.0000

For a scale that measures more than one factor, one would expect to find groups of questions that are highly correlated with each other. If a participant selected a high

rating on one question measuring that construct, then the same participant would be expected to select a high rating on other questions measuring that same factor. The participant scale appears to be an example of this event. The scale correlation matrix for the participant rating scale is shown in Table 3.

Table 3. Participant Scale Correlation Matrix

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26
Q1	1.00																									
Q2	0.48	1.00																								
Q3	-0.09	0.18	1.00																							
Q4	0.54	0.68	-0.02	1.00																						
Q5	0.47	0.64	-0.07	0.69	1.00																					
Q6	0.35	0.40	0.22	0.51	0.43	1.00																				
Q7	0.67	0.64	0.00	0.63	0.62	0.42	1.00																			
Q8	0.46	0.56	0.04	0.58	0.59	0.30	0.65	1.00																		
Q9	0.41	0.68	0.02	0.65	0.67	0.37	0.59	0.57	1.00																	
Q10	0.39	0.70	0.12	0.59	0.61	0.24	0.53	0.55	0.66	1.00																
Q11	0.53	0.56	0.05	0.66	0.50	0.36	0.59	0.46	0.59	0.58	1.00															
Q12	0.40	0.63	0.13	0.53	0.58	0.36	0.57	0.42	0.60	0.53	0.46	1.00														
Q13	0.42	0.56	0.08	0.55	0.55	0.28	0.58	0.49	0.51	0.59	0.46	0.49	1.00													
Q14	0.35	0.57	0.14	0.58	0.57	0.46	0.56	0.48	0.51	0.59	0.50	0.43	0.50	1.00												
Q15	0.45	0.60	-0.02	0.68	0.54	0.41	0.54	0.44	0.52	0.59	0.65	0.40	0.49	0.72	1.00											
Q16	0.39	0.59	0.05	0.65	0.51	0.39	0.54	0.45	0.58	0.58	0.60	0.45	0.51	0.61	0.78	1.00										
Q17	0.29	0.50	-0.09	0.54	0.69	0.27	0.48	0.49	0.57	0.52	0.38	0.38	0.44	0.42	0.42	0.46	1.00									
Q18	0.16	0.09	0.07	0.28	0.28	0.42	0.14	0.18	0.21	0.02	0.12	0.04	0.07	0.10	0.12	0.15	0.37	1.00								
Q19	0.42	0.65	0.02	0.60	0.64	0.30	0.59	0.57	0.75	0.61	0.60	0.67	0.55	0.48	0.53	0.56	0.52	0.15	1.00							
Q20	0.37	0.57	0.10	0.52	0.58	0.27	0.50	0.49	0.65	0.55	0.51	0.64	0.45	0.42	0.42	0.47	0.49	0.13	0.76	1.00						
Q21	0.52	0.61	0.00	0.64	0.74	0.37	0.69	0.75	0.64	0.56	0.50	0.49	0.59	0.52	0.53	0.51	0.62	0.20	0.64	0.57	1.00					
Q22	0.58	0.62	0.00	0.68	0.62	0.40	0.67	0.55	0.56	0.53	0.61	0.49	0.47	0.57	0.60	0.54	0.51	0.19	0.64	0.56	0.68	1.00				
Q23	0.50	0.56	0.06	0.67	0.65	0.40	0.64	0.63	0.56	0.55	0.59	0.49	0.52	0.64	0.61	0.63	0.55	0.21	0.65	0.52	0.78	0.78	1.00			
Q24	0.41	0.45	0.14	0.64	0.49	0.44	0.43	0.43	0.48	0.42	0.44	0.26	0.38	0.56	0.56	0.48	0.39	0.28	0.46	0.48	0.48	0.56	0.59	1.00		
Q25	0.39	0.64	-0.04	0.64	0.83	0.39	0.61	0.58	0.64	0.65	0.49	0.57	0.56	0.59	0.52	0.55	0.69	0.24	0.69	0.58	0.76	0.68	0.74	0.48	1.00	
Q26	0.40	0.36	0.13	0.46	0.46	0.41	0.41	0.42	0.42	0.37	0.34	0.29	0.37	0.47	0.43	0.41	0.38	0.33	0.41	0.39	0.56	0.44	0.53	0.53	0.54	1.00

Factor Structure within the Expert Measurement Scale

Principle axis factoring was used to extract an initial set of potential factors from the obtained data for the expert reviewer surveys. The six questions were designated as variables Q1-Q6, with the first question being assigned the variable name Q1, the second, Q2, and so on.. The calculations extracted only one factor with the loadings shown in the unrotated factor matrix given in Table 4.

Table 4. Unrotated Item-Factor Loadings for Expert Reviewers Quality Survey

	Factor 1
Q1	.44702
Q2	.65159
Q3	.72804
Q4	.73071
Q5	.67237
Q6	.81262

Here, factor 1 accounted for over 46 percent of the total response variance with no other factors being extracted. The resultant scree plot for the expert reviewers quality scale is shown in figure 1.

The pronounced break in the scree plot between factor 1 and the other factors, and the observation that all survey items loaded strongly on that factor suggested this scale was indeed unidimensional. The factor reported to be measured previously was the quality of the action plan and is referenced as such here.

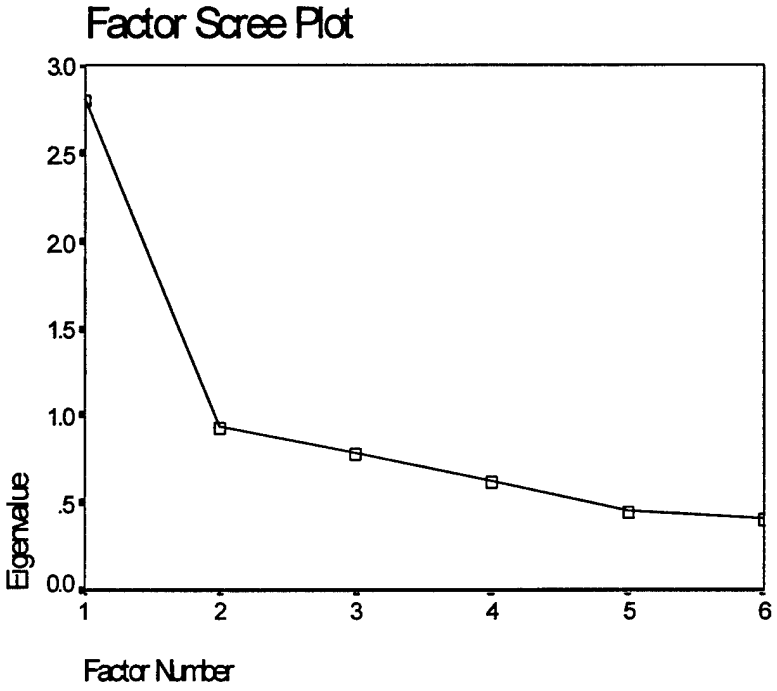

Figure 1. Factor Scree Plot for Expert Reviewer Quality Survey

Cautionary Note on the Results of the Expert Factor Analysis

Although the factor loadings for the expert reviewer's quality survey appear strong, the reader is advised to be very critical of those results. While the *n* was 756, the number of questions was only six, with each of the six experts using the six-item survey to evaluate the 21 different squadron's action plans. It is entirely possible that the factor analysis efforts were not given enough items to find an underlying factor structure within the context of this particular measurement instrument. Factor analysis itself could try to extract the underlying facets of a multi-faceted construct such as quality with the assumption that there are multiple items associated with each of these facets. If such facets actually exist in this measurement instrument, they may have had only one or two

associated survey items. Thus, the apparent scale unidimensionality, suggested by the item-factor loadings and scree plot reported previously for the expert reviewer's quality survey, could be accounted for by highly intercorrelated sub-scales of quality—subscales which simply did not have enough individual items to produce separate and discernible factors. This does not, however, invalidate the analysis or conclusions to follow. Quality, even in its most aggregated form is a valid measure for the action plans evaluated. There just may be some facet of quality that overwhelms the rest of the facets. This overwhelming facet may influence an expert to provide highly correlated measures across the scale. It is not possible to discern which facet influences what expert from the data provided.

Factor Structure within the Participant Measurement Scale

The same procedure as discussed above for the expert reviewer's scale was used to examine the quality scale administered to the strategic planning participants. A factor matrix for the quality survey administered to all strategic planning participants, both those that were face-to-face and those that were supported by the GSS is presented in Table 5.

Table 5. Unrotated Item-Factor Loadings for Participant Quality Survey

	Factor 1	Factor 2	Factor 3	Factor 4
Q1	0.6223	0.0391	-0.0393	-0.3651
Q2	0.8014	-0.1842	0.1712	0.1275
Q3	0.0639	0.2231	0.6173	0.6068
Q4	0.8386	0.1109	0.0343	-0.1486
Q5	0.8283	-0.0027	-0.2813	0.0918
Q6	0.5271	0.5355	0.1935	0.1024

Table 5. Unrotated Item-Factor Loadings for Participant Quality Survey (Continued)

Q7	0.7932	-0.0745	-0.0313	-0.1479
Q8	0.7262	-0.0443	-0.1637	0.0196
Q9	0.8005	-0.1513	-0.0555	0.1813
Q10	0.7578	-0.2804	0.1538	0.0936
Q11	0.7264	-0.0875	0.2234	-0.2087
Q12	0.6807	-0.3094	0.0743	0.3094
Q13	0.6893	-0.1818	0.0643	0.0235
Q14	0.7313	0.1112	0.3027	-0.1124
Q15	0.7513	0.0511	0.3027	-0.3542
Q16	0.7436	0.0044	0.2656	-0.1897
Q17	0.6792	0.0537	-0.4281	0.1390
Q18	0.2629	0.7105	-0.3216	0.2205
Q19	0.8045	-0.2452	-0.0694	0.1860
Q20	0.7154	-0.2110	-0.0386	0.3194
Q21	0.8323	-0.0052	-0.2520	0.0087
Q22	0.8082	0.0338	-0.0383	-0.1630
Q23	0.8334	0.0874	-0.0457	-0.1127
Q24	0.6616	0.3657	0.1511	-0.0832
Q25	0.8363	-0.0252	-0.2650	0.1167
Q26	0.6012	0.4086	-0.0379	0.0455

Although the four-factor structure indicated above appears somewhat chaotic, Factor 1 actually accounted for over 51 percent of the total variance in item responses, with the next highest factor, Factor 2, contributing only another 6 percent, a ratio of better than 8:1 compared to the first two eigen values. The fact that all items had sizeable loads on the first factor, coupled with a pronounced break in the scree plot between factor 1 and the remaining factors (see Figure 2), suggested that the participant quality scale was unidimensional.

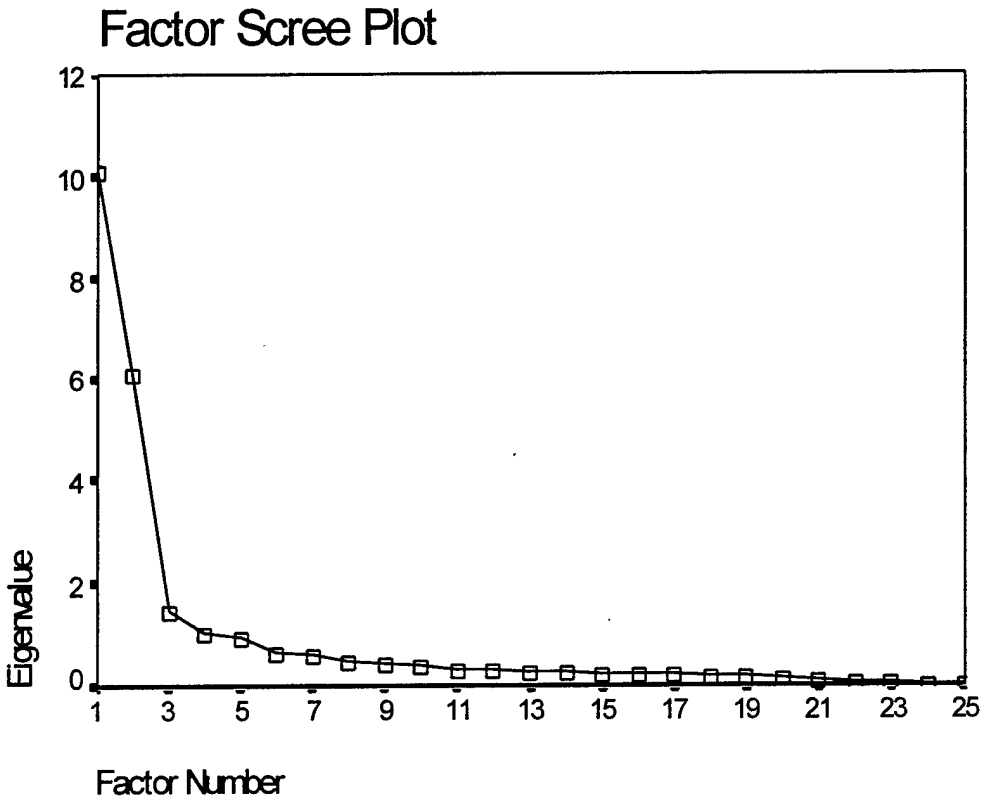

Figure 2. Factor Scree Plot for Participant Quality Survey

Since the previous work reported only one scale reliability, but that two constructs, satisfaction and commitment, were measured, the single factor unrotated solution was not expected. A close examination of the survey questions lends support to a one factor scale measuring overall quality. There are questions covering the participant's satisfaction with the action plans produced as well as questions assessing their satisfaction with the procedures used. Thus, the apparent scale unidimensionality, suggested by the item-factor loadings and scree plot reported previously for the participant's survey, could be accounted for by highly intercorrelated sub-scales of

quality—subscales which simply did not have enough individual items to produce separate and discernible factors with an unrotated factor analysis.

Further evaluation of the participant scale was then done using a varimax rotation to see if the expected factors emerged. The varimax procedure converged in only eight iterations producing the results of the analysis shown in Table 6.

This analysis clearly produces the expected two factor solution. Factor 1 is represented by 12 items, while factor 2 is represented with 10 items. The survey questions themselves seem to define the first factor as the satisfaction with product, while the second factor assesses the participant's satisfaction with the procedure used to develop the product, in this case, the strategic action plans.

Table 6. Rotated Item-Factor Loadings for Participant Quality Survey

	Factor 1	Factor 2	Factor 3	Factor 4
Q1	0.2745	0.5967	0.1590	-0.2589
Q2	0.6704	0.4897	0.0455	0.1745
Q3	0.0476	0.0025	0.1129	0.8878
Q4	0.4726	0.6484	0.3031	-0.0552
Q5	0.7100	0.3331	0.3651	-0.1594
Q6	0.1214	0.4308	0.5693	0.2970
Q7	0.5444	0.5650	0.1539	-0.1349
Q8	0.5926	0.3630	0.2418	-0.1228
Q9	0.7390	0.3523	0.1661	0.0431
Q10	0.6736	0.4621	-0.0510	0.1241
Q11	0.4076	0.6797	0.0187	0.0169
Q12	0.7496	0.2431	-0.0262	0.1968
Q13	0.5712	0.4299	0.0313	0.0288
Q14	0.3402	0.6880	0.1822	0.1709
Q15	0.2746	0.8373	0.0870	0.0071
Q16	0.3743	0.7108	0.0915	0.0759
Q17	0.6373	0.1473	0.4315	-0.2298
Q18	0.0411	-0.0322	0.8503	0.0143
Q19	0.7915	0.3338	0.0925	0.0200

Table 6. Rotated Item-Factor Loadings for Participant Quality Survey (Continued)

Q20	0.7631	0.2170	0.1114	0.1342
Q21	0.6690	0.3989	0.3366	-0.1905
Q22	0.4998	0.5934	0.2509	-0.1317
Q23	0.5173	0.5824	0.3174	-0.0966
Q24	0.2252	0.5851	0.4407	0.1179
Q25	0.7330	0.3284	0.3473	-0.1350
Q26	0.2700	0.3848	0.5539	0.0647

Scale Reliability Measures

Next, the scales extracted during the factor analysis were evaluated for reliability using Cronbach's alpha. Since there were two factors extracted from the participant survey instrument, two different calculations were made. The results of the analysis for the first factor gave a scale alpha of .94 for the 12 item scale measuring Factor 1. The results are presented in Table 7.

Table 7. Reliability Analysis for Participant Factor 1

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
Q2	57.4289	170.6834	0.7739	0.9388
Q5	57. 0448	167.5324	0. 8192	0. 9372
Q8	57. 3874	166.2634	0. 6900	0. 9424
Q9	57. 3383	169.9572	0. 7959	0. 9381
Q10	57. 2777	167.3450	0. 7451	0. 9398
Q12	57. 7997	171.9423	0. 6766	0. 9420
Q13	57. 6851	169.6386	0. 6576	0. 9432
Q17	57. 3510	174.6599	0. 6688	0. 9422
Q19	57. 5019	170.7023	0. 8047	0. 9380
Q20	57. 5989	175.5525	0. 7163	0. 9409
Q21	57. 1596	164.5234	0. 8042	0. 9376
Q25	57. 0046	168.1901	0. 8287	0. 9370

With no factors having a significantly higher alpha if the item was deleted, all items were kept for subsequent analysis. Factor 2 analysis was completed the same as for

Factor 1. The resultant alpha for the 10 item scale measuring Factor 2 was .93 and is shown in Table 8.

Table 8. Reliability Analysis for Participant Factor 2

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
Q1	48.4116	125.7225	0.6077	0.9309
Q4	47.7260	122.1091	0.8049	0.9216
Q7	48.1237	121.4800	0.7338	0.9247
Q11	47.8862	121.6310	0.7224	0.9252
Q14	47.3877	121.3317	0.7142	0.9257
Q15	47.5383	115.9027	0.7902	0.9218
Q16	47.5753	120.0777	0.7368	0.9245
Q22	47.7388	123.2780	0.7864	0.9226
Q23	47.6884	119.2335	0.7959	0.9214
Q24	47.7897	124.1651	0.6452	0.9291

Once again, with no factors having a significantly higher alpha if the item was deleted, all items were kept for subsequent analysis.

The analysis for the Expert Evaluator's Quality Scale was completed in the same manner with the overall scale alpha being a much lower .7601, but still above .70 which is generally considered acceptable for behavioral research (Nunnally, 1967), as shown in Table 9. Thus, this scale has a high reliability which means the evaluation of the accuracy of the instrument to measure the one extracted factor is very favorable. One would expect this instrument to provide reliable measures of the factor as a function of the respondents understanding of the question and not as a result of a variation in true score (Cronbach, 1971).

Table 9. Reliability Analysis for Expert Evaluator Factor 1

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
Q1	21.2067	25.9514	0.3091	0.7675
Q2	22.2241	20.4878	0.4723	0.7408
Q3	20.6845	23.3853	0.5628	0.7152
Q4	21.0257	21.9927	0.5471	0.7132
Q5	21.9210	21.9392	0.4949	0.7271
Q6	21.9555	20.0234	0.6647	0.6778

Once again, with no factors having a significantly higher alpha if the item was deleted, all items were kept for subsequent analysis.

Assessing the Differences in Action Plan Quality

Given the validity and reliability of the scales used in this study, further analysis examined the resulting differences in scale scores between the groups. The reviewer's scoring was matched to the appropriate experimental group, face-to-face and GSS. When this was done, a standard paired t-test was used to determine if there were differences in the experts' evaluations of the action plans. For each expert evaluator, their scores for all GSS supported squadron action plans were totaled and then averaged to provide a composite score. A similar composite score was calculated for their Face-to-Face composite scores. These scores were then paired and the t-test performed. The results reveal that there was indeed a difference between sample means ($t = 2.96$, $p < .05$), and more specifically that the mean total score of the GSS supported group ($\mu_{GSS} = 4.63$) was significantly higher than the mean total score of the face-to-face group ($\mu_{FTF} = 4.14$) that did not use GSS. This suggests that the GSS supported groups produced significantly higher quality action plans than the traditional face-to-face groups.

Assessing the Differences in Participant Perceptions

Two sample t-tests were used to determine the differences in satisfaction with product, satisfaction with process, and overall satisfaction between the two groups. Satisfaction with the strategic planning process was higher in the GSS supported groups ($\mu_{GSS} = 5.63$) than the non-supported groups ($\mu_{FTF} = 4.67$, $t = 4.12$, $p < .05$). The GSS supported groups also reported higher satisfaction with the action plans produced ($t = 2.07$, $p < .05$, $\mu_{GSS} = 5.39 > \mu_{FTF} = 4.87$). The t-test for the overall satisfaction for a one factor solution also favored the GSS supported groups ($t = 2.92$, $p < .05$, $\mu_{GSS} = 5.50 > \mu_{FTF} = 4.78$). All of these results support the idea of GSS use increasing the participants' self-reported satisfaction with both the process used to create the action plans and the action plans themselves.

Further Participant Results

As stated previously, the GSS supported groups used a process that limited their action plan generation time to one meeting that took less than 8 hours for the entire production of the action plans. The Non-supported group participants reported their approximate time spent and number of meetings in their survey. Of the 42 respondents, the average number of meetings was 3.4, ranging as high as 8 meetings, to complete the action plan development. The average time spent on the strategic planning process for the Non-GSS groups was over 17.7 hours, varying from 90 hours to a low of five hours while, once again, the GSS groups met once for an average of less than 8 hours. Additionally, while all GSS groups finished their action plans in the starting month of

August, the Non-GSS groups finished as late as March, with the average finish in December.

Post Hoc Analysis

To determine if the differences in satisfaction between the various groups had any predictive abilities as to the quality of the product as evaluated by the experts, stepwise linear regressions were performed for each group and for the overall population. The first regression included all participants, both GSS and face-to-face groups satisfaction ratings with the paired reviewers' evaluation used as the dependent variable. The resulting model had no significant variables except the constant, which is not meaningful in the context of this study, see Table 10.

Table 10. Stepwise Regression of Expert Rating for All Participants

Variable(s) Included	β	R^2	MSE
Constant	25.75	0.00	24.25
Variable(s) Excluded	T	P	
Satisfaction with Process	-1.06	0.30	
Satisfaction with Product	-0.85	0.41	

Stepwise at .10

The next series of stepwise linear regressions separated out the groups again and paired them with their expert ratings. The model for the face-to-face groups eliminated both of the satisfaction variables, leaving only the constant once again, see Table 11.

Table 11. Stepwise Regression of Expert Rating for FtF Participants

Variable(s) Included	β	R^2	MSE
Constant	24.73	0.00	19.32
Variable(s) Excluded	T	P	
Satisfaction with Process	-1.64	0.13	
Satisfaction with Product	-1.22	0.24	

Stepwise at .10

The model for the GSS group eliminated the satisfaction with product variable, but kept the satisfaction with process variable since it served as a significant predictor of the expert evaluation ($\beta = -.89$, $p < .10$). It should be noted that while satisfaction with process was not eliminated for this model, it provided only another .05 to the overall R^2 of .56. As such, this factor, though significant, adds little to the overall predictive ability of the model. The results of this analysis is presented in Table12.

Table 12. Stepwise Regression of Expert Rating for GSS Participants

Variable(s) Included	β	R^2	MSE
Constant	78.38	0.56	16.83
Satisfaction with Process	-0.89		
Variable(s) Excluded	T	P	
Satisfaction with Product	-0.85	0.41	

Stepwise at .10

Synthesis

After reporting the original results from the previous statistical analysis, this chapter started with a rigorous examination of the experts which led to the elimination of one expert due to extreme bias. This was followed by a series of validation and reliability tests of the measurement instrument, namely the two post process surveys administered to

the participants and the evaluation scale used by the experts to rate the action plans. This led to the identification of two satisfaction measures for the participant scales and an overall quality measure from the expert instrument, each with a high reliability measure. Only these significant factors were used in the resulting analysis. Next, the validated factors were tested to discover differences in the quality of the action plans produced by the two groups as rated by the panel of experts. Then, the participants' self reported measures of satisfaction with process and satisfaction with product were tested. In all cases, both the existence and the direction of these differences were then reported. Finally, these variables were used in stepwise linear regressions to test their ability to predict the quality of the action plans produced.

V. Results

Discussion

Strategic planning is performed throughout the U.S. Air Force as a leadership decision making process to determine the focus and direction of organizations at all levels. In today's downsizing force, the strategic planning process is a vital element in the distribution and allocation of scarce resources. The current process is extremely time consuming, taking three to four months to complete at most wings. A computer-mediated strategic planning process is supposed to help reduce the constraints associated with bringing a large group of people together to collaborate. Group support systems are technology designed to directly impact and change the behavior of groups to improve group effectiveness, efficiency and satisfaction. The data analyzed in the previous section supports this assertion.

Interpretation of Results

Since the propositions were developed from the literature review and further refine the stated research focus to evaluate the efforts of the Air Force research project created to improve strategic planning at Air Force wing level using a computer-mediated communication group support system, they will be used to outline the interpretation of results.

Proposition 1: *Higher quality action plans will be produced by groups employing GSS than by traditional face-to-face groups.*

This proposition was supported by the data analysis. The expert panels scores showed a statistically significant higher mean score for the GSS supported groups. While,

generally speaking, the review of recent research predicted this would happen, the degree to which the groups would diverge was not predictable. In this case the effect was quite small, moving the face-to-face average of 4.14, roughly neutral, to only 4.63, or about half a rating higher, for the GSS groups. That both groups mean score was near neutral as judged by the experts is somewhat disconcerting though. This may be an affect of the scoring, the lack of experience in the participant members with strategic planning, or an indication that the expert reviewers diverged in the overall opinions for each action plan reviewed. While the means were statistically significant in identifying differences between GSS and Non GSS, these differences did not apparently have a "dramatic" influence of quality. Basically, there were differences between the products produced using the GSS and those created using the more traditional, Face-To-Face meeting method, but it is open to debate how practically important these differences were. This is not to say that the differences should be dismissed, though, but rather they are worthy of further examination because, while the effect is positive, the potential value is still uncertain. Overall though, this proposition lends support to the continued adoption of GSS technology for these types of problems.

Proposition 2: *Groups employing GSS will report a higher satisfaction with the decision process than traditional face-to-face groups.*

This proposition was also supported by the data analysis. The participants' self reported satisfaction with process scores showed a higher rating for the GSS supported groups. This means that the members who used the GSS to produce their action plans were more satisfied with the process used to develop their action plans than the members

of the traditional face-to-face groups. The effect was relatively larger for this effect than the other survey measured factors. The mean was only 4.67 for the face-to-face group, but the GSS groups average reported scores were nearly a whole rating higher at 5.63. This is a clear indication of group satisfaction with the process used to develop action plans increasing due to GSS usage. Therefore, this proposition also lends support to the continued adoption of GSS technology for these types of problems.

Proposition 3: *Groups employing GSS will report a higher satisfaction with the action plan produced than traditional face-to-face groups.*

This proposition was also supported by the data analysis. The participants' self reported satisfaction with product ratings also showed a higher mean for the GSS supported groups. This effect by the mean differing from 4.87 for the face-to-face groups upward to 5.63 for the GSS groups. This is a clear indication of group satisfaction with the product, in this case the action plans, being rated significantly higher with GSS usage. Therefore, this proposition also lends support to the continued adoption of GSS technology for these types of problems.

Proposition 4: *Groups employing GSS will complete the action plan development process faster than traditional face-to-face groups.*

This proposition was the most strongly supported of all the propositions by the data analysis. The use of the GSS cut the number of meetings from an average of 3.4 down to just one. Due to the delays in scheduling and just the logistical details of gathering everyone together, the GSS provided greater efficiency, since some squadrons did not finish the process until into the next calendar year, even though all squadrons had

an August start date. Even without the enhancement in effectiveness and satisfaction that a GSS can provide, this result of greater efficiency alone would lend support to efforts to further the spread and use of GSS technology for these sorts of decision making processes.

Linear Regressions. While overall, the results of the linear regressions were mildly disappointing, there was some indication of a rather surprising result. Specifically, the result of the GSS linear regression that had satisfaction with process as the only significant variable left in the model, eliminating satisfaction with product as a significant predictor of the experts' evaluation of the action plans. This indicates that the participants' self-reported satisfaction with the process used to create the action plans was a stronger indicator of the quality of the action plan, as gauged by the expert panel, than their own assessment of the same plan. Such reasoning implies there is something qualitatively better about GSS use that leads to a quantitatively better product. Such a result calls for further evaluation in future efforts before any definite statements can be made, but it is still a compelling result from this analysis.

Implications

For strategic planners and information technology professionals in the Air Force, the results of these analyses are compelling. Both groups should be actively learning more about this technology and its potential benefits to them and their peers. If such results become the norm from Air Force field studies, the prevalence of these type of computer mediated communication systems should increase.

Researchers should find the extensive examination and validation of the measurement instruments, especially the participant scales, most beneficial. Future use of these scales will preclude the normal scale development exercises common to research efforts. With these validated scales, the researcher can spend more time on experimental design and data gathering knowing that the constructs of satisfaction with process and satisfaction with product are being adequately and reliably measured.

Limitations

The original data gathering did have some basic limitations. Foremost is probably the problems with the expert reviewers. First, there were a limited number of experts selected to do the reviewing. With a larger group of experts, the variations seen in the scores and the low inter-item correlations may have been avoided. Second, the experience level of the selected experts in this sample was less than might have been expected. Strategic planning is a complex process, and three years experience may not be enough experience to be considered an "expert" in this arena. Finally, the scale used to gauge the quality of the action plans may be insufficient because, effectively, the one factor extracted may be an artifice of the factor analysis method. Given only six items, there was little that could be done using factor analysis to try and separate the various types or subscales of quality that should be measured when gauging an action plan output from the strategic planning process. The reviewers score, then, is at best a general signal from somewhat experienced raters as to the overall quality of the submitted action plans without anything concrete to be said about any specific characteristic for any particular plan reviewed.

Suggestions for Future Research

Future researchers could remedy all of the above limitations by modifying and validating existing quality measures. These scales would enable the researcher to determine which of the characteristics of quality are most mediated through the use of the GSS. Further research should also focus on the real variable of interest in this type of research—performance. As these organizations start their annual process with the review of last year's action plans, it would be beneficial to get their own ratings as to the previous year's action plan quality, or effectiveness. A measure of the perception of how last year's action plan helped them to focus their efforts and perform would also be useful information to gather. Granted, the turnover in personnel from last year will be problematic, but not so devastating as to invalidate the effort. These efforts, along with a repetition of the previous work would naturally lend itself to a longitudinal study of the GSS effects on the strategic formation process adding validity to any results obtained. Finally, efforts could be made to determine the underlying reasons for the favorable effects reported here. Varying the task type or environment may lend some insight into this question.

Conclusion

It is clear that there are still questions about how to properly conduct strategic planning to produce the highest quality plans in the most effective and efficient manner. To answer this question, the Air Force has created a research project aimed at discovering new methods to improve strategic planning at Air Force wing levels using a computer-mediated communication system as a tool. The research project's goal is to apply

collaborative processes and technologies, such as GSSs, to improve the quality of the strategic planning process for the Air Force. This thesis analyzed the data from one of those studies. The thorough evaluation of the measurement instruments led to validated scales that could be valuable for future use. Using this scale, the results report finding a significant increase in overall plan quality, and increased participant satisfaction with both the process employed and the product created when a GSS was used. These results lend support to the continued fielding of such systems to support the decision making process for these types of problems. Furthermore, continued research should be conducted to try and discover the underlying mechanisms of these results and increase the already favorable effects.

Appendix A. Reviewer's Evaluation of Action Plans

The rating scale is where 4 is the middle position on the scale and represents "undecided" or "neutral." Moving out from the center, a 3 or 5 represents "slight" agreement or disagreement, a 2 or 6 represents "moderate" agreement or disagreement, a 1 or 7 represents "strong" agreement or disagreement. **Please answer honestly; you are assured the information provided on this questionnaire is confidential.**

SA N SD	
7 6 5 4 3 2 1	This squadron's action plans are high quality.
7 6 5 4 3 2 1	This squadron's action plans are achievable.
7 6 5 4 3 2 1	Implementation of these action plans will be realistic for the Squadron.
7 6 5 4 3 2 1	These action plans will receive a high level of buy-in from the squadron.
7 6 5 4 3 2 1	This Squadron's action plans have fully addressed the group's targets.
7 6 5 4 3 2 1	It is clear how the success of these plans will be measured.

Reviewer Profile

How many years have you been in the Armed Forces? ____

How many years have you participated in strategic planning? _____

Appendix B. Participant's Evaluation of Action Plans Process (Non GSS supported)

The following questions concern the strategic planning process in which you participated. The rating scale is where 4 is the middle position on the scale and represents "undecided" or "neutral." Moving out from the center, a 3 or 5 represents "slight" agreement or disagreement, a 2 or 6 represents "moderate" agreement or disagreement, a 1 or 7 represents "strong" agreement or disagreement. **Please answer honestly; you are assured the information provided on this questionnaire is confidential.**

SA N SD	
7 6 5 4 3 2 1	I came up with a lot of suggestions for the group to consider during our squadron's strategic planning process.
7 6 5 4 3 2 1	Our squadron did a good job coming up with action plans.
7 6 5 4 3 2 1	We got off onto a lot of tangents instead of sticking to the issue when we were creating the action plans.
7 6 5 4 3 2 1	The procedure used to develop our squadron's action plans was effective.
7 6 5 4 3 2 1	I am personally committed to implementing the action plans our squadron developed.
7 6 5 4 3 2 1	There was LESS conflict in the interaction of our strategic planning session than usual.
7 6 5 4 3 2 1	I was satisfied with my own interaction in the strategic planning process.
7 6 5 4 3 2 1	I did NOT feel like I was part of the decision making process when we were developing action plans.
7 6 5 4 3 2 1	I think our squadron's action plans are effective implementations of our group's targets.
7 6 5 4 3 2 1	I was disappointed in the quality of our squadron action plans.
7 6 5 4 3 2 1	The procedure our squadron used to develop action plans was difficult to follow.
7 6 5 4 3 2 1	Our squadron developed the best action plans possible.

7 6 5 4 3 2 1	I do NOT feel much buy-in to the action plans developed by our squadron.
7 6 5 4 3 2 1	The method our squadron used to conduct the strategic planning slowed down our group's progress.
7 6 5 4 3 2 1	Key issues did not receive enough time or attention during our strategic planning session.
7 6 5 4 3 2 1	The procedure our squadron used to develop action plans inhibited our ability to develop the best plans.
7 6 5 4 3 2 1	I am compelled to implement the action plans our squadron developed.
7 6 5 4 3 2 1	There were LESS verbal challenges in the interaction of our strategic planning session than usual.
7 6 5 4 3 2 1	I was satisfied with the action plans our squadron developed.
7 6 5 4 3 2 1	I was happy with the number of action plans our squadron came up with during our strategic planning procedure.
7 6 5 4 3 2 1	I felt free to participate in the strategic planning process.
7 6 5 4 3 2 1	The procedure used to develop action plans was easy for me to understand.
7 6 5 4 3 2 1	During the meeting, I was relaxed when we developed the action plans.
7 6 5 4 3 2 1	The strategic planning process took more time than was productive.
7 6 5 4 3 2 1	I will work hard to implement the action plans my squadron developed.
7 6 5 4 3 2 1	There was MORE disagreement in the strategic planning session than usual.

Demographic Information

I am MALE _____ FEMALE _____

How old are you? _____

How many computer-supported meetings have you participated in _____?

On average, how many people met when your squadron developed action plans? _____

How many times did your squadron meet to discuss and complete action plans? _____

How many total hours did YOU spend on this year's strategic planning process? _____

What year and month did your squadron complete its 1997 strategic plan? _____

Which squadron are you a member of _____?

Appendix C. Participant's Evaluation of Action Plans Process (GSS supported)

The following questions concern the electronic group interaction in which you participated. The rating scale is where 4 is the middle position on the scale and represents "undecided" or "neutral." Moving out from the center, a 3 or 5 represents "slight" agreement or disagreement, a 2 or 6 represents "moderate" agreement or disagreement, a 1 or 7 represents "strong" agreement or disagreement. **Please answer honestly; you are assured the information provided on this questionnaire is confidential.**

SA N SD	
7 6 5 4 3 2 1	I came up with a lot of suggestions for group to consider.
7 6 5 4 3 2 1	Our squadron did a good job coming up with action plans.
7 6 5 4 3 2 1	We got off onto a lot of tangents instead of sticking to the issue.
7 6 5 4 3 2 1	The procedure used to develop these action plans was effective.
7 6 5 4 3 2 1	I am personally committed to implementing the action plans we developed.
7 6 5 4 3 2 1	There was LESS conflict in today's interaction than usual.
7 6 5 4 3 2 1	I was satisfied with my own interaction in this group.
7 6 5 4 3 2 1	I did NOT feel like I was part of the decision making process when we were developing action plans.
7 6 5 4 3 2 1	I think our squadrons' action plans are effective implementations of the Group targets.
7 6 5 4 3 2 1	I was disappointed in the quality of our squadron action plans.
7 6 5 4 3 2 1	The procedure we used to develop action plans was difficult to follow.
7 6 5 4 3 2 1	Our squadron developed the best action plans possible.
7 6 5 4 3 2 1	I do NOT feel much buy-in to the action plans we developed.
7 6 5 4 3 2 1	The use of the electronic meeting system slowed down our groups progress.

7 6 5 4 3 2 1	We could have done a better job developing action plans if we had not used an electronic meeting systems.
7 6 5 4 3 2 1	The procedure we used to develop action plans inhibited our ability to develop the best plans.
7 6 5 4 3 2 1	I am compelled to implement the action plans.
7 6 5 4 3 2 1	There were LESS verbal challenges in the interaction than usual.
7 6 5 4 3 2 1	I was satisfied with the action plans our group developed.
7 6 5 4 3 2 1	I was happy with the number of action plans we came up with today.
7 6 5 4 3 2 1	I felt free to participate in this group.
7 6 5 4 3 2 1	The procedure used to develop action plans was easy for me to understand.
7 6 5 4 3 2 1	I felt relaxed using electronic meeting systems to develop action plans.
7 6 5 4 3 2 1	I would use an electronic meeting system for strategic planning if I had the opportunity.
7 6 5 4 3 2 1	Using the electronic meeting system shorted the time it took to develop action plans.
7 6 5 4 3 2 1	I will work hard to implement these action plans.
7 6 5 4 3 2 1	There was MORE disagreement in the group than usual.

Demographic Information

I am MALE FEMALE

How old are you? _____

Prior to today's interaction, how many electronic meetings have you participated in? _____

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Vita

Captain Bryan K. Hasty was born on [redacted]. He graduated Valedictorian from Pocahontas High School in 1983 and entered the United States Air Force on 14 October 1984 as a Computer and Electronic Switching Systems Specialist. After ten months training at Keesler AFB, he was assigned to K.I. Sawyer AFB as a Command and Control System Electronics Technician. While there, he completed his undergraduate studies, earning a Bachelor of Science with Honors in Computer Science with a minor in Mathematics from Northern Michigan University in May of 1990. After being reassigned to Malmstrom AFB, he was accepted into Officer Training School, receiving his commission on 21 January 1994. His first commissioned assignment was at Barksdale AFB as a communications officer where he earned a Master of Science degree in Information Systems Management from Louisiana State University. In March 1997 he entered the School of Logistics and Acquisition Management, Air Force Institute of Technology in the Graduate Information Systems program.

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	September 1998	Master's Thesis

4. TITLE AND SUBTITLE

EFFECTS OF GROUP SUPPORT SYSTEMS ON UNITED STATES AIR FORCE STRATEGIC PLANNING EFFORTS

5. FUNDING NUMBERS

6. AUTHOR(S)

BRYAN K. HASTY, Capt, USAF

7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(S)

Air Force Institute of Technology
2950 P Street
WPAFB OH 45433-7765

8. PERFORMING ORGANIZATION REPORT NUMBER

AFIT/GIS/LAS/98S-1

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Air Force Research Laboratory
Human Effectiveness Directorate
2610 7th Street
Wright-Patterson AFB, OH 45433-7901

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT (*Maximum 200 Words*)

Strategic planning at an Air Force wing is a team based activity that offers many advantages to the Air Force. But, it is clear there are still questions about how to properly conduct strategic planning to produce the highest quality plans in the most effective and efficient manner. To answer this question, the Air Force created a research project aimed at discovering new methods to improve strategic planning at Air Force wing levels using a computer-mediated communication system. The research project's goal is to apply collaborative processes and technologies, such as Group Support Systems (GSS), to improve the quality of the strategic planning process. This thesis validated the measurement instruments and analyzed the data from one of those studies. The thorough evaluation of the measurement instruments led to validated scales that could be valuable for future use. The analysis shows a significant increase in overall plan quality, and increased participant satisfaction with both the process employed and the product created when the groups used a GSS instead of traditional face-to-face methods. These results lend support to the continued fielding of such systems to support the decision making process for these types of problems.

14. Subject Terms
Computer Communications, Decision Making, Planning, and Decision Support Systems

15. NUMBER OF PAGES
71

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

AFIT Control Number AFIT/GIS/LAS/98S-1

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3. **Please estimate** what this research would have cost in terms of manpower and dollars if it had been accomplished under contract or if it had been done in-house.

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