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Knowledge Acquisition and Structuring by Multiple Experts in a Group Support Systems Environment

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ABSTRACT

This study addresses the impact of Group Decision Support Systems (GDSS) on expert system development by multiple Domain Experts. Current approaches to building expert systems rely heavily on knowledge acquisition and prototyping by a Knowledge Engineer working directly with the Domain Expert. Although the complexity of knowledge domains and new organizational approaches demand the involvement of multiple experts, standard procedures limit the ability of the Knowledge Engineer to work with more than one expert at a time.

Group Decision Support Systems offer a networked computerized environment for group work activities, in which multiple experts may express their ideas concurrently and anonymously through the electronic channel. GDSS systems have been widely used in other applications to support idea generation, conflict management, and the organizing, prioritizing, and synthesizing of ideas. The effects of many group process and technical factors on GDSS have been widely studied and documented.

A review of the literature on expert systems, GDSS, and GDSS in relation to expert systems was conducted. Knowledge gained from this review was applied in the construction of an exploratory research model intended to provide the necessary breadth to identify factors worthy of future, more statistically-based, investigation. Domain Experts represented by college students were charged with developing and prioritizing

ideas for creating a pre-prototypical expert system. The treatment group worked in a GDSS environment with a facilitator; a control group worked with a facilitator but without the assistance of GDSS. Each group then exchanged facilitators and technology to address another real-life problem. Additional groups worked with GDSS over time, addressing both problems. Data were gathered, analyzed and discussed relating to group efficiency factors, group process factors, attitudinal factors, and product quality factors. Independent Knowledge Engineers and Domain Experts evaluated the validity and verifiability of the group products. Analysis focused on the effect of GDSS in facilitating the acquisition and structuring of ideas for expert systems by multiple Domain Experts.

DEDICATION

To my wife, Judy, and to my Mother who truly made this possible and to Zoe who is still missed.

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This study has benefitted from the support of many different friends and colleagues, each of whom contributed in their own way. Dr. Fred Steier, Chair of my Dissertation Committee, offered constant guidance, encouragement and an objective, clarifying vision of the project. The members of the Committee, Dr. Billie Reed, Dr. Barry Clemson and Dr. Sam Coppage, all offered different and important perspectives.

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CHAPTER ONE

BACKGROUND OF THE STUDY

Introduction

There is a widespread and urgent awareness that knowledge, as much as any other business resource, is an asset to be stored, retrieved, and disseminated as needed. Stewart (1994) calls it "intellectual capital". Expert systems are a tool used to encode and preserve the knowledge and reasoning skills of experts in many domains, creating a pool of information and experience which can be used at any time in the future, even in the absence of the source experts themselves. Computer systems are used to emulate the reasoning processes of the human experts, based on specific domain knowledge and a series of rules or frames to organize that knowledge. Such expert systems offer a variety of potential benefits. "Knowledge that exists in an organization can be used to create differential advantage" (McDonald, in Stewart, 1991). "An expert system is a knowledge-based program that provides 'expert quality' solutions to problems in a specific domain" (Luger & Stubblefield, 1989, p. 291). "The real value of expert systems technology lies in its allowing relatively unskilled people to operate at nearly the level of highly trained experts" (Hammer & Champy, 1993, p. 93). While most other software programs are useless until they have been piloted and most or all the problems worked out, expert systems are unique in that prototypes can be introduced into the workstream for on-going revision and incremental improvement. A review of the literature shows the use of expert systems to be a very effective tool in increasing productivity and enhancing quality in group performance.

Expert Systems

The conventional approach to developing expert systems involves a Knowledge Engineer working closely with one Domain Expert at a time. Two major phases are involved; the first is knowledge acquisition, in which, through a variety of techniques, information is elicited from the Domain Expert about his knowledge, experience and procedures. Once the information is gathered, a series of rules or frames is usually developed. The resultant rule- or frame-based prototype system is intended to approximate the expert's role when applied to specific situations. This conventional approach can lead to several inherent problems (Keyes, 1990; Lewis, 1991b; Lewis & Jacobs, 1993; Liou, 1989). Such a form of development is very expensive, and therefore useful only to large organizations. Also, the failure rate can be high, especially for projects developing large expert systems (Meyer & Curley, 1988). The Knowledge Engineer must devote long periods of time to developing an understanding of the specific domain, interviewing the expert, developing rules, and building the man-machine interface that will allow access to the captured knowledge. Some expert systems can thus take years to develop. Further, the amount of time and commitment needed to complete the process can frustrate and alienate a practicing expert. "The lack of a willing expert is among the most prevalent reasons for failure" (Lewis & Jacobs, 1993, p. 184).

For all of the above reasons, many experts have tried to move away from a reliance on Knowledge Engineers, preferring to develop expert systems on their own. There are many advantages to self-development. Keyes (1990) found that up to fifty percent of the total expert system could be completed during the prototyping phase, now typically done by the Knowledge Engineer after working with the Domain Expert; however, self-prototyping is possible. A self-developed expert system, independent of the Knowledge Engineer, can involve more effective knowledge acquisition, provide for constant self-evaluation and improvement, limit the frustration and expense associated with the Knowledge Engineer's role, and expand the role of expert systems to smaller companies with fewer resources.

Unfortunately, such domain expert-developed knowledge-based systems may also have limited success. Few Domain Experts have the programming knowledge necessary to build effective systems. Most are unaware of the complexities involved in rule-building or in making the developing expert system intuitive and "user friendly." While recent technology has provided a number of interfaces that are useful to self-developed expert systems, knowledge about these interfaces has not been widely disseminated. Furthermore, a single interface is seldom adequate; a managed set is required for most situations and that is not yet available (Lewis, 1991a). Despite the advantages inherent in self-developed knowledge-based systems, the great majority of medium and large applications are still dependent upon the Knowledge Engineer. A goal of expert system development, therefore, may still be to shift a larger part of the knowledge acquisition and idea prioritizing phase to the Domain Expert, by whatever means possible.

Multiple Experts

In recent years, expert systems applications have become much more complex, and the required expertise now frequently resides in groups of experts, rather than one individual. Often the nature of the task makes it impossible for the individual to handle alone; at other times there is an expectation that using additional human resources will improve the quality of the work, or decrease the probability of poor work (Hackman and Morris, 1983). "Although their knowledge often overlaps, each individual also has knowledge that the other experts do not have. This means that expertise for software consultation resides not in one individual but in several consultants who provide such services regularly" (Liou, 1989, p. 20). Unfortunately, because of the problems of time, expense, complexity of rules, and conflicts in varied approaches among same-domain human experts, Knowledge Engineers usually rely on information gained from only one expert. The difficulties of knowledge acquisition through interviewing become compounded when working with multiple individuals. With only one Knowledge Engineer and expert, there are difficulties with communication, semantics, and understanding that often require several interviews. With multiple experts, there are conflicts between their problem solving methods, communication barriers among experts, and difficulties with synthesizing results. With only one Knowledge Engineer and multiple experts, the interviews must be done sequentially, taking more time. With several Knowledge Engineers, differences in their approach and capability may affect the quality of the information gained. The difficulty of integrating this information into one knowledge base is compounded, as is the difficulty of interpreting multiple results. Therefore, many Knowledge Engineers avoid the complexity of working with multiple experts, thereby losing the richness and validity of their combined knowledge.

Group Decision Support Systems

Recent technology does offer a way to involve multiple experts in the process of knowledge acquisition and knowledge prioritizing. Group Decision Support Systems (GDSS) were originally defined as integrated computer-based systems to facilitate the solution of an unstructured or semi-structured task by a group that has joint responsibility for performing it (DeSanctis & Gallupe, 1987). The technology has been widely applied to a variety of group work activities. Some applications include idea generation, topic discussion, information sharing, knowledge elicitation, conflict management, consensus building and decision making. In a setting that includes networked computer workstations, groups may meet face-to-face, with a computer-based electronic medium used to support or replace verbal communication. "This electronic channel can be configured to deliver a structured interaction process, automatically store prior entries, provide anonymity, allow parallel electronic communication, and support groups distributed by time or space" (Valacich, Dennis & Nunamaker, 1992). GDSS focuses on group rather than individual activities. "A

GDSS is designed to minimize the process losses associated with group work and capitalize on the advantages provided by the collaboration of multiple problem solvers ... the automation involved in a GDSS offers potential advantages associated with the speed of processing individuals' data inputs and the use of telecommunications to involve remote or even anonymous individuals in real-time group work" (Jessup & Tansik, 1991, p. 266).

The research already done on GDSS and expert systems would suggest that many of the problems in using multiple experts to develop expert systems can be eliminated through the use of GDSS for knowledge acquisition and prioritizing. Multiple experts can respond to interview questions at the same time, or can add their input at a later date. GDSS provides a forum for conflict management and group decision making, which would allow the experts to prioritize and agree upon rules. The function of the Knowledge Engineer could be reduced to that of facilitator, thus enhancing the role and subsequent commitment of the experts themselves. Since GDSS cuts the time for decision making significantly, the frustration and expense of expert involvement is limited. The GDSS environment encourages the free flow of information and analysis for on-going incremental improvement of the finished expert system. GDSS, therefore, appears to provide a useful tool in developing expert systems by multiple experts.

Statement of the Problem

Little empirical research has been done to verify the usefulness of GDSS in using multiple experts for knowledge acquisition and prioritizing. The literature on expert systems has concentrated mainly on the role of the Knowledge Engineer, the technical steps to building a rule- or frame-based system, and on the interfaces and commercial products available for self-development by individual Domain Experts. While there exists a strong body of constantly expanding literature defining GDSS, and studying its application to many related fields, few studies were discovered that discussed the role of GDSS and multiple experts in knowledge acquisition and prioritizing for expert systems. What little work has been done with expert systems and GDSS was limited to the role of GDSS in idea generation. No empirical laboratory or field studies could be found involving GDSS in structuring or prioritizing ideas for later rule development or in looking at the commitment of experts in on-going prototyping.

This study was designed to explore the following major problem: What is the relationship between GDSS and the development and structuring of ideas for expert systems using multiple experts?

Purpose of the Study

This study was designed to investigate the possible impact of GDSS on knowledge acquisition and prioritizing for future developmental prototyping of expert systems. It was intended to help identify the specific factors that may be most influential in this application, and are therefore worthy of further study. In order to do so, the study focused upon the use of multiple Domain Experts in knowledge acquisition and structuring for a pre-prototypical expert system. An exploratory approach was used, in which groups composed of similar sample members were asked to generate, categorize, sequence and prioritize ideas for use in a prototype expert system. The study followed a laboratory-based experimental format, using students of similar backgrounds as subjects, and addressing a field in which they were presumed to be truly expert. The treatment groups used a facilitator and worked in a GDSS environment; the control groups worked with a facilitator but without GDSS. Both groups were monitored, their work evaluated qualitatively and quantitatively, and certain specific factors were evaluated for both groups. In order to examine the interaction of the standing groups with the task and the technology, all groups created two products - one without GDSS assistance and one using the GDSS technology. Both groups followed the same script, used the same group process tools, and worked in the same order. In addition, other non-GDSS groups worked with a facilitator in a less structured environment. Finally, a small group met twice using only GDSS to solve two different problems. Practicing Knowledge Engineers and Domain Experts empirically evaluated the quality of the respective group products.

Factors investigated included those found to be significant in previous related studies, as well as those predicted to be of specific importance in developing and prototyping expert systems. Data were gathered about both the product and the process through written questionnaires of participants' perceptions, through facilitator observations, through objective measurements of the verifiability and validity of the organized ideas developed by both groups, and through measurement of pre-determined objective success criteria for all groups.

Need for the Study

While expert systems are commonly accepted as an important tool in preserving and applying human knowledge, many organizations are unable to take advantage of the process because of the cost and complexity of development. The current preferred approach to knowledge acquisition depends upon either single experts, or multiple experts interviewed in sequential order. Such an approach limits the amount of basic knowledge elicited, and prohibits the synergy possible in group interaction among experts. If, indeed, GDSS can cut down on the time and expense of development, efficiently involve multiple experts, allow Domain Experts to contribute not only to knowledge acquisition but also to knowledge prioritizing, and encourage and commit reluctant Domain Experts to on-going involvement in step-by-step prototyping of expert systems, many more organizations can benefit from the technology. This study was intended to identify the specific factors worthy of further attention in applying GDSS to the development of expert systems. Business, government, and educational groups all may find the results of this study useful.

Assumptions of the Study

The study rests upon the following theses, or assumptions:

1. Expert systems rely primarily upon the successful acquisition of knowledge from Domain Experts, who are most closely aware of the requirements of an expert system.
2. In order for incremental prototyping of expert systems to succeed, the necessary Domain Experts must be willing to give their time, energy, and expertise beyond the first knowledge acquisition stages. Their commitment rests on their feelings of ownership in the product and process.
3. GDSS provides an appropriate tool for not only knowledge acquisition from multiple experts, but also for the synthesis of crucial information and consensus upon structure and priority of generated ideas.

Contributions of the Study

It is anticipated that this study will contribute to the body of information on GDSS and expert systems by adding to the general knowledge about GDSS and knowledge acquisition using multiple experts, by validating or questioning the findings of previous studies in the area, and by identifying and studying factors effecting an efficient and innovative method of acquiring knowledge from multiple experts. This is the first such exploratory study to involve both objective Knowledge Engineers and Domain Experts in evaluating the usefulness and quality of products developed for expert systems using GDSS-supported group knowledge acquisition meetings. Systems built by multiple experts in a GDSS environment may be more quickly and efficiently developed, may be of equal or greater value than those built by a Knowledge Engineer based on knowledge acquisition from one expert, and may increase the satisfaction and involvement of the participants. This study contributes specific information about all these factors.

Research Questions

In order to determine the impact of GDSS on expert systems, the following specific research questions were addressed:

1. What is the impact of GDSS on the group process activity of knowledge acquisition and prioritizing?
2. What is the impact of GDSS on the feeling of ownership of the Domain Experts self-developing the systems?
3. What is the impact of GDSS on the quality of the product for the expert system?

Definitions

For the purpose of clarity and to assist the reader, the following terms are defined as they are used in this study:

Domain Expert -
: a person who, through years of training and experience, has become extremely proficient at problem solving in a particular domain.

Expert systems -

computer programs that use domain-specific knowledge to emulate the reasoning process of human experts.

Group Support System (GDSS) -
an integrated computer-based system that facilitates the solution of an unstructured or semi-structured task by a group.

Knowledge acquisition -
the process of extracting, prioritizing, and organizing knowledge from several sources, mainly human experts, so it can be used in a computer program.

Knowledge Engineer -
the person who designs and builds the expert system. This person is usually a computer scientist experienced in applied artificial intelligence methods.

Prototype -
an initial version of an expert system that is developed to test effectiveness of the overall knowledge being employed to solve a particular problem.

Quality -
a subjective measure of expert system products in terms of verifiability and validity.

Verification -
the process of assuring the internal consistency and completeness of a product; "building the system right" - refers to structure.

Validation -
the process of assuring that the product has the potential to help the user as intended in the original requirements and objectives; "building the right system" - refers to content.

Assumptions and Limitations of the Study

This study rests upon the assumptions that all subjects had the same degree of experience with expert systems; that the subjects are experts in the field discussed; and that the facilitators remained impartial and equally adept in dealing with both the control and treatment groups. Limitations of the study may include problems and biases inherent in the GDSS software, over which the investigator had no control, as well as the possibility of uncontrolled intervening and moderating variables arising through the unobserved and unrecorded interaction of participants in their daily lives, outside the study environment. While every effort was made to control the study factors and to provide a degree of rigor, such intervening context variables may well arise in an exploratory study, and their effect must be acknowledged. In addition, the fact that there was only one Domain Expert for the safety problem may be considered a limitation, despite the suitability of the expert used.

Organization of the Study

Chapter One of the study includes an overview of the background of the study, statement of the problem, research questions, design of the study and need for this study. Chapter Two focuses upon an in-depth review of the literature on expert systems, on GDSS, and on how GDSS has been used in expert systems development. Chapter Three contains a description of the framework of the study, including the theoretical foundation and the methodological framework. Chapter Four delineates the methodology, including design of the study, a description of how data were gathered, and a plan for analysis and discussion of the data and findings. A description of anticipated outcomes is also included. Chapter Five includes a report of the findings from the study and an analysis of the data, and Chapter Six discusses final hypotheses and conclusions based on the study and includes suggestions for further, more rigorous, investigation.

CHAPTER TWO

REVIEW OF THE LITERATURE

Introduction

A review of the literature was conducted in order to explore the previous research on GDSS and expert systems and to identify the important research issues. These included expert systems in general, the effectiveness of group support systems in other applications, domain expert-developed expert systems, the use of multiple experts in knowledge acquisition, and the relationship between expert systems and GDSS. A brief summary of the most relevant findings is presented below, and forms the basis for the theoretical framework of this study.

Expert Systems

Expert systems have been defined as "computer systems that incorporate the knowledge and expertise of human experts in a specialized domain to make intelligent decisions within that domain" (White & Goldsmith, 1990, p. 276). Meyer & Curley (1991) define expert systems as "software applications that incorporate substantial amounts of human reasoning for problem solving and decision-making assistance" (p. 455). Dhar refers to expert systems' "ability to engage in judgmental reasoning similar to that of domain experts and to exhibit comparable levels of performance" (1987, p. 25). Expert systems attempt to encode the knowledge and reasoning skills of the Domain Experts. Artificial intelligence systems that achieve expert-level competence in solving problems by bringing to mind a body of knowledge are called knowledge-based systems, or expert systems (Feigenbaum, McCorduck & Nii, 1988).

Expert systems are becoming increasingly important in the business, military, and educational world. According to Mykytyn, Mykytyn & Slinkman (1990) "The excitement generated by the advent of Expert Systems ... has led to prodigious research and substantial financial investment in these systems" (p. 27). "Knowledge-based system technology is becoming an increasingly important asset in support of the achievement of corporate goals through strategic information systems" (Maletz, 1990, p. 323). Expert systems have been used in a variety of applications. The Knowledge Engineering Handbook of Theory and Practice discusses medical applications, financial planning and business management, military applications, space science, and quality of life enhancement (White & Goldsmith, 1990). Dhar (1987) indicated that major efforts in expert systems have been in medicine, geological exploration, analysis of oil-well logs, mass spectroscopy interpretation, and computer configuration. Mykytyn, et al. point out that artificial intelligence is moving from "very specific, academically oriented efforts, such as medical diagnosis, to more managerially oriented corporate issues" (1990, p. 27). "Thus, it is clear that managing the development and use of expert systems technology is of growing importance as an increasing number of organizations seek to apply the technology to their own operations" (Meyer & Curley, 1991, p. 455).

Components of Expert Systems

The main components of an expert system consist of a knowledge base, an inference engine, and a user interface (Mishkoff, 1986; White & Goldsmith, 1990). The knowledge base contains the Domain Expert's accumulated knowledge, experience, and procedural guidelines. The inference engine employs the mechanism of using the knowledge to draw an inference, and the user interface allows the user to interact with the system and to access the knowledge and inferential rules (Liou, 1989). According to Mykytyn, et al. (1990), the knowledge base contains the system's factual knowledge as well as the heuristics of the expert, and the inference engine defines how the rules in the knowledge base are to be applied to the problem. The inference engine decides which rules will be utilized, accesses the appropriate rules, executes the rules, interacts with the user to gain needed information about the problem and makes a recommendation when a satisfactory approach has been found. The user interface communicates with the user, translating between the computer system and the human user. A properly developed user interface makes the expert system easy to use by providing support for the needs, preferences, and individual differences of the users (p. 28).

Information for the knowledge base is most often elicited from the expert by a Knowledge Engineer who then matches the information to an appropriate software tool to build the expert system.

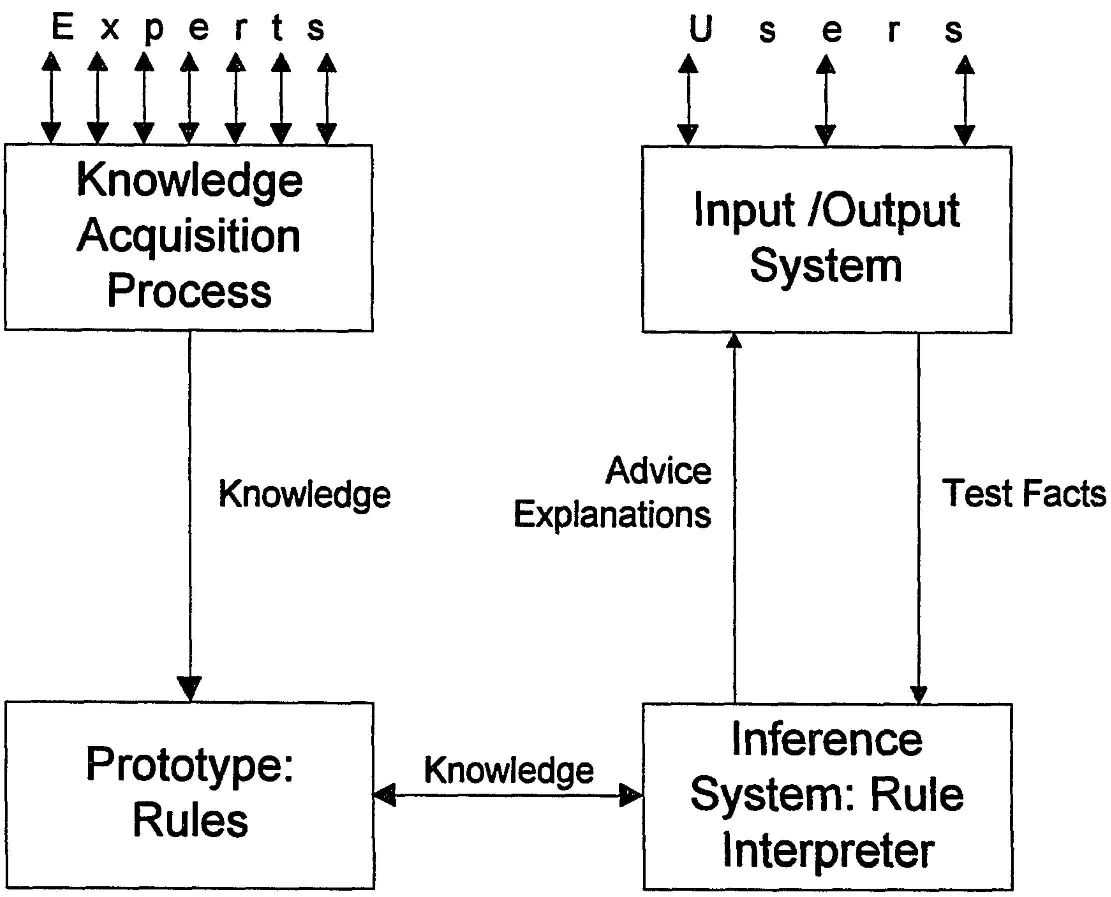
> The knowledge engineer extracts knowledge from experts (who are particularly proficient at using the knowledge) and integrates it into an overall knowledge system architecture. Thus the knowledge engineer constructs a knowledge base and ultimately designs a KBS (knowledge-based system) out of elementary knowledge components, such as facts, beliefs, and heuristics. Since knowledge is not directly observable - only the results of applying it are - the knowledge engineer uses a variety of methods to reconstruct the inferred knowledge (White & Goldsmith, 1990, pp. 44-45).

Developing Expert Systems

Building an expert system is an iterative and evolutionary process (Dhar, 1987). Once a prototype is developed, it presents a model that the Domain Expert can critique, modify, refine and improve. "Once the domain has been conceptualized, a model established, rules derived and a prototype tested and improved, the domain can be safely expanded through slow and incremental steps" (Lewis, 1991b, p. 65). Figure 1 presents a graphical representation of the steps in prototyping of an expert system.

A successful expert system is measured by several specific variables. According to White & Goldsmith, authors of a handbook for Knowledge Engineer certification (1990), testing and validation procedures include:

- prototype test and evaluation applied to general software verification and validation procedures;
- prototype to pilot conversion, continuing with software validation and verification, and test cases to compare against known solutions;



GDSS and Conventional System for Prototype Development and Test

Figure 1

- operational implementation, to obtain user feedback about interfaces and gaps in the knowledge base for unexpected situations; and,
- maintenance and enhancement, to update the knowledge base and document overall system performance (pp. 46-47).

An empirical evaluation was suggested by several investigators (Liou, 1989; Sambamurthy, 1989; Hayes, 1991). Such an evaluation can be accomplished by observing the system in operation, submitting the knowledge system to a panel of Domain Experts, or submitting the system to a panel of Knowledge Engineers for evaluation.

Problems with Expert System Development

Many experts have pointed out problems with the conventional development of expert systems. Because of the time and expense involved, expert systems have been largely the province of larger companies (Keyes, 1990; Lewis, 1991b). The failure rate is high, especially for attempted large expert systems (Meyer & Curley, 1988). The commitment of time and attention can alienate Domain Experts (McGraw & Harbison-Briggs; 1989; Keyes, 1990). Lack of knowledgeable and sympathetic management support can doom a system (Waterman, 1985). Unreal expectations of an expert system may lead to excessive frustration and disappointment (Mykytyn et al., 1990; Waterman, 1985). There is a shortage of trained Knowledge Engineers (Maletz, 1990). Finally, the complexity of the knowledge acquisition stage as approached by the Knowledge Engineer can add to the time, expense, possibility of misunderstanding, and alienation of Domain Experts (Keyes, 1990; Liou, 1989; McGraw & Harbison-Briggs, 1989). Since the prevalent approach to knowledge acquisition and expert system development is defined as on-going prototyping, the continued involvement of the Domain Experts required for reaction and feedback as the system evolves must be assumed, and is a necessary component. Many current approaches to knowledge engineering make this cooperation difficult to obtain.

Knowledge Acquisition

The knowledge acquisition phase, during which the Knowledge Engineer works directly with the Domain Expert, is the most important phase in building a successful expert system. "It is the most important task in the expert system development process because the power of an expert system derives from the knowledge it possesses, not from the particular formalism and inference scheme it employs" (Feigenbaum in Liou & Nunamaker, 1993, p. 121). "Knowledge acquisition - leading other people to describe how they do what they do - is one of the greatest challenges in building expert systems" (Scott, Clayton & Gibson, 1991, p. v).

> Knowledge acquisition is a bottleneck in the construction of expert systems. The knowledge engineer's job is to act as a go-between to help an expert build a system. Since the knowledge engineer has far less knowledge of the domain than the expert, however, communication problems impede the process of transferring expertise into a program. The vocabulary initially used by the expert to talk about the domain with a novice is often inadequate for problem solving; thus the knowledge engineer and expert must work together to extend and refine it. One of the most difficult aspects of the knowledge engineer's task is helping the expert to structure the domain knowledge to identify and formalize the domain concepts (Hayes-Roth, Waterman & Lenat in Boose & Gaines, 1988, p. vii).

This was true in 1988 and is still true today. Other knowledge acquisition problems include possible bias from the Knowledge Engineer, difficulty in the expert's understanding his or her own cognitive process, difficulties in communicating the expert's processes and understanding those cognitive processes, a superficial understanding of the domain or processes, leading to a dysfunctional expert system, disagreement among experts, and the difficulty in working with multiple experts (Mykytyn, et al., 1990; Liou, 1989; Liou & Nunamaker, 1993). Also noted as problematic have been the abilities and attitude of the Domain Expert, the suitability of the domain area, and the ability of the Knowledge Engineer to select appropriate knowledge representation tools (White & Goldsmith, 1990).

Roth (1990) categorizes techniques of knowledge acquisition as being direct, indirect, or computer-based. Direct approaches include interviews, questionnaires, free listing or object features, observation of task performance, protocol analysis, context focusing, interruption analysis, drawing closed curves, concept (card) sorting, and inferential flow analysis. While many of these approaches may not be appropriate in a GDSS setting, variations on group interviewing and questionnaires can be used.

Unstructured interviewing requires the experts to verbally describe the knowledge and heuristics that are used in solving the domain problem; structured interviews are those revolving around planned scenarios, specific aspects of the domain procedures, classification, goal decomposition and procedural stimulation. Interviews are useful in quickly generating a large body of knowledge regarding the terminology and main components of the domain (Gammack & Young, 1985 in Roth, 1990, p. 13).

Questionnaires ask the expert to respond to questions in written form, and can be easily translated to the electronic medium. Questions can be either open-ended or formatted. Open-ended questions are designed to stimulate the expert's thought processes, while formatted questions can elicit specific types of knowledge. Roth suggests that questionnaires are useful in discovering both objects of the domain and relationships between objects. "Questionnaires provide an efficient means of gathering information ...and have the advantage of permitting responses from several experts to be easily obtained and analyzed" (p. 15).

Roth's discussion indicates that direct methods of knowledge acquisition have several limitations; they rely on the experts' ability to access their own mental processes, the experts' ability to express those processes verbally, and on the accuracy of the Knowledge Engineer's interpretation of the material expressed. "These limitations suggest that the knowledge acquisition bottleneck will not be substantially eliminated using only direct methods of knowledge acquisition" (Roth, 1990, p. 23).

Indirect methods of knowledge acquisition allow the Knowledge Engineer to perceive the Domain Expert's thought processes without relying on direct verbal expression of that knowledge. Methods include multidimensional scaling, hierarchical clustering, general weighted networks, ordered trees from recall, and repertory grid analysis. Hierarchical clustering, which is a scaling technique that can produce a hierarchical structural representation of knowledge based on similarity judgements between domain items (Roth 1990, p. 28) can be productively used in a GDSS environment as well as in a pencil and paper setting. GDSS can also be used to assist the creation of a repertory grid, representing similarity ratings and relationships among domain elements. Domain elements are identified and rated against distinguishing traits to uncover dimensions of similarity/dissimilarity. Elements are then arrayed along a top of the grid, and all dimensions are listed on the side. Every element is then rated against every dimension to develop relationship ratings. According to Roth (p. 34), the repertory grid technique is best suited to problems of analysis, such as debugging, diagnosis, interpretation or classification.

Roth also cites three methods of computer-based knowledge acquisition: computer-assisted knowledge conceptualization, automated repertory grid-based systems, and rule induction systems. Computer-based knowledge conceptualization builds a base of facts and rules that help an expert structure a new body of knowledge. The goal is to help codify the art of knowledge engineering.

Indirect methods, Roth contends, often rely on assumptions that are not always appropriate to the data being collected. She further notes that computer-based approaches still rely on an available expert, willing to learn to interact with the system, and willing to commit a considerable amount of time to the interaction.

Input From Multiple Experts

Liou (1989) pointed out that while earlier expert systems addressed very narrow domains, typically requiring the knowledge of only one individual expert, expert systems are now more complicated, and the domains more complex. Input from multiple experts is now required in the knowledge acquisition stage. Several advantages to using multiple experts are noted. First, the time that Domain Experts can contribute to knowledge acquisition is both limited and expensive. When several experts are involved, the commitment from each individual is minimized. Secondly, the knowledge acquisition phase can be more flexibly designed, as it is not necessary for each expert to be present at the same time and in the same place. Even if one expert is not available, sessions that do not require his or her participation can be conducted. Thirdly, the interaction among experts provides many different sources of divergent thinking and idea gathering (pp. 20-22). Further, "Studies have shown that expert systems based on discussions with a single expert do not emulate most real-life decision making, while expert systems that are based on inputs from several experts may reflect multiple lines of reasoning" (Liou & Nunamaker, 1993). Meyer & Booker (1991) cite several studies which indicate benefits from using diverse experts. They define diverse experts as those likely to view and solve the problem in different manners (p. 87). Diverse experts, particularly in face-to-face meetings, provide better quality answers (Seaver, 1976, in Meyer & Booker, 1991). Ascher (1978, in Meyer & Booker), suggests that multiple experts are more accurate because they reflect the most up-to-date consensus. Using multiple experts can minimize the influence of a single individual and help the group overcome the tendency to cling to one conservative point of view (Meyer & Booker, p. 87). Dym & Levitt (1991) emphasize that multiple experts can be used to reinforce the understanding of a repeatable and capturable task (p. 338). McGraw & Harbison-Briggs summarize the primary benefits of multiple-expert participation as increased ease of access and strengths associated with multiple lines of reasoning (1989, p. 249). These multiple lines of reasoning allow the Knowledge Engineer to stimulate interaction that can be used to derive a synthesis of expertise.

Unfortunately, the involvement of multiple experts can increase the complexity of knowledge acquisition, making the Knowledge Engineer's task even more difficult. Not only does the Knowledge Engineer have to merge each individual expert's knowledge structure into one, but he or she must also generate group knowledge which does not necessarily reside in any one Domain Expert, but evolves as a result of group interaction (Liou, 1989, p. 23). McGraw & Harbison-Briggs note the problems associated with multiple-expert teams as being member equality, upward-ripple paranoia, confidentiality, access, and consensus versus diversity (1989, p. 250). Group members may be unwilling to risk exposing their ideas in front of those of greater status (member equality). An expert may fear repercussions from superiors if they disagree with stated opinion (upward-ripple paranoia). Domain Experts may feel threatened by knowing that their contributions will be shared with others (confidentiality). All of these issues may affect obtaining access to practicing experts, as may conflicting schedules. Finally, multiple experts will yield multiple opinions, many of which may be conflicting. All of these issues must be foreseen and dealt with by the Knowledge Engineer.

Approaches to Multiple Experts

Most traditional methods of knowledge acquisition, including interviewing, questionnaires, observation and protocol analysis are designed for acquiring knowledge from a single expert (Liou & Nunamaker, 1993). When only one Knowledge Engineer is involved, the process must be sequential, i.e., one expert at a time. When selecting multiple experts for individual consultation, it is important to determine not only domain expertise but also communication abilities and the willingness to work in a small group. Feigenbaum (1985, in McGraw & Harbison-Briggs 1989, p. 251) notes that "You have to find people who are willing to meet the knowledge engineers halfway over the bridge between computer science and the target discipline." The interaction must remain private if the expert so desires, and it is important to debrief the experts at the end of each session. When conflicting views among experts exist, the need for several iterations of interviews makes the process very time consuming. If multiple Knowledge Engineers are used to conduct parallel interviews, the coordination among them becomes important and time consuming, as well. "Conflicts can arise between the experts, between knowledge engineers' understanding of the problem domain, or the same expert may even have different opinions at different times and places" (Liou & Nunamaker, 1993, p. 122).

Another approach is to meet with multiple experts in a single interview. Single interviews with multiple experts may cease to be productive because the experts argue among themselves and do not provide useful information. These arguments are most common when the experts share the same domain and are used to working individually rather than in a group (Scott, Clayton & Gibson, 1991, pp. 450-1). Hunter (1985, in McGraw & Harbison-Briggs, 1989) feels that it is best to consolidate the experts and let them argue it out before trying to embed the acquired knowledge into the system. McGraw & Harbison-Briggs also point out that the "selected system architecture also will affect the way that multiple experts are used. If the system is designed to handle multiple lines of reasoning, it is acceptable to acquire diverse information without demanding that experts reach a consensus. If the architecture is designed such that a combination or integration of expertise is required, knowledge acquisition sessions must be tailored toward reaching a consensus" (1989, p. 253).

Self-Development by Domain Experts

Several alternate approaches have been developed to minimize the influence of the Knowledge Engineer, increase Domain Expert involvement, and extend the use of expert systems to a wider arena (Lewis & Jacobs, 1993). Efforts have been made to encourage development by end-users, or by Domain Experts. Meyer & Curley (1991) note that successful development is a factor of the level of knowledge and complexity desired of the system. Low-knowledge/low-technology systems can be developed by end users with basic software skills training, but more complicated systems must rely on computer and artificial intelligence professionals. Mykytyn, Mykytyn & Slinkman point out that organizations may take advantage of "readily available expert system shells" in order to build their own systems (1990, p. 31). Lewis & Jacobs (1993) refer to "an abundance of interfaces, with easy-to-use and -understand techniques." They characterize expert-developed systems as those that can best elicit knowledge from the Domain Expert, provide the basis for on-going improvement of the prototyped system, overcome the negative factors inherent in the Knowledge Engineer's role, keep costs down, and encourage greater commercial interest in the design of new development interfaces. They warn, however, that domain-expert developed systems are most appropriate for narrow and specific domains.

Keyes (1990) lists the advantages of self-development by Domain Experts: they have the information and the interests, they can talk the language of other Domain Experts, they are obviously interested in the subject area, and they have the potential to understand, interpret and record the specific knowledge they have built up during the years (p. 89). It should be noted that all of the work cited above deals with partial self-development by single Domain Experts, working with interfaces that make it easier to communicate with prepared systems. Self-development by multiple experts is an area yet to be investigated by researchers and practitioners in the field.

Summary

A review of the literature on expert systems suggests that their nature, complexity, and importance are expanding rapidly. Such systems generally have relied on the successful interaction of a Knowledge Engineer and one or more Domain Experts, most crucially during the phase of knowledge acquisition. While the necessity of involving multiple Domain Experts has increased, the role and standard methods of the Knowledge Engineer are not currently suited to knowledge acquisition with more than one expert at a time. In an attempt to limit the role of the Knowledge Engineer, many organizations are experimenting with user- and expert- developed expert systems. It remains to find a structure that will facilitate self- development by multiple experts in a collegial and cooperative environment.

Group Decision Support Systems

Group Decision Support Systems (GDSS) are a combination of communication, computer, and decision technologies that support problem formulation and solution in group meetings (DeSanctis & Gallupe, 1987). An effective GDSS is designed to increase the efficiency and effectiveness of group activities by removing common communication barriers and by directing the organization, timing, or content of discussion (Liou & Nunamaker, 1993). An obvious advantage of the use of an electronic tool is the improved processing speed, making for a more efficient use of group time (Miranda, 1991). According to Huber (1984), the need for a GDSS arose from the following dilemma:

> Managers, and other professionals, spend a good deal of their time in decision-related meetings; meetings where people possessing different facts, expertise, and points of view share and use information in order to select their individual or collective courses of action. It appears that the current and increasing complexity and turbulence of organizational environments can only heighten demands for such information and use. On the other hand, increases in the time spent in meetings require decreases in the time spent in other managerial or professional activities, and as a consequence will be resisted in many instances.

GDSS has been perceived to have the potential to assist groups to make better quality decisions, to facilitate more equal rates of participation (Dennis, George, Jessup, Nunamaker & Vogel, 1988), to make better use of time and adapt more rapidly to change (Grohowski, McGoff, Vogel, Martz & Nunamaker, 1990), and to increase the satisfaction of participants (Connolly, Jessup & Valacich, 1990). In addition, the parallel and anonymous flow of communication may ameliorate previously studied limits to communication. Tyran, Dennis, Vogel & Nunamaker (1992) describe a phenomenon labeled production blocking. When one group member "has the floor," he or she may block the generation or communication of ideas from other members. Such blocking comes in several forms: attenuation blocking when members must wait to contribute, and forget or suppress their ideas because they no longer seem relevant. Concentration blocking occurs when members try hard to remember and formulate their own ideas and therefore cannot process new information, and attention blocking occurs when members pay so much attention to the ideas of others that they do not formulate their own ideas and comments. Tyran et al suggest that attenuation and concentration blocking are caused by the sequential nature of spoken verbal communication (one person at a time) which forces participants to wait their turn. Attention blocking arises from the need to constantly monitor the single communication channel to avoid missing important information. GDSS, by facilitating parallel communication, allows for the interaction of larger numbers of participants. All members can contribute at the same time without interrupting one another, and can add, piggy-back, or comment on the contributions of others without missing important information.

Tyran et al. also suggest that members who are unsure of the reception of their ideas are reluctant to contribute. This reluctance may be due to the apprehension of the members themselves, pressure to conform to the group's position, or the influence of powerful group members. They cite Shaw (1981, in Tyran, et al., 1992) on experimental studies that have found that overall group performance can decrease when apprehensive members do not share information with the group. This suggests that communication that can enable members to contribute freely without evaluation apprehension would positively benefit group interaction.

GDSS provides many features that counteract communication blocking among group members. These include anonymity, parallel communication, structured communication, facilitator support, and fast electronic communication. Tyran et al (1992) note that anonymity, the electronic channel of communication, specific GDSS tools, and easy input all seemed to allow equality of input and increased communication among GDSS group participants.

GDSS Applications

While the initial focus of the use of GDSS technology was to support groups in decision making, it has become clear that the technology can also support a wide variety of collaborative tasks (Dennis, Heminger, Nunamaker & Vogel, 1990). Among the applications reported in the literature are group planning (Dennis, et al, 1988), stakeholder analysis (Sambamurthy, 1989), knowledge acquisition (Liou, 1989; Liou & Nunamaker, 1993; Lipp, 1993), idea generating and problem solving (Jessup, Connolly & Galegher, 1990; Valacich, Dennis & Nunamaker, 1992), group decision making (Zigurs, Poole & DeSanctis, 1988; Jessup & Tansik, 1991), quality team meetings

(DeSanctis, Poole, Lewis, & DeSharnais, 1992), mediation (Connolly, Jessup & Valacich, 1990), and strategic management (Tyran, Dennis, Vogel & Nunamaker, 1992), among others. Valacich, Dennis & Nunamaker (1992) list applicable group tasks of 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 (pp.261-262).

GDSS and Related Factors

A number of recent studies have examined various related factors in order to determine the best GDSS model for specific applications. Among these are group size, structure and arrangement, the role of anonymity, the type of groupware (software used), and many other related factors. The results of several of these studies are reported in the following section.

The impact of size of work groups has been addressed by a number of investigators. According to Dennis, Heminger, Nunamaker & Vogel (1990) early group process research had indicated that an optimum member number was either three or five. Shaw (1981, in Tyran et al., 1992) notes that large group meetings are generally less effective and less satisfying to group members than small group meetings. Participation decreases as group size increases. According to DeSanctis & Gallupe (1987), as membership increases, the number of potential exchanges rises and the frequency, duration, and intimacy exchange all decline. Consensus becomes harder to achieve, and satisfaction with the group declines. They further note that there is greater interest in expressing information or opinions, and less interest in receiving from others. Smaller groups are more likely to actively attempt to resolve opinion differences.

Groups using GDSS appear to be able to integrate larger numbers of participants successfully. A University of Arizona study involving IBM workers and executives using groups of eight to ten members found that larger groups tended to slightly outperform smaller groups relative to expectations (Grohowski, McGoff, Vogel, Martz & Nunamaker, 1990). They concluded that the effective number of meeting participants is increased with GDSS. Tyran, Dennis, Vogel & Nunamaker (1992) summarized eight case studies in which group size ranged from eighteen to thirty-one. They concluded that the group technology used "can be used to support large Strategic Management groups in an effective and efficient manner" (p. 330). Valacich et al. (1990) looked at the effect of size in a GDSS environment on several factors affecting idea generation. They found that the total number of comments per individual was not affected by size, that there was a greater number of unique solutions coming from larger groups, and a larger number of critical comments in large groups. In a second 1992 study, Valacich, Dennis & Nunamaker found no difference in group member satisfaction and effectiveness as a factor of size. Dennis et al. (1990) found that satisfaction increased with group size. Dennis, George, Jessup, Nunamaker & Vogel (1988) note that "as the size of group meetings increases the meetings have the potential to span several hierarchical levels in the organization" (p. 614), increasing productivity.

Another major area of investigation is the effect of anonymity on GDSS work groups. Dennis, Valacich & Nunamaker (1992) found that anonymity did not affect quantity of ideas or quality, nor were anonymous groups more effective. An earlier study (1988) by Dennis, George, Jessup, Nunamaker & Vogel concluded that total number of comments, and number of critical comments increased with anonymity. Connolly, Jessup & Valacich (1990) looked at the effects of anonymity and evaluative tone on idea generation, and concluded that "groups working anonymously and with a critical confederate produced the greatest number of original solutions and overall comments, yet average solution quality per item and average solution rarity" were not affected (p. 689). Grohowski et al., in their study of GDSS at IBM (1990) suggest that the anonymity offered by GDSS can attack some group dysfunctions such as member status incongruities, fear of reprisals, groupthink, etc. They conclude that anonymity is particularly beneficial in the meeting process. Jessup et al. (1990) studied the effects of anonymity with GDSS in idea generating, and found that group members whose contributions were anonymous generated more comments, were more critical and probing, and were more likely to contribute to the ideas advanced by others. Valacich, Dennis & Nunamaker in a 1992 summary of seven studies of anonymity, again found that the total number of comments and critical comments increased with anonymity. They found that the there was no impact on the number of unique solutions with anonymity, and that overall satisfaction was not affected.

Several studies have addressed the issue of proximity, or physical closeness, either as an isolated factor or associated with anonymity. Jessup & Tansik (1991) discovered that proximity led to increased member satisfaction - that is, those working in the same room were more satisfied with the session, even if working anonymously. Interestingly, those working face-to-face and anonymously generated the most critical comments. Jessup et al (1988) reported overall satisfaction to increase with proximity. DeSanctis & Gallupe (1987) also examined proximity, this time in relation to group size. They summarized previous research that indicated that GDSS can act to provide a buffer between face-to-face group participants and can also act to reduce perceived distance between dispersed members.

The way that the group organizes for action has been found to affect the success of the task addressed. A group that follows a plan and stays on task accomplishes more than a group that engages in extraneous activities. Hayes (1991) notes that "involvement acts as a motivator and will lead to more productivity and efficiency" (p. 52). Jessup, Connolly, & Galegher (1990) found that when group members interacted through the computer only, crosstalk was virtually non-existent (p. 315). Zigurs, Poole & DeSanctis (1988) note that a GDSS environment promotes electronic interaction, minimizing the influence of those who dominate through the more common forms of verbal, non-verbal and written communication (p. 626). This means that all members start as equal contributors to the group. The Zigurs study found that the distribution of influence among GDSS group members is more evenly distributed than among manual group members, that there was a greater amount of substantive interaction in the GDSS group, and that the GDSS group found greater consensus than did the manual group. In a 1990 study of GDSS in an IBM management task, Grohowski et al. discovered that GDSS groups provided a significant savings in man-hours needed to perform a task, and that the savings of time were independent of the ongoing completeness of group members and the degree to which cooperation was required. They did find that groups that were more formal, more recently established, or less cohesive tended to achieve higher levels of man-hour savings than similar groups that met without GDSS support. From comments made by participants and from their statistical analysis, the investigators concluded that "overall, automated support for groups tends to change the way people work together in terms of average meeting size, group structure, and methods of addressing complex problems" (p. 376). Specific points made were that participants stay focused on the task at hand and that pre-planning of meetings takes on increased importance.

In a recent study, Zigurs & Kozar (1994) looked at the impact of the GDSS technology on the roles that group members expect to fulfill, and actually do fulfill. They found that the GDSS technology itself was perceived by group members to fill a variety of roles normally taken by human members. Primarily, these included the task-related roles of Recorder and Proceduralist, and the group-building roles Gatekeeper and Motivator. They note that their findings may come as a surprise to some GDSS designers and researchers who have questioned the socio-emotional climate created to the technology. "It would appear that participants view this technology as already providing considerable group-building support for group process (p.285)."

In a study of GDSS and strategic planning, Tyran et al (1992) looked at specific tools for each phase of planning. Many of the phases were very similar to those involved in building expert systems. They discovered that empowered groups used primarily electronic communication for divergent thinking (problem exploration or idea generating) because the goal was to rapidly collect many ideas, information or opinions. GDSS offered tools for these tasks. With activities revolving around convergent tasks (consensus building and idea organization), the objective was to resolve multiple and conflicting viewpoints. These tasks called for verbal interaction, and several features of GDSS were found to be useful for this application. Specific GDSS tools for organizing, analyzing, prioritizing and evaluating were also found to be available for these tasks. In this study, the GDSS Group Systems Software developed by the University of Arizona was used.

Sambamurthy & Chin (1994) emphasize the role of attitudes developed by groups toward the GDSS. They found that attitudes toward the technology are initially dictated by the perceived ease of use. In succeeding sessions, the emphasis moves from ease of use to the perceived value of the technology in achieving group goals. They conclude that groups that group perceptions of the usefulness and ease of the GDSS influence how extensively the GDSS is used, and that the extensiveness of GDSS use influences on the group decision-making performance. Sambamurthy & Chin note that GDSS provide varying levels of communication and consensus support for supporting group decision-making activities. They speak to "equivocality", or the "potential for multiple and conflicting interpretations (p.217)." GDSS can reduce equivocality by overcoming the process losses and facilitating process gains, through providing rules and procedures that steer groups away from inhibiting behaviors.

According to Sambamurthy and DeSanctis (1990), GDSS designs that provide higher levels of communication and support enable groups to develop higher levels of post-meeting consensus, greater confidence in their recommendations, and more favorable perceptions about the quality of their recommendations.

Liou (1989) summarized research about the positive effects of GDSS on group tasks by indicating that GDSS may: serve as a medium for group interaction, provide various communication channels to enhance the group's information handling capacity, and provide a collective group memory to prevent the loss of ideas and save time in repetitive group process by imposing structure (p. 44).

GDSS and Expert Systems

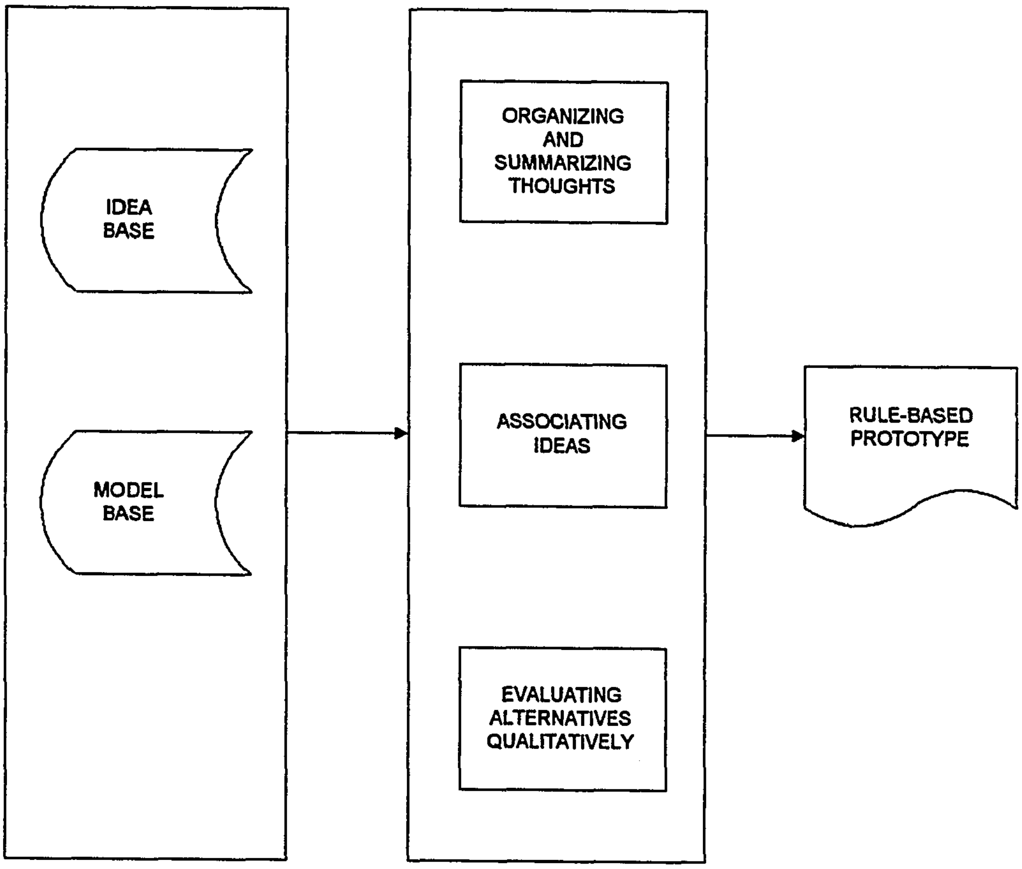
A thorough review of the literature revealed very few empirical studies addressing the application of GDSS to expert system development. A 1989 study by Irene Liou at the University of Arizona looked at the role of GDSS in the knowledge acquisition stage of expert systems. A non-experimental field study was conducted, focusing on the development of a help desk for a manufacturing facility. A GDSS lab was constructed, using University of Arizona-developed group software. Twelve Domain Experts were involved in the knowledge acquisition phase. The study focused on planning for knowledge acquisition, knowledge extraction, knowledge analysis, and knowledge verification. Liou reported six major advantages and findings: 1) knowledge is documented electronically; 2) knowledge extraction from individual experts can be performed in parallel; 3) conflicts can be addressed during the knowledge extraction phase; 4) interaction among experts results in an enlarged and enriched domain of expertise; 5) structured analysis techniques such as task analysis can be used to plan for knowledge acquisition; 6) a designated primary expert can be of great help when dealing with multiple experts (p. 117). In a follow-up paper, Liou and Nunamaker concluded that a group approach to acquiring knowledge from multiple experts using GDSS proved useful (1993, p. 131).

Summary

The review of the relevant literature on expert systems and GDSS indicates that while there is widespread interest in expert systems, current approaches to development relying on a Knowledge Engineer have limited the role of the Domain Expert, handicapped the use of multiple experts in knowledge acquisition, and required a major investment of time, money and human resources. GDSS has been exhaustively studied in a variety of applications, and has been shown to reduce the time for knowledge acquisition and idea generation, facilitate conflict management and consensus seeking, and encourage synthesis of ideas and planning.

Knowledge engineering is itself a form of systems development, during which natural methods for observing intelligent behavior, such as problem solving, reasoning, judging, communicating, and perceiving, are first examined, then organized and prioritized into rules which serve as the basis for the resulting knowledge-based system (Mykytyn, et al, 1990, White & Goldsmith, 1990). It seems apparent that multiple Domain Experts, organized and guided by the GDSS, could use their own knowledge and experience to easily and productively accomplish the same goals. GDSS software has been developed and thoroughly studied, and many different tools exist to meet the strategic and human needs of multiple experts in developing useful expert systems.

Figure 2 presents a graphical representation of how GDSS can be used to develop a knowledge-based expert system.



Idea Processing System

Figure 2

CHAPTER THREE

RESEARCH FRAMEWORK

Introduction

This chapter presents the conceptual and research framework that forms the foundation for this study. It builds upon the research reviewed in the previous section, and extends the work of specific scholars in GDSS, group process, and expert systems.

Conceptual Framework

This research is based upon the work of Johnson and Johnson (1975) and McGrath (1984) on group processes and outcomes, and on DeSanctis and Gallupe's discussion of Adaptive Structuration Theory (1987) of group responses to structure. Together, these components yield an integrated and sequential model of how group composition, task, work organization and technology affect the elicitation and prioritizing of knowledge from multiple experts for building expert systems.

Group Processes

Johnson and Johnson (1975) early on addressed the tasks of groups and the specific roles of group members. They note that an effective group has three core activities - 1) accomplishing its goals; 2) maintaining itself internally; and, 3) developing and changing in a way that improves its effectiveness (p.3). Johnson and Johnson list several dimensions of group effectiveness that pertain to these core activities and that together make up a model that can be used to evaluate how well the group is functioning. These dimensions are as follows:

> 1. Group goals must be clearly understood, be relevant to the needs of group members, stimulate cooperation, and evoke from every member a high level of commitment to their accomplishment.
>
> 2. Group members must communicate their ideas and feelings accurately and clearly. Effective, two-way communication is the basis of all group functioning and the interaction of its members.
>
> 3. Participation and leadership must be distributed among members. All should participate, all should be listened to; as leadership needs arise, members should take turns meeting them. Any member should feel free to fulfill a leadership function as he or she sees the need. The equalization of participation and leadership is necessary to make certain that all members are involved in and satisfied with the group, and that all are committed to putting into practice the decisions made by the group. It also assures that the resources of every member are fully used, and it increases the togetherness or cohesiveness of the group.
>
> 4. Appropriate decision-making procedures must be used flexibly in order to match them with the needs of the situation. There must be a balance between the availability of time and resources (such as members' skills) and the method of decision making used. Another balance must be struck between the size and seriousness of the decision, the commitment needed to put it into practice, and the method used for making the decision. The most effective way of making a decision, of course, is by consensus (everyone agrees); consensus promotes distributed participation, the equalization of power, productive controversy, cohesion, involvement, and commitment.
>
> 5. Power and influence need to be equal throughout the group and be based on expertise, ability, and access to information, not on authority.
>
> 6. Conflicts among those with opposing opinions and ideas are to be encouraged; conflicts promote involvement in the group, quality and

creativity in decision making, and commitment to putting decisions into practice. Minority opinions should be accepted and used. Conflicts prompted by incompatible needs or goals, by the scarcity of a resource (power or money), and by competitiveness must be negotiated in a manner that is mutually satisfying and does not weaken cooperative interdependence among group members.

7. Group cohesion needs to be at a high level. Cohesion is related to interpersonal attraction among members, each members's desire to continue as part of the group, the members' satisfaction with and liking for their group membership, and the level of acceptance, support, and trust among the members.

8. Adequacy in problem solving needs to be high. Problems must be resolved with minimal energy and in a way that eliminates them permanently. Structures and procedures should exist for sensing the existence of problems, inventing and putting into practice possible solutions, and evaluating the effectiveness of the solutions. When problems are dealt with adequately, the problem-solving ability of the group is increased, innovation is encouraged, and the group effectiveness is improved.

9. The interpersonal effectiveness of members needs to be high. Interpersonal effectiveness relates to how well the consequences of your behavior matches your intentions. (Johnson and Johnson. pp. 3-4)

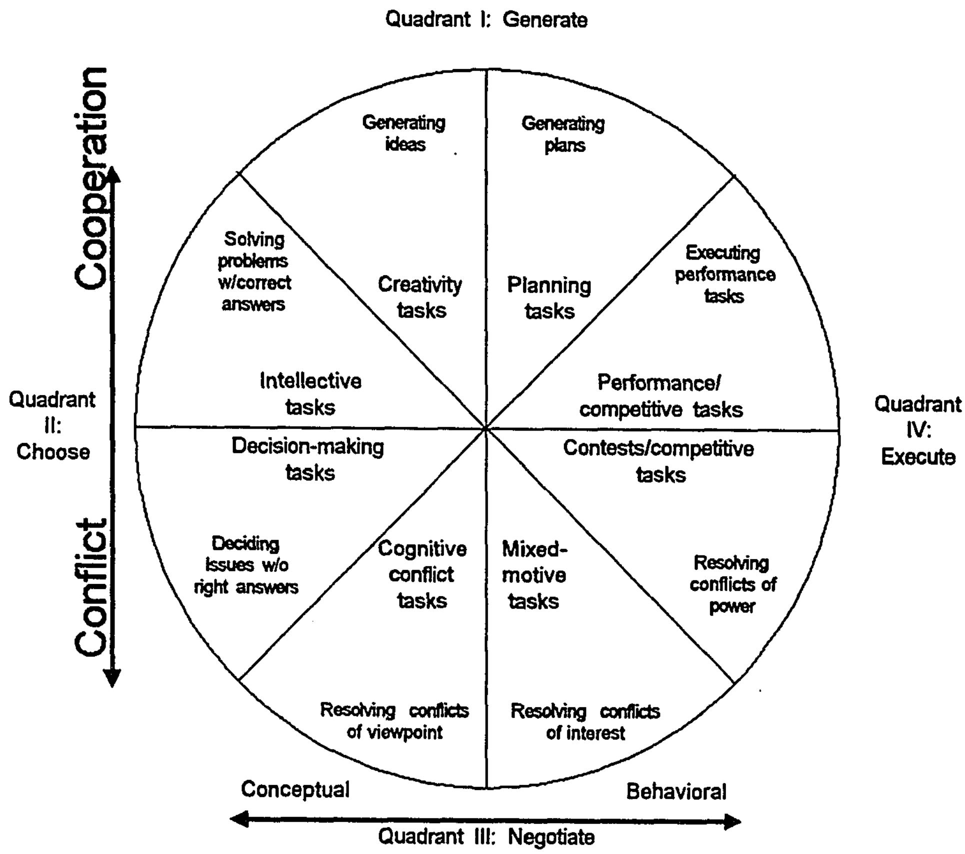
Johnson and Johnson's work is reflected in models developed for studying GDSS, as well as in group theory in general (for example, in the theory of Adaptive Structuration). Their emphases on task and maintenance functions, on clear communication, on shared leadership and full participation, on choosing appropriate tools to match the task, and on developing commitment to the task and group all contribute to the design of this study and to the factors being evaluated.

McGrath (1984) developed one of the earliest frameworks for the study of GDSS. McGrath's Circumplex matches group tasks to processes, illustrating and categorizing the variety of tasks that a GDSS can accomplish. An abbreviated model is presented in Figure 3. This model is useful because it illustrates that groups must use different kinds of skills and processes to successfully achieve different types of tasks. McGrath points out that GDSS groups must function conceptually as well as behaviorally, must choose as well as execute. Specific GDSS tools must be chosen with care and be matched appropriately to the nature of the process and tasks involved.

In this study, multiple experts engaged in knowledge acquisition and prioritizing were involved in several of McGrath's categories: generating ideas, solving problems, and resolving conflicts of viewpoint. The experts therefore must both generate and negotiate ideas, and must use tools for cooperation as well as resolving conflict.

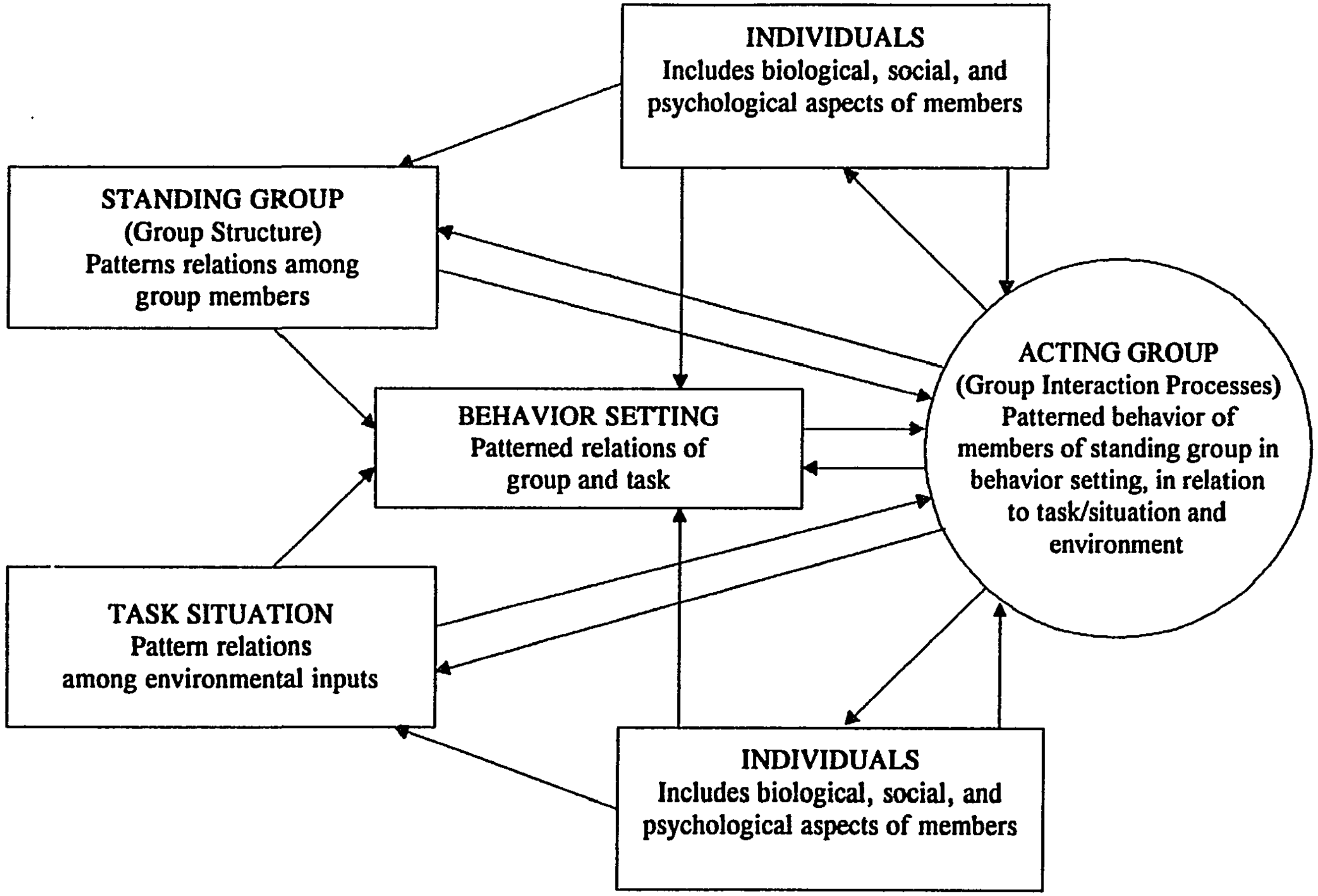
McGrath's 1984 model of group interaction (see Figure 4) points out that group processes are a product of group structure, the nature and needs of the individual members, the nature of the task and the technological environment, and the behavior setting. The group interaction processes are the patterned behavior of the members of the group in a specific behavior setting, in relation to the task, situation, and environment. Of interest in this study is which of these variables best support the development of ideas and structure for building expert systems, and which best support the continued interest and involvement of group members.

McGrath et al. (1989) also noted that groups perform three independent, but generally simultaneous functions. These include production, member support, and facilitation of group well-being. The production function leads to the achievement of task outcomes; member support and facilitation of group well-being are group maintenance functions. In this study, all three functions are considered outcome



Task Circumplex (Adapted from McGrath, 1984)

Figure 3



McGrath's Conceptual Framework
for the Study of Groups
Figure 4

variables. The task outcomes are the generation of ideas and knowledge and the subsequent categorizing and prioritizing of those ideas. Member support and group well-being are measured by commitment to the group and ownership of the product. Since expert systems grow through step-by-step prototyping, on-going ownership and commitment to the group is essential to continued participation in the process of prototyping.

The McGrath and Johnson and Johnson models share several important strands. Both take note of the importance of group functions addressing task, group maintenance, and the role of individual members. Both note that group members' satisfaction with the group directly affects their continued commitment to the group and its product. Both stress that groups must address and be skillful in handling tasks involving divergent thinking and creativity, conflict and negotiation, and cooperation. Both also recognize the influence of the characteristics of group members and the group itself on the group's ability to function, and on its unique method of functioning.

Group and Task Structuring

Adaptive Structuration Theory (AST) was developed by Poole et al. (1985) and applied in GDSS research in several succeeding studies (Poole & DeSanctis, 1987; 1989, Watson, 1987). AST focuses on the way in which groups appropriate and adapt structures to address evolving group needs. It is concerned with what structures are appropriated and reproduced from the group's context, and how the structures are adaptively applied. A key premise is that the type of structure and the manner in which it is presented can influence the degree to which the structure is adopted by the group, and therefore the degree to which the structure can provide intended benefits. The more comfortable a group is with the technology used, the more faithfully the Structuration will be appropriated. Structural adaptation suggests that a group modifies its relationships and functioning as it accommodates or adapts to the technology.

There is a difference between structure made available for potential appropriation by the group, and that actually appropriated for use. The key to successful appropriation is to select the best structural components for the needs of the group. According to DeSanctis et al. (1989) interaction structures have two key components: the content, which include specified rules and resources, and the implementation mechanism, or the means by which a structure is delivered. The mechanism can influence the extent to which content is faithfully appropriated by the group.

Structure and content can be classified along a continuum from very specific or comprehensive, to very open, or limited (DeSanctis et al., 1989). Limited structures provide only a context or orientation for group work. Highly comprehensive structures specify step-by-step procedures. Examples might be Robert's Rules of Order, or specific voting techniques. Mechanisms for implementing structure can also vary in the degree of control offered to the group. Poole (1990) identified five dimensions in which structured procedures may vary: scope, comprehensiveness, restrictiveness, group control, and member involvement.

Adaptive Structuration Theory speaks to the moderating effect of information technology. It suggests that the success of a group is less dependent upon the actual technology used than on the manner in which the technology is appropriated. Attitudes toward the technology, the spirit with which the technology is adopted and the structural features appropriated determine the group meeting outcomes. This also suggests that each group will be different, and that tools and approaches must be tailored to the needs of each particular group. Poole & Jackson, in Jessup & Valacich (1993), indicate that an effective group must maintain a balance between independent, private thinking, and structured, coordinated work. "In terms of GDSS design, this suggests that effective systems would be based on designs that (a) provide features to facilitate independent, private thinking, (b) provide features to focus members' attention and encourage convergent thinking, give members autonomous control over features to enable them to 'wander' by themselves through GDSS procedures as they think independently, (d) keep records of group ideas and actions so that members who miss ongoing group discussion can inform themselves of what transpired, and (e) incorporate procedural structures that alternate between independent and group-centered foci and that synchronize members' alternatives" (p. 287). These designs relate directly to the Johnson and Johnson model.

Adaptive Structuration complements both the Johnson & Johnson and the McGrath models. All suggest the need for appropriate support for members, careful choice of tools to fit the needs of the group, and room for the groups to make choices within the technology offered. Both Johnson and Johnson and Adaptive Structuration note that groups will change and adapt in a manner that best suits their needs. All three models speak to the need of adequate tools and skills for meeting problems of conflict and competition. Johnson and Johnson forecast the need for freedom for the group to select from a variety of tools the ones that best meet its needs at the time. All three models clearly state that the success of the group at tasks offered is a direct result of the interaction between group member characteristics, the success of the group at maintaining itself, and the tools and environment with which it works.

Summary

In this study, attention was paid to all of the above in designing a system that would encourage both divergent and convergent thinking, necessary to knowledge acquisition. Work groups were left intact while working both in a non-GDSS and a GDSS environment, and attention was paid to the interaction between the group and the different technologies offered. External structures made available to the multiple experts in this study came from a facilitator and from computer support to reduce process losses. In both structural content and implementation mechanisms, a relatively high degree of control was exercised. Specific tools were chosen to advance the tasks identified from Johnson and Johnson and McGrath's model, and the environment and approach to the task were directed by a facilitator. Consistency in the choice of tools, specific task, work environment and scope of activities was desirable due to the exploratory experimental nature of the study.

A fourth conceptual framework which was examined and was acknowledged to be of potential importance is Warfield's 1974 work on Interpretive Structural Modeling (ISM). A process used to help individuals or groups organize ideas by identifying and summarizing relationships between specific items, ISM can be used to structure ideas following the generation of sets of concepts. It is appropriate for GDSS use because it imposes order on a complexity of items through the use of computer support and/or group facilitation (Roth, 1990).

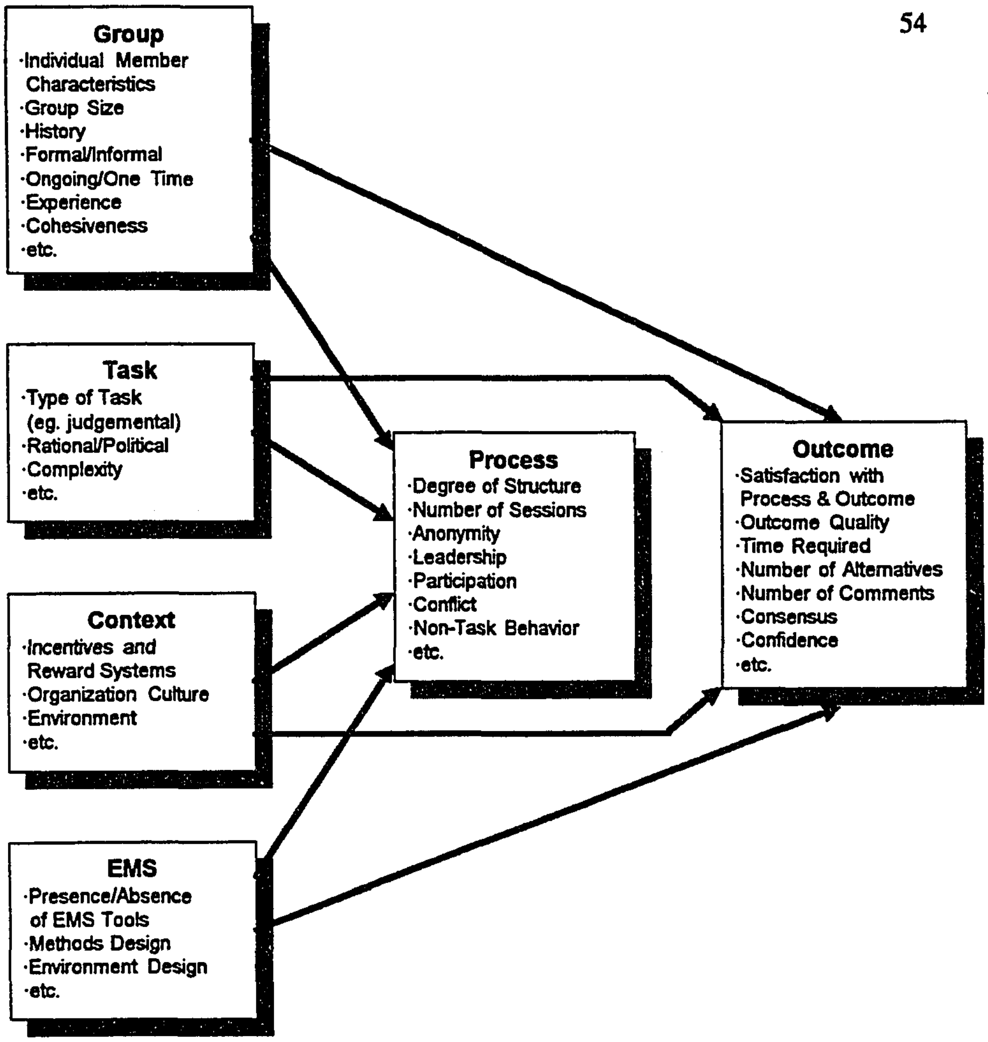
ISM permits the development of digraph-based models drawing upon a set of ideas and primary transitive contextual relationships. Such relationships are defined as comparative, definitive, influence, spatial, temporal, or mathematical. The method is interpretive, since the group decides whether and how items are related. It is structural, in that an overall structure is extracted from the relationships among the complex set of ideas. Finally, it is modeling in that the specific relationships are in a graphic form. All of these elements are of use in building an expert system (Roth, 1990).

An ISM session requires multiple experts, a group facilitator who is familiar with the process, and access to appropriate software. The session is structured and restricted, in that it follows a specific procedure for identifying phrases that express subordinate relationships between items or ideas. A series of paired comparisons between ideas are then made by the group. Relations are applied to pairs of ideas systematically, the group decides whether the relationship is true, and the results are stored in the computer. The computer then can produce a model of the group's thinking.

According to Roth (1990) ISM provides a way to structure the concepts, constraints, and heuristics of the experts' knowledge in an efficient way. It allows an expert group to manage a large set of domain concepts effectively. As a possible next component in an ultimate model for GDSS-built expert systems, ISM was perceived as a guide to efficiently prioritizing idea relationships.

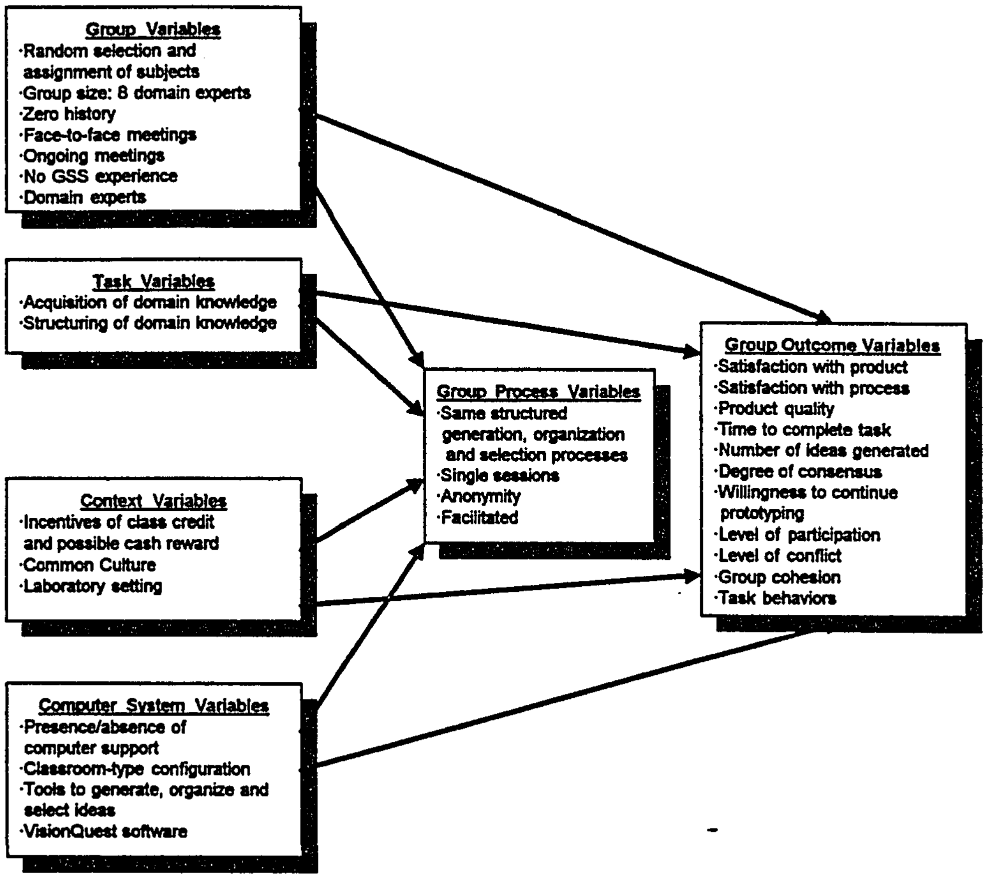
Research Framework

Data collection for this study was based upon a research model developed by Dennis et al. (1988) which integrates other models used for the study of group processes and outcomes, including McGrath (1984) and DeSanctis and Gallupe (1987). This model was chosen because it is comprehensive, because it is specifically intended for research in Group Decision Support Systems, and because it is consistent with the theoretical framework discussed above. This framework for GDSS research is also useful because it further illuminates relationships among classes of research dimensions, as well as defining the dimensions. The model identifies six classes of variables which should be considered in empirical studies of GDSS: group characteristics, task, context, environment, group process, and process outcomes (See Figure 5). The following discussion describes how the six classes of variables were operationalized for the purposes of this study. A model of the specific variables examined is presented in Figure 6.



GDSS Research Model (Adapted from Dennis, et al, 1988)

Figure 5



Research Framework For This Study

Figure 6

Group Variables

This set of variables is concerned with characteristics of the group - size, group proximity, and past experience with the problem, with characteristics of the individuals in the group, and with group cohesiveness and motivation, past group history, and future relationships. In this study, size, proximity, and experience with the problem and the tools were all controlled. Group or cluster sizes were approximately equal, all groups met together in similar settings, and all group members were equally familiar with the problem area. Group history was operationalized by answers to specific questions dealing with previous experience with other group members in the face to face groups. Group cohesiveness and motivation to continue working on the task were treated as outcome variables, and were assessed through the subject response questionnaires at the end of the study.

Task Variables

Variables defining the exact task faced by the group are those which deal with the rational dimensions, breadth and depth of the task, and the time required to complete the task. The exact task, defined as the development of organization of ideas for expert system pre-prototyping, was the same for treatment and control groups. Therefore, the complexity and rational nature of the task was the same for each group or cluster. Time taken to complete the task was measured as an outcome variable, assessed by the extent to which the agenda was completed.

Context Variables

These variables address the larger context in which the group meeting occurs. Variables include the organizational culture or experimental situation, the environment, and the individual incentive and awards systems. In this study, context variables were controlled as much as possible. All subjects were chosen from the same Old Dominion University student culture, and all were exposed to the same experimental situations in similar settings. All subjects were given the same incentive (points toward their final class grade). Other unanticipated context variables that arose during the course of the study impacted on all groups equally, and did not invalidate comparisons between groups. Such context variables were noted and discussed throughout the analysis section.

Computer System Variables

This set of variables concerns the presence or absence of computer support and the specific characteristics of the system used in the research. In this study, the primary independent variable was the presence or absence of computer support for knowledge acquisition and prioritizing. Both control and treatment groups were assigned a facilitator, and both proceeded using the same kinds of tools for divergent and convergent thinking - generating and categorizing ideas. The GDSS system chosen, VisionQuest, offers the same tools as those used in non-computer-aided knowledge acquisition. Among these are brainstorming, categorizing, consensus seeking, evaluating and assigning responsibility.

Group Process Variables

These variables are concerned with such aspects as the degree of structure, the number of sessions, anonymity, leadership, participation, conflict, and non-task behavior. In this study, several of these aspects were controlled. All domain group meetings were structured and led by a facilitator, and most were one-time meetings. Of interest was the level of participation, conflict, and off-task behavior noted between groups with and without GDSS support. Levels of participation and off-task behavior were operationalized by the participants' perceptions as assessed through the exit survey. This post-session questionnaire also measured the perceived climate and level of frustration of the participants as indicators of conflict.

Group Outcome Variables

This set of variables includes many measures of group outcome such as group satisfaction with the process and outcome, outcome quality, decision time as operationalized by the degree of completion of the agenda, number of alternatives considered, number of comments made by members, amount of consensus, and confidence in the outcome. In this study, data were collected on satisfaction with the process and product, decision time, number of ideas generated, degree of consensus, and commitment to the group and the process. Facilitators tracked and recorded the number of ideas considered, as well as participation from members. An exit questionnaire was used to measure satisfaction with the process and product, degree of consensus, and willingness to continue prototyping the expert system. Objective and uninvolved Domain Experts measured quality as the validity, verifiability and prioritization of categorized ideas.

Based on the theoretical research issues described earlier, a methodological research model was developed. The model incorporates other earlier attempts to structure the steps in knowledge acquisition, ties them to structured group process activities, and describes how these activities should be addressed in a GDSS environment. A thorough description of the methodological model is found in Chapter Four.

Summary

This section reviewed the conceptual and research bases for this study of the impact of GDSS on knowledge acquisition and prioritizing with multiple experts. A theoretical model involving group characteristics and processes, task and structure characteristics, and organization of knowledge was derived from the review of relevant literature, and an appropriate research model was adapted. Research variables were identified and operationalized. In the next section, a problem statement is developed and discussed, and the design of the study is described. Dependent variables are further identified and specific data collection techniques for each are listed.

CHAPTER FOUR

METHODOLOGY

Introduction

This chapter of the dissertation discusses the research model and design of the study, the factors to be investigated, the method of data collection, and the proposed methods of data analysis.

Design of the Study

The purpose of this exploratory study was to determine the impact of GDSS on knowledge acquisition and structure using multiple experts for knowledge-based systems. An exploratory approach was chosen because of the newness of the technology and the originality of the application. Little previous research data exists. "The purpose of exploratory data collection is to understand enough about what is happening in the program and what outcomes may be important to then identify key variables that can be operationalized quantitatively. Exploratory research relies on naturalistic inquiry, the collection of qualitative data, and inductive analysis because sufficient information is not available to permit the use of quantitative measures and experimental designs" (Patton, 1987, p. 37). The study was organized around a seminaturalistic, pseudo-experimental design to gather data about factors contributing to the main research issues: GDSS and knowledge acquisition and idea prioritizing for pre-prototyping expert systems; GDSS and feelings of ownership among the Domain Experts; and, GDSS and the quality of the product. A pseudo-experimental design was chosen for several reasons. First, Adaptive Structuration Theory suggests that the degree of control exercised in the selection of content and processes of group interaction is an important factor in group outcomes. Accordingly, both the tools used and the order in which they were used were treated as a control factor. In order to maintain such control, a laboratory setting was preferred. Second, in order to isolate the effect of treatment (GDSS software) in the development of a user-built expert system prototype, it was necessary to be aware of any intervening variables such as history, professional status, relationships, and work environment. A better degree of control was more likely to occur in a laboratory-type setting. Finally, this is a new approach to knowledge acquisition, and a new application of GDSS. According to Dennis, Nunamaker, & Vogel (1989), laboratory experimentation is preferable when a subject or application is new. The rigor only obtainable in a controlled laboratory study is required in such situations. Patton (1987) notes that qualitative data can be collected in an experimental design where participants have been randomly divided into treatment and control groups. An exploratory study such as this benefits from both the degree of rigor implicit in a semi-experimental environment and the richness and complexity received from qualitative data.

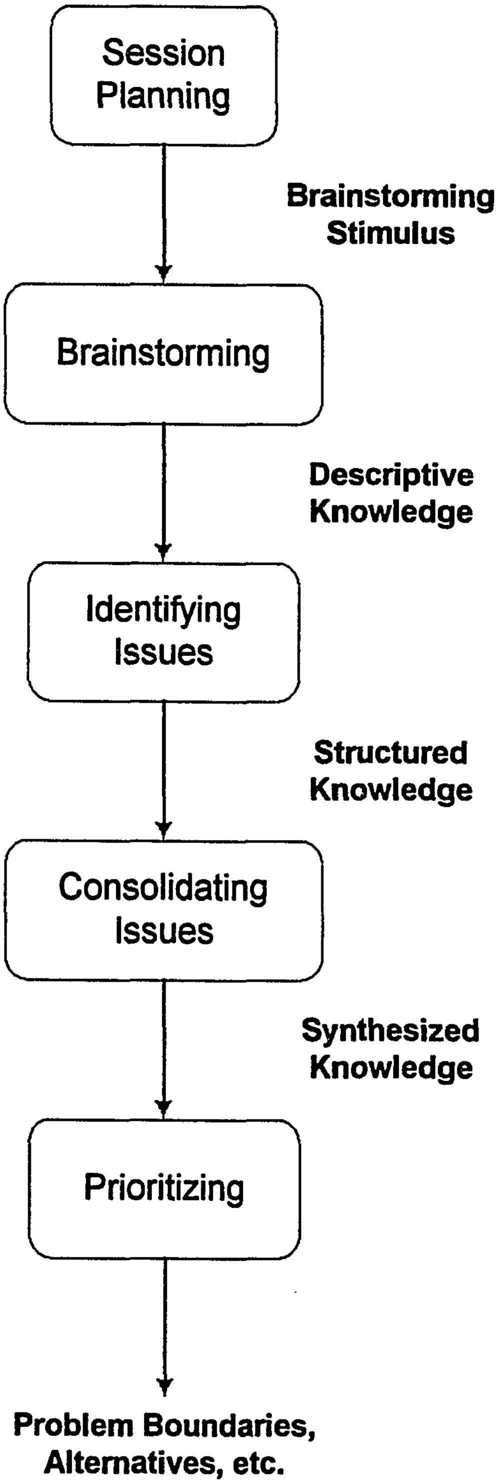
Certain findings in the literature have differed about the value of experimental studies. Dennis, George, Jessup, Nunamaker & Vogel (1988) noted that a review of six studies found a difference in experimental and field findings, and suggest that it is very important that researchers describe in detail the GDSS, task, procedures and measures used in their studies. They suggest that experimental studies need to provide larger, more realistic group sizes than the three or four members typically used, and that the task assigned be as complex as those found in "real life" (p. 603). According to Sambamurthy & Chin (1994), an experimental approach is deemed more appropriate to manipulate the delivery of communication in GDSS designs, to obtain an adequate sample size of groups of testing of outcome predictions, and for control over task characteristics and other factors extraneous to the research model. With this in mind, an experimental plan using student subjects working in groups of seven to nine members and addressing problems in which they had real and recent interest was devised.

A review of the literature was conducted in order to identify the factors found by previous researchers to be most significant in small group processes, in knowledge acquisition, in prototyping for expert systems, in the use of multiple experts in knowledge based systems, in Group Decision Support Systems (GDSS) in general, in GDSS for applications and tools, and in the role of GDSS in expert systems. The specific factors examined in this study were derived from those identified in the above research.

Research Plan

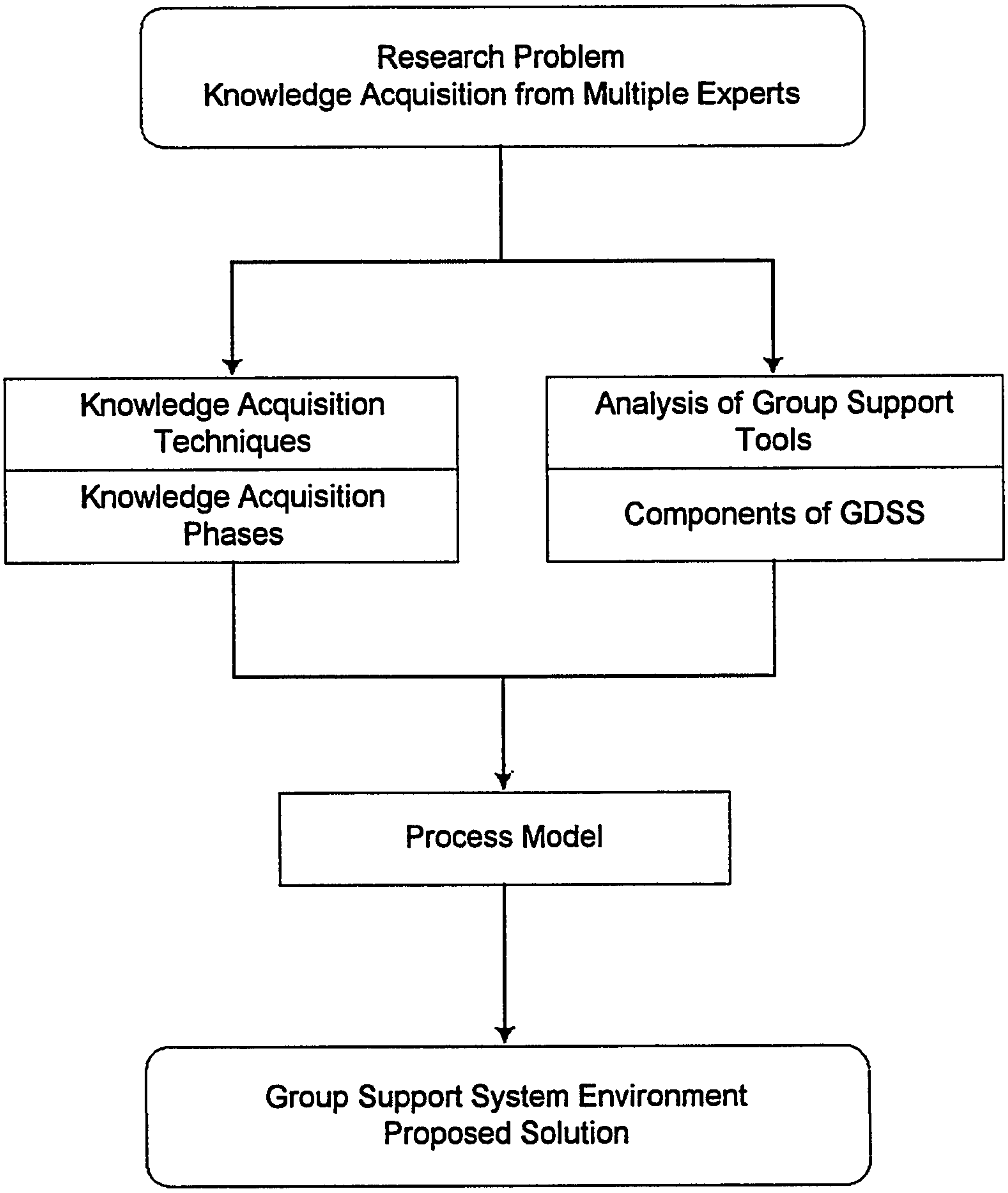
Building on all the research foundations investigated, an appropriate research model for this study was developed. Useful in constructing the research design for the study was the process model for studying GDSS developed by Liou (1989) at the University of Arizona (see Figure 7). This model was used to help generate ideas (divergent thinking), categorize and identify major relationships for problem solution, and select the most appropriate ideas for inclusion in the eventual expert system (convergent thinking). It was, however, incomplete. The research model developed for the current study incorporates information about existing knowledge acquisition techniques and specific phases in knowledge acquisition for expert systems with information about the elements in GDSS environments and the characteristics of group support tools. It was tied together with Liou's process model for use in knowledge acquisition in a GDSS environment. The new research model addresses the areas to be investigated in this specific study. The model actually used for this study is presented in Figure 7A.

The exploratory research model used investigated a broad spectrum of factors, utilizing a qualitative and descriptive approach. Data were collected about the human factors of group involvement, personal and professional satisfaction, and commitment to the group, task, and process. The effect of the technological and environmental context was considered, as well as the impact of repeated exposure to the GDSS. The usefulness of the process was evaluated by external Knowledge Engineers and Domain Experts. The wide range of the factors considered in the study was intended both to



Process Model

Figure 7



Research Framework

Figure 7A

provide substantiation of previous findings and to suggest factors of interest in this study worthy of further examination.

Several pairs of comparison experimental groups were involved. The first group in each pair met in a same-time same-place setting, working with a trained facilitator in face-to-face communication to build the basis for an expert system. This formed the control group. The second, or treatment group, met with another facilitator using Group Decision Support Software on networked computer stations to work toward an expert system on the same problem as the control group's. The independent variable was thus the use of GDSS. The facilitators guided both groups through the steps of knowledge acquisition and organization. Similar tools were used for each step. At a second session five days later, the groups switched roles, technology, and facilitators, and respond to another, similar task. This allowed the researcher to examine the relative impact of task problem and group composition versus the impact of technology, and provided a greater amount of subjective data from group members reacting to both settings.

Subject Population Context

Several criteria were considered in selecting the subjects for this study. First, availability was important. Subjects had to commit to a minimum of two fifty-minute meetings, with the possibility of more. Secondly, there had to be some interest in the process and problem - a degree of knowledge and a reason to care about the product. Third, a common history was desirable. Given these criteria, student subjects seemed to be most appropriate. Such students had a common interest and background, they knew each other through the classes they were taking, and there was a reasonable expectation that they would be available during the study period. Finally, problems could be chosen that would directly affect the students' true-life interests.

The members of all study groups were drawn from a pool of undergraduate students at Old Dominion University. Application for the use of human subjects was made to, and granted by, the Human Subjects Committee of the College of Engineering and Technology and the University Human Subjects' Institutional Review Board. In order to obtain participation, the researcher contacted several appropriate departments in the College of Engineering and Technology and the College of Business and Public Administration. Contacts were made through the Deans and Chairpersons, and in some cases directly with professors and instructors. Appropriate groups were identified through reviewing course descriptions and required textbooks from the above departments' classes to ascertain which most closely related to the topic and context of the study. The classes that were eventually accepted were those with course content including either Groupware or Expert Systems, and whose instructors were most interested and positive about the process and project. These classes all came from the Department of Management Information Systems/Decision Sciences. Participation was encouraged by the instructors, who offered credit toward class grades, but also offered alternative activities as needed to fulfill the same course credit. In some cases, subjects worked with groups different from their normal class section, but most class sections had total participation. Instructors' comments and the initial verbal comments from students reflected an interest in and appreciation of the study.

Student subjects were at approximately the same stage in their college career - juniors and seniors. All subjects were enrolled in the same undergraduate MIS/DS class, of which there were several sections, and most had a similar technological background. The classes had met long enough that students knew one another reasonably well. Most sections were large enough to be divided into two groups, each of which were further divided into two clusters. One half of the section worked with GDSS first; the other, in a face-to-face setting. Participants were assigned to cluster groups randomly; however, a demographic questionnaire administered to section members prior to the study was used to gather data on age, gender, and familiarity with computer technology.

Prior to the start of the study, the researcher met with all participants for a fifty minute class session, in which the student experts were provided with instruction on the nature of expert systems, steps in and guidelines for rule-building, and the appropriate technology to be used in their group processes (the script for this meeting can be found in Appendix A). This instruction controlled for variations in experience with the technology and provided a common base of familiarity with the terminology and tools used. At the same time, students were briefed on their role in the experiment, their rights to confidentiality were reviewed, and they were afforded the opportunity to withdraw without penalty from the study. At the close of the session, the participants signed a Human Subjects Release form, required by the University (See Appendix B).

Facilitators' Context

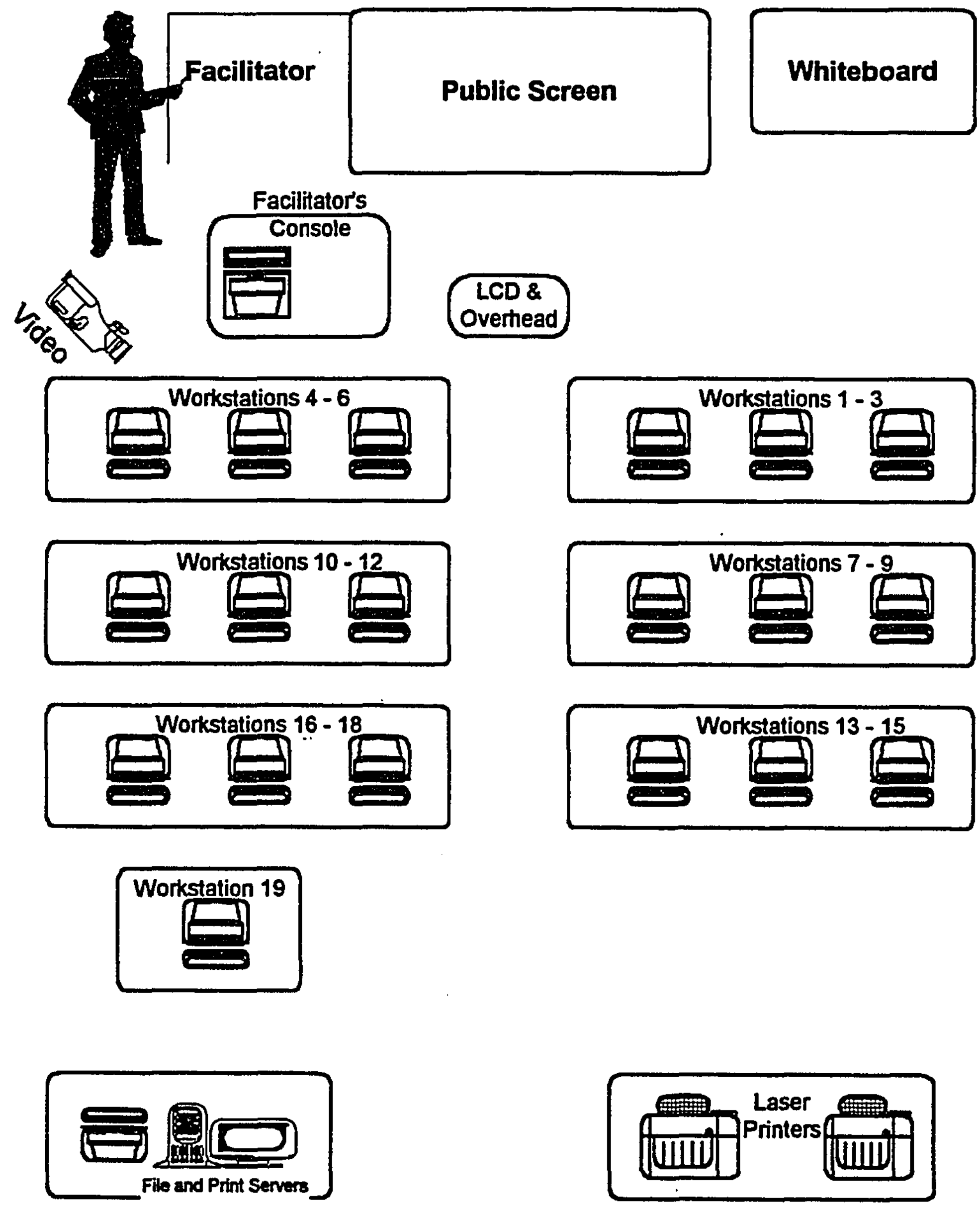
Three facilitators were used in this study, and specific criteria were also used in selecting them. First, the facilitators had to be experienced in working with problem-solving groups, in conflict resolution, and goal setting. Secondly, the facilitators had to command respect from the student subjects. Third, the facilitators needed a basic understanding of the purpose of the study, and the tools used to advance the process. The researcher himself acted as facilitator for all GDSS groups. Two other facilitators were chosen to work with the Face-to-Face groups. One facilitator was a college professor, used to working with small groups and with undergraduate and graduate students. His own dissertation had involved eliciting problems from individuals and small groups. The second facilitator was a public school administrator, possessing a doctorate in educational leadership, also trained in facilitation, with a resume including state-wide workshops in leadership, problem-solving, and strategic planning. All three facilitators were widely experienced in working with task-oriented work groups.

To control for any possible difference in the facilitators' approach or activities between the GDSS and Face-to-Face groups, the facilitators for each followed the same script for both groups (See Appendices C and D, E and F for the respective scripts). The script discussed the purpose and procedures to be followed, gave specific directions, and involved the same tools in the same order. The Face-to-Face groups met in the same room, at different times. Responses from both the Facilitators and the subjects indicated that there was a positive and effective relationship between the facilitators and their groups.

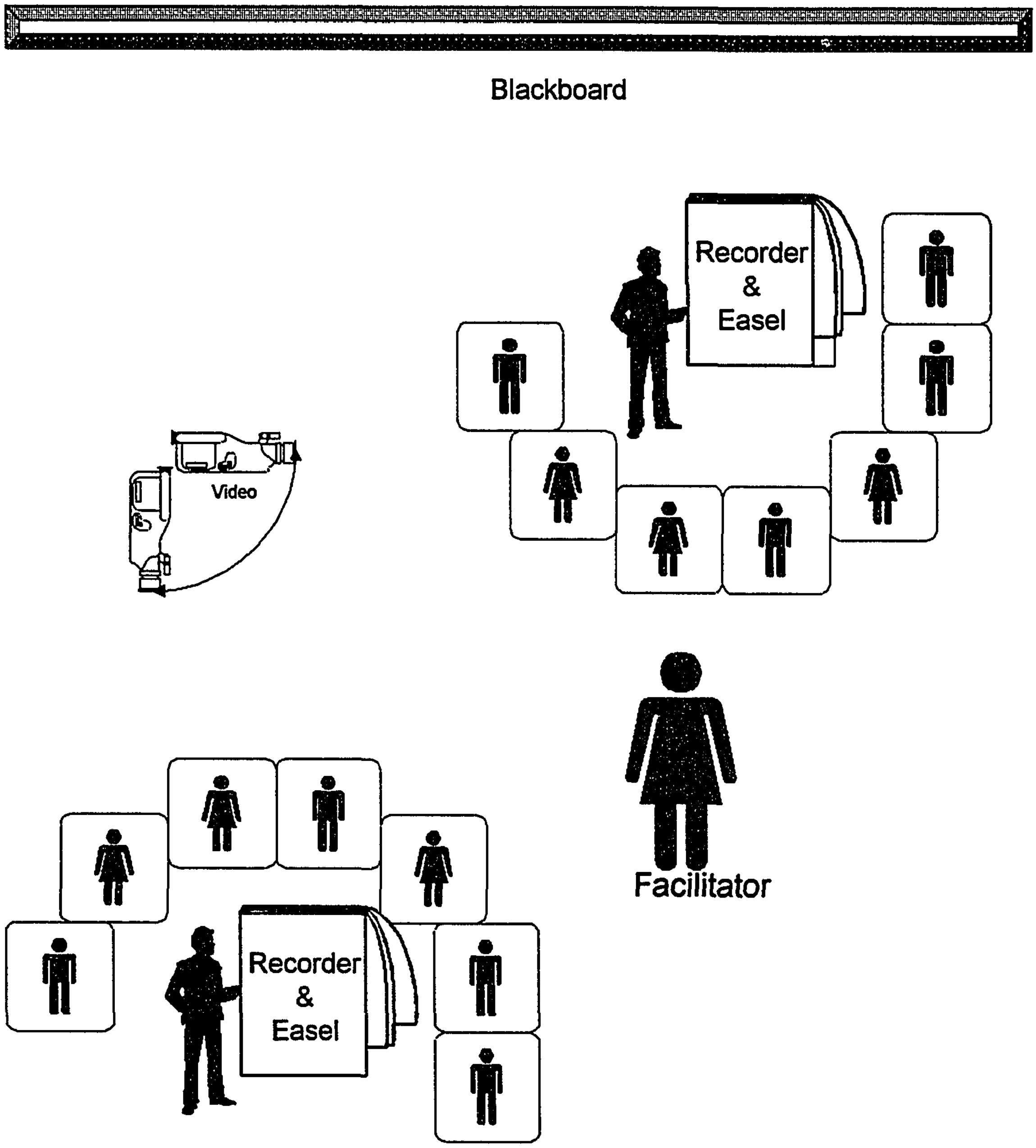
Physical Context

Both the control and treatment groups met in an appropriate setting on the Old Dominion University campus. The GDSS group met in a computer laboratory, outfitted with computer stations, tables, blackboard, podium, overhead projector, screen and direct view LCD projector (to project views from the computer screen). Student subjects sat at computer work stations arranged in rows, facing the front of the room. Each subject worked with his/her own work station, comprised of a keyboard and monitor. The facilitator was stationed at the front of the room, facing the subjects. He worked with the master work station, and the LCD projector flashed the display from his monitor on a large screen behind him. In addition, an overhead projector was used to display the problem statement throughout the sessions. A video camera was positioned at one side of the laboratory to film the activities. See Figure 8A for a sketch of the GDSS physical environment. Tools used included the facilitator's script, chalk and chalkboard, overhead transparencies, ruled paper for charts as necessary, and notepads and pens.

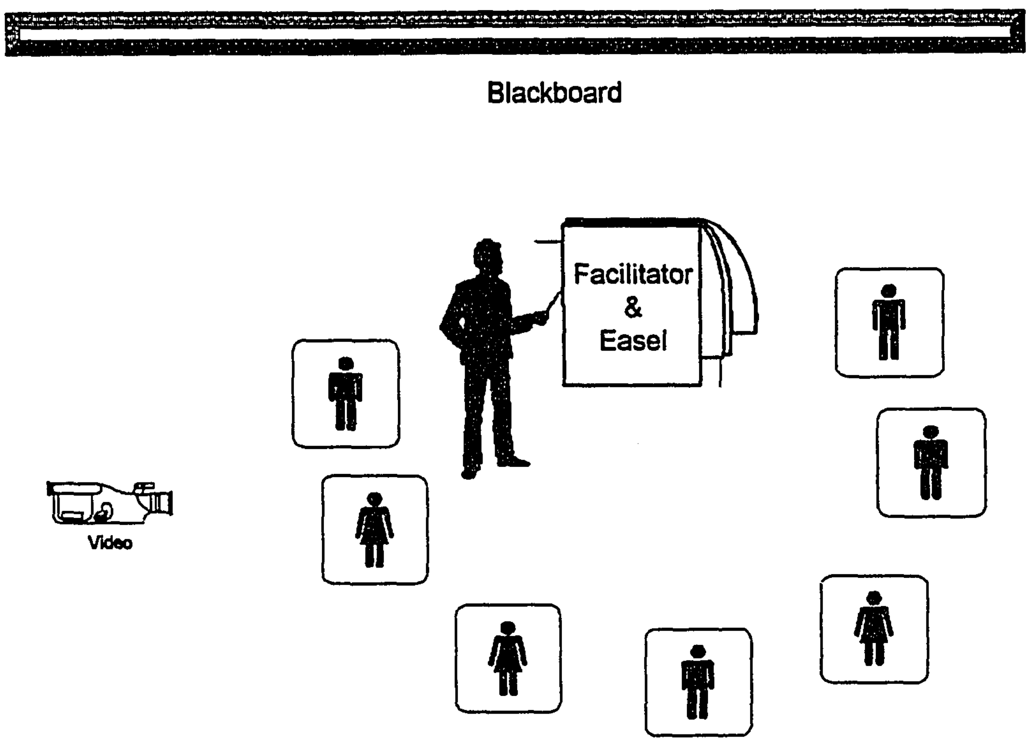
The Face-to-Face control groups met in their normal classroom building, in a classroom identical to the one in which they normally met. Their tools included paper, pads, chalk and blackboard, facilitator's script, markers, poster paper and easels. Subjects sat in chairs grouped in circles. One facilitator worked with two clusters at once, and arranged each group at opposite corners of the room (see Figure 8B). The other facilitator worked with only one cluster, and that group worked together in one corner (Figure 8C). In each case, the task and the agenda were posted. A video



Physical Setting
GDSS Multi-Cluster Sessions
Figure 8A



Physical Setting
Face-to-Face Two Cluster Sessions
Figure 8B



Physical Setting
Face-to-Face Single Cluster Session
Figure 8C

camera was positioned so as to catch the majority of the activity for both sessions. Each group met in single sessions, during which they addressed identical tasks at each meeting.

Structural Context

To allow a greater range of exploration, three approaches were used to collect data about GDSS. First, pairs of groups met in tightly controlled comparison groups, as described above. In these groups, the facilitators followed exactly the same procedures and scripts. Secondly, comparison groups met with a GDSS facilitator who followed the standard script and tools, and with a face-to-face facilitator who worked toward the same knowledge acquisition and idea organization goals, but who used a group-specific procedure, different from both the GDSS facilitator and the other face-to-face facilitator. This allowed the researcher to look at the role of the facilitator and the degree of imposed structure. Finally, one group of student experts met only in the GDSS setting, but met more than once and addressed more than one problem using GDSS technology. This provided information on how groups might adapt to the technology over time.

The highest degree of imposed structure came from the GDSS context. Here, the facilitator controlled the technology, the agenda, the physical environment, and the rate and flow of communication. The second highest degree of structure was imposed by the Face-to-Face facilitator working with only one group. Since he worked directly with the group, he controlled the agenda, the flow of discussion and communication, and the specific procedures. All discussion was directed to and through him. The least degree of structure was imposed by the Face-to-Face facilitator working with two groups at once. Although she introduced the activities and controlled the agenda and timing, the groups themselves decided on a leader, specific ways to respond to the task, and the rate and flow of discussion.

Technological Context

Several Group Decisions Support Systems were investigated for this study. After this investigation and discussion, research agreements were obtained from the producers of two major GDSS packages, Ventana's GroupSystems and Collaborative Technologies' VisionQuest. Based on funding, ease of use, and availability, the decision was made to use VisionQuest. Working with the University's Computer Center, the VisionQuest software was installed in an appropriate and available instructional computer laboratory. Multiple practice sessions were run, with and without group subjects, to be sure that the software and University hardware were working together, and that the agenda would work smoothly.

Knowledge acquisition and prioritizing involves the stages of idea generation, categorization, and prioritizing. The tools chosen for these group tasks were selected according to several criteria in the research framework. First, they must be useful to groups working both with and without GDSS support. Second, as a control variable, the same tools must be used for both groups. Third, they must be easy for the facilitator to explain and the group members to understand. Finally, they should be the best possible tools for the specific group task involved. Due to the size of the groups and the need to quickly eliminate repetitious ideas while transferring input from one tool to another, the GDSS facilitator elected to work with two GDSS groups at once. This was an innovation, and it was necessary to work closely with the VisionQuest developers to find the best methods for doing so.

Tools used in this study were chosen based upon an expert system for GDSS tool selection developed at the University of Arizona (Aiken, 1991). This system takes into account individual and group characteristics, time available for the group to work, type of task, degree of structure and control, kinds of interaction required, type of output desired, and degree of overlap in the knowledge domain required. Selection of the VisionQuest GDSS tools was made in accordance with the Aiken study. These tools corresponded with the group process tools for the non-GDSS group.

Tools selected for the idea generation stage for both groups were Brainwriting (GDSS) and brainstorming (non-GDSS). Each group was asked to brainstorm for three full minutes. The GDSS group entered their ideas on the computer, and their own ideas as well as the total group ideas appeared on each individual screen. In the Face-to-Face groups, a member recorded each idea on chart paper. Then, using either the GDSS record on the projector or their own screen (GDSS) or a Face-to-Face recorder's list, each group reviewed the ideas generated during the first phase. The groups were then asked to attack the problem again, and continue brainstorming for a second round of two minutes. Tools selected for the prioritizing and sequencing stage were Rating and Sub-Grouping (GDSS) and facilitated rating and choosing (non-GDSS). The

GDSS subjects were presented with the total list of ideas on their screen. They first rated each idea on a scale of one to five, according to previously selected criteria, such as acceptability, practicality, and effectiveness. The facilitator used the VisionQuest software to quickly total the scores arithmetically, and presented the group with the highest rated ideas from each criteria. From these, each group member selected the ideas he or she personally felt to be most valuable in solving the group's problem. They did so by highlighting them on their own screen. Again, these ideas were totaled electronically and the results briefly displayed to the cluster group on their own screens. The Face-to-Face groups also completed the same activities; however, they came to consensus on the rating activities, and voted independently for the ideas they most valued. Their votes were totaled after the conclusion of the meeting. Tools for the categorizing stage were Compactor (GDSS) and facilitated categorizing and assigning responsibility (non-GDSS). The GDSS groups were presented with a list of the groups' ideas on their individual screens, with duplicates eliminated, and the Face-to-Face groups used the written record on the easels in front of them. Each GDSS member categorized each idea independently on their screen, according to which of several previously identified groups was most responsible for implementation, or according to what attribute was most necessary to success. The Face-to-Face Groups did so together, as a group. Again, all tools had been used and evaluated during the pilot study.

As previously noted, all three facilitators followed the same basic scripts. Specific steps and directions are found in Appendices C and D, E and F.

Instrumentation

In order to gather data to answer each research question, both objective and subjective techniques were used. First, selected groups were video- and audio-taped to allow for later data collection and interpretation. Second, groups were observed by their facilitators, who completed a Facilitator's Questionnaire for each group (See Appendix G). Third, a panel of three independent Knowledge Engineers evaluated the usefulness of the ideas for building prototypical expert systems, and independent Domain Experts in each of the fields addressed by the task problems evaluated the quality of the ideas (See Appendices H and I, J and K for the respective directions and evaluation forms). Fourth, the participating sample members themselves completed entry and exit surveys designed to provide demographic information about their background and their subsequent feelings on the nature of their involvement with the product and the process under study (Appendices L and M for the surveys used for the GDSS and Face-to-Face groups). Finally, selected participants completed a follow-up questionnaire designed to check their perceptions several days after the end of the experiment (Appendix N). Such self-reporting has been advocated as a valid strategy for understanding users' behaviors with a new technology, such as GDSS (Sheppard, Heatwick & Warshaw, 1988).

Data Collection

Data were collected about specific dependent variables in order to answer the research questions. For ease of discussion, the variables and appropriate method of data collection were grouped under the research question to which they primarily pertain.

Question: What is the impact of GDSS on the group process activity of knowledge acquisition and prioritizing?

Variable 1: Number of ideas. The number of ideas generated by each group was recorded during the knowledge acquisition stage. Responses were normalized by dividing the number of ideas by the number of members of each group.

Variable 2: Time needed for each stage. This was a direct measure of the degree of completion for all groups in the knowledge acquisition and the knowledge organization stages.

Variable 3: Nature of interaction of group members. Participants themselves rated this factor, and the facilitators addressed this in their comment sheets.

Question: What is the impact of GDSS on the feeling of ownership of the Domain Experts self-developing the systems?

Variable 4: Personal satisfaction. Group members were asked to rank their own feelings of comfort and satisfaction with the process through an exit survey. Questions were formulated through a Likert-type satisfaction scale.

Variable 5: Professional satisfaction. Group members were also asked to respond to questions about their role as a Domain Expert.

Questions addressed their feelings about the appropriateness of the process, their assessment of the value of the approach, and their willingness to repeat the experience.

Variable 6: Satisfaction with the product. Members were also asked to rate their group's product. They were asked to indicate how closely the product reflected their own thinking, and how much ownership they felt in the product.

Question: What is the impact of GDSS on the quality of the product of the expert system?

Variable 7: Verifiability of the product derived. An independent panel of three professional Knowledge Engineers were asked to evaluate the usefulness of the ideas and categories for building an expert system from each group, using a similar Likert-type scale.

Variable 8: Validity of the product derived. Independent Domain Experts evaluated the correctness of the ideas and priorities from each group. The panel used a Likert-type scale to rate products against specific verification criteria.

Variable 9: Breadth and Depth. The sophistication of the product was evaluated by the individual Domain Experts against their professional background and experience.

Variable 10: Thoroughness of ideas. The creativity and divergent thinking of the ideas of each group was also assessed by the Domain Experts who evaluated their final recommendations. The video and audio tapes were used for analysis and verification of remarks.

Piloting of the Study

Prior to the initiation of the actual study, several pilot studies were conducted. Small groups, including a Domain Expert, group facilitator, and subject "expert" met several times with the researcher to critique the script, tools, and procedures for clarity and practicality. As a result of these meetings, the order of the agenda was changed, modifications were made to the method of using the software, and new tools were added. A major pilot, also involving students enrolled at Old Dominion University, also was conducted. The participating subjects were unaware that their session was a pilot, and responded very seriously to the tasks. The domain chosen was one in which all participants were already experienced and interested, and which was capable of a varying degree of sophistication. After the pilot session was completed, all participants were asked to use all forms and surveys, and the facilitators evaluated the success of the procedure. The pilot highlighted the difficulty of transferring data from one GDSS tool to another, and illuminated problems with the network operating system and the University Computer Center's support of the VisionQuest GDSS package. As a result, minor modifications in the process and procedure were made prior to the commencement of the actual study, the script was modified to give the facilitator time to transfer data, and further arrangements were made with the University Computer Center to ensure that the system would not degrade and fail. The subsequent study occurred almost immediately, using the modified scripts, agendas, and software system safeguards.

Analysis of the Data

For convenience of analysis and discussion, the outcome variables under study have been grouped into four categories. For each, a definition is given, variables are listed, and modes of analysis are indicated. The categories include:

Group Efficiency Factors. These variables relate to the objective measures which define the expense and time savings of GDSS and expert systems, and relate to research question number 1, What is the impact of GDSS on the group process activity of knowledge acquisition and prioritizing? The measures include number of crucial ideas, time needed for knowledge acquisition, and whether the agenda was completed. Data on these variables were gathered through objective measures of completion and number. Data were normalized by number of ideas per cluster member, and was analyzed using descriptive procedures.

Group Process Factors. These factors also relate to research question number 1, and measure how groups organize and interact with one another to solve work problems. These include the nature of the members' interaction, the amount of time off- and on-task, the interaction strategy of each group, and the degree of cooperation achieved by the separate groups. Data were gathered through evaluative surveys completed by the group participants and by facilitator observations and viewing of selected video tapes of the group process. The most appropriate forms of qualitative analysis and discussion were selected for these factors.

Attitudinal Factors. These factors deal with the subjective experience of the participants in both groups. They relate directly to research question number 2, What is the impact of GDSS on the feeling of ownership of the Domain Experts self-developing the systems? Variables analyzed dealt with personal satisfaction, professional satisfaction, satisfaction with the product, and commitment to the continuing process. Data on these variables were gathered through exit surveys, written questionnaires, and narrative comments. Appropriate qualitative and descriptive analysis techniques were used.

Product Quality Factors. These variables were used to measure the empirical and subjective quality of the product each group developed. The factors analyzed included diversity of ideas, verifiability of the derived recommendations, validity of the derived recommendations, and breadth and depth. All of these relate to the research question number 3, What is the impact of GDSS on the quality of the product of the expert system? Independent experts were used, and the evaluation was both qualitative and descriptive.

Anticipated Outcomes

Based upon previous research outcomes and the theories upon which this study rests, the following outcomes were anticipated for each of the variables under study:

Variable 1: Number of ideas. It was anticipated that the GDSS groups would generate more ideas than the non-GDSS groups during the idea generation phase.

Variable 2: Time needed for each stage. Based upon the findings of previous studies, it was anticipated that the GDSS group would take less time than the non-GDSS group in all stages.

Variable 3: Nature of interactions of group members. It was anticipated that the nature of the interactions of the GDSS group would be more focused and on-task than those of the non-GDSS group.

Variable 4: Personal satisfaction. Based upon a more restricted level of human interaction, it was anticipated that there would be less personal satisfaction expressed by the GDSS group members than by those in the non-GDSS group.

Variable 5: Professional satisfaction. It was anticipated that the GDSS group would be more willing to repeat the experience than would the group working without GDSS.

Variable 6: Satisfaction with the product. It was anticipated that the GDSS group would feel more strongly that the final product reflects their thinking, and that there would be a greater feeling of ownership of the results than with the non-GDSS group.

Variable 7: Verifiability of the product derived. It was anticipated that there would be no difference between the two groups on this factor.

Variable 8: Validity of the product derived. It was anticipated that the GDSS group may generate less relevant ideas than those of the non-GDSS group, as the anonymity inherent in the GDSS lab may lead to some creative thinking that was not directly useful for an expert system.

Variable 9: Breadth and Depth. It was anticipated that these factors would be greater in the GDSS group than in the non-GDSS group.

Variable 10: Thoroughness of ideas. It was anticipated that the GDSS groups would generate a greater originality and thoroughness of ideas than the non-GDSS group.

Discussions and Conclusions

The purpose of this study was to investigate and verify the impact of using GDSS in the development of expert systems involving multiple experts. The factors examined were those identified in previous studies as being important in group process, GDSS, or expert systems. In this study, they were applied in a new way. Analysis and discussion revolved around the success of GDSS in facilitating expert system development, as measured by the identified outcome variables. Attention was paid to the Adaptive Structuration shown by groups, and discussion focused not only on what factors affect expert system development, but also how the group adapts and uses the technology. Since this was an exploratory study, the discussion was limited to the findings about the specific groups studied, and no attempt was made to apply inferential statistical analyses to other groups or settings. Comparison was limited to the matched group pairs, and their performance in the two technological environments studied. A major source of data came from the subjective reactions of the participants themselves.

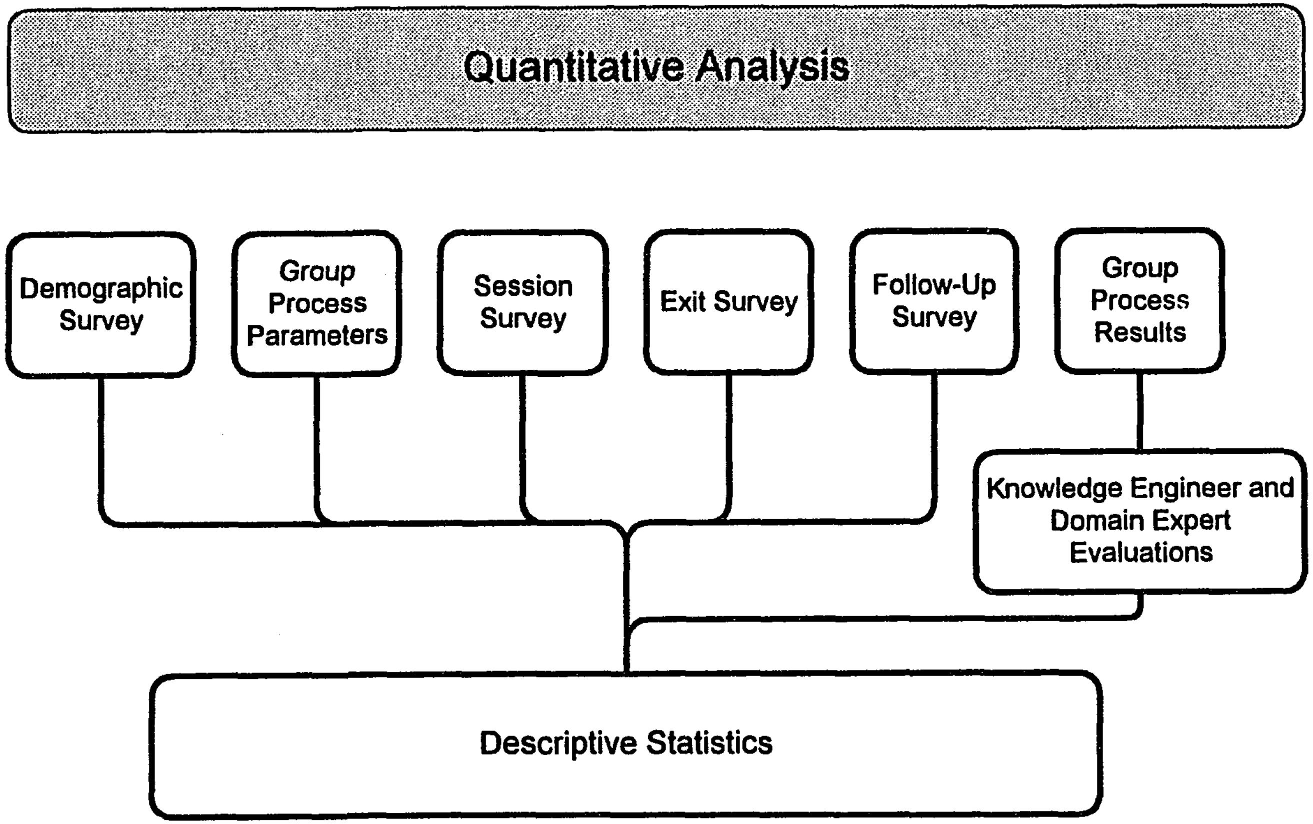
While the specific predictions of this study may not be tested because of the small sample size, it was anticipated that the results of this study will help suggest, identify and describe factors contributing to the success of a positive new approach to preserving and applying knowledge by using two state-of-the-art technologies. Suggestions for further, more rigorous studies using inferential statistics were based on the findings of this study, and will form a substantial contribution to the body of knowledge about GDSS and expert systems.

Summary

In this chapter, the exploratory research model and design of the study were explained, the factors investigated were identified and anticipated outcomes given, the conduct of the study delineated, the steps in data collection outlined, and the value of the study for future research proposed. In this exploratory study, the goal was to approach the problem from as many different points of view as possible, in order to provide the most information for evaluation and further research. Therefore, two approaches to analysis were also employed. The quantitative analysis focused on the demographic data, the group process parameters (completion factors), subject responses as gathered through session surveys, exit surveys, follow-up surveys, and group process results. These group process results were then evaluated by both Knowledge

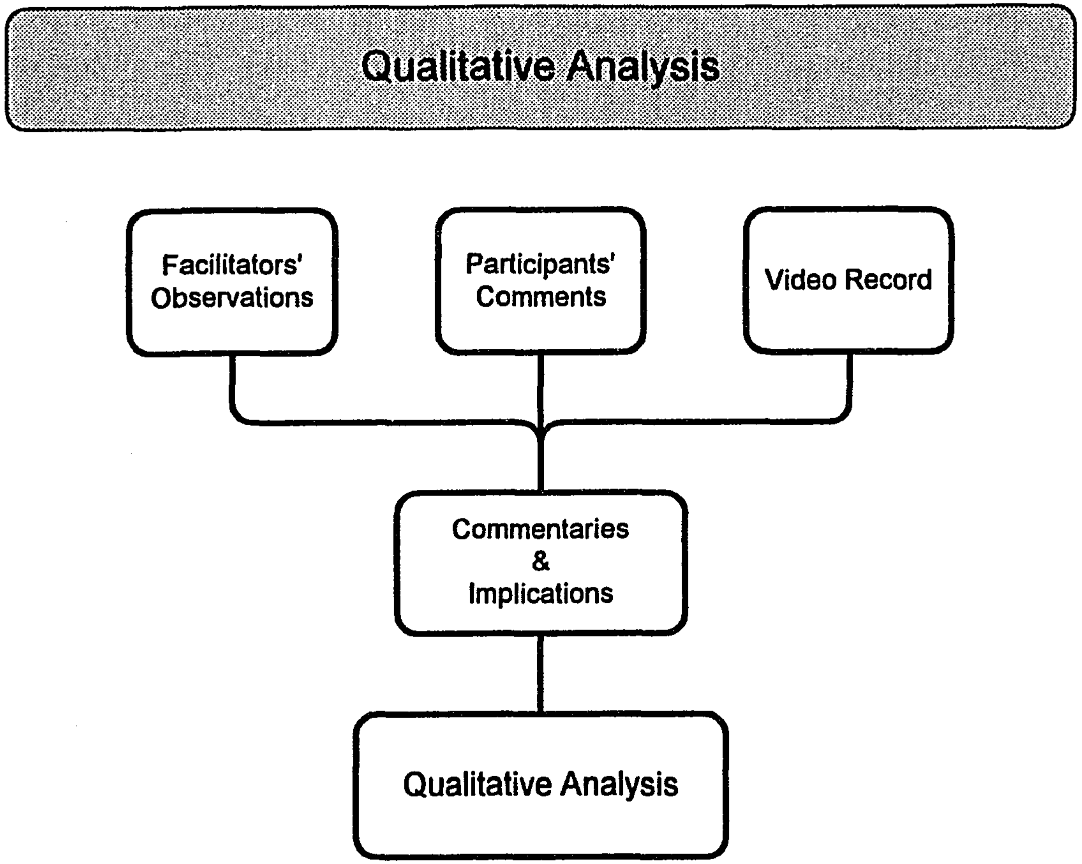
Engineers and Domain Experts, and their responses, as well as all of the above data, were reported in terms of descriptive statistics (see Figure 9 for a graphical model of the quantitative analysis flow). A qualitative approach was used for the subjective data gathered from the facilitator's observations, the comments of the subjects, Domain Experts and Knowledge Engineers, and the results of the video-taped records of the group meetings. The model for the qualitative analysis is shown in Figure 10.

In the following chapter, the data is reported and analyzed, and the actual outcomes related to those previously anticipated.



Elements of Quantitative Analysis

Figure 9



Elements of Qualitative Analysis

Figure 10

CHAPTER FIVE

RESULTS

Introduction

The purpose of this chapter is to report and analyze the results of the several aspects of data collection used in the study. The first part of the chapter deals with quantitative analysis, in reporting and summarizing the descriptive statistics gathered from the various sources. The demographics of the study population are described, results from the two approaches to creating expert systems reported and compared, responses to the several subject surveys reported, and the evaluations of the Knowledge Engineers and Domain Experts summarized. The group process parameters affecting the group results are discussed. The second part of the chapter deals with the qualitative analysis of the subjective data gathered from participant comments, and from the comments of Domain Experts, Knowledge Engineers, facilitators' comments, and the video records. The facilitators' responses and the result of the analysis of the video records are described, and comments from students, Domain Experts, and Knowledge Engineers are summarized. Analysis is organized around the individual study factors and the research questions they answer. Since this was an exploratory study, multiple approaches to gathering and analyzing data were used. The study is highly descriptive, and involves many approaches to organizing the data; therefore, many different figures will be offered and discussed in this analysis. To make the material easily accessible, the figures are placed in the body of the text, rather than in the appendices.

Quantitative Data Analysis

Demographics of the Subject Population

The experimental population consisted of 58 students, organized into eight different groups, or clusters. For convenience, each cluster was given a number and a letter to identify it. From an original population of 12 clusters and a total of 91 individuals, four clusters of 33 students were selected for the pilot study. Those pilot results were used to modify and improve the experiment, and therefore are not reported here. The remaining clusters were those participating in comparison groups (GDSS vs. Face-to-face), or in extended and repeated GDSS sessions. The subsequent N, or sample size, may vary from analysis to analysis, depending on the groups involved.

Number and Gender

Clusters 2A and 2B, 4A and 4B, 5, and 6 participated in both GDSS and Face-to-face sessions. Cluster a contained three males and six females; Cluster 2B had five males and one female. Cluster 4A contained five males and three females; Cluster 4B had seven males and two females. Cluster 5 was formed of four males and three females, and Cluster 6 had four males and three females. Clusters 7 and 9 worked with GDSS only, but worked in two different problems in two different meetings. Cluster 7 contained two males and three females; Cluster 9 had four males and three females. Altogether, the study population was comprised of 34 males, totaling 58.62% of the population, and 24 females, or 41.38%. See Figure 11 for a total summary of the number and gender of the experimental population.

Age

Respondents were asked to give their age within a span of a few years. No respondents were younger than eighteen years old. Twenty-two individuals, or 37.93% were from 18 to 21 years old, 23 students, or 39.66% were from 22 to 25 years old, eight people, or 13.79% were between 26 and 29 years of age, and five students, or 8.62% were thirty years or older. See Figure 12 for the breakdown per cluster.

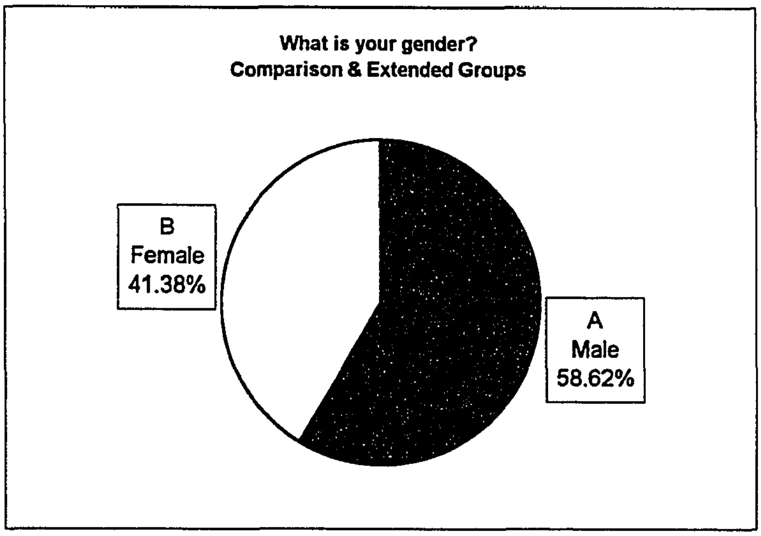
Professional Working Status

Respondents were asked to give their current job status, and to describe how it related to their studies. Overall, only 10.34% of the subject population described themselves as part-time students (See Figure 13A). Another 29.31% were not working at all. Some 36.21% were working at part-time jobs not related to their major fields, and 13.79% were working at part-time jobs described as related to their majors. Students working full-time at jobs unrelated to their studies comprised 8.62%, and

Demographics
What is your gender?
A, Male
B, Female
GDSS and Gender - Counts and Percentages for Each Cluster, Each Group and Total Participants

			1)GENDER		
Group	Cluster	Data	A	B	Grand Total
2	A	Count of GENDER	3	6	9
		Percent GENDER	33.33%	66.67%	100.00%
	B	Count of GENDER	5	1	6
		Percent GENDER	83.33%	16.67%	100.00%
2 Count of GENDER			8	7	15
2 Percent GENDER			53.33%	46.67%	100.00%
4	A	Count of GENDER	5	3	8
		Percent GENDER	62.50%	37.50%	100.00%
	B	Count of GENDER	7	2	9
		Percent GENDER	77.78%	22.22%	100.00%
4 Count of GENDER			12	5	17
4 Percent GENDER			70.59%	29.41%	100.00%
5	A	Count of GENDER	4	3	7
		Percent GENDER	57.14%	42.86%	100.00%
5 Count of GENDER			4	3	7
5 Percent GENDER			57.14%	42.86%	100.00%
6	A	Count of GENDER	4	3	7
		Percent GENDER	57.14%	42.86%	100.00%
6 Count of GENDER			4	3	7
6 Percent GENDER			57.14%	42.86%	100.00%
7	A	Count of GENDER	2	3	5
		Percent GENDER	40.00%	60.00%	100.00%
7 Count of GENDER			2	3	5
7 Percent GENDER			40.00%	60.00%	100.00%
9	A	Count of GENDER	4	3	7
		Percent GENDER	57.14%	42.86%	100.00%
9 Count of GENDER			4	3	7
9 Percent GENDER			57.14%	42.86%	100.00%
Total Count of GENDER			34	24	58
Total Percent GENDER			58.62%	41.38%	100.00%

Male	Female
A	B
58.62%	41.38%

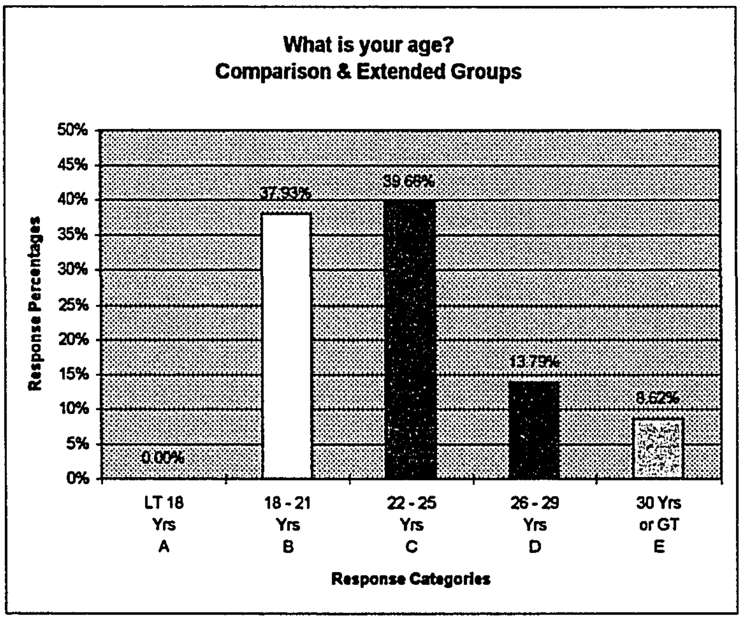


Number and Gender of Participants
Figure 11

Demographics
What is your age?
A, Less Than 18 Years
B, 18 - 21 Years
C, 22-25 Years
D, 26 - 29 Years
E, 30 Years or More
GDSS and Age - Counts and Percentages for Each Cluster, Each Group and Total Participants

			2)AGE				
Group	Cluster	Data	B	C	D	E	Grand Total
2	A	Count of AGE	5	2	2	0	9
		Percent AGE	55.56%	22.22%	22.22%	0.00%	100.00%
	B	Count of AGE	1	4	0	1	6
		Percent AGE	16.67%	66.67%	0.00%	16.67%	100.00%
2 Count of AGE			6	6	2	1	15
2 Percent AGE			40.00%	40.00%	13.33%	6.67%	100.00%
4	A	Count of AGE	3	1	1	3	8
		Percent AGE	37.50%	12.50%	12.50%	37.50%	100.00%
	B	Count of AGE	3	5	1	0	9
		Percent AGE	33.33%	55.56%	11.11%	0.00%	100.00%
4 Count of AGE			6	6	2	3	17
4 Percent AGE			35.29%	35.29%	11.76%	17.65%	100.00%
5	A	Count of AGE	3	2	2	0	7
		Percent AGE	42.86%	28.57%	28.57%	0.00%	100.00%
5 Count of AGE			3	2	2	0	7
5 Percent AGE			42.86%	28.57%	28.57%	0.00%	100.00%
6	A	Count of AGE	3	3	1	0	7
		Percent AGE	42.86%	42.86%	14.29%	0.00%	100.00%
6 Count of AGE			3	3	1	0	7
6 Percent AGE			42.86%	42.86%	14.29%	0.00%	100.00%
7	A	Count of AGE	3	2	0	0	5
		Percent AGE	60.00%	40.00%	0.00%	0.00%	100.00%
7 Count of AGE			3	2	0	0	5
7 Percent AGE			60.00%	40.00%	0.00%	0.00%	100.00%
9	A	Count of AGE	1	4	1	1	7
		Percent AGE	14.29%	57.14%	14.29%	14.29%	100.00%
9 Count of AGE			1	4	1	1	7
9 Percent AGE			14.29%	57.14%	14.29%	14.29%	100.00%
Total Count of AGE			22	23	8	5	58
Total Percent AGE			37.93%	39.66%	13.79%	8.62%	100.00%

A	B	C	D	E
LT 18 Yrs	18 - 21 Yrs	22 - 25 Yrs	26 - 29 Yrs	30 Yrs or GT
0.00%	37.93%	39.66%	13.79%	8.62%



Age and Categories of Participants
Figure 12

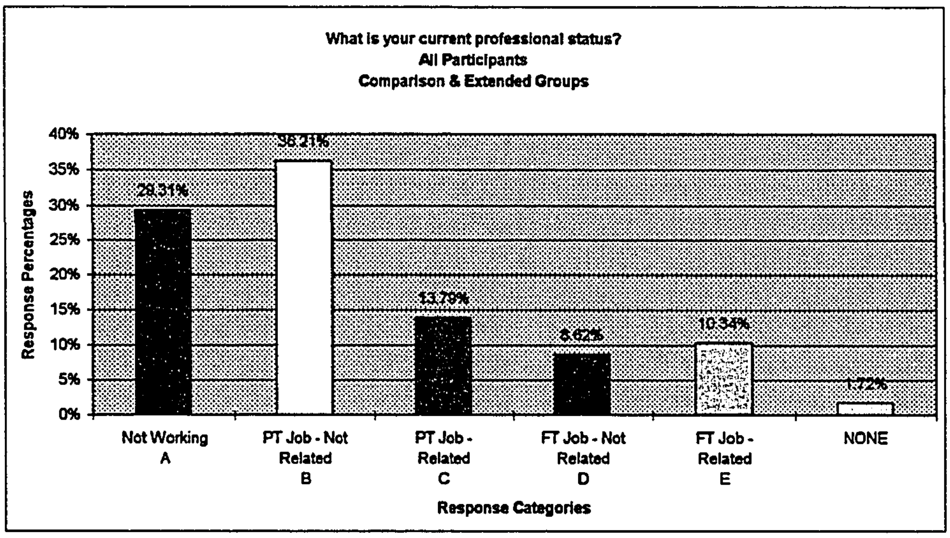
Demographics
What is your current professional status?
A, Full-Time Student
B, Part-Time Student

A, Not Working
B, Part-Time Job Not Related to Studies
C, Part-Time Job Related to Studies
D, Full-Time Job Not Related to Studies
E, Full-Time Job Related to Studies
GDSS and Work Status - Counts and Percentages for Each Cluster, Each Group and Total Participants

3)WKSTATUS1	(All)

Group	Cluster	Data	3WKSTATUS2 A	B	C	D	E	NONE	Grand Total
2	A	Count WKSTATUS	3	4	0	2	0	0	9
		Percent WKSTATUS	33.33%	44.44%	0.00%	22.22%	0.00%	0.00%	100.00%
	B	Count WKSTATUS	0	1	3	1	1	0	6
		Percent WKSTATUS	0.00%	16.67%	50.00%	16.67%	16.67%	0.00%	100.00%
2 Count WKSTATUS			3	5	3	3	1	0	15
2 Percent WKSTATUS			20.00%	33.33%	20.00%	20.00%	6.67%	0.00%	100.00%
4	A	Count WKSTATUS	2	3	1	0	2	0	8
		Percent WKSTATUS	25.00%	37.50%	12.50%	0.00%	25.00%	0.00%	100.00%
	B	Count WKSTATUS	2	3	2	1	0	1	9
		Percent WKSTATUS	22.22%	33.33%	22.22%	11.11%	0.00%	11.11%	100.00%
4 Count WKSTATUS			4	6	3	1	2	1	17
4 Percent WKSTATUS			23.53%	35.29%	17.65%	5.88%	11.76%	5.88%	100.00%
5	A	Count WKSTATUS	3	3	0	0	1	0	7
		Percent WKSTATUS	42.86%	42.86%	0.00%	0.00%	14.29%	0.00%	100.00%
5 Count WKSTATUS			3	3	0	0	1	0	7
5 Percent WKSTATUS			42.86%	42.86%	0.00%	0.00%	14.29%	0.00%	100.00%
6	A	Count WKSTATUS	2	3	1	1	0	0	7
		Percent WKSTATUS	28.57%	42.86%	14.29%	14.29%	0.00%	0.00%	100.00%
6 Count WKSTATUS			2	3	1	1	0	0	7
6 Percent WKSTATUS			28.57%	42.86%	14.29%	14.29%	0.00%	0.00%	100.00%
7	A	Count WKSTATUS	1	3	0	0	1	0	5
		Percent WKSTATUS	20.00%	60.00%	0.00%	0.00%	20.00%	0.00%	100.00%
7 Count WKSTATUS			1	3	0	0	1	0	5
7 Percent WKSTATUS			20.00%	60.00%	0.00%	0.00%	20.00%	0.00%	100.00%
9	A	Count WKSTATUS	4	1	1	0	1	0	7
		Percent WKSTATUS	57.14%	14.29%	14.29%	0.00%	14.29%	0.00%	100.00%
9 Count WKSTATUS			4	1	1	0	1	0	7
9 Percent WKSTATUS			57.14%	14.29%	14.29%	0.00%	14.29%	0.00%	100.00%
Total Count WKSTATUS			17	21	8	5	6	1	58
Total Percent WKSTATUS			29.31%	36.21%	13.79%	8.62%	10.34%	1.72%	100.00%

A	B	C	D	E	
Not Working	PT Job - Not Related	PT Job - Related	FT Job - Not Related	FT Job - Related	NONE
29.31%	36.21%	13.79%	8.62%	10.34%	1.72%



Working Status of Participants
Figure 13A

10.34% described themselves as having full-time jobs related to their studies (Figure 13).

Experience with Computers

Subjects were asked to describe their ongoing experience using personal computers. Subjects reported that 37.93% seldom used PC's, 39.66% used them occasionally, and 13.79% used them frequently. Only 8.62% used personal computers all the time. See Figure 14.

Ability to Type

Respondents were also asked about their perceived ability to type. Only 6.90% responded they could only "hunt and peck", while 17.24% indicated they were poor typists. Another 50% said they could type fairly well, and only 6.90% indicated they could type very well. See Figure 15 for the breakdown per cluster group.

Degree of Familiarity with GDSS

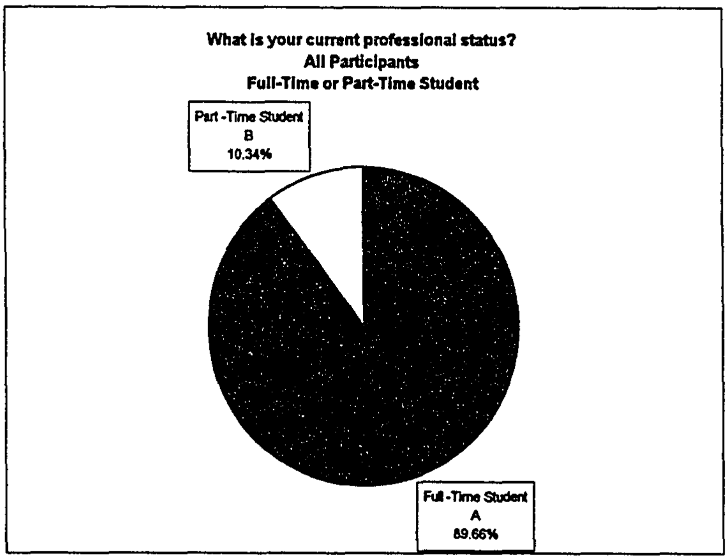
All subjects were asked to indicate their degree of familiarity with Group Decision Support Systems prior to commencing the study. Less than twenty percent, or 17.24% indicated they had never heard of GDSS before, over half or 51.72% were vaguely familiar with GDSS, 27.59% responded that they were familiar with but had never used GDSS, and only 3.45% had even limited hands-on experience. Figure 16 shows the responses per cluster group.

Demographics
What is your current professional status?
A, Full-Time Student
B, Part-Time Student

A, Not Working
B, Part-Time Job Not Related to Studies
C, Part-Time Job Related to Studies
D, Full-Time Job Not Related to Studies
E, Full-Time Job Related to Studies
GDSS and Work Status - Counts and Percentages for Each Cluster, Each Group and Total Participants

			3)WKSTATUS1		
Group	Cluster	Data	A	B	Grand Total
2	A	Count of WKSTATUS	8	1	9
		Percent of WKSTATUS	88.89%	11.11%	100.00%
	B	Count of WKSTATUS	5	1	6
		Percent of WKSTATUS	83.33%	16.67%	100.00%
2 Count of WKSTATUS			13	2	15
2 Percent of WKSTATUS			86.67%	13.33%	100.00%
4	A	Count of WKSTATUS	7	1	8
		Percent of WKSTATUS	87.50%	12.50%	100.00%
	B	Count of WKSTATUS	9	0	9
		Percent of WKSTATUS	100.00%	0.00%	100.00%
4 Count of WKSTATUS			16	1	17
4 Percent of WKSTATUS			94.12%	5.88%	100.00%
5	A	Count of WKSTATUS	7	0	7
		Percent of WKSTATUS	100.00%	0.00%	100.00%
5 Count of WKSTATUS			7	0	7
5 Percent of WKSTATUS			100.00%	0.00%	100.00%
6	A	Count of WKSTATUS	7	0	7
		Percent of WKSTATUS	100.00%	0.00%	100.00%
6 Count of WKSTATUS			7	0	7
6 Percent of WKSTATUS			100.00%	0.00%	100.00%
7	A	Count of WKSTATUS	4	1	5
		Percent of WKSTATUS	80.00%	20.00%	100.00%
7 Count of WKSTATUS			4	1	5
7 Percent of WKSTATUS			80.00%	20.00%	100.00%
9	A	Count of WKSTATUS	5	2	7
		Percent of WKSTATUS	71.43%	28.57%	100.00%
9 Count of WKSTATUS			5	2	7
9 Percent of WKSTATUS			71.43%	28.57%	100.00%
Total Count of WKSTATUS			52	6	58
Total Percent of WKSTATUS			89.66%	10.34%	100.00%

A	B
Full-Time Student	Part-Time Student
89.66%	10.34%

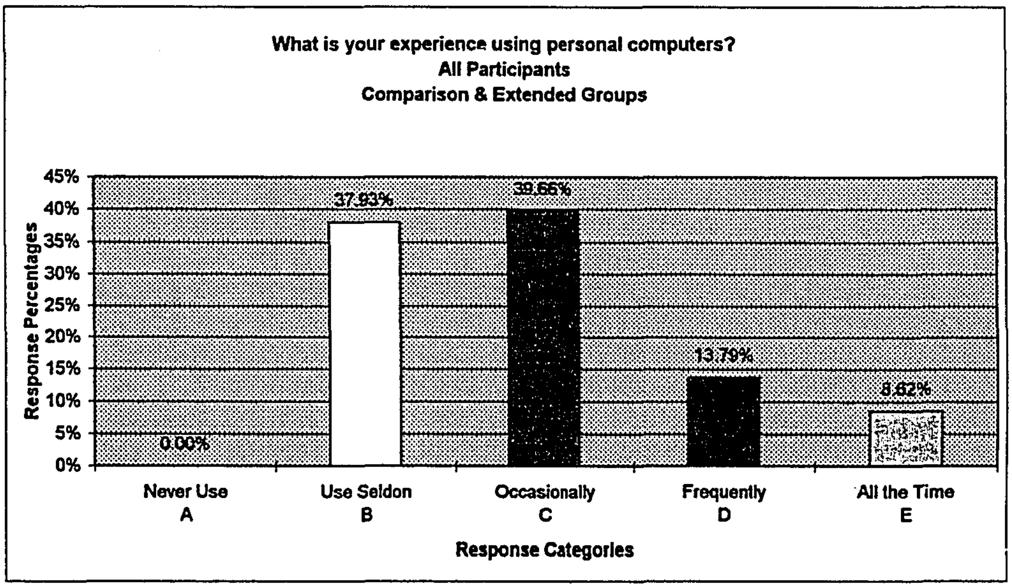


Professional Status of Participants
Figure 13

Demographics
What is your experience using personal computers?
A, Never used one before
B, Use seldom
C, Use occasionally
D, Use frequently
E, Use all the time
GDSS and Computer Experience - Counts and Percentages for Each Cluster, Each Group and Total Participants

			4)COMPEXP				
Group	Cluster	Data	B	C	D	E	Grand Total
2	A	Count of COMPEXP	0	4	5	0	9
		Percent of COMPEXP2	0.00%	44.44%	55.56%	0.00%	100.00%
	B	Count of COMPEXP	0	4	2	0	6
		Percent of COMPEXP2	0.00%	66.67%	33.33%	0.00%	100.00%
2 Count of COMPEXP			0	8	7	0	15
2 Percent of COMPEXP2			0.00%	53.33%	46.67%	0.00%	100.00%
4	A	Count of COMPEXP	1	2	4	1	8
		Percent of COMPEXP2	12.50%	25.00%	50.00%	12.50%	100.00%
	B	Count of COMPEXP	0	4	5	0	9
		Percent of COMPEXP2	0.00%	44.44%	55.56%	0.00%	100.00%
4 Count of COMPEXP			1	6	9	1	17
4 Percent of COMPEXP2			5.88%	35.29%	52.94%	5.88%	100.00%
5	A	Count of COMPEXP	2	4	1	0	7
		Percent of COMPEXP2	28.57%	57.14%	14.29%	0.00%	100.00%
5 Count of COMPEXP			2	4	1	0	7
5 Percent of COMPEXP2			28.57%	57.14%	14.29%	0.00%	100.00%
6	A	Count of COMPEXP	0	3	4	0	7
		Percent of COMPEXP2	0.00%	42.86%	57.14%	0.00%	100.00%
6 Count of COMPEXP			0	3	4	0	7
6 Percent of COMPEXP2			0.00%	42.86%	57.14%	0.00%	100.00%
7	A	Count of COMPEXP	0	4	0	1	5
		Percent of COMPEXP2	0.00%	80.00%	0.00%	20.00%	100.00%
7 Count of COMPEXP			0	4	0	1	5
7 Percent of COMPEXP2			0.00%	80.00%	0.00%	20.00%	100.00%
9	A	Count of COMPEXP	0	4	1	2	7
		Percent of COMPEXP2	0.00%	57.14%	14.29%	28.57%	100.00%
9 Count of COMPEXP			0	4	1	2	7
9 Percent of COMPEXP2			0.00%	57.14%	14.29%	28.57%	100.00%
Total Count of COMPEXP			3	29	22	4	58
Total Percent of COMPEXP2			5.17%	50.00%	37.93%	6.90%	100.00%

A	B	C	D	E
Never Use	Use Seldon	Occasionally	Frequently	All the Time
0.00%	37.93%	39.66%	13.79%	8.62%

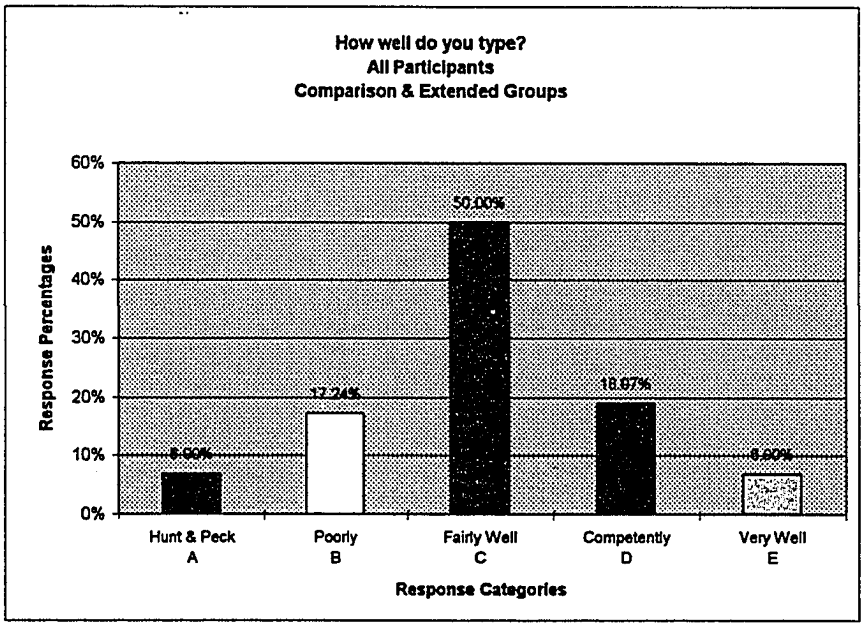


Participants' Experience Using Computers
Figure 14

Demographics
How well to you type?
A, Hunt and Peck
B, Poorly
C, Fairly Well
D, Competently
E, Very Well
GDSS and Typing Ability - Counts and Percentages for Each Cluster, Each Group and Total Participants

			5)TYPING					
Group	Cluster	Data	A	B	C	D	E	Grand Total
2	A	Count of TYPING	0	2	5	2	0	9
		Percent of TYPING	0.00%	22.22%	55.56%	22.22%	0.00%	100.00%
	B	Count of TYPING	1	3	2	0	0	6
		Percent of TYPING	16.67%	50.00%	33.33%	0.00%	0.00%	100.00%
2 Count of TYPING			1	5	7	2	0	15
2 Percent of TYPING			6.67%	33.33%	46.67%	13.33%	0.00%	100.00%
4	A	Count of TYPING	1	0	2	4	1	8
		Percent of TYPING	12.50%	0.00%	25.00%	50.00%	12.50%	100.00%
	B	Count of TYPING	0	1	6	2	0	9
		Percent of TYPING	0.00%	11.11%	66.67%	22.22%	0.00%	100.00%
4 Count of TYPING			1	1	8	6	1	17
4 Percent of TYPING			5.88%	5.88%	47.06%	35.29%	5.88%	100.00%
5	A	Count of TYPING	2	0	4	1	0	7
		Percent of TYPING	28.57%	0.00%	57.14%	14.29%	0.00%	100.00%
5 Count of TYPING			2	0	4	1	0	7
5 Percent of TYPING			28.57%	0.00%	57.14%	14.29%	0.00%	100.00%
6	A	Count of TYPING	0	2	3	1	1	7
		Percent of TYPING	0.00%	28.57%	42.86%	14.29%	14.29%	100.00%
6 Count of TYPING			0	2	3	1	1	7
6 Percent of TYPING			0.00%	28.57%	42.86%	14.29%	14.29%	100.00%
7	A	Count of TYPING	0	1	3	0	1	5
		Percent of TYPING	0.00%	20.00%	60.00%	0.00%	20.00%	100.00%
7 Count of TYPING			0	1	3	0	1	5
7 Percent of TYPING			0.00%	20.00%	60.00%	0.00%	20.00%	100.00%
9	A	Count of TYPING	0	1	4	1	1	7
		Percent of TYPING	0.00%	14.29%	57.14%	14.29%	14.29%	100.00%
9 Count of TYPING			0	1	4	1	1	7
9 Percent of TYPING			0.00%	14.29%	57.14%	14.29%	14.29%	100.00%
Total Count of TYPING			4	10	29	11	4	58
Total Percent of TYPING			6.90%	17.24%	50.00%	18.97%	6.90%	100.00%

A	B	C	D	E
Hunt & Peck	Poorly	Fairly Well	Competently	Very Well
6.90%	17.24%	50.00%	18.97%	6.90%

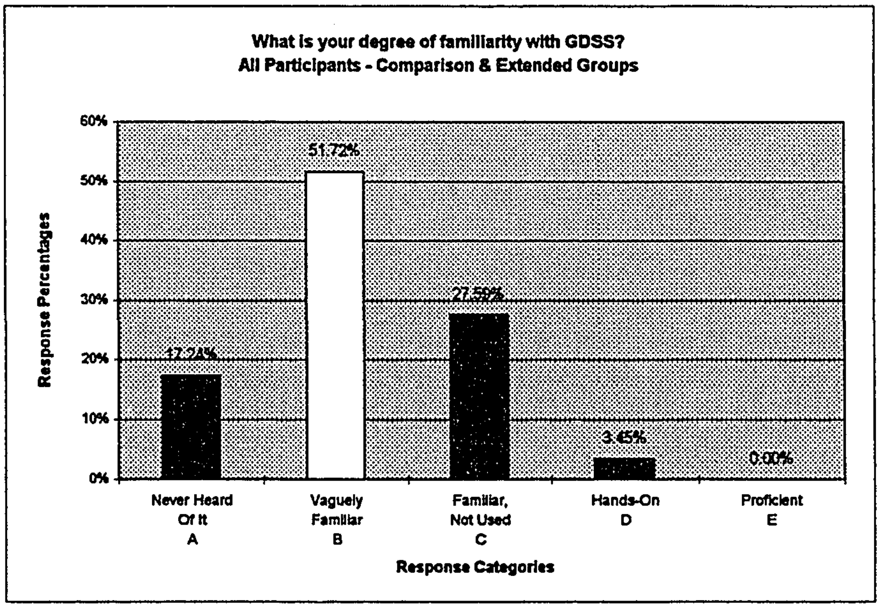


Participants' Ability to Type
Figure 15

Demographics
What is your degree of familiarity with Group Decision Support Systems?
A, Never heard of it before today
B, Vaguely familiar with it before this session
C, Familiar with it but never used
D, Limited hands-on experience
E, Proficient in its use
GDSS and GDSS Familiarity - Counts and Percentages for Each Cluster, Each Group and Total Participants

			6)GDSSFAM				
Group	Cluster	Data	A	B	C	D	Grand Total
2	A	Count of GDSSFAM	3	4	2	0	9
		Percent of GDSSFAM	33.33%	44.44%	22.22%	0.00%	100.00%
	B	Count of GDSSFAM	1	3	2	0	6
		Percent of GDSSFAM	16.67%	50.00%	33.33%	0.00%	100.00%
2 Count of GDSSFAM			4	7	4	0	15
2 Percent of GDSSFAM			26.67%	46.67%	26.67%	0.00%	100.00%
4	A	Count of GDSSFAM	0	6	1	1	8
		Percent of GDSSFAM	0.00%	75.00%	12.50%	12.50%	100.00%
	B	Count of GDSSFAM	4	3	2	0	9
		Percent of GDSSFAM	44.44%	33.33%	22.22%	0.00%	100.00%
4 Count of GDSSFAM			4	9	3	1	17
4 Percent of GDSSFAM			23.53%	52.94%	17.65%	5.88%	100.00%
5	A	Count of GDSSFAM	1	2	4	0	7
		Percent of GDSSFAM	14.29%	28.57%	57.14%	0.00%	100.00%
5 Count of GDSSFAM			1	2	4	0	7
5 Percent of GDSSFAM			14.29%	28.57%	57.14%	0.00%	100.00%
6	A	Count of GDSSFAM	0	6	1	0	7
		Percent of GDSSFAM	0.00%	85.71%	14.29%	0.00%	100.00%
6 Count of GDSSFAM			0	6	1	0	7
6 Percent of GDSSFAM			0.00%	85.71%	14.29%	0.00%	100.00%
7	A	Count of GDSSFAM	1	3	1	0	5
		Percent of GDSSFAM	20.00%	60.00%	20.00%	0.00%	100.00%
7 Count of GDSSFAM			1	3	1	0	5
7 Percent of GDSSFAM			20.00%	60.00%	20.00%	0.00%	100.00%
9	A	Count of GDSSFAM	0	3	3	1	7
		Percent of GDSSFAM	0.00%	42.86%	42.86%	14.29%	100.00%
9 Count of GDSSFAM			0	3	3	1	7
9 Percent of GDSSFAM			0.00%	42.86%	42.86%	14.29%	100.00%
Total Count of GDSSFAM			10	30	16	2	58
Total Percent of GDSSFAM			17.24%	51.72%	27.59%	3.45%	100.00%

A	B	C	D	E
Never Heard Of It	Vaguely Familiar	Familiar, Not Used	Hands-On	Proficient
17.24%	51.72%	27.59%	3.45%	0.00%



Participants' Familiarity with GDSS
Figure 16

Attitude Toward GDSS

In addition to asking about familiarity with Group Decision Support Systems, the demographic questionnaire addressed respondents' attitudes toward using the systems. Prior to beginning the study, no negative responses were noted. Some 39.66% of responses indicated a Neutral attitude toward GDSS, 39.66% indicated that they were somewhat positive, and 20.69% of responses were extremely positive. Figure 17 shows responses per cluster group.

Degree of Familiarity With Expert Systems

Student respondents had only a slightly higher degree of familiarity with Expert Systems. They indicated that 3.45% had never before heard of this approach to knowledge preservation, 34.46% were vaguely familiar with it, 51.72% were familiar with Expert Systems but had never used them, 8.62% had limited hands-on experience, and 1.72%, or one person, felt proficient in their use. See Figure 18.

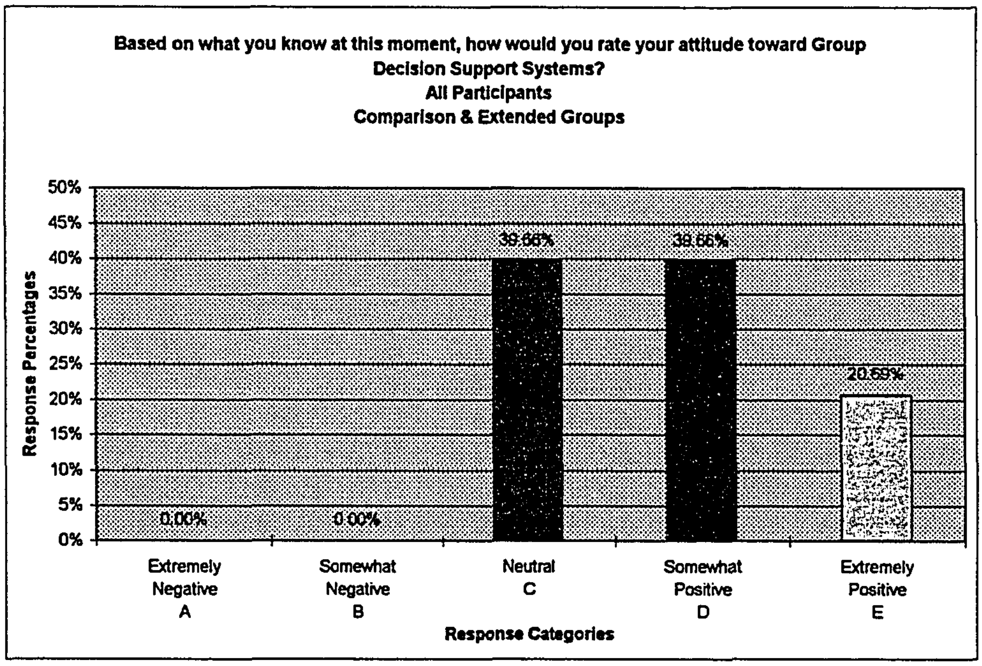
Attitude Toward Expert Systems

Similar attitudes were shown toward using Expert Systems prior to beginning the study. There were no negative responses, 37.93% of subjects indicated that they were Neutral, 39.66% were somewhat positive, and 22.41% were extremely positive. See Figure 19.

Demographics
Based on what you know at this moment, how would you rate your attitude toward Group Decision Support Systems?
A, Extremely Negative
B, Somewhat Negative
C, Neutral
D, Somewhat Positive
E, Extremely Positive
GDSS and Attitude Toward GDSS - Counts and Percentages for Each Cluster, Each Group and Total Participants

			7)GDSSFEEL			
Group	Cluster	Data	C	D	E	Grand Total
2	A	Count of GDSSFEEL	3	3	3	9
		Percent of GDSSFEEL	33.33%	33.33%	33.33%	100.00%
	B	Count of GDSSFEEL	3	2	1	6
		Percent of GDSSFEEL	50.00%	33.33%	16.67%	100.00%
2 Count of GDSSFEEL			6	5	4	15
2 Percent of GDSSFEEL			40.00%	33.33%	26.67%	100.00%
4	A	Count of GDSSFEEL	1	3	4	8
		Percent of GDSSFEEL	12.50%	37.50%	50.00%	100.00%
	B	Count of GDSSFEEL	5	2	2	9
		Percent of GDSSFEEL	55.56%	22.22%	22.22%	100.00%
4 Count of GDSSFEEL			6	5	6	17
4 Percent of GDSSFEEL			35.29%	29.41%	35.29%	100.00%
5	A	Count of GDSSFEEL	3	4	0	7
		Percent of GDSSFEEL	42.86%	57.14%	0.00%	100.00%
5 Count of GDSSFEEL			3	4	0	7
5 Percent of GDSSFEEL			42.86%	57.14%	0.00%	100.00%
6	A	Count of GDSSFEEL	1	6	0	7
		Percent of GDSSFEEL	14.29%	85.71%	0.00%	100.00%
6 Count of GDSSFEEL			1	6	0	7
6 Percent of GDSSFEEL			14.29%	85.71%	0.00%	100.00%
7	A	Count of GDSSFEEL	4	1	0	5
		Percent of GDSSFEEL	80.00%	20.00%	0.00%	100.00%
7 Count of GDSSFEEL			4	1	0	5
7 Percent of GDSSFEEL			80.00%	20.00%	0.00%	100.00%
9	A	Count of GDSSFEEL	3	2	2	7
		Percent of GDSSFEEL	42.86%	28.57%	28.57%	100.00%
9 Count of GDSSFEEL			3	2	2	7
9 Percent of GDSSFEEL			42.86%	28.57%	28.57%	100.00%
Total Count of GDSSFEEL			23	23	12	58
Total Percent of GDSSFEEL			39.66%	39.66%	20.69%	100.00%

A	B	C	D	E
Extremely Negative	Somewhat Negative	Neutral	Somewhat Positive	Extremely Positive
0.00%	0.00%	39.66%	39.66%	20.69%

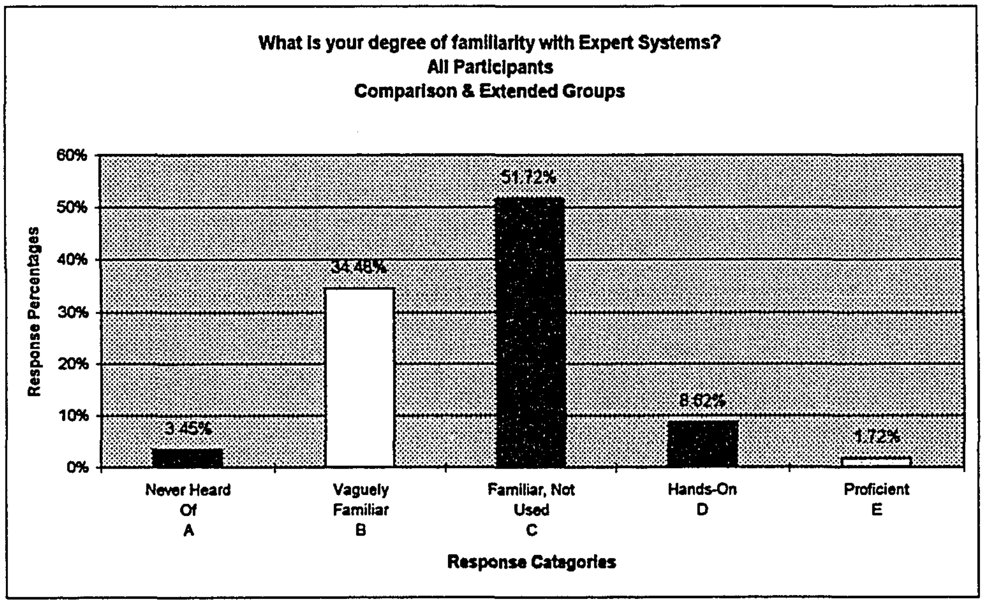


Participants' Attitude Toward GDSS
Figure 17

Demographics
What is your degree of familiarity with Expert Systems?
A, Never heard of them before today
B, Vaguely familiar with them before this session
C, Familiar with them but never used
D, Limited hands-on experience
E, Proficient in their use
GDSS and Expert Systems Familiarity - Counts and Percentages for Each Cluster, Each Group and Total Participants

			8)ESFAM					
Group	Cluster	Data	A	B	C	D	E	Grand Total
2	A	Count of ESFAM	0	4	5	0	0	9
		Percent of ESFAM	0.00%	44.44%	55.56%	0.00%	0.00%	100.00%
	B	Count of ESFAM	0	2	3	0	1	6
		Percent of ESFAM	0.00%	33.33%	50.00%	0.00%	16.67%	100.00%
2 Count of ESFAM			0	6	8	0	1	15
2 Percent of ESFAM			0.00%	40.00%	53.33%	0.00%	6.67%	100.00%
4	A	Count of ESFAM	0	3	4	1	0	8
		Percent of ESFAM	0.00%	37.50%	50.00%	12.50%	0.00%	100.00%
	B	Count of ESFAM	2	3	3	1	0	9
		Percent of ESFAM	22.22%	33.33%	33.33%	11.11%	0.00%	100.00%
4 Count of ESFAM			2	6	7	2	0	17
4 Percent of ESFAM			11.76%	35.29%	41.18%	11.76%	0.00%	100.00%
5	A	Count of ESFAM	0	1	6	0	0	7
		Percent of ESFAM	0.00%	14.29%	85.71%	0.00%	0.00%	100.00%
5 Count of ESFAM			0	1	6	0	0	7
5 Percent of ESFAM			0.00%	14.29%	85.71%	0.00%	0.00%	100.00%
6	A	Count of ESFAM	0	2	4	1	0	7
		Percent of ESFAM	0.00%	28.57%	57.14%	14.29%	0.00%	100.00%
6 Count of ESFAM			0	2	4	1	0	7
6 Percent of ESFAM			0.00%	28.57%	57.14%	14.29%	0.00%	100.00%
7	A	Count of ESFAM	0	3	2	0	0	5
		Percent of ESFAM	0.00%	60.00%	40.00%	0.00%	0.00%	100.00%
7 Count of ESFAM			0	3	2	0	0	5
7 Percent of ESFAM			0.00%	60.00%	40.00%	0.00%	0.00%	100.00%
9	A	Count of ESFAM	0	2	3	2	0	7
		Percent of ESFAM	0.00%	28.57%	42.86%	28.57%	0.00%	100.00%
9 Count of ESFAM			0	2	3	2	0	7
9 Percent of ESFAM			0.00%	28.57%	42.86%	28.57%	0.00%	100.00%
Total Count of ESFAM			2	20	30	5	1	58
Total Percent of ESFAM			3.45%	34.48%	51.72%	8.62%	1.72%	100.00%

A	B	C	D	E
Never Heard Of	Vaguely Familiar	Familiar, Not Used	Hands-On	Proficient
3.45%	34.48%	51.72%	8.62%	1.72%

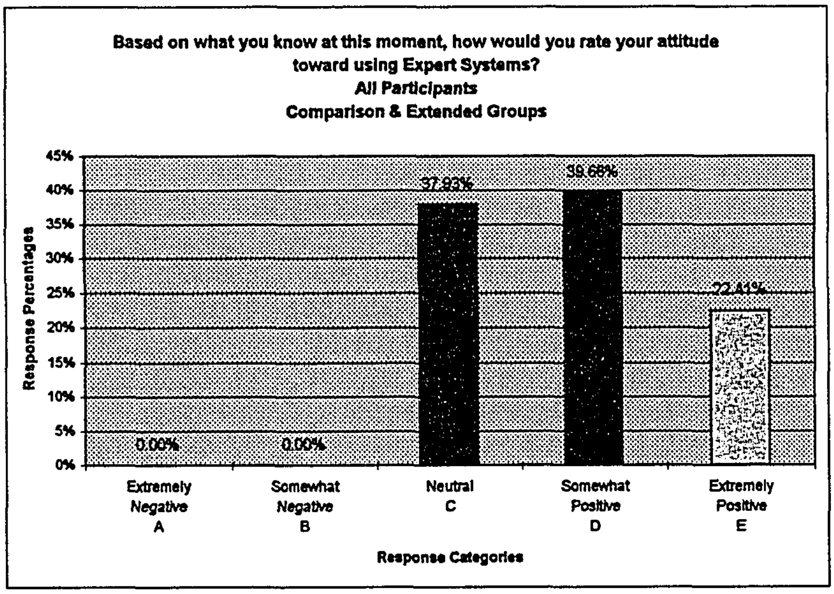


Participants' Familiarity with Expert Systems
Figure 18

Demographics
Based on what you know at this moment, how would you rate your attitude toward using Expert Systems?
A, Extremely Negative
B, Somewhat Negative
C, Neutral
D, Somewhat Positive
E, Extremely Positive
GDSS and Attitude Toward Expert Systems - Counts and Percentages for Each Cluster, Each Group and Total Participants

			9)ESFEEL			
Group	Cluster	Data	C	D	E	Grand Total
2	A	Count of ESFEEL	3	3	3	9
		Percent of ESFEEL	33.33%	33.33%	33.33%	100.00%
	B	Count of ESFEEL	2	3	1	6
		Percent of ESFEEL	33.33%	50.00%	16.67%	100.00%
2 Count of ESFEEL			5	6	4	15
2 Percent of ESFEEL			33.33%	40.00%	26.67%	100.00%
4	A	Count of ESFEEL	1	4	3	8
		Percent of ESFEEL	12.50%	50.00%	37.50%	100.00%
	B	Count of ESFEEL	5	2	2	9
		Percent of ESFEEL	55.56%	22.22%	22.22%	100.00%
4 Count of ESFEEL			6	6	5	17
4 Percent of ESFEEL			35.29%	35.29%	29.41%	100.00%
5	A	Count of ESFEEL	3	3	1	7
		Percent of ESFEEL	42.86%	42.86%	14.29%	100.00%
5 Count of ESFEEL			3	3	1	7
5 Percent of ESFEEL			42.86%	42.86%	14.29%	100.00%
6	A	Count of ESFEEL	1	5	1	7
		Percent of ESFEEL	14.29%	71.43%	14.29%	100.00%
6 Count of ESFEEL			1	5	1	7
6 Percent of ESFEEL			14.29%	71.43%	14.29%	100.00%
7	A	Count of ESFEEL	4	1	0	5
		Percent of ESFEEL	80.00%	20.00%	0.00%	100.00%
7 Count of ESFEEL			4	1	0	5
7 Percent of ESFEEL			80.00%	20.00%	0.00%	100.00%
9	A	Count of ESFEEL	3	2	2	7
		Percent of ESFEEL	42.86%	28.57%	28.57%	100.00%
9 Count of ESFEEL			3	2	2	7
9 Percent of ESFEEL			42.86%	28.57%	28.57%	100.00%
Total Count of ESFEEL			22	23	13	58
Total Percent of ESFEEL			37.93%	39.66%	22.41%	100.00%

A	B	C	D	E
Extremely Negative	Somewhat Negative	Neutral	Somewhat Positive	Extremely Positive
0.00%	0.00%	37.93%	39.66%	22.41%



Participants' Attitude Toward Expert Systems
Figure 19

Hours Spent in Meetings

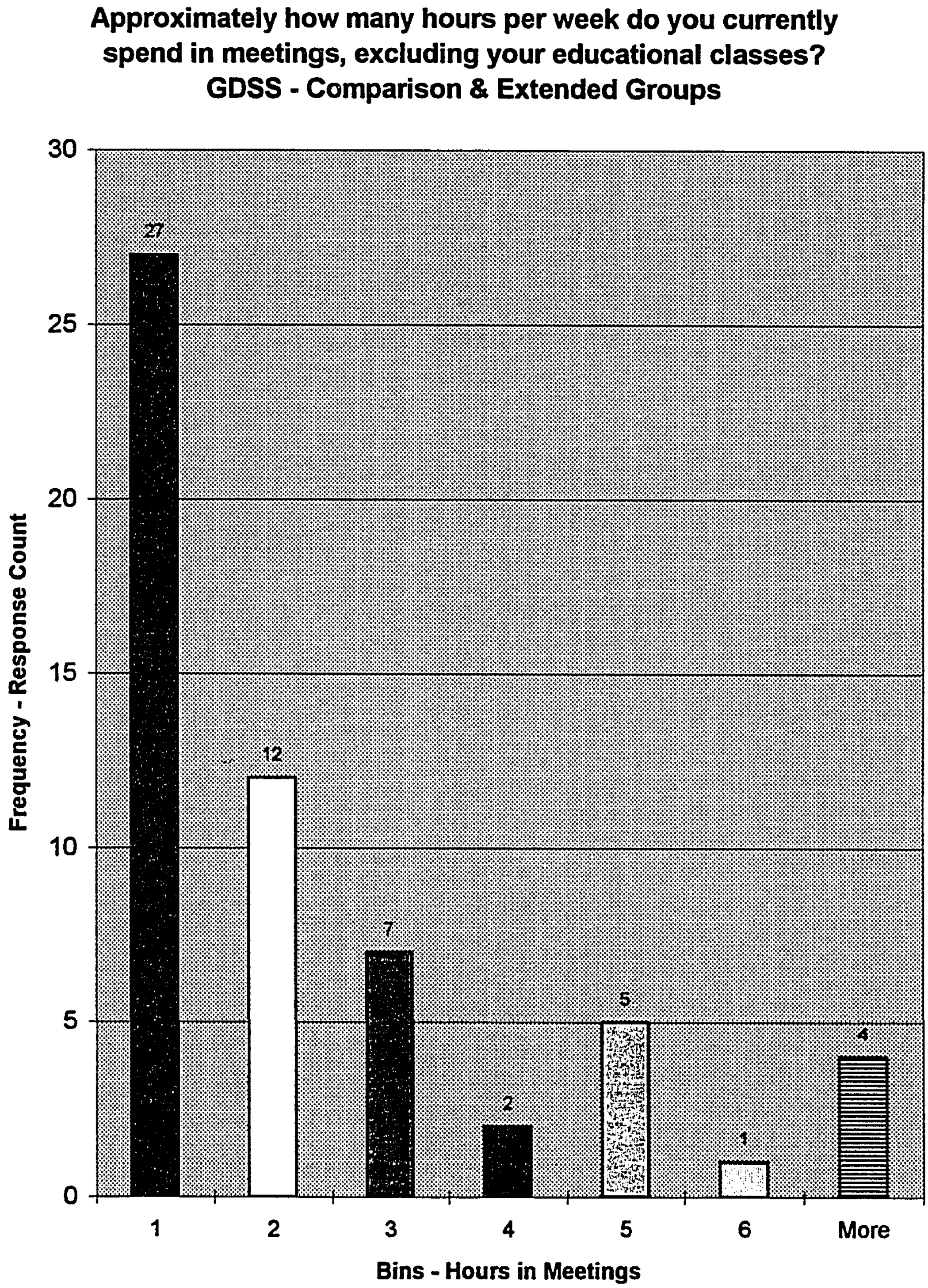
In order to ascertain the basis for future comparison, the student subjects were asked to estimate the hours per week they normally spent in meetings, excluding classes. Almost two thirds of the group reported spending two or fewer hours per week. Figure 20 shows the histogram or frequency distribution of responses in hours per week.

Attitude Toward Working In Groups

As this exploratory study was addressed to working in groups, the student "experts" were asked about their general comfort level in groups. Only two persons, or 3.45% Strongly Disagreed that they liked to work in groups, and another 8.62% of responses Disagreed. Responses from 29.31% of the subjects were Neutral, and 36.21% Agreed. Finally, 22.41% Strongly Agreed that they liked to work in groups. See Figure 21 for cluster group breakdowns.

Influence in Groups

Perceived influence in groups was elicited by asking the student "experts" to respond to the statement, "I am normally influential in groups." Again, no-one Strongly Disagreed and only two individuals, or 3.45% Disagreed. Another 36.21% were Neutral, and 44.83% Agreed. Another 15.52% Strongly Agreed. See Figure 22.

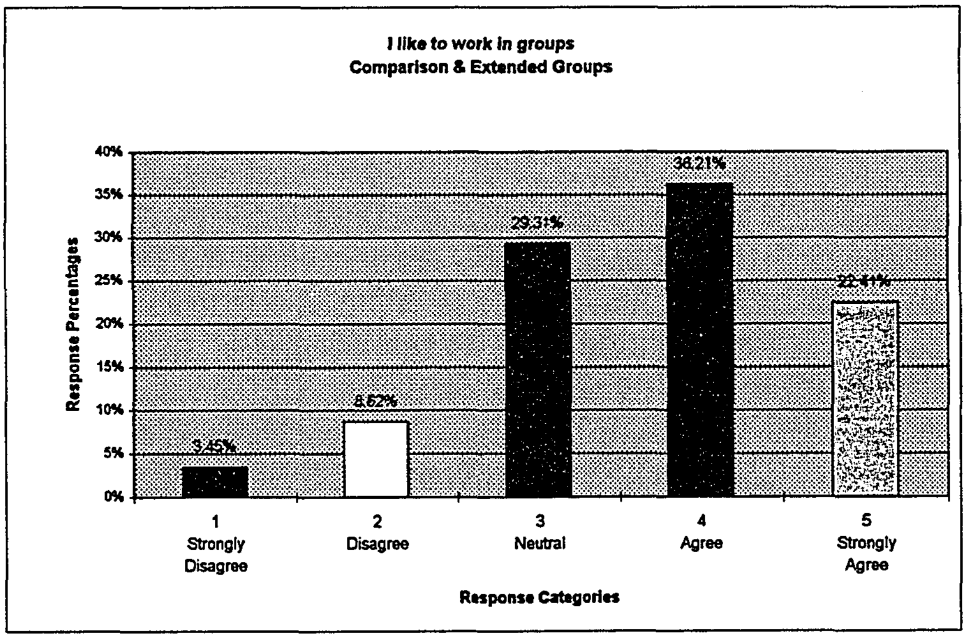


Participants' Time Spent in Meetings
Figure 20

Demographics
I like to work in groups
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Work in Groups - Counts and Percentages for Each Cluster, Each Group and Total Participants

			11B)GRPLIK					
Group	Cluster	Data	1	2	3	4	5	Grand Total
2	A	Count of GRPLIK	0	2	3	2	2	9
		Percent of GRPLIK	0.00%	22.22%	33.33%	22.22%	22.22%	100.00%
	B	Count of GRPLIK	0	1	0	5	0	6
		Percent of GRPLIK	0.00%	16.67%	0.00%	83.33%	0.00%	100.00%
2 Count of GRPLIK			0	3	3	7	2	15
2 Percent of GRPLIK			0.00%	20.00%	20.00%	46.67%	13.33%	100.00%
4	A	Count of GRPLIK	1	0	3	1	3	8
		Percent of GRPLIK	12.50%	0.00%	37.50%	12.50%	37.50%	100.00%
	B	Count of GRPLIK	0	0	4	5	0	9
		Percent of GRPLIK	0.00%	0.00%	44.44%	55.56%	0.00%	100.00%
4 Count of GRPLIK			1	0	7	6	3	17
4 Percent of GRPLIK			5.88%	0.00%	41.18%	35.29%	17.65%	100.00%
5	A	Count of GRPLIK	0	1	2	3	1	7
		Percent of GRPLIK	0.00%	14.29%	28.57%	42.86%	14.29%	100.00%
5 Count of GRPLIK			0	1	2	3	1	7
5 Percent of GRPLIK			0.00%	14.29%	28.57%	42.86%	14.29%	100.00%
6	A	Count of GRPLIK	1	0	1	3	2	7
		Percent of GRPLIK	14.29%	0.00%	14.29%	42.86%	28.57%	100.00%
6 Count of GRPLIK			1	0	1	3	2	7
6 Percent of GRPLIK			14.29%	0.00%	14.29%	42.86%	28.57%	100.00%
7	A	Count of GRPLIK	0	1	3	0	1	5
		Percent of GRPLIK	0.00%	20.00%	60.00%	0.00%	20.00%	100.00%
7 Count of GRPLIK			0	1	3	0	1	5
7 Percent of GRPLIK			0.00%	20.00%	60.00%	0.00%	20.00%	100.00%
9	A	Count of GRPLIK	0	0	1	2	4	7
		Percent of GRPLIK	0.00%	0.00%	14.29%	28.57%	57.14%	100.00%
9 Count of GRPLIK			0	0	1	2	4	7
9 Percent of GRPLIK			0.00%	0.00%	14.29%	28.57%	57.14%	100.00%
Total Count of GRPLIK			2	5	17	21	13	58
Total Percent of GRPLIK			3.45%	8.62%	29.31%	36.21%	22.41%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
3.45%	8.62%	29.31%	36.21%	22.41%

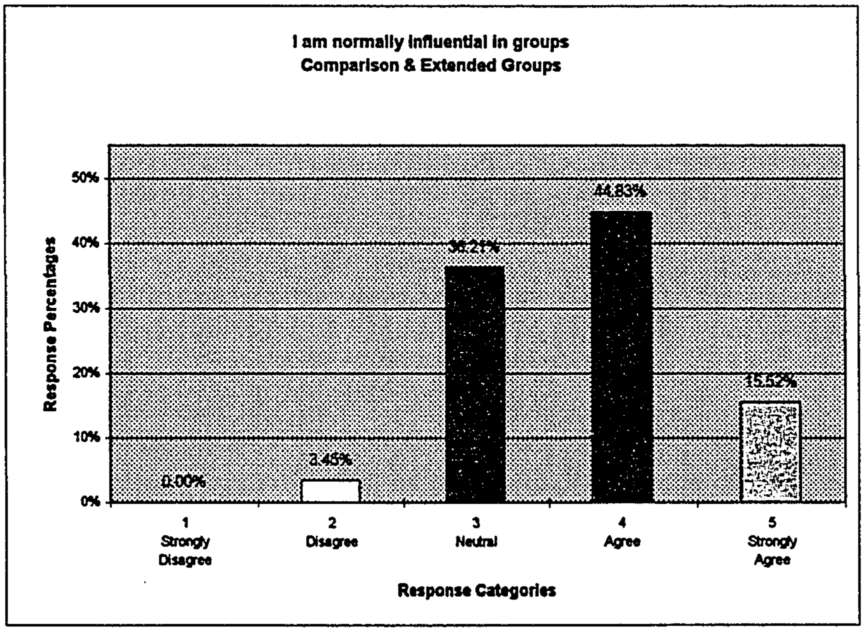


Participants' Attitude Toward Working in Groups
Figure 21

Demographics
I am normally influential in groups
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Influence in Groups - Counts and Percentages for Each Cluster, Each Group and Total Participants

			11A)GRPINFL				
Group	Cluster	Data	2	3	4	5	Grand Total
2	A	Count of GRPINFL	0	6	3	0	9
		Percent of GRPINFL	0.00%	66.67%	33.33%	0.00%	100.00%
	B	Count of GRPINFL	0	2	4	0	6
		Percent of GRPINFL	0.00%	33.33%	66.67%	0.00%	100.00%
2 Count of GRPINFL			0	8	7	0	15
2 Percent of GRPINFL			0.00%	53.33%	46.67%	0.00%	100.00%
4	A	Count of GRPINFL	0	1	6	1	8
		Percent of GRPINFL	0.00%	12.50%	75.00%	12.50%	100.00%
	B	Count of GRPINFL	0	5	3	1	9
		Percent of GRPINFL	0.00%	55.56%	33.33%	11.11%	100.00%
4 Count of GRPINFL			0	6	9	2	17
4 Percent of GRPINFL			0.00%	35.29%	52.94%	11.76%	100.00%
5	A	Count of GRPINFL	1	3	3	0	7
		Percent of GRPINFL	14.29%	42.86%	42.86%	0.00%	100.00%
5 Count of GRPINFL			1	3	3	0	7
5 Percent of GRPINFL			14.29%	42.86%	42.86%	0.00%	100.00%
6	A	Count of GRPINFL	0	3	2	2	7
		Percent of GRPINFL	0.00%	42.86%	28.57%	28.57%	100.00%
6 Count of GRPINFL			0	3	2	2	7
6 Percent of GRPINFL			0.00%	42.86%	28.57%	28.57%	100.00%
7	A	Count of GRPINFL	1	1	2	1	5
		Percent of GRPINFL	20.00%	20.00%	40.00%	20.00%	100.00%
7 Count of GRPINFL			1	1	2	1	5
7 Percent of GRPINFL			20.00%	20.00%	40.00%	20.00%	100.00%
9	A	Count of GRPINFL	0	0	3	4	7
		Percent of GRPINFL	0.00%	0.00%	42.86%	57.14%	100.00%
9 Count of GRPINFL			0	0	3	4	7
9 Percent of GRPINFL			0.00%	0.00%	42.86%	57.14%	100.00%
Total Count of GRPINFL			2	21	26	9	58
Total Percent of GRPINFL			3.45%	36.21%	44.83%	15.52%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
0.00%	3.45%	36.21%	44.83%	15.52%



Participants' Perceived Influence in Groups
Figure 22

Contributions to Group Discussion

In an additional question about the nature of their group work, subjects were asked to respond to the statement, "I contribute a lot to group discussion." No-one Strongly Disagreed, and only three individuals, or 5.17% Disagreed. More than a third, or 37.93% were Neutral, and 36.21% Agreed with the statement. The remaining 20.69% Strongly Agreed that they normally contributed a lot to group discussion. See Figure 23.

Satisfaction with Group Role

As a final check on group performance, the subjects were asked to respond to the statement, "I am normally satisfied with my role in groups." Here, no-one Strongly Disagreed. Four individuals, or 6.90% Disagreed with the statement. Only 20.69% were Neutral, and 53.45% Agreed. Finally, 18.97% Strongly Agreed. Figure 24 shows the breakdown per cluster group.

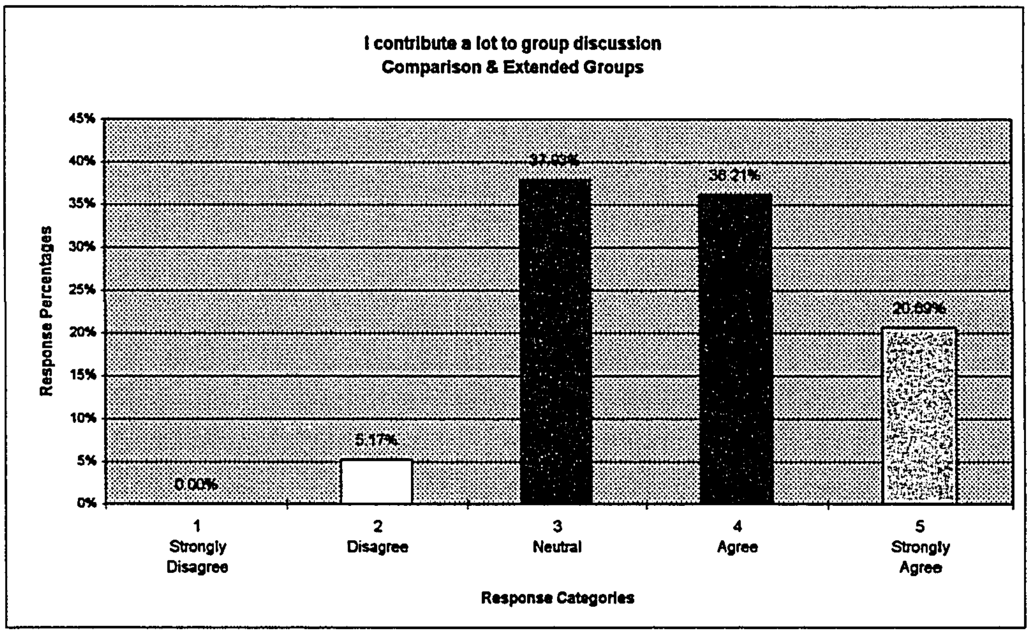
Group Process Parametric Results

The primary variable in this study was the use of Group Decision Support Systems in creating the structure of a pre-prototypical Expert System for use by Knowledge Engineers. Student "experts" participated in two knowledge acquisition and organization sessions - once in a standard facilitated meeting and once using GDSS. After each session, the group results were evaluated in terms of time taken,

Demographics
I contribute a lot to group discussion
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Contribution to Group Discussion - Counts and Percentages for Each Cluster, Each Group and Total Participants

			11C)GRPCONTRIB				
Group	Cluster	Data	2	3	4	5	Grand Total
2	A	Count of GRPCONTRIB	2	3	2	2	9
		Percent of GRPCONTRIB	22.22%	33.33%	22.22%	22.22%	100.00%
	B	Count of GRPCONTRIB	0	1	4	1	6
		Percent of GRPCONTRIB	0.00%	16.67%	66.67%	16.67%	100.00%
2 Count of GRPCONTRIB			2	4	6	3	15
2 Percent of GRPCONTRIB			13.33%	26.67%	40.00%	20.00%	100.00%
4	A	Count of GRPCONTRIB	0	0	6	2	8
		Percent of GRPCONTRIB	0.00%	0.00%	75.00%	25.00%	100.00%
	B	Count of GRPCONTRIB	0	6	2	1	9
		Percent of GRPCONTRIB	0.00%	66.67%	22.22%	11.11%	100.00%
4 Count of GRPCONTRIB			0	6	8	3	17
4 Percent of GRPCONTRIB			0.00%	35.29%	47.06%	17.65%	100.00%
5	A	Count of GRPCONTRIB	1	3	2	1	7
		Percent of GRPCONTRIB	14.29%	42.86%	28.57%	14.29%	100.00%
5 Count of GRPCONTRIB			1	3	2	1	7
5 Percent of GRPCONTRIB			14.29%	42.86%	28.57%	14.29%	100.00%
6	A	Count of GRPCONTRIB	0	3	4	0	7
		Percent of GRPCONTRIB	0.00%	42.86%	57.14%	0.00%	100.00%
6 Count of GRPCONTRIB			0	3	4	0	7
6 Percent of GRPCONTRIB			0.00%	42.86%	57.14%	0.00%	100.00%
7	A	Count of GRPCONTRIB	0	4	0	1	5
		Percent of GRPCONTRIB	0.00%	80.00%	0.00%	20.00%	100.00%
7 Count of GRPCONTRIB			0	4	0	1	5
7 Percent of GRPCONTRIB			0.00%	80.00%	0.00%	20.00%	100.00%
9	A	Count of GRPCONTRIB	0	2	1	4	7
		Percent of GRPCONTRIB	0.00%	28.57%	14.29%	57.14%	100.00%
9 Count of GRPCONTRIB			0	2	1	4	7
9 Percent of GRPCONTRIB			0.00%	28.57%	14.29%	57.14%	100.00%
Total Count of GRPCONTRIB			3	22	21	12	58
Total Percent of GRPCONTRIB			5.17%	37.93%	36.21%	20.69%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
0.00%	5.17%	37.93%	36.21%	20.69%

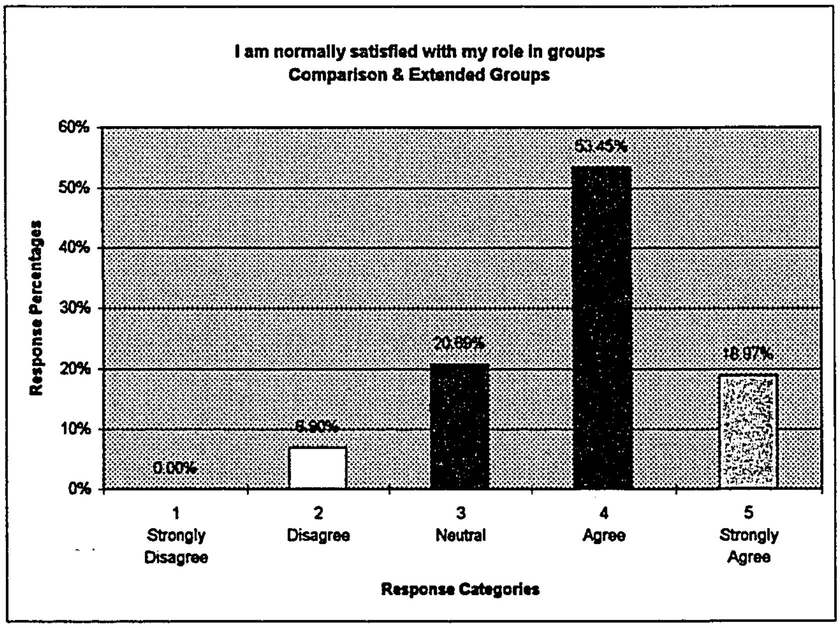


Participants' Contribution to Group Discussion
Figure 23

Demographics
I am normally satisfied with my role in groups
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Satisfaction With Role in Groups - Counts and Percentages for Each Cluster, Each Group and Total Participants

			11D)GRPSAT				
Group	Cluster	Data	2	3	4	5	Grand Total
2	A	Count of GRPSAT	1	1	6	1	9
		Percent of GRPSAT	11.11%	11.11%	66.67%	11.11%	100.00%
	B	Count of GRPSAT	0	1	4	1	6
		Percent of GRPSAT	0.00%	16.67%	66.67%	16.67%	100.00%
2 Count of GRPSAT			1	2	10	2	15
2 Percent of GRPSAT			6.67%	13.33%	66.67%	13.33%	100.00%
4	A	Count of GRPSAT	1	1	5	1	8
		Percent of GRPSAT	12.50%	12.50%	62.50%	12.50%	100.00%
	B	Count of GRPSAT	1	2	5	1	9
		Percent of GRPSAT	11.11%	22.22%	55.56%	11.11%	100.00%
4 Count of GRPSAT			2	3	10	2	17
4 Percent of GRPSAT			11.76%	17.65%	58.82%	11.76%	100.00%
5	A	Count of GRPSAT	0	2	3	2	7
		Percent of GRPSAT	0.00%	28.57%	42.86%	28.57%	100.00%
5 Count of GRPSAT			0	2	3	2	7
5 Percent of GRPSAT			0.00%	28.57%	42.86%	28.57%	100.00%
6	A	Count of GRPSAT	1	1	4	1	7
		Percent of GRPSAT	14.29%	14.29%	57.14%	14.29%	100.00%
6 Count of GRPSAT			1	1	4	1	7
6 Percent of GRPSAT			14.29%	14.29%	57.14%	14.29%	100.00%
7	A	Count of GRPSAT	0	3	1	1	5
		Percent of GRPSAT	0.00%	60.00%	20.00%	20.00%	100.00%
7 Count of GRPSAT			0	3	1	1	5
7 Percent of GRPSAT			0.00%	60.00%	20.00%	20.00%	100.00%
9	A	Count of GRPSAT	0	1	3	3	7
		Percent of GRPSAT	0.00%	14.29%	42.86%	42.86%	100.00%
9 Count of GRPSAT			0	1	3	3	7
9 Percent of GRPSAT			0.00%	14.29%	42.86%	42.86%	100.00%
Total Count of GRPSAT			4	12	31	11	58
Total Percent of GRPSAT			6.90%	20.69%	53.45%	18.97%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
0.00%	6.90%	20.69%	53.45%	18.97%



Participants' Satisfaction with Their Role in Groups
Figure 24

degree of completion, and number of ideas. The result are reported by process, groups, and task problems.

Ideas Generated

One measure of the success of the groups was the number of the ideas generated through each process - GDSS and Face-to-Face.

"Improving the Safety and Security of ODU Students".

This problem was the first to be presented to each group. Half of the groups met in the GDSS environment, and the rest in a Face-to-Face meeting. Because two of the GDSS groups (four clusters) were used as part of the pilot, their results are not presented here. In this initial meeting, the number of ideas generated for the Face-to-Face groups ranged from 15 to 29. The range for the GDSS groups was 37 to 45. When the results were normalized for each participant, the ideas per person in the Face-To-Face groups ranged from 3.00 to 4.83; those for the GDSS groups ranged from 5.29 to 9.00 ideas per participant. While the average number of ideas for all groups addressing this problem was 4.38, the Face-to-Face groups averaged only 3.04 per participant. The average number for the GDSS groups was 6.62. See Figure 25.

"Landing a Job in Your Field After Graduation".

Ten groups were given this problem. This was the second meeting for each group. This time, they approached a different task with a different facilitator and using

Session Parameters - Ideas Generated
Improving the Personal Safety & Security of Students at ODU

			Idea Generation	
Group/Cluster	Type Session	Participants	Ideas	Ideas/Participant
2A	Face-to-Face	9	27	3.00
2B	Face-to-Face	6	29	4.83
4A	Face-to-Face	8	25	3.13
4B	Face-to-Face	9	19	2.11
6A	Face-to-Face	7	15	2.14
5A	GDSS	7	37	5.29
7A	GDSS	5	45	9.00
9A	GDSS	7	39	5.57
Average Ideas/Participant for all Safety				4.38
Average Ideas/Participant for Face-to-Face Only				3.04
Average Ideas/Participant for GDSS Only				6.62

Safety Problem - Ideas Generated
Figure 25

a different technology. The number of ideas generated in the Face-to-Face groups ranged from 15 to 33; those in the GDSS groups ranged from 24 to 51. When the results were normalized per participant, the Face-to-Face groups generated from 2.29 to 4.71 ideas per person, the GDSS groups from 4.00 to 6.43 per participant. The average number of ideas per participant for this problem was 4.13. Face-to-Face groups generated only 3.00 ideas per person, while the GDSS average was 5.26, an obvious difference. See Figure 26.

Time Taken and Degree of Completion

The factors of time taken and degree of completion were both operationalized as the degree to which the planned agenda was completed. Since the agendas and scripts for the GDSS and one set of facilitated Face-to-Face groups were identical, and since the general goals and tools of the second set of facilitated Face-to-Face groups were also identical, it seemed legitimate to use degree of completion as a measure of the success of the groups in meeting their goals. Each group was expected to complete four basic steps in idea generation and prioritizing. The steps included brainstorming or Brainwriting, rating their ideas, subgrouping their ideas according to importance, and categorizing them according to the most responsible parties. The data collected on this factor is also presented by problem, process and group.

Session Parameters - Ideas Generated
Landing a Job in Your Major Area of Study for After Graduation

			Idea Generation	
Group/Cluster	Type Session	Participants	Ideas	Ideas/Participant
1A	Face-to-Face	8	23	2.88
1B	Face-to-Face	6	15	2.50
3A	Face-to-Face	7	16	2.29
3B	Face-to-Face	8	21	2.63
5A	Face-to-Face	7	33	4.71
2A	GDSS	9	44	4.89
2B	GDSS	6	24	4.00
4A	GDSS	7	45	6.43
4B	GDSS	9	51	5.67
6A	GDSS	7	37	5.29
Average Ideas/Participant for all Job Search				4.13
Average Ideas/Participant for Face-to-Face Only				3.00
Average Ideas/Participant for GDSS Only				5.26

Job Problem - Ideas Generated
Figure 26

"Improving the Safety and Security of ODU Students".

In this problem, the degree of success of the Face-to-Face groups varied from 50% to 75%. Two groups completed only half the agenda - Brainstorming and Rating. The other three groups completed 75%. No Face-to-face group completed all of the activities. On the other hand, all of the GDSS groups completed 100% of the agenda. This was the first time the groups had met. See Figure 27.

"Landing a Job in Your Field After Graduation".

Again, the Face-to-Face groups were less successful at completing the agenda. Two groups again completed only 50%, one group completed 75%, and two groups completed 100% of the agenda. All five of the GDSS groups again completed 100% of the agenda. See Figure 28.

Responses to Exit Survey

After each session, participants responded to exit surveys addressing the factors under study. In this section, responses to the questions from the GDSS and Face-to-Face sessions are reported and compared.

Perceptions of Group Decision Support Systems

As the majority of participants were unfamiliar with GDSS, and reported themselves as using personal computers only occasionally, the subjects were asked

Session Parameters - Agenda Completion and Ideas Generated
How to Improve the Personal Safety and Security of Students at ODU

		Phase Completion (Yes = Completion, No = Incomplete)				
Group Cluster	Type Session	Brainwriting	Rating	Sub-Group	Compactor	Percent Complete
2A	Face-to-Face	YES	YES	YES	NO	75%
2B	Face-to-Face	YES	YES	NO	NO	50%
4A	Face-to-Face	YES	YES	YES	NO	75%
4B	Face-to-Face	YES	YES	YES	NO	75%
5A	GDSS	YES	YES	YES	YES	100%
6A	Face-to-Face	YES	YES	NO	NO	50%
7A	GDSS	YES	YES	YES	YES	100%
9A	GDSS	YES	YES	YES	YES	100%

Safety Problem - Degree of Completion

Figure 27

Session Parameters - Agenda Completion
How to Land a Job in Your Major Area of Study for After Graduation

Group Cluster	Type Session	Phase Completion (Yes = Completion, No = Incomplete) Brainwriting	Rating	Sub-Group	Compactor	Percent Complete
1A	Face-to-Face	YES	YES	YES	NO	75%
1B	Face-to-Face	YES	YES	YES	YES	100%
2A	GDSS	YES	YES	YES	YES	100%
2B	GDSS	YES	YES	YES	YES	100%
3A	Face-to-Face	YES	YES	YES	YES	100%
3B	Face-to-Face	YES	YES	NO	NO	50%
4A	GDSS	YES	YES	YES	YES	100%
4B	GDSS	YES	YES	YES	YES	100%
5A	Face-to-Face	YES	YES	NO	NO	50%
6A	GDSS	YES	YES	YES	YES	100%

Job Problem - Degree of Completion

Figure 28

about their perceptions of the systems' ease of use in communication. Their responses to four statements are described below.

"Working with GDSS is often frustrating." The large majority of student "experts" Disagreed with this statement. Responses indicated that 53.33% Strongly Disagreed, 28.89% Disagreed, 15.56% were Neutral, and only one person, or 2.22% Agreed. No-one Strongly Agreed. See Figure 29.

"The GDSS is rigid and inflexible to use." Again, the great majority of respondents Disagreed. The responses showed 40.00% Strongly Disagreeing, and 48.89% Disagreeing. Only 8.89% were Neutral, and one individual, or 2.22% Agreed. See Figure 30.

"It is easy for me to express myself using GDSS." Responses to this statement indicated a high degree of agreement. Only 6.67% Strongly Disagreed, 2.22% Disagreed, and 15.56% were Neutral. In contrast, 40.00% Agreed, and 35.56% Strongly Agreed. See Figure 31.

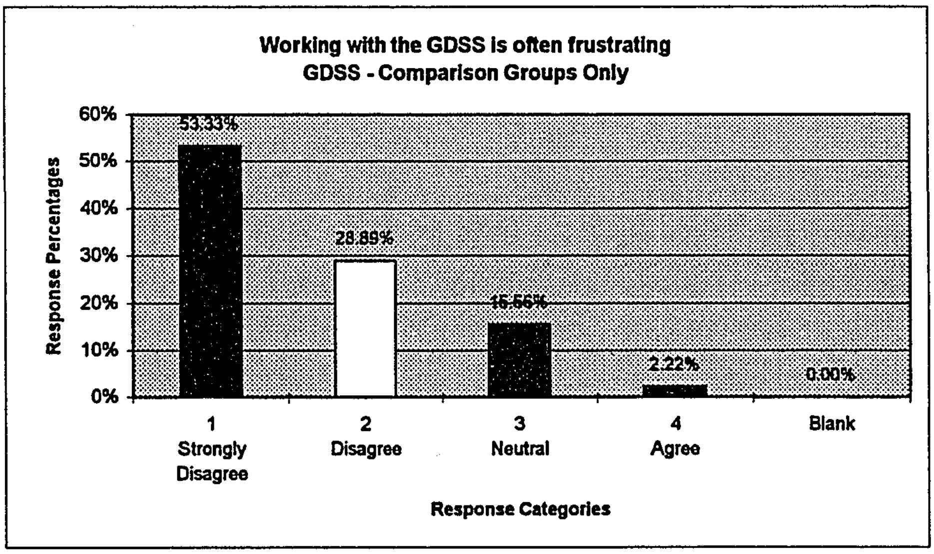
"It is easy to understand what others think using GDSS." Figure 32 shows that the majority of participants also agreed to this statement. Only three individuals, or 6.67% Strongly Disagreed, and four people, or 8.89% Disagreed. Neutral responses accounted for 17.78%, and 40.00% Agreed. Twelve individuals, comprising 26.67% Strongly Agreed with this statement.

Working with the GDSS is often frustrating
GDSS - Comparison Groups Only
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS Frustrating - Counts and Percentages for Each Cluster, Each Group and Total Participants

Problem	(All)

			GDSSFRUST					
Group	Cluster	Data	1	2	3	4	(blank)	Grand Total
2	A	Count of GDSSFRUST	5	2	2	0	0	9
		Percent of GDSSFRUST2	55.56%	22.22%	22.22%	0.00%	0.00%	100.00%
	B	Count of GDSSFRUST	3	3	0	0	0	6
		Percent of GDSSFRUST2	50.00%	50.00%	0.00%	0.00%	0.00%	100.00%
2 Count of GDSSFRUST			8	5	2	0	0	15
2 Percent of GDSSFRUST2			53.33%	33.33%	13.33%	0.00%	0.00%	100.00%
4	A	Count of GDSSFRUST	4	3	0	0	0	7
		Percent of GDSSFRUST2	57.14%	42.86%	0.00%	0.00%	0.00%	100.00%
	B	Count of GDSSFRUST	4	0	4	1	0	9
		Percent of GDSSFRUST2	44.44%	0.00%	44.44%	11.11%	0.00%	100.00%
4 Count of GDSSFRUST			8	3	4	1	0	16
4 Percent of GDSSFRUST2			50.00%	18.75%	25.00%	6.25%	0.00%	100.00%
5	A	Count of GDSSFRUST	4	2	1	0	0	7
		Percent of GDSSFRUST2	57.14%	28.57%	14.29%	0.00%	0.00%	100.00%
5 Count of GDSSFRUST			4	2	1	0	0	7
5 Percent of GDSSFRUST2			57.14%	28.57%	14.29%	0.00%	0.00%	100.00%
6	A	Count of GDSSFRUST	4	3	0	0	0	7
		Percent of GDSSFRUST2	57.14%	42.86%	0.00%	0.00%	0.00%	100.00%
6 Count of GDSSFRUST			4	3	0	0	0	7
6 Percent of GDSSFRUST2			57.14%	42.86%	0.00%	0.00%	0.00%	100.00%
Total Count of GDSSFRUST			24	13	7	1	0	45
Total Percent of GDSSFRUST2			53.33%	28.89%	15.56%	2.22%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	
1	2	3	4	Blank
53.33%	28.89%	15.56%	2.22%	0.00%



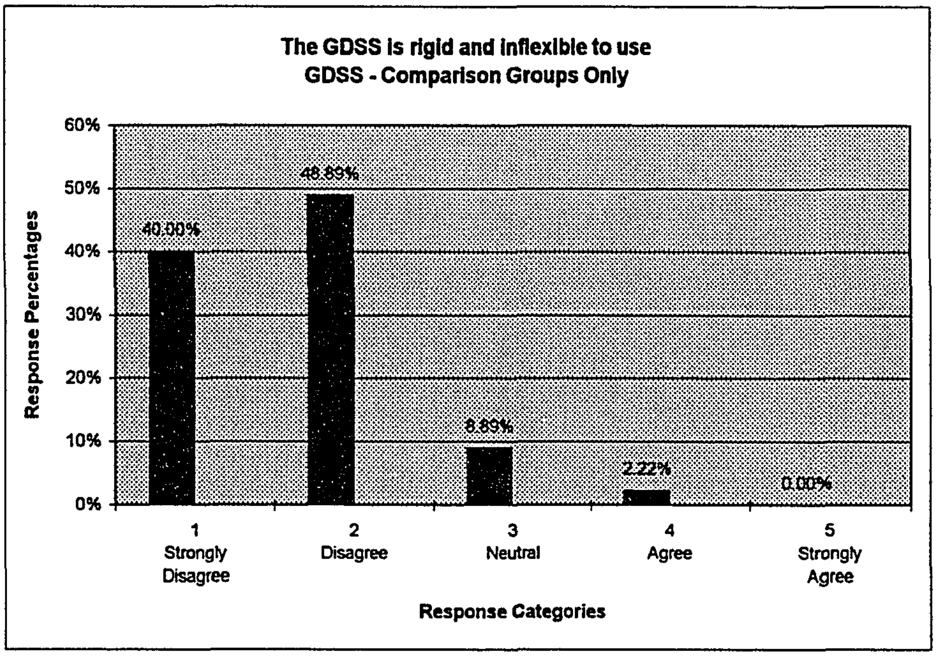
"Working with GDSS is often frustrating."
Figure 29

The GDSS is rigid and inflexible to use
GDSS - Comparison Groups Only
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS is Rigid and Inflexible - Counts and Percentages for Each Cluster, Each Group and Total Participants

Problem	(All)

			GDSSRIGID					
Group	Cluster	Data	1	2	3	4	(blank)	Grand Total
2	A	Count of GDSSRIGID	4	4	0	1	0	9
		Percent of GDSSRIGID	44.44%	44.44%	0.00%	11.11%	0.00%	100.00%
	B	Count of GDSSRIGID	2	4	0	0	0	6
		Percent of GDSSRIGID	33.33%	66.67%	0.00%	0.00%	0.00%	100.00%
2 Count of GDSSRIGID			6	8	0	1	0	15
2 Percent of GDSSRIGID			40.00%	53.33%	0.00%	6.67%	0.00%	100.00%
4	A	Count of GDSSRIGID	4	3	0	0	0	7
		Percent of GDSSRIGID	57.14%	42.86%	0.00%	0.00%	0.00%	100.00%
	B	Count of GDSSRIGID	3	4	2	0	0	9
		Percent of GDSSRIGID	33.33%	44.44%	22.22%	0.00%	0.00%	100.00%
4 Count of GDSSRIGID			7	7	2	0	0	16
4 Percent of GDSSRIGID			43.75%	43.75%	12.50%	0.00%	0.00%	100.00%
5	A	Count of GDSSRIGID	2	3	2	0	0	7
		Percent of GDSSRIGID	28.57%	42.86%	28.57%	0.00%	0.00%	100.00%
5 Count of GDSSRIGID			2	3	2	0	0	7
5 Percent of GDSSRIGID			28.57%	42.86%	28.57%	0.00%	0.00%	100.00%
6	A	Count of GDSSRIGID	3	4	0	0	0	7
		Percent of GDSSRIGID	42.86%	57.14%	0.00%	0.00%	0.00%	100.00%
6 Count of GDSSRIGID			3	4	0	0	0	7
6 Percent of GDSSRIGID			42.86%	57.14%	0.00%	0.00%	0.00%	100.00%
Total Count of GDSSRIGID			18	22	4	1	0	45
Total Percent of GDSSRIGID			40.00%	48.89%	8.89%	2.22%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
1	2	3	4	5	Blank
40.00%	48.89%	8.89%	2.22%	0.00%	0.00%



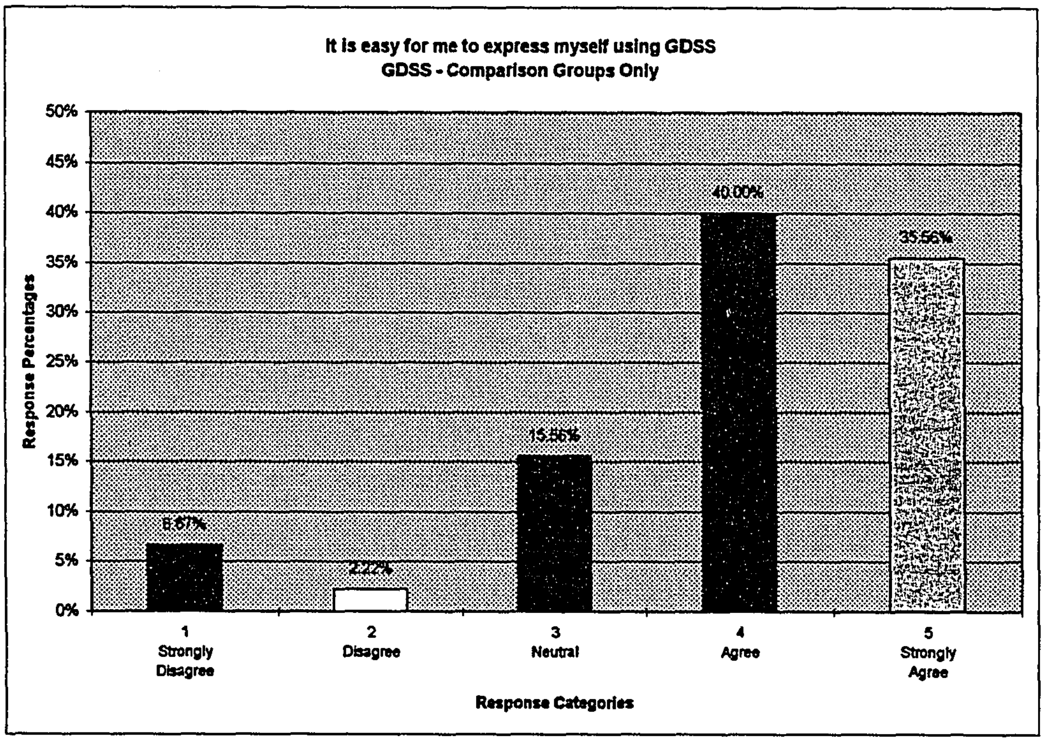
"The GDSS is rigid and inflexible to use."
Figure 30

It is easy for me to express myself using GDSS
GDSS - Comparison Groups Only
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Ease of Expression - Counts and Percentages for Each Cluster, Each Group and Total Participants

Problem	(All)

			GDSSXPRES						
Group	Cluster	Data	1	2	3	4	5	(blank)	Grand Total
2	A	Count of GDSSXPRES	0	0	1	3	5	0	9
		Percent of GDSSXPRES	0.00%	0.00%	11.11%	33.33%	55.56%	0.00%	100.00%
	B	Count of GDSSXPRES	0	0	0	4	2	0	6
		Percent of GDSSXPRES	0.00%	0.00%	0.00%	66.67%	33.33%	0.00%	100.00%
2 Count of GDSSXPRES			0	0	1	7	7	0	15
2 Percent of GDSSXPRES			0.00%	0.00%	6.67%	46.67%	46.67%	0.00%	100.00%
4	A	Count of GDSSXPRES	0	0	0	4	3	0	7
		Percent of GDSSXPRES	0.00%	0.00%	0.00%	57.14%	42.86%	0.00%	100.00%
	B	Count of GDSSXPRES	2	1	1	2	3	0	9
		Percent of GDSSXPRES	22.22%	11.11%	11.11%	22.22%	33.33%	0.00%	100.00%
4 Count of GDSSXPRES			2	1	1	6	6	0	16
4 Percent of GDSSXPRES			12.50%	6.25%	6.25%	37.50%	37.50%	0.00%	100.00%
5	A	Count of GDSSXPRES	0	0	3	3	1	0	7
		Percent of GDSSXPRES	0.00%	0.00%	42.86%	42.86%	14.29%	0.00%	100.00%
5 Count of GDSSXPRES			0	0	3	3	1	0	7
5 Percent of GDSSXPRES			0.00%	0.00%	42.86%	42.86%	14.29%	0.00%	100.00%
6	A	Count of GDSSXPRES	1	0	2	2	2	0	7
		Percent of GDSSXPRES	14.29%	0.00%	28.57%	28.57%	28.57%	0.00%	100.00%
6 Count of GDSSXPRES			1	0	2	2	2	0	7
6 Percent of GDSSXPRES			14.29%	0.00%	28.57%	28.57%	28.57%	0.00%	100.00%
Total Count of GDSSXPRES			3	1	7	18	16	0	45
Total Percent of GDSSXPRES			6.67%	2.22%	15.56%	40.00%	35.56%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
1	2	3	4	5	Blank
6.67%	2.22%	15.56%	40.00%	35.56%	0.00%

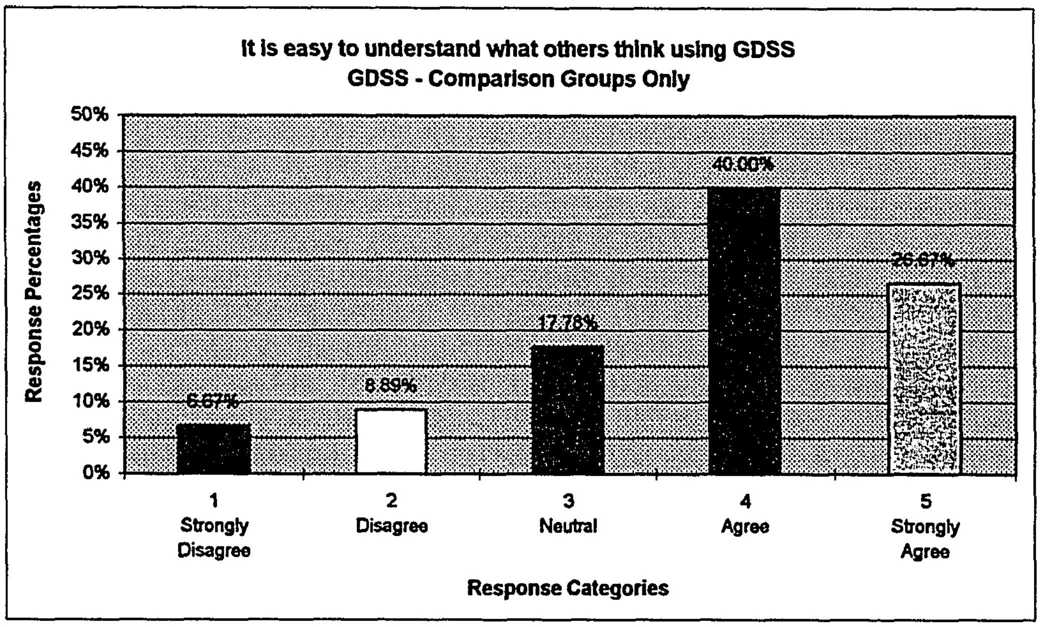


"It is easy for me to express myself using GDSS."
Figure 31

It is easy to understand what others think using GDSS
GDSS - Comparison Groups Only
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Understanding Others - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GDSSOTHERS						
Group	Cluster	Data	1	2	3	4	5	(blank)	Grand Total
2	A	Count of GDSSOTHERS	1	1	1	3	3	0	9
		Count of GDSSOTHERS2	11.11%	11.11%	11.11%	33.33%	33.33%	0.00%	100.00%
	B	Count of GDSSOTHERS	0	0	2	3	1	0	6
		Count of GDSSOTHERS2	0.00%	0.00%	33.33%	50.00%	16.67%	0.00%	100.00%
2 Count of GDSSOTHERS			1	1	3	6	4	0	15
2 Count of GDSSOTHERS2			6.67%	6.67%	20.00%	40.00%	26.67%	0.00%	100.00%
4	A	Count of GDSSOTHERS	0	0	1	3	3	0	7
		Count of GDSSOTHERS2	0.00%	0.00%	14.29%	42.86%	42.86%	0.00%	100.00%
	B	Count of GDSSOTHERS	1	1	2	3	2	0	9
		Count of GDSSOTHERS2	11.11%	11.11%	22.22%	33.33%	22.22%	0.00%	100.00%
4 Count of GDSSOTHERS			1	1	3	6	5	0	16
4 Count of GDSSOTHERS2			6.25%	6.25%	18.75%	37.50%	31.25%	0.00%	100.00%
5	A	Count of GDSSOTHERS	1	1	0	3	2	0	7
		Count of GDSSOTHERS2	14.29%	14.29%	0.00%	42.86%	28.57%	0.00%	100.00%
5 Count of GDSSOTHERS			1	1	0	3	2	0	7
5 Count of GDSSOTHERS2			14.29%	14.29%	0.00%	42.86%	28.57%	0.00%	100.00%
6	A	Count of GDSSOTHERS	0	1	2	3	1	0	7
		Count of GDSSOTHERS2	0.00%	14.29%	28.57%	42.86%	14.29%	0.00%	100.00%
6 Count of GDSSOTHERS			0	1	2	3	1	0	7
6 Count of GDSSOTHERS2			0.00%	14.29%	28.57%	42.86%	14.29%	0.00%	100.00%
Total Count of GDSSOTHERS			3	4	8	18	12	0	45
Total Count of GDSSOTHERS2			6.67%	8.89%	17.78%	40.00%	26.67%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
1	2	3	4	5	Blank
6.67%	8.89%	17.78%	40.00%	26.67%	0.00%



"It is easy to understand what others think using GDSS."
Figure 32

Satisfaction with Product

Participants were asked to respond to a series of statements designed to measure their satisfaction with their cluster's product. Three statements were offered.

"I have confidence in our group's recommendations." Students in the GDSS groups showed a high degree of confidence (Figure 33). No-one Strongly Disagreed, and only 11.11% Disagreed. The Neutral responses accounted for only 13.33%. Over 75% showed agreement; 64.44% Agreed with the statement and 11.11% Strongly Agreed. Students in the Face-to-Face groups expressed a slightly higher degree of confidence. No one Strongly Disagreed with the statement, and only 3 people, or 6.52% Disagreed. The Neutral opinions comprised only 10.87%, and 58.70% Agreed. Finally, 23.91% Strongly Agreed. See Figure 34.

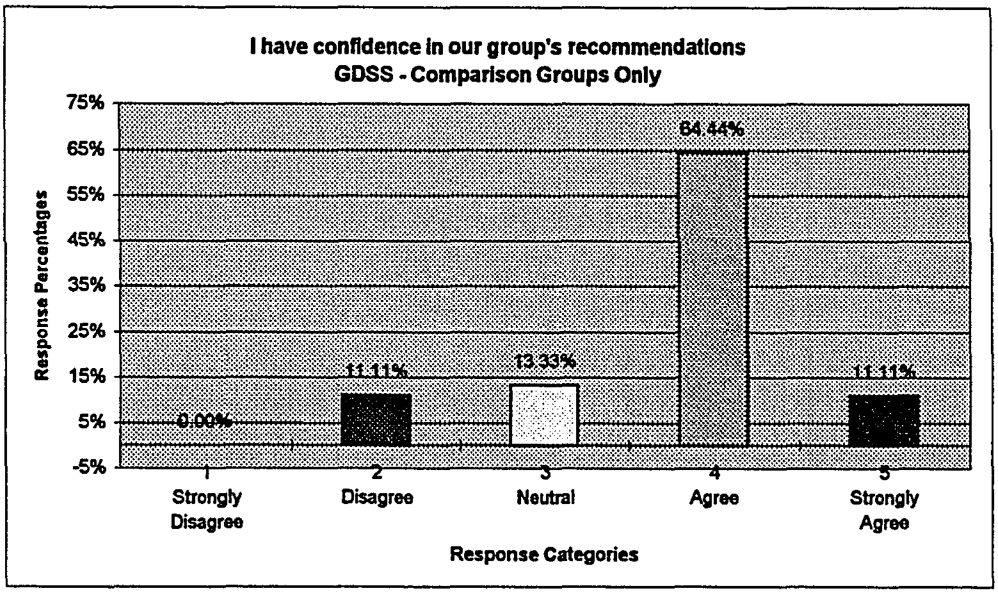
"I am sure our model will be useful for others to follow." In commenting on their GDSS experience, no one Strongly Disagreed with this statement (Figure 35). 8.89% Disagreed, and a full 20.00% were Neutral. Responses further indicated that 55.56% Agreed, and 15.56% Strongly Agreed. Responses from the Face-to-Face groups were similarly positive. No one Strongly Disagreed, and only 10.87% Disagreed. The Neutral responses comprised 10.87%, and 47.83% Agreed. A full 30.43% Strongly Agreed. See Figure 36.

"Our rating, subgrouping and categorizing were thorough enough for good recommendations." Responses from the GDSS group indicated that 1 student, or 2.22% Strongly Disagreed. 8.89% Disagreed, and 17.78% were Neutral (Figure 37). In terms of agreement, 53.33% Agreed, and 17.78% Strongly Agreed. Responses

GDSS - I have confidence in our group's recommendations
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Confidence in Recommendations - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GPRODCONF					
Group	Cluster	Data	2	3	4	5	(blank)	Grand Total
2	A	Count of G	0	1	8	0	0	9
		Count of G	0.00%	11.11%	88.89%	0.00%	0.00%	100.00%
	B	Count of G	0	2	4	0	0	6
		Count of G	0.00%	33.33%	66.67%	0.00%	0.00%	100.00%
2 Count of GPRODCONF			0	3	12	0	0	15
2 Count of GPRODCONF2			0.00%	20.00%	80.00%	0.00%	0.00%	100.00%
4	A	Count of G	1	0	4	2	0	7
		Count of G	14.29%	0.00%	57.14%	28.57%	0.00%	100.00%
	B	Count of G	2	2	4	1	0	9
		Count of G	22.22%	22.22%	44.44%	11.11%	0.00%	100.00%
4 Count of GPRODCONF			3	2	8	3	0	16
4 Count of GPRODCONF2			18.75%	12.50%	50.00%	18.75%	0.00%	100.00%
5	A	Count of G	1	0	5	1	0	7
		Count of G	14.29%	0.00%	71.43%	14.29%	0.00%	100.00%
5 Count of GPRODCONF			1	0	5	1	0	7
5 Count of GPRODCONF2			14.29%	0.00%	71.43%	14.29%	0.00%	100.00%
6	A	Count of G	1	1	4	1	0	7
		Count of G	14.29%	14.29%	57.14%	14.29%	0.00%	100.00%
6 Count of GPRODCONF			1	1	4	1	0	7
6 Count of GPRODCONF2			14.29%	14.29%	57.14%	14.29%	0.00%	100.00%
Total Count of GPRODCONF			5	6	29	5	0	45
Total Count of GPRODCONF2			11.11%	13.33%	64.44%	11.11%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
0.00%	11.11%	13.33%	64.44%	11.11%



GDSS Groups: "I have confidence in our group's recommendations."
Figure 33

Non-GDSS - I have confidence in our group's recommendations
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Confidence in Recommendations - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GPRODCONF				
Group	Cluster	Data	2	3	4	5	Grand Total
2	A	Count of GPRODCONF	0	0	6	3	9
		Percent of GPRODCONF	0.00%	0.00%	66.67%	33.33%	100.00%
	B	Count of GPRODCONF	2	0	3	1	6
		Percent of GPRODCONF	33.33%	0.00%	50.00%	16.67%	100.00%
2 Count of GPRODCONF			2	0	9	4	15
2 Percent of GPRODCONF			13.33%	0.00%	60.00%	26.67%	100.00%
4	A	Count of GPRODCONF	0	2	4	2	8
		Percent of GPRODCONF	0.00%	25.00%	50.00%	25.00%	100.00%
	B	Count of GPRODCONF	0	2	4	3	9
		Percent of GPRODCONF	0.00%	22.22%	44.44%	33.33%	100.00%
4 Count of GPRODCONF			0	4	8	5	17
4 Percent of GPRODCONF			0.00%	23.53%	47.06%	29.41%	100.00%
5	A	Count of GPRODCONF	0	1	5	1	7
		Percent of GPRODCONF	0.00%	14.29%	71.43%	14.29%	100.00%
5 Count of GPRODCONF			0	1	5	1	7
5 Percent of GPRODCONF			0.00%	14.29%	71.43%	14.29%	100.00%
6	A	Count of GPRODCONF	1	0	5	1	7
		Percent of GPRODCONF	14.29%	0.00%	71.43%	14.29%	100.00%
6 Count of GPRODCONF			1	0	5	1	7
6 Percent of GPRODCONF			14.29%	0.00%	71.43%	14.29%	100.00%
Total Count of GPRODCONF			3	5	27	11	46
Total Percent of GPRODCONF			6.52%	10.87%	58.70%	23.91%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
0.00%	6.52%	10.87%	58.70%	23.91%

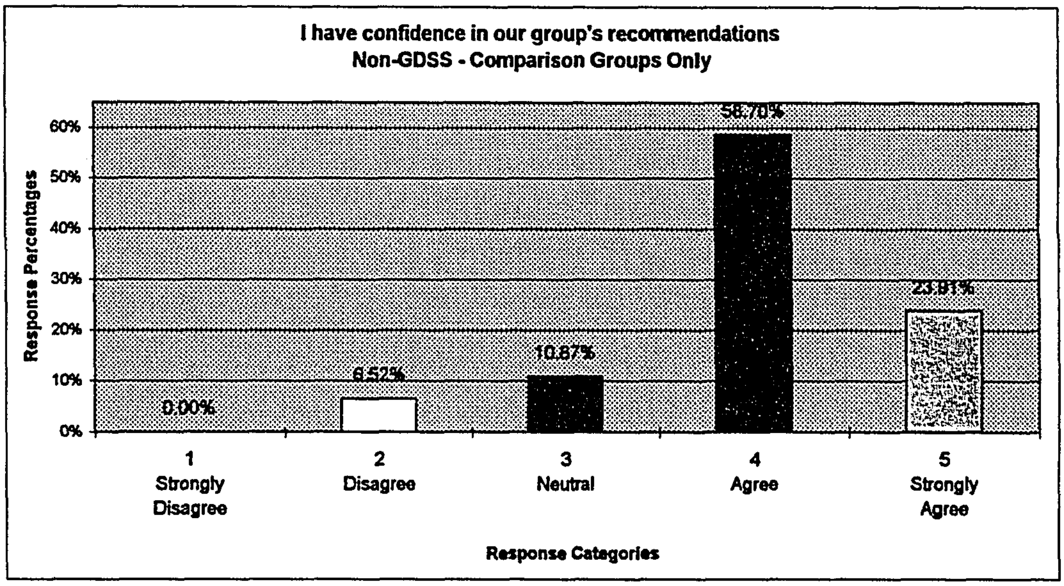
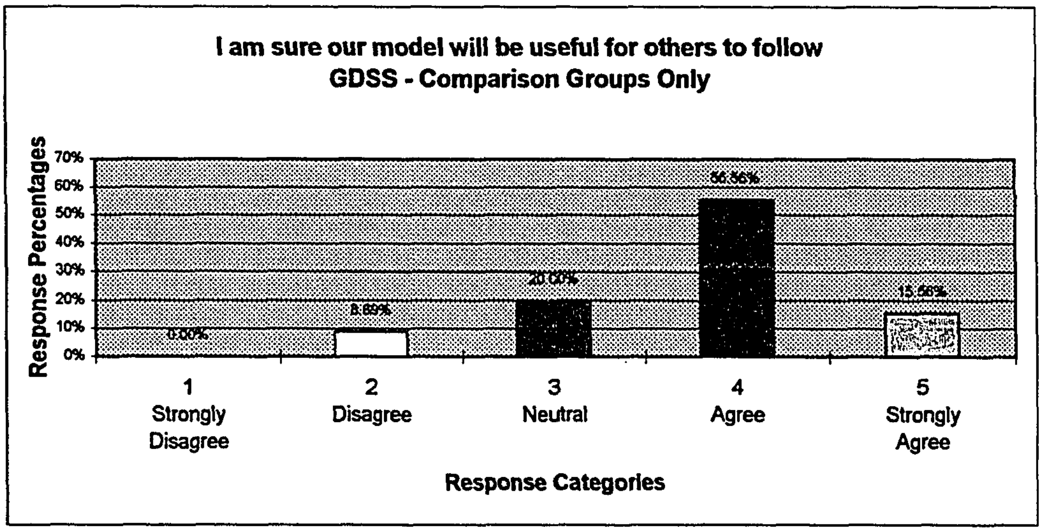


Figure 34

GDSS - I am sure our model will be useful for others to follow
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Model Useful for Others - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GPRODUSE					
Group	Cluster	Data	2	3	4	5	(blank)	Grand Total
2	A	Count of GPRODUSE	0	2	5	2	0	9
		Count of GPRODUSE2	0.00%	22.22%	55.56%	22.22%	0.00%	100.00%
	B	Count of GPRODUSE	1	1	4	0	0	6
		Count of GPRODUSE2	16.67%	16.67%	66.67%	0.00%	0.00%	100.00%
2 Count of GPRODUSE			1	3	9	2	0	15
2 Count of GPRODUSE2			6.67%	20.00%	60.00%	13.33%	0.00%	100.00%
4	A	Count of GPRODUSE	1	0	4	2	0	7
		Count of GPRODUSE2	14.29%	0.00%	57.14%	28.57%	0.00%	100.00%
	B	Count of GPRODUSE	2	3	3	1	0	9
		Count of GPRODUSE2	22.22%	33.33%	33.33%	11.11%	0.00%	100.00%
4 Count of GPRODUSE			3	3	7	3	0	16
4 Count of GPRODUSE2			18.75%	18.75%	43.75%	18.75%	0.00%	100.00%
5	A	Count of GPRODUSE	0	1	5	1	0	7
		Count of GPRODUSE2	0.00%	14.29%	71.43%	14.29%	0.00%	100.00%
5 Count of GPRODUSE			0	1	5	1	0	7
5 Count of GPRODUSE2			0.00%	14.29%	71.43%	14.29%	0.00%	100.00%
6	A	Count of GPRODUSE	0	2	4	1	0	7
		Count of GPRODUSE2	0.00%	28.57%	57.14%	14.29%	0.00%	100.00%
6 Count of GPRODUSE			0	2	4	1	0	7
6 Count of GPRODUSE2			0.00%	28.57%	57.14%	14.29%	0.00%	100.00%
Total Count of GPRODUSE			4	9	25	7	0	45
Total Count of GPRODUSE2			8.89%	20.00%	55.56%	15.56%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
0.00%	8.89%	20.00%	55.56%	15.56%

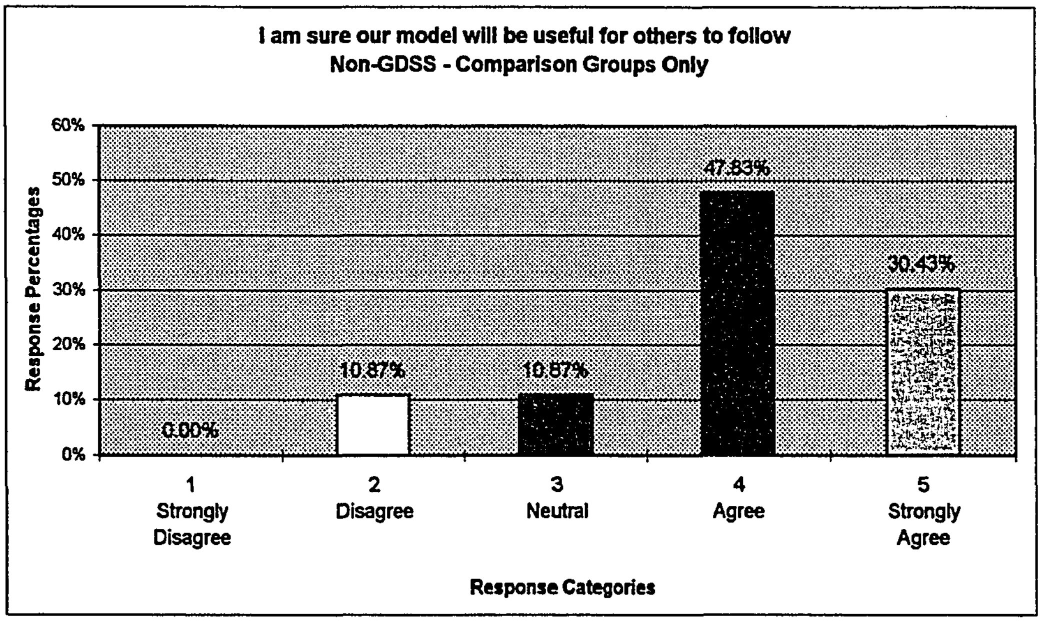


GDSS: "I am sure our model will be useful for others to follow."
Figure 35

Non-GDSS - I am sure our model will be useful for others to follow
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Model Useful for Others - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GPRODUSE				
Group	Cluster	Data	2	3	4	5	Grand Total
2	A	Count of GPRODUSE	0	0	4	5	9
		Percent of GPRODUSE	0.00%	0.00%	44.44%	55.56%	100.00%
	B	Count of GPRODUSE	1	2	2	1	6
		Percent of GPRODUSE	16.67%	33.33%	33.33%	16.67%	100.00%
2 Count of GPRODUSE			1	2	6	6	15
2 Percent of GPRODUSE			6.67%	13.33%	40.00%	40.00%	100.00%
4	A	Count of GPRODUSE	2	1	3	2	8
		Percent of GPRODUSE	25.00%	12.50%	37.50%	25.00%	100.00%
	B	Count of GPRODUSE	1	0	4	4	9
		Percent of GPRODUSE	11.11%	0.00%	44.44%	44.44%	100.00%
4 Count of GPRODUSE			3	1	7	6	17
4 Percent of GPRODUSE			17.65%	5.88%	41.18%	35.29%	100.00%
5	A	Count of GPRODUSE	0	2	5	0	7
		Percent of GPRODUSE	0.00%	28.57%	71.43%	0.00%	100.00%
5 Count of GPRODUSE			0	2	5	0	7
5 Percent of GPRODUSE			0.00%	28.57%	71.43%	0.00%	100.00%
6	A	Count of GPRODUSE	1	0	4	2	7
		Percent of GPRODUSE	14.29%	0.00%	57.14%	28.57%	100.00%
6 Count of GPRODUSE			1	0	4	2	7
6 Percent of GPRODUSE			14.29%	0.00%	57.14%	28.57%	100.00%
Total Count of GPRODUSE			5	5	22	14	46
Total Percent of GPRODUSE			10.87%	10.87%	47.83%	30.43%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
0.00%	10.87%	10.87%	47.83%	30.43%

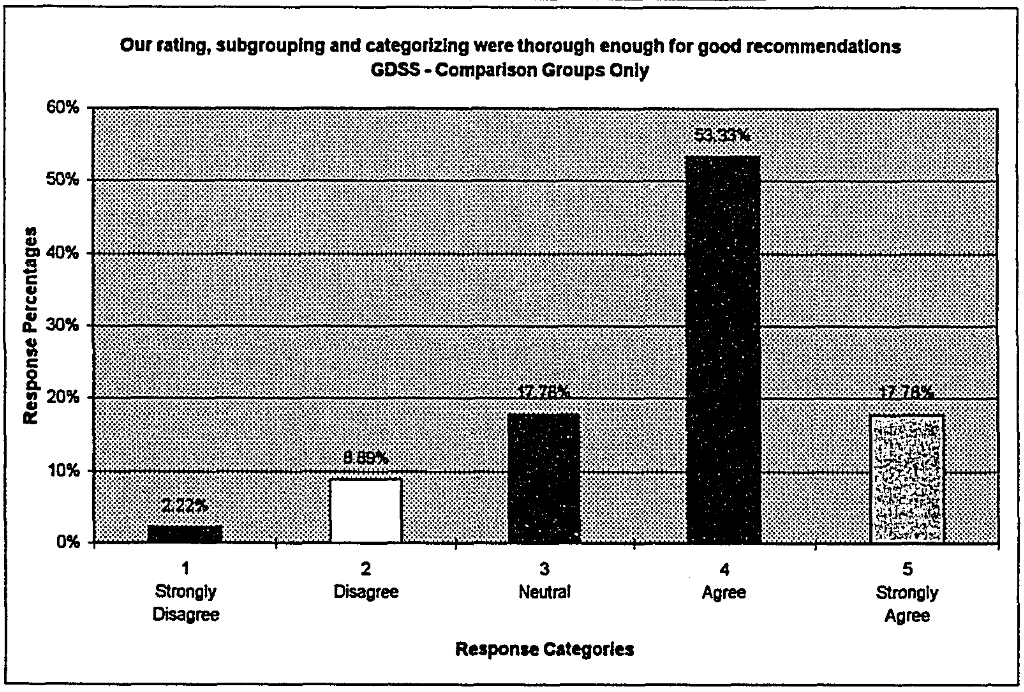


Non-GDSS: "I am sure our model will be useful for others to follow."
Figure 36

GDSS - Our rating, subgrouping and categorizing were thorough enough for good recommendations
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Convergence for Good Recommendations - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GPRODSTRUCT						
Group	Cluster	Data	1	2	3	4	5	(blank)	Grand Total
2	A	Count of GPRODSTRUCT	0	0	2	5	2	0	9
		Count of GPRODSTRUCT2	0.00%	0.00%	22.22%	55.56%	22.22%	0.00%	100.00%
	B	Count of GPRODSTRUCT	0	1	1	3	1	0	6
		Count of GPRODSTRUCT2	0.00%	16.67%	16.67%	50.00%	16.67%	0.00%	100.00%
2 Count of GPRODSTRUCT			0	1	3	8	3	0	15
2 Count of GPRODSTRUCT2			0.00%	6.67%	20.00%	53.33%	20.00%	0.00%	100.00%
4	A	Count of GPRODSTRUCT	0	0	1	5	1	0	7
		Count of GPRODSTRUCT2	0.00%	0.00%	14.29%	71.43%	14.29%	0.00%	100.00%
	B	Count of GPRODSTRUCT	1	1	3	3	1	0	9
		Count of GPRODSTRUCT2	11.11%	11.11%	33.33%	33.33%	11.11%	0.00%	100.00%
4 Count of GPRODSTRUCT			1	1	4	8	2	0	16
4 Count of GPRODSTRUCT2			6.25%	6.25%	25.00%	50.00%	12.50%	0.00%	100.00%
5	A	Count of GPRODSTRUCT	0	1	0	4	2	0	7
		Count of GPRODSTRUCT2	0.00%	14.29%	0.00%	57.14%	28.57%	0.00%	100.00%
5 Count of GPRODSTRUCT			0	1	0	4	2	0	7
5 Count of GPRODSTRUCT2			0.00%	14.29%	0.00%	57.14%	28.57%	0.00%	100.00%
6	A	Count of GPRODSTRUCT	0	1	1	4	1	0	7
		Count of GPRODSTRUCT2	0.00%	14.29%	14.29%	57.14%	14.29%	0.00%	100.00%
6 Count of GPRODSTRUCT			0	1	1	4	1	0	7
6 Count of GPRODSTRUCT2			0.00%	14.29%	14.29%	57.14%	14.29%	0.00%	100.00%
Total Count of GPRODSTRUCT			1	4	8	24	8	0	45
Total Count of GPRODSTRUCT2			2.22%	8.89%	17.78%	53.33%	17.78%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
2.22%	8.89%	17.78%	53.33%	17.78%



GDSS: "Our rating, subgrouping and categorizing were thorough enough for good recommendations."

Figure 37

from the Face-to-Face group were again positive. One person, or 2.17% Strongly Disagreed, and 3 persons, or 6.52% Disagreed. Students with a Neutral opinion comprised 23.91% of responses, and 47.83% Agreed. Another 19.57% Strongly Agreed to this statement. See Figure 38.

Personal Satisfaction

In order to measure the personal satisfaction that the participants derived from their respective group experiences, the subjects were asked to respond to six different statements. Again, responses were elicited immediately after each group meeting.

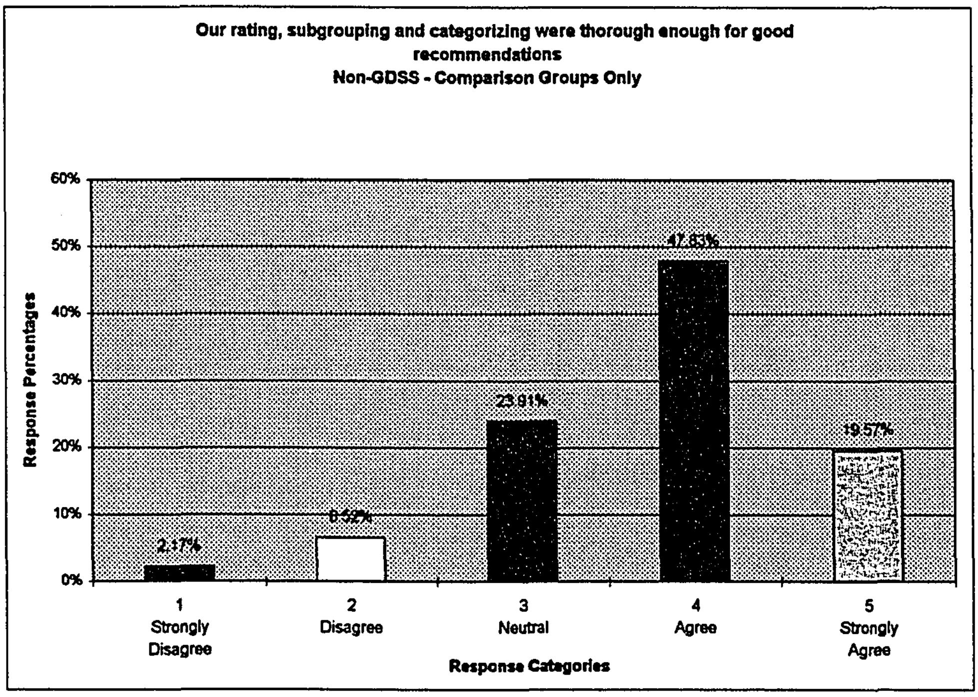
"I feel that the final model reflects my inputs." Responses from the GDSS groups indicted that 4.44% indicated both Strong Disagreement and Disagreement (Figure 39). Over one quarter (26.67%) were Neutral. Subjects further indicated that 55.56% were in Agreement, and 6.67% Strongly Agreed. Responses from the non-GDSS, or Face-to-Face groups, were markedly more positive. Only 8.70% Strongly Disagreed, and no-one Disagreed. The Neutral responses were limited to 10.87%, and a full 67.39% Agreed. Finally, 13.04% Strongly Agreed. See Figure 40.

"I feel that my time in the group was productive." Responses to this statement indicated that well over eighty percent of GDSS participants felt their time was productive (Figure 41). Only 2.22% responded with Strongly Disagree, or with Disagree. The Neutral responses comprised 11.11%, and 53.33% Agreed. Over 30% (31.11%) Strongly Agreed. Responses from the Face-to-Face groups were similar. No-one Strongly Disagreed, and only one person, or 2.17% Disagreed. Another

Non-GDSS - Our rating, subgrouping and categorizing were thorough enough for good recommendations
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Convergence for Good Recommendations - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GPRODSTRUCT					
Group	Cluster	Data	1	2	3	4	5	Grand Total
2	A	Count of GPRODSTRUCT	0	0	1	5	3	9
		Percent of GPRODSTRUCT	0.00%	0.00%	11.11%	55.56%	33.33%	100.00%
	B	Count of GPRODSTRUCT	0	1	0	4	1	6
		Percent of GPRODSTRUCT	0.00%	16.67%	0.00%	66.67%	16.67%	100.00%
2 Count of GPRODSTRUCT			0	1	1	9	4	15
2 Percent of GPRODSTRUCT			0.00%	6.67%	6.67%	60.00%	26.67%	100.00%
4	A	Count of GPRODSTRUCT	1	0	1	6	0	8
		Percent of GPRODSTRUCT	12.50%	0.00%	12.50%	75.00%	0.00%	100.00%
	B	Count of GPRODSTRUCT	0	0	2	4	3	9
		Percent of GPRODSTRUCT	0.00%	0.00%	22.22%	44.44%	33.33%	100.00%
4 Count of GPRODSTRUCT			1	0	3	10	3	17
4 Percent of GPRODSTRUCT			5.88%	0.00%	17.65%	58.82%	17.65%	100.00%
5	A	Count of GPRODSTRUCT	0	1	4	1	1	7
		Percent of GPRODSTRUCT	0.00%	14.29%	57.14%	14.29%	14.29%	100.00%
5 Count of GPRODSTRUCT			0	1	4	1	1	7
5 Percent of GPRODSTRUCT			0.00%	14.29%	57.14%	14.29%	14.29%	100.00%
6	A	Count of GPRODSTRUCT	0	1	3	2	1	7
		Percent of GPRODSTRUCT	0.00%	14.29%	42.86%	28.57%	14.29%	100.00%
6 Count of GPRODSTRUCT			0	1	3	2	1	7
6 Percent of GPRODSTRUCT			0.00%	14.29%	42.86%	28.57%	14.29%	100.00%
Total Count of GPRODSTRUCT			1	3	11	22	9	46
Total Percent of GPRODSTRUCT			2.17%	6.52%	23.91%	47.83%	19.57%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
2.17%	6.52%	23.91%	47.83%	19.57%

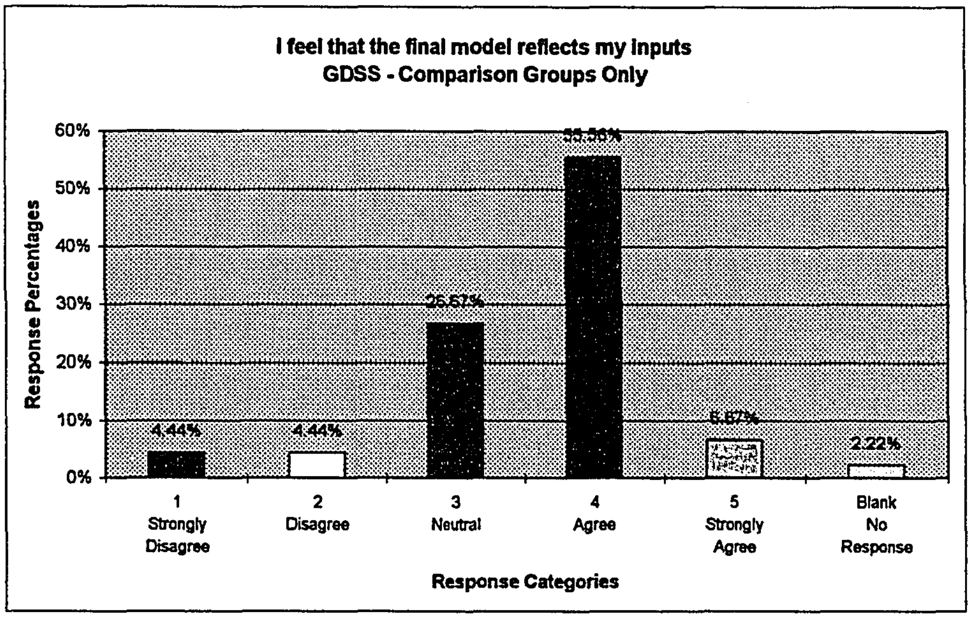


Non-GDSS: "Our rating, subgrouping and categorizing were thorough enough for good recommendations."
Figure 38

GDSS - I feel that the final model reflects my inputs
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Input into Final Model - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GMYINPUT							
Group	Cluster	Data	1	2	3	4	5	NONE	(blank)	Grand Total
2	A	Count of GMYINPUT	0	0	3	5	1	0	0	9
		Count of GMYINPUT2	0.00%	0.00%	33.33%	55.56%	11.11%	0.00%	0.00%	100.00%
	B	Count of GMYINPUT	0	0	3	3	0	0	0	6
		Count of GMYINPUT2	0.00%	0.00%	50.00%	50.00%	0.00%	0.00%	0.00%	100.00%
2 Count of GMYINPUT			0	0	6	8	1	0	0	15
2 Count of GMYINPUT2			0.00%	0.00%	40.00%	53.33%	6.67%	0.00%	0.00%	100.00%
4	A	Count of GMYINPUT	0	0	2	4	1	0	0	7
		Count of GMYINPUT2	0.00%	0.00%	28.57%	57.14%	14.29%	0.00%	0.00%	100.00%
	B	Count of GMYINPUT	1	1	1	4	1	1	0	9
		Count of GMYINPUT2	11.11%	11.11%	11.11%	44.44%	11.11%	11.11%	0.00%	100.00%
4 Count of GMYINPUT			1	1	3	8	2	1	0	16
4 Count of GMYINPUT2			6.25%	6.25%	18.75%	50.00%	12.50%	6.25%	0.00%	100.00%
5	A	Count of GMYINPUT	1	1	2	3	0	0	0	7
		Count of GMYINPUT2	14.29%	14.29%	28.57%	42.86%	0.00%	0.00%	0.00%	100.00%
5 Count of GMYINPUT			1	1	2	3	0	0	0	7
5 Count of GMYINPUT2			14.29%	14.29%	28.57%	42.86%	0.00%	0.00%	0.00%	100.00%
6	A	Count of GMYINPUT	0	0	1	6	0	0	0	7
		Count of GMYINPUT2	0.00%	0.00%	14.29%	85.71%	0.00%	0.00%	0.00%	100.00%
6 Count of GMYINPUT			0	0	1	6	0	0	0	7
6 Count of GMYINPUT2			0.00%	0.00%	14.29%	85.71%	0.00%	0.00%	0.00%	100.00%
Total Count of GMYINPUT			2	2	12	25	3	1	0	45
Total Count of GMYINPUT2			4.44%	4.44%	26.67%	55.56%	6.67%	2.22%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
4.44%	4.44%	26.67%	55.56%	6.67%	2.22%

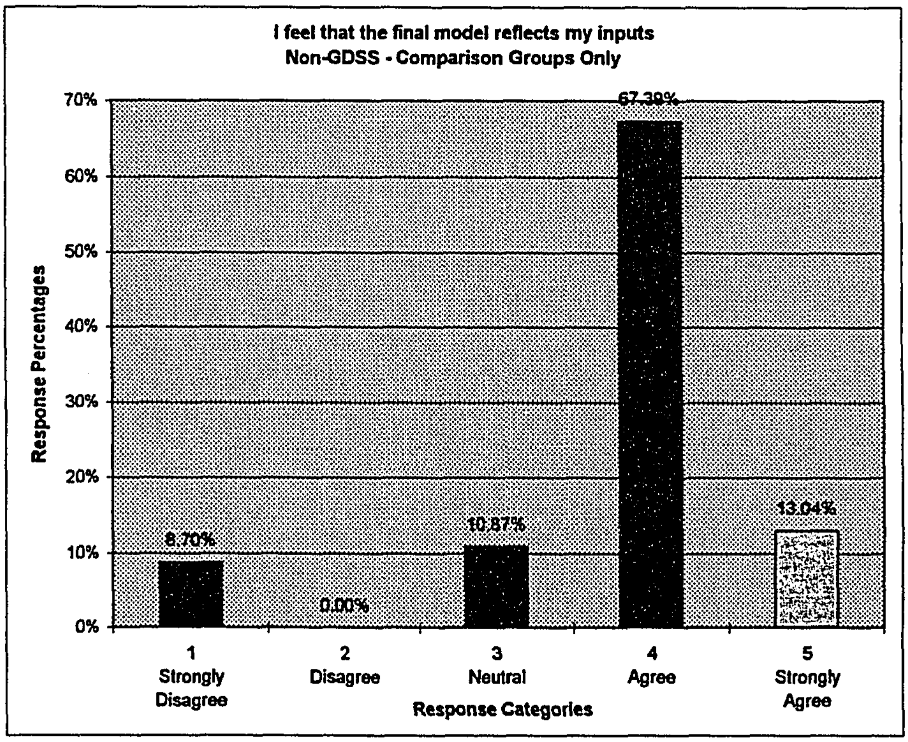


GDSS: "I feel that the final model reflects my inputs."
Figure 39

Non-GDSS - I feel that the final model reflects my inputs
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Input into Final Model - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GMYINPUT				
Group	Cluster	Data	1	3	4	5	Grand Total
2	A	Count of GMYINPUT	0	1	6	2	9
		Percent of GMYINPUT	0.00%	11.11%	66.67%	22.22%	100.00%
	B	Count of GMYINPUT	1	0	4	1	6
		Percent of GMYINPUT	16.67%	0.00%	66.67%	16.67%	100.00%
2 Count of GMYINPUT			1	1	10	3	15
2 Percent of GMYINPUT			6.67%	6.67%	66.67%	20.00%	100.00%
4	A	Count of GMYINPUT	1	1	5	1	8
		Percent of GMYINPUT	12.50%	12.50%	62.50%	12.50%	100.00%
	B	Count of GMYINPUT	0	1	8	0	9
		Percent of GMYINPUT	0.00%	11.11%	88.89%	0.00%	100.00%
4 Count of GMYINPUT			1	2	13	1	17
4 Percent of GMYINPUT			5.88%	11.76%	76.47%	5.88%	100.00%
5	A	Count of GMYINPUT	1	2	3	1	7
		Percent of GMYINPUT	14.29%	28.57%	42.86%	14.29%	100.00%
5 Count of GMYINPUT			1	2	3	1	7
5 Percent of GMYINPUT			14.29%	28.57%	42.86%	14.29%	100.00%
6	A	Count of GMYINPUT	1	0	5	1	7
		Percent of GMYINPUT	14.29%	0.00%	71.43%	14.29%	100.00%
6 Count of GMYINPUT			1	0	5	1	7
6 Percent of GMYINPUT			14.29%	0.00%	71.43%	14.29%	100.00%
Total Count of GMYINPUT			4	5	31	6	46
Total Percent of GMYINPUT			8.70%	10.87%	67.39%	13.04%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
8.70%	0.00%	10.87%	67.39%	13.04%

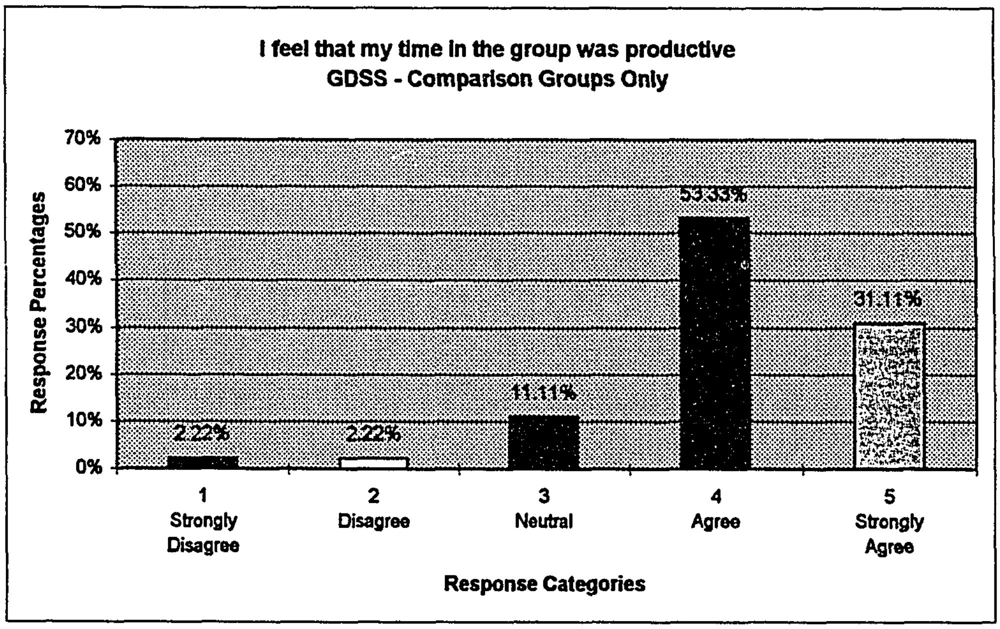


Non-GDSS: "I feel the final model reflects my inputs."
Figure 40

GDSS - I feel that my time in the group was productive
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Productive Time in the Group - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GTIMEGOOD						
Group	Cluster	Data	1	2	3	4	5	(blank)	Grand Total
2	A	Count of GTIMEGOOD	0	0	1	3	5	0	9
		Count of GTIMEGOOD2	0.00%	0.00%	11.11%	33.33%	55.56%	0.00%	100.00%
	B	Count of GTIMEGOOD	0	0	1	5	0	0	6
		Count of GTIMEGOOD2	0.00%	0.00%	16.67%	83.33%	0.00%	0.00%	100.00%
2 Count of GTIMEGOOD			0	0	2	8	5	0	15
2 Count of GTIMEGOOD2			0.00%	0.00%	13.33%	53.33%	33.33%	0.00%	100.00%
4	A	Count of GTIMEGOOD	0	0	0	4	3	0	7
		Count of GTIMEGOOD2	0.00%	0.00%	0.00%	57.14%	42.86%	0.00%	100.00%
	B	Count of GTIMEGOOD	1	1	1	3	3	0	9
		Count of GTIMEGOOD2	11.11%	11.11%	11.11%	33.33%	33.33%	0.00%	100.00%
4 Count of GTIMEGOOD			1	1	1	7	6	0	16
4 Count of GTIMEGOOD2			6.25%	6.25%	6.25%	43.75%	37.50%	0.00%	100.00%
5	A	Count of GTIMEGOOD	0	0	1	4	2	0	7
		Count of GTIMEGOOD2	0.00%	0.00%	14.29%	57.14%	28.57%	0.00%	100.00%
5 Count of GTIMEGOOD			0	0	1	4	2	0	7
5 Count of GTIMEGOOD2			0.00%	0.00%	14.29%	57.14%	28.57%	0.00%	100.00%
6	A	Count of GTIMEGOOD	0	0	1	5	1	0	7
		Count of GTIMEGOOD2	0.00%	0.00%	14.29%	71.43%	14.29%	0.00%	100.00%
6 Count of GTIMEGOOD			0	0	1	5	1	0	7
6 Count of GTIMEGOOD2			0.00%	0.00%	14.29%	71.43%	14.29%	0.00%	100.00%
Total Count of GTIMEGOOD			1	1	5	24	14	0	45
Total Count of GTIMEGOOD2			2.22%	2.22%	11.11%	53.33%	31.11%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
2.22%	2.22%	11.11%	53.33%	31.11%	0.00%



GDSS: "I feel the final model reflects my inputs."
Figure 41

13.04% were Neutral. Again, 54.35% Agreed, and 30.43% Strongly Agreed. See Figure 42 for comparison.

"I enjoyed working with this group." Responses from the GDSS groups showed that only one person each, or 2.22% responded to Strongly Disagree and Disagree (Figure 43). Students indicating a Neutral opinion comprised 15.56% of the GDSS population. In Agreement were 42.22% of responses, and 37.78% Strongly Agreed. Students in the Face-to-Face groups had no-one Strongly Disagreeing or Disagreeing, and 15.22% undecided or Neutral. Another 56.52% Agreed, and 28.26% Strongly Agreed that they had enjoyed working with their group. See Figure 44 for numbers and percentages.

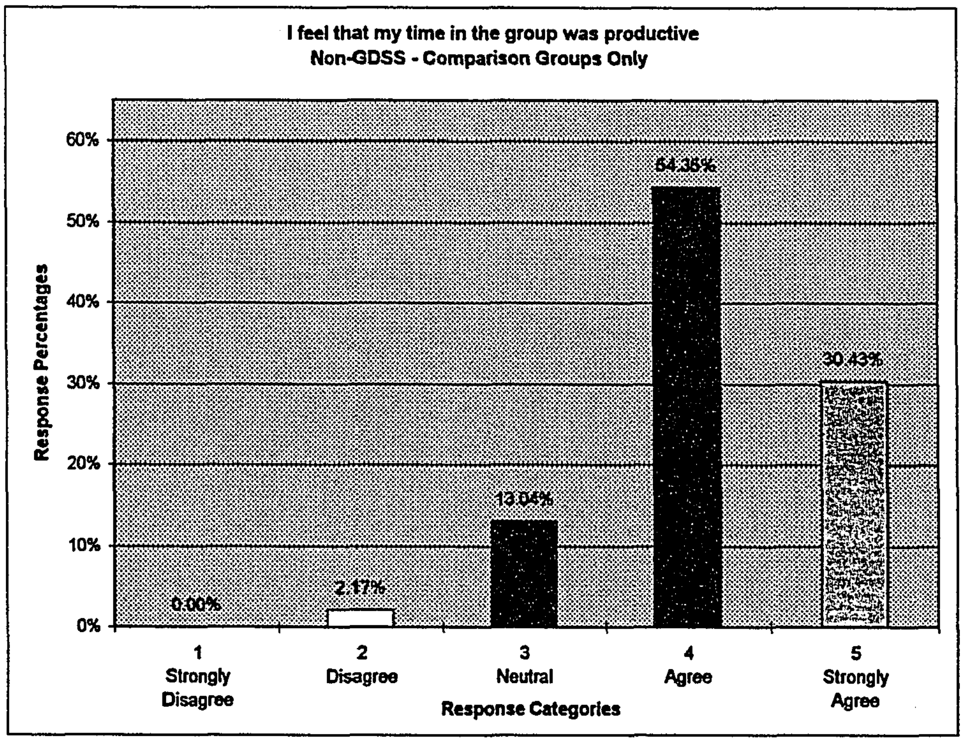
"I felt comfortable to disagree with other members' ideas." Responses from the GDSS groups indicated that only one person (2.22%) Strongly Disagreed, and no-one Disagreed (Figure 45). A full 22.22% were Neutral, and 40.00% Agreed. A percentage of 35.56% Strongly Agreed with this statement. Responses from the Face-to-Face groups showed no Strong Disagreement, and 6.52% Disagreement. Responses indicated 30.43% were Neutral, and 34.78% Agreed. Another 28.26% Strongly Agreed that they felt comfortable to Disagree. See Figure 46.

"I freely offered my own ideas." The GDSS responses indicated strong agreement with this statement. One person (2.22%) Strongly Disagreed, and no-one Disagreed. Only two persons (4.44%) were Neutral. Responses indicating Agreement comprised 40.00%, and a full 53.33% indicated Strong Agreement. See Figure 47. The Non-GDSS, or Face-to-Face groups, were only slightly less positive. Also, while

Non-GDSS - I feel that my time in the group was productive
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Productive Time in the Group - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GTIMEGOOD				
Group	Cluster	Data	2	3	4	5	Grand Total
2	A	Count of GTIMEGOOD	0	0	4	5	9
		Percent of GTIMEGOOD	0.00%	0.00%	44.44%	55.56%	100.00%
	B	Count of GTIMEGOOD	0	1	4	1	6
		Percent of GTIMEGOOD	0.00%	16.67%	66.67%	16.67%	100.00%
2 Count of GTIMEGOOD			0	1	8	6	15
2 Percent of GTIMEGOOD			0.00%	6.67%	53.33%	40.00%	100.00%
4	A	Count of GTIMEGOOD	0	2	4	2	8
		Percent of GTIMEGOOD	0.00%	25.00%	50.00%	25.00%	100.00%
	B	Count of GTIMEGOOD	0	0	7	2	9
		Percent of GTIMEGOOD	0.00%	0.00%	77.78%	22.22%	100.00%
4 Count of GTIMEGOOD			0	2	11	4	17
4 Percent of GTIMEGOOD			0.00%	11.76%	64.71%	23.53%	100.00%
5	A	Count of GTIMEGOOD	1	1	3	2	7
		Percent of GTIMEGOOD	14.29%	14.29%	42.86%	28.57%	100.00%
5 Count of GTIMEGOOD			1	1	3	2	7
5 Percent of GTIMEGOOD			14.29%	14.29%	42.86%	28.57%	100.00%
6	A	Count of GTIMEGOOD	0	2	3	2	7
		Percent of GTIMEGOOD	0.00%	28.57%	42.86%	28.57%	100.00%
6 Count of GTIMEGOOD			0	2	3	2	7
6 Percent of GTIMEGOOD			0.00%	28.57%	42.86%	28.57%	100.00%
Total Count of GTIMEGOOD			1	6	25	14	46
Total Percent of GTIMEGOOD			2.17%	13.04%	54.35%	30.43%	100.00%

Strongly Disagr	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
0.00%	2.17%	13.04%	54.35%	30.43%

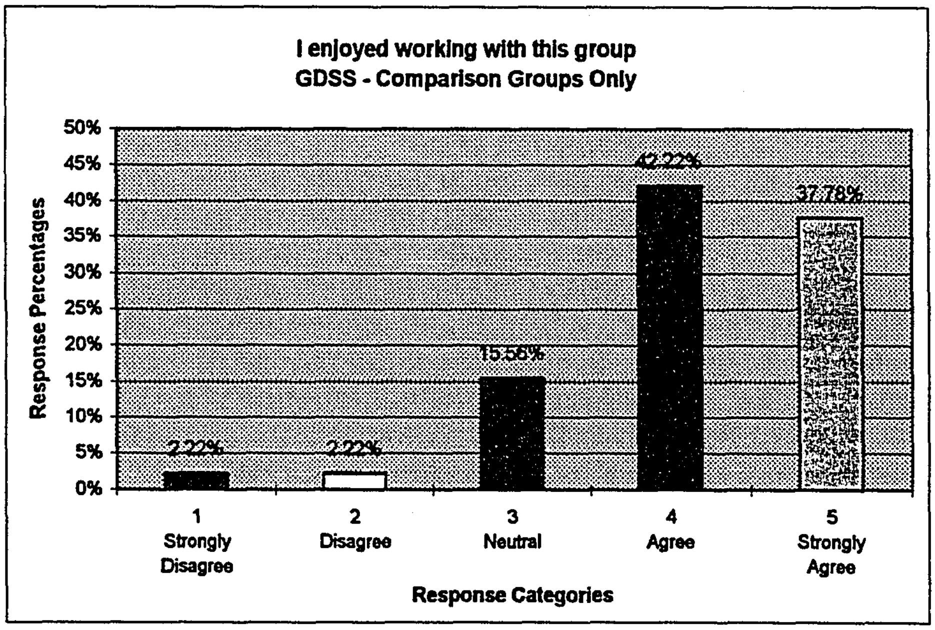


Non-GDSS: "I feel my time in the group was productive."
Figure 42

GDSS - I enjoyed working with this group
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Productive Time in the Group - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GENJOY						
Group	Cluster	Data	1	2	3	4	5	(blank)	Grand Total
2	A	Count of GENJOY	0	0	2	3	4	0	9
		Percent of GENJOY	0.00%	0.00%	22.22%	33.33%	44.44%	0.00%	100.00%
	B	Count of GENJOY	0	0	1	3	2	0	6
		Percent of GENJOY	0.00%	0.00%	16.67%	50.00%	33.33%	0.00%	100.00%
2 Count of GENJOY			0	0	3	6	6	0	15
2 Percent of GENJOY			0.00%	0.00%	20.00%	40.00%	40.00%	0.00%	100.00%
4	A	Count of GENJOY	1	0	1	1	4	0	7
		Percent of GENJOY	14.29%	0.00%	14.29%	14.29%	57.14%	0.00%	100.00%
	B	Count of GENJOY	0	1	3	3	2	0	9
		Percent of GENJOY	0.00%	11.11%	33.33%	33.33%	22.22%	0.00%	100.00%
4 Count of GENJOY			1	1	4	4	6	0	16
4 Percent of GENJOY			6.25%	6.25%	25.00%	25.00%	37.50%	0.00%	100.00%
5	A	Count of GENJOY	0	0	0	5	2	0	7
		Percent of GENJOY	0.00%	0.00%	0.00%	71.43%	28.57%	0.00%	100.00%
5 Count of GENJOY			0	0	0	5	2	0	7
5 Percent of GENJOY			0.00%	0.00%	0.00%	71.43%	28.57%	0.00%	100.00%
6	A	Count of GENJOY	0	0	0	4	3	0	7
		Percent of GENJOY	0.00%	0.00%	0.00%	57.14%	42.86%	0.00%	100.00%
6 Count of GENJOY			0	0	0	4	3	0	7
6 Percent of GENJOY			0.00%	0.00%	0.00%	57.14%	42.86%	0.00%	100.00%
Total Count of GENJOY			1	1	7	19	17	0	45
Total Percent of GENJOY			2.22%	2.22%	15.56%	42.22%	37.78%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
2.22%	2.22%	15.56%	42.22%	37.78%	0.00%

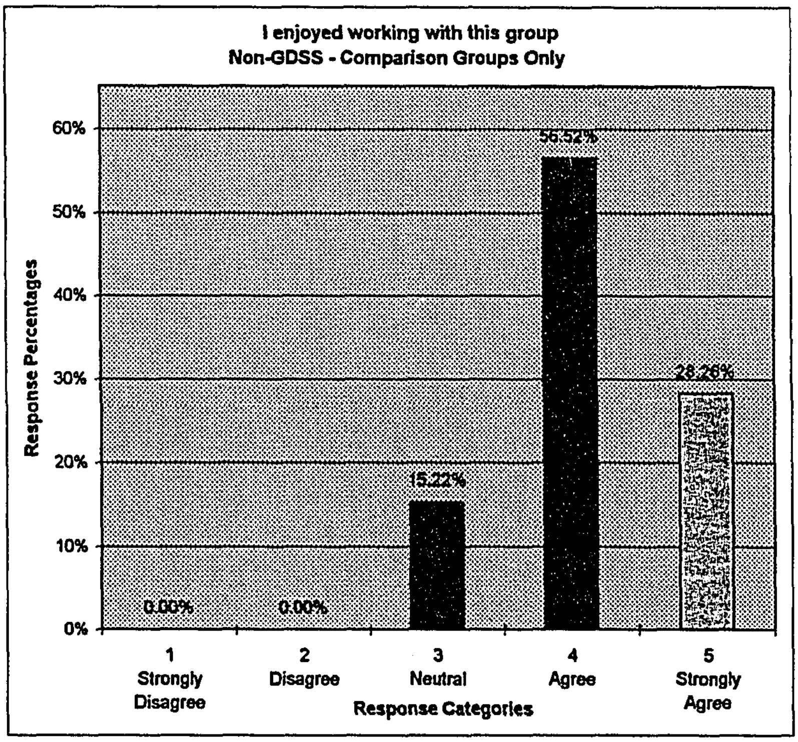


GDSS: "I enjoyed working with this group."
Figure 43

Non-GDSS - I enjoyed working with this group
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Productive Time in the Group - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GENJOY			
Group	Cluster	Data	3	4	5	Grand Total
2	A	Count of GENJOY	0	4	5	9
		Percent of GENJOY	0.00%	44.44%	55.56%	100.00%
	B	Count of GENJOY	0	5	1	6
		Percent of GENJOY	0.00%	83.33%	16.67%	100.00%
2 Count of GENJOY			0	9	6	15
2 Percent of GENJOY			0.00%	60.00%	40.00%	100.00%
4	A	Count of GENJOY	0	5	3	8
		Percent of GENJOY	0.00%	62.50%	37.50%	100.00%
	B	Count of GENJOY	2	6	1	9
		Percent of GENJOY	22.22%	66.67%	11.11%	100.00%
4 Count of GENJOY			2	11	4	17
4 Percent of GENJOY			11.76%	64.71%	23.53%	100.00%
5	A	Count of GENJOY	2	3	2	7
		Percent of GENJOY	28.57%	42.86%	28.57%	100.00%
5 Count of GENJOY			2	3	2	7
5 Percent of GENJOY			28.57%	42.86%	28.57%	100.00%
6	A	Count of GENJOY	3	3	1	7
		Percent of GENJOY	42.86%	42.86%	14.29%	100.00%
6 Count of GENJOY			3	3	1	7
6 Percent of GENJOY			42.86%	42.86%	14.29%	100.00%
Total Count of GENJOY			7	26	13	46
Total Percent of GENJOY			15.22%	56.52%	28.26%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
0.00%	0.00%	15.22%	56.52%	28.26%

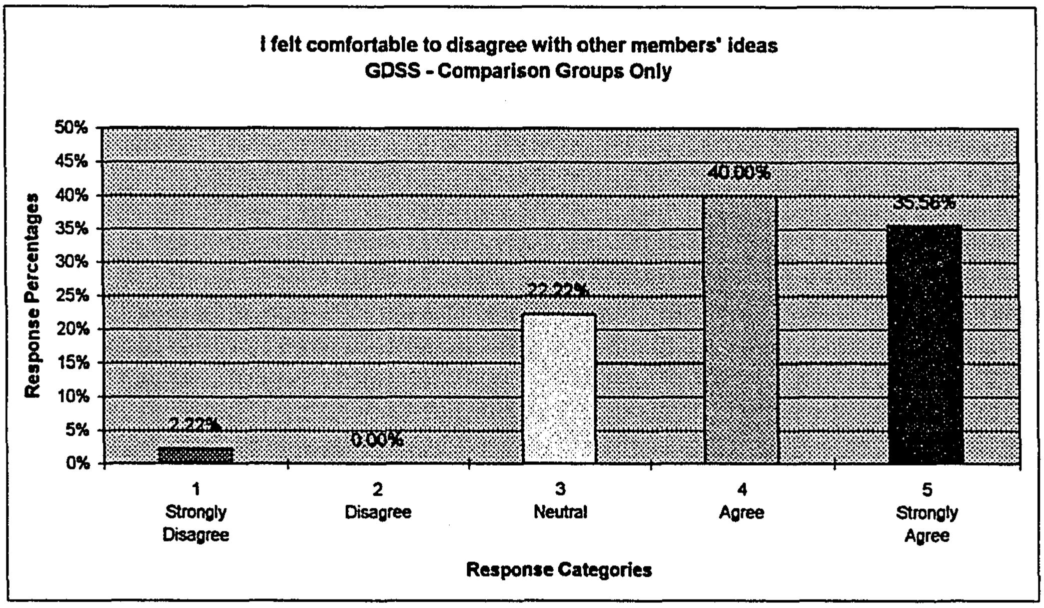


Non-GDSS: "I enjoyed working with this group."
Figure 44

GDSS - I felt comfortable to disagree with other members' ideas
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Disagreeing with Other Members - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GOKDISAGR					
Group	Cluster	Data	1	3	4	5	(blank)	Grand Total
2	A	Count of GOKDISAGR	0	3	2	4	0	9
		Percent of GOKDISAGR	0.00%	33.33%	22.22%	44.44%	0.00%	100.00%
	B	Count of GOKDISAGR	0	0	5	1	0	6
		Percent of GOKDISAGR	0.00%	0.00%	83.33%	16.67%	0.00%	100.00%
2 Count of GOKDISAGR			0	3	7	5	0	15
2 Percent of GOKDISAGR			0.00%	20.00%	46.67%	33.33%	0.00%	100.00%
4	A	Count of GOKDISAGR	0	2	1	4	0	7
		Percent of GOKDISAGR	0.00%	28.57%	14.29%	57.14%	0.00%	100.00%
	B	Count of GOKDISAGR	1	3	3	2	0	9
		Percent of GOKDISAGR	11.11%	33.33%	33.33%	22.22%	0.00%	100.00%
4 Count of GOKDISAGR			1	5	4	6	0	16
4 Percent of GOKDISAGR			6.25%	31.25%	25.00%	37.50%	0.00%	100.00%
5	A	Count of GOKDISAGR	0	1	3	3	0	7
		Percent of GOKDISAGR	0.00%	14.29%	42.86%	42.86%	0.00%	100.00%
5 Count of GOKDISAGR			0	1	3	3	0	7
5 Percent of GOKDISAGR			0.00%	14.29%	42.86%	42.86%	0.00%	100.00%
6	A	Count of GOKDISAGR	0	1	4	2	0	7
		Percent of GOKDISAGR	0.00%	14.29%	57.14%	28.57%	0.00%	100.00%
6 Count of GOKDISAGR			0	1	4	2	0	7
6 Percent of GOKDISAGR			0.00%	14.29%	57.14%	28.57%	0.00%	100.00%
Total Count of GOKDISAGR			1	10	18	16	0	45
Total Percent of GOKDISAGR			2.22%	22.22%	40.00%	35.56%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
2.22%	0.00%	22.22%	40.00%	35.56%	0.00%

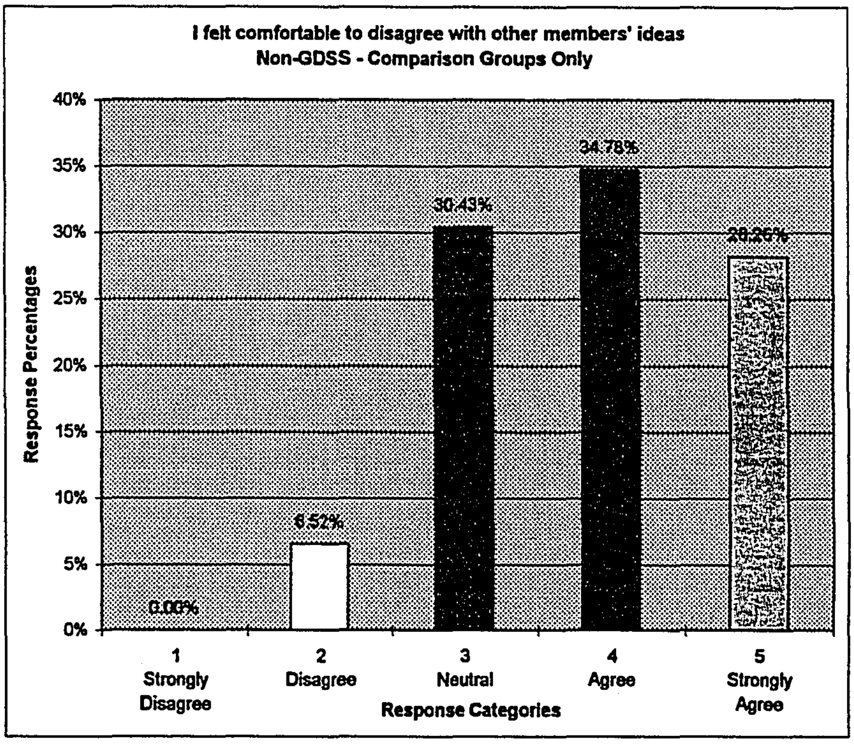


GDSS: "I felt comfortable to disagree with other members' ideas."
Figure 45

Non-GDSS - I felt comfortable to disagree with other members' ideas
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Disagreeing with Other Members - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GOKDISAGR				
Group	Cluster	Data	2	3	4	5	Grand Total
2	A	Count of GOKDISAGR	1	1	4	3	9
		Percent of GOKDISAGR	11.11%	11.11%	44.44%	33.33%	100.00%
	B	Count of GOKDISAGR	0	3	2	1	6
		Percent of GOKDISAGR	0.00%	50.00%	33.33%	16.67%	100.00%
2 Count of GOKDISAGR			1	4	6	4	15
2 Percent of GOKDISAGR			6.67%	26.67%	40.00%	26.67%	100.00%
4	A	Count of GOKDISAGR	0	2	2	4	8
		Percent of GOKDISAGR	0.00%	25.00%	25.00%	50.00%	100.00%
	B	Count of GOKDISAGR	1	6	2	0	9
		Percent of GOKDISAGR	11.11%	66.67%	22.22%	0.00%	100.00%
4 Count of GOKDISAGR			1	8	4	4	17
4 Percent of GOKDISAGR			5.88%	47.06%	23.53%	23.53%	100.00%
5	A	Count of GOKDISAGR	1	1	3	2	7
		Percent of GOKDISAGR	14.29%	14.29%	42.86%	28.57%	100.00%
5 Count of GOKDISAGR			1	1	3	2	7
5 Percent of GOKDISAGR			14.29%	14.29%	42.86%	28.57%	100.00%
6	A	Count of GOKDISAGR	0	1	3	3	7
		Percent of GOKDISAGR	0.00%	14.29%	42.86%	42.86%	100.00%
6 Count of GOKDISAGR			0	1	3	3	7
6 Percent of GOKDISAGR			0.00%	14.29%	42.86%	42.86%	100.00%
Total Count of GOKDISAGR			3	14	16	13	46
Total Percent of GOKDISAGR			6.52%	30.43%	34.78%	28.26%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
0.00%	6.52%	30.43%	34.78%	28.26%

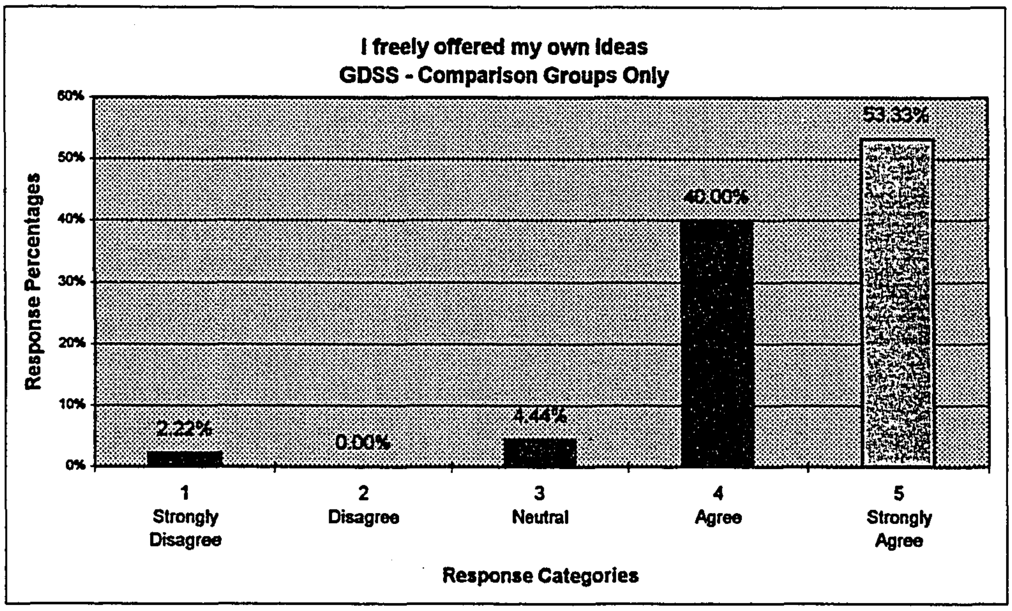


Non-GDSS: "I felt comfortable to disagree with other members' ideas."
Figure 46

GDSS - I freely offered my own ideas
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Freely Offered Ideas - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GOFFERIDEA					
Group	Cluster	Data	1	3	4	5	(blank)	Grand Total
2	A	Count of GOFFERIDEA	0	2	3	4	0	9
		Count of GOFFERIDEA2	0.00%	22.22%	33.33%	44.44%	0.00%	100.00%
	B	Count of GOFFERIDEA	0	0	4	2	0	6
		Count of GOFFERIDEA2	0.00%	0.00%	66.67%	33.33%	0.00%	100.00%
2 Count of GOFFERIDEA			0	2	7	6	0	15
2 Count of GOFFERIDEA2			0.00%	13.33%	46.67%	40.00%	0.00%	100.00%
4	A	Count of GOFFERIDEA	0	0	2	5	0	7
		Count of GOFFERIDEA2	0.00%	0.00%	28.57%	71.43%	0.00%	100.00%
	B	Count of GOFFERIDEA	1	0	2	6	0	9
		Count of GOFFERIDEA2	11.11%	0.00%	22.22%	66.67%	0.00%	100.00%
4 Count of GOFFERIDEA			1	0	4	11	0	16
4 Count of GOFFERIDEA2			6.25%	0.00%	25.00%	68.75%	0.00%	100.00%
5	A	Count of GOFFERIDEA	0	0	3	4	0	7
		Count of GOFFERIDEA2	0.00%	0.00%	42.86%	57.14%	0.00%	100.00%
5 Count of GOFFERIDEA			0	0	3	4	0	7
5 Count of GOFFERIDEA2			0.00%	0.00%	42.86%	57.14%	0.00%	100.00%
6	A	Count of GOFFERIDEA	0	0	4	3	0	7
		Count of GOFFERIDEA2	0.00%	0.00%	57.14%	42.86%	0.00%	100.00%
6 Count of GOFFERIDEA			0	0	4	3	0	7
6 Count of GOFFERIDEA2			0.00%	0.00%	57.14%	42.86%	0.00%	100.00%
Total Count of GOFFERIDEA			1	2	18	24	0	45
Total Count of GOFFERIDEA2			2.22%	4.44%	40.00%	53.33%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
2.22%	0.00%	4.44%	40.00%	53.33%	0.00%



GDSS: "I freely offered my own ideas."
Figure 47

no-one either Strongly Disagreed or Disagreed, the Neutral response was 10.87%. Subjects in Agreement were 52.17%, and 36.96% Strongly Agreed. See Figure 48 for numbers and percentages.

"I remained interested and attentive to the group's activities." Again, students responding to their GDSS experience were very positive (Figure 49). No subject Strongly Disagreed, and only one person (2.22%) Disagreed. Only two individuals (4.44%) were Neutral, and a full 57.78% Agreed. Another 35.56% Strongly Agreed that they had remained involved. Responses from the Face-to-Face groups were slightly less positive. Again, no-one Strongly Disagreed, and only one individual (2.17%) Disagreed. The Neutral response was 8.70%. Students in Agreement comprised 41.30%, and 47.83% Strongly Agreed. See Figure 50.

Perception of Group Interaction

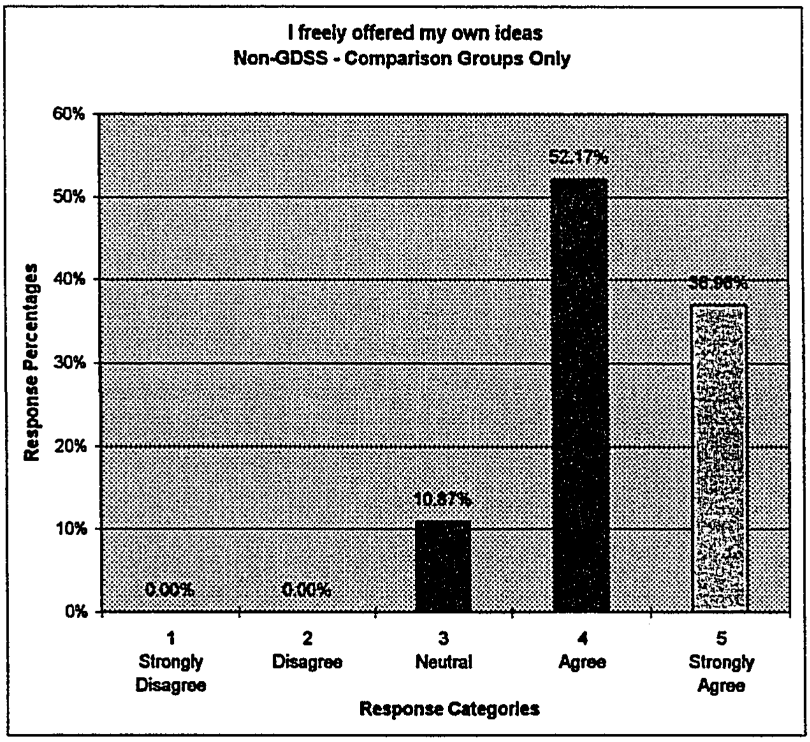
Respondents were asked to comment on how their respective GDSS and Face-to-Face groups worked together. Seven statements were offered for their reaction.

"People worked together better than in most groups." Responses from the GDSS groups indicated limited disagreement (See Figure 51). Two persons, or 4.44% Strongly Disagreed, and no-one Disagreed. There was a relatively high degree of uncertainty as expressed in a 35.56% Neutral response. In Agreement were 46.67%, and 13.33% Strongly Agreed. In the Face-to-Face groups, no-one Strongly Disagreed, and 6.52% Disagreed. The Neutral responses reached a high 41.30%. In Agreement were 34.78%, and 17.39% Strongly Agreed. See Figure 52.

Non-GDSS - I freely offered my own ideas
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Freely Offered Ideas - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GOFFERIDEA			
Group	Cluster	Data	3	4	5	Grand Total
2	A	Count of GOFFERIDEA	1	4	4	9
		Percent of GOFFERIDEA	11.11%	44.44%	44.44%	100.00%
	B	Count of GOFFERIDEA	1	3	2	6
		Percent of GOFFERIDEA	16.67%	50.00%	33.33%	100.00%
2 Count of GOFFERIDEA			2	7	6	15
2 Percent of GOFFERIDEA			13.33%	46.67%	40.00%	100.00%
4	A	Count of GOFFERIDEA	1	3	4	8
		Percent of GOFFERIDEA	12.50%	37.50%	50.00%	100.00%
	B	Count of GOFFERIDEA	0	7	2	9
		Percent of GOFFERIDEA	0.00%	77.78%	22.22%	100.00%
4 Count of GOFFERIDEA			1	10	6	17
4 Percent of GOFFERIDEA			5.88%	58.82%	35.29%	100.00%
5	A	Count of GOFFERIDEA	1	3	3	7
		Percent of GOFFERIDEA	14.29%	42.86%	42.86%	100.00%
5 Count of GOFFERIDEA			1	3	3	7
5 Percent of GOFFERIDEA			14.29%	42.86%	42.86%	100.00%
6	A	Count of GOFFERIDEA	1	4	2	7
		Percent of GOFFERIDEA	14.29%	57.14%	28.57%	100.00%
6 Count of GOFFERIDEA			1	4	2	7
6 Percent of GOFFERIDEA			14.29%	57.14%	28.57%	100.00%
Total Count of GOFFERIDEA			5	24	17	46
Total Percent of GOFFERIDEA			10.87%	52.17%	36.96%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
0.00%	0.00%	10.87%	52.17%	36.96%

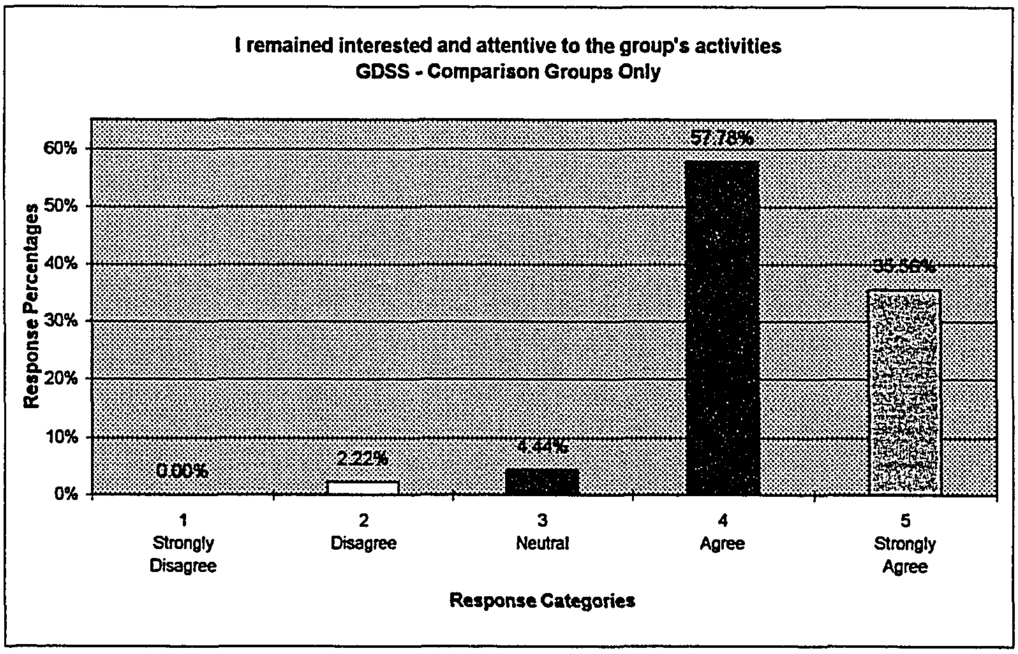


Non-GDSS: "I freely offered my own ideas."
Figure 48

GDSS - I remained interested and attentive to the group's activities
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Interest in Activities - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GINTEREST					
Group	Cluster	Data	2	3	4	5	(blank)	Grand Total
2	A	Count of GINTEREST	0	1	6	2	0	9
		Count of GINTEREST2	0.00%	11.11%	66.67%	22.22%	0.00%	100.00%
	B	Count of GINTEREST	0	0	4	2	0	6
		Count of GINTEREST2	0.00%	0.00%	66.67%	33.33%	0.00%	100.00%
2 Count of GINTEREST			0	1	10	4	0	15
2 Count of GINTEREST2			0.00%	6.67%	66.67%	26.67%	0.00%	100.00%
4	A	Count of GINTEREST	0	0	3	4	0	7
		Count of GINTEREST2	0.00%	0.00%	42.86%	57.14%	0.00%	100.00%
	B	Count of GINTEREST	1	1	4	3	0	9
		Count of GINTEREST2	11.11%	11.11%	44.44%	33.33%	0.00%	100.00%
4 Count of GINTEREST			1	1	7	7	0	16
4 Count of GINTEREST2			6.25%	6.25%	43.75%	43.75%	0.00%	100.00%
5	A	Count of GINTEREST	0	0	4	3	0	7
		Count of GINTEREST2	0.00%	0.00%	57.14%	42.86%	0.00%	100.00%
5 Count of GINTEREST			0	0	4	3	0	7
5 Count of GINTEREST2			0.00%	0.00%	57.14%	42.86%	0.00%	100.00%
6	A	Count of GINTEREST	0	0	5	2	0	7
		Count of GINTEREST2	0.00%	0.00%	71.43%	28.57%	0.00%	100.00%
6 Count of GINTEREST			0	0	5	2	0	7
6 Count of GINTEREST2			0.00%	0.00%	71.43%	28.57%	0.00%	100.00%
Total Count of GINTEREST			1	2	26	16	0	45
Total Count of GINTEREST2			2.22%	4.44%	57.78%	35.56%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
0.00%	2.22%	4.44%	57.78%	35.56%	0.00%

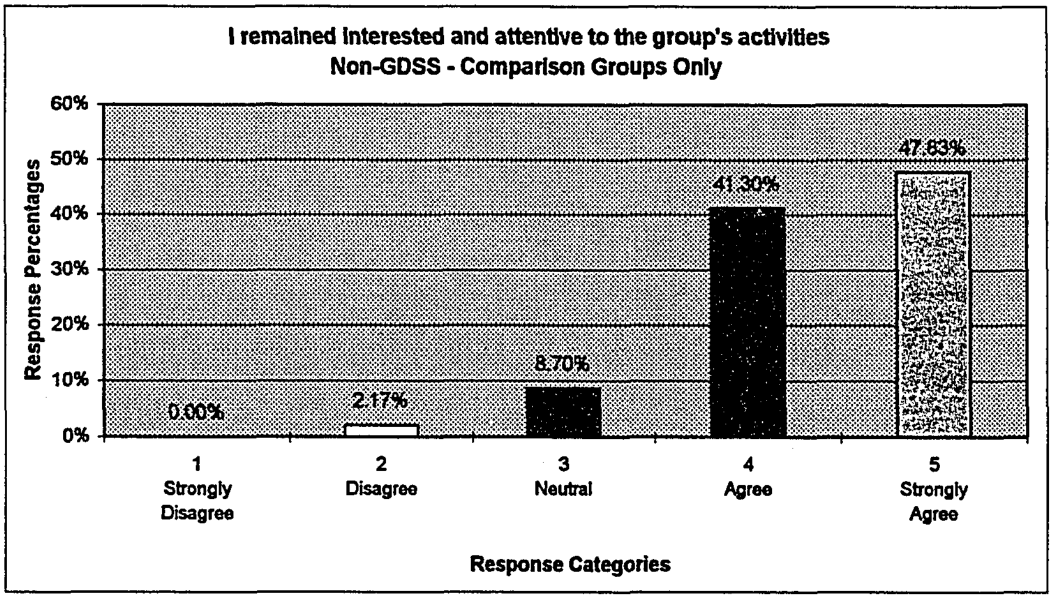


GDSS: "I remained interested and attentive to the group's activities."
Figure 49

Non-GDSS - I remained interested and attentive to the group's activities
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Interest in Activities - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GINTEREST				
Group	Cluster	Data	2	3	4	5	Grand Total
2	A	Count of GINTEREST	0	0	3	6	9
		Percent of GINTEREST	0.00%	0.00%	33.33%	66.67%	100.00%
	B	Count of GINTEREST	0	0	3	3	6
		Percent of GINTEREST	0.00%	0.00%	50.00%	50.00%	100.00%
2 Count of GINTEREST			0	0	6	9	15
2 Percent of GINTEREST			0.00%	0.00%	40.00%	60.00%	100.00%
4	A	Count of GINTEREST	0	0	2	6	8
		Percent of GINTEREST	0.00%	0.00%	25.00%	75.00%	100.00%
	B	Count of GINTEREST	0	1	5	3	9
		Percent of GINTEREST	0.00%	11.11%	55.56%	33.33%	100.00%
4 Count of GINTEREST			0	1	7	9	17
4 Percent of GINTEREST			0.00%	5.88%	41.18%	52.94%	100.00%
5	A	Count of GINTEREST	1	3	1	2	7
		Percent of GINTEREST	14.29%	42.86%	14.29%	28.57%	100.00%
5 Count of GINTEREST			1	3	1	2	7
5 Percent of GINTEREST			14.29%	42.86%	14.29%	28.57%	100.00%
6	A	Count of GINTEREST	0	0	5	2	7
		Percent of GINTEREST	0.00%	0.00%	71.43%	28.57%	100.00%
6 Count of GINTEREST			0	0	5	2	7
6 Percent of GINTEREST			0.00%	0.00%	71.43%	28.57%	100.00%
Total Count of GINTEREST			1	4	19	22	46
Total Percent of GINTEREST			2.17%	8.70%	41.30%	47.83%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
0.00%	2.17%	8.70%	41.30%	47.83%

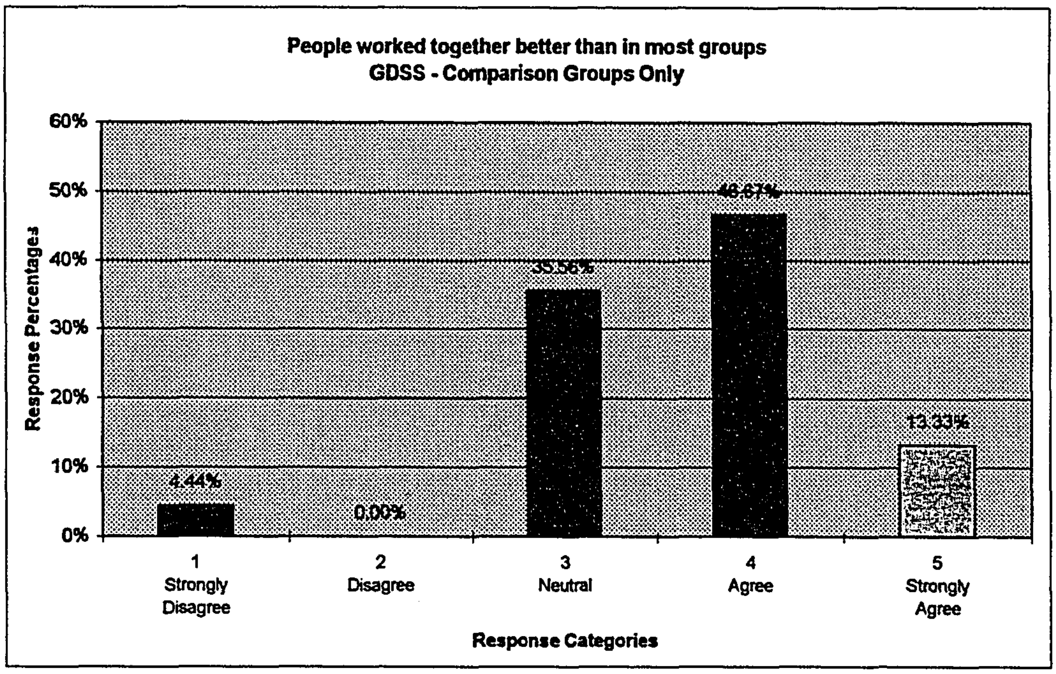


Non-GDSS: I remained interested and attentive to the group's activities."
Figure 50

GDSS - People worked together better than in most groups
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Working Together - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GWORKTOG					
Group	Cluster	Data	1	3	4	5	(blank)	Grand Total
2	A	Count of GWORKTOG	0	3	6	0	0	9
		Percent of GWORKTOG	0.00%	33.33%	66.67%	0.00%	0.00%	100.00%
	B	Count of GWORKTOG	0	5	0	1	0	6
		Percent of GWORKTOG	0.00%	83.33%	0.00%	16.67%	0.00%	100.00%
2 Count of GWORKTOG			0	8	6	1	0	15
2 Percent of GWORKTOG			0.00%	53.33%	40.00%	6.67%	0.00%	100.00%
4	A	Count of GWORKTOG	1	2	3	1	0	7
		Percent of GWORKTOG	14.29%	28.57%	42.86%	14.29%	0.00%	100.00%
	B	Count of GWORKTOG	1	3	4	1	0	9
		Percent of GWORKTOG	11.11%	33.33%	44.44%	11.11%	0.00%	100.00%
4 Count of GWORKTOG			2	5	7	2	0	16
4 Percent of GWORKTOG			12.50%	31.25%	43.75%	12.50%	0.00%	100.00%
5	A	Count of GWORKTOG	0	2	4	1	0	7
		Percent of GWORKTOG	0.00%	28.57%	57.14%	14.29%	0.00%	100.00%
5 Count of GWORKTOG			0	2	4	1	0	7
5 Percent of GWORKTOG			0.00%	28.57%	57.14%	14.29%	0.00%	100.00%
6	A	Count of GWORKTOG	0	1	4	2	0	7
		Percent of GWORKTOG	0.00%	14.29%	57.14%	28.57%	0.00%	100.00%
6 Count of GWORKTOG			0	1	4	2	0	7
6 Percent of GWORKTOG			0.00%	14.29%	57.14%	28.57%	0.00%	100.00%
Total Count of GWORKTOG			2	16	21	6	0	45
Total Percent of GWORKTOG			4.44%	35.56%	46.67%	13.33%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
4.44%	0.00%	35.56%	46.67%	13.33%	0.00%

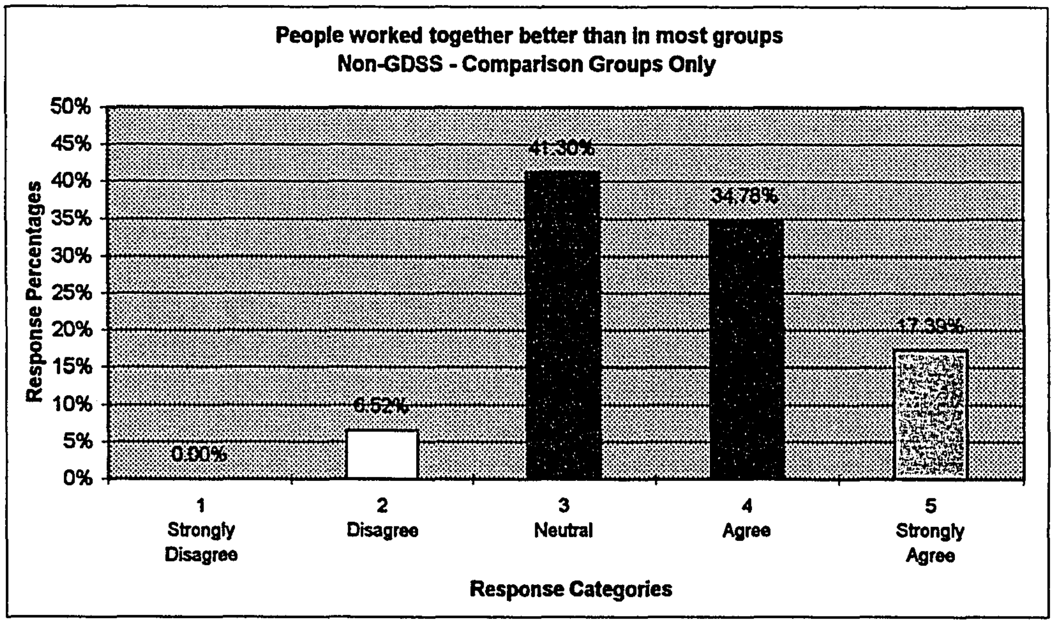


GDSS: "People worked together better than in most groups."
Figure 51

Non-GDSS - People worked together better than in most groups
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Working Together - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GWORKTOG				
Group	Cluster	Data	2	3	4	5	Grand Total
2	A	Count of GWORKTOG	0	1	5	3	9
		Percent of GWORKTOG	0.00%	11.11%	55.56%	33.33%	100.00%
	B	Count of GWORKTOG	1	3	2	0	6
		Percent of GWORKTOG	16.67%	50.00%	33.33%	0.00%	100.00%
2 Count of GWORKTOG			1	4	7	3	15
2 Percent of GWORKTOG			6.67%	26.67%	46.67%	20.00%	100.00%
4	A	Count of GWORKTOG	0	5	1	2	8
		Percent of GWORKTOG	0.00%	62.50%	12.50%	25.00%	100.00%
	B	Count of GWORKTOG	1	3	4	1	9
		Percent of GWORKTOG	11.11%	33.33%	44.44%	11.11%	100.00%
4 Count of GWORKTOG			1	8	5	3	17
4 Percent of GWORKTOG			5.88%	47.06%	29.41%	17.65%	100.00%
5	A	Count of GWORKTOG	1	2	3	1	7
		Percent of GWORKTOG	14.29%	28.57%	42.86%	14.29%	100.00%
5 Count of GWORKTOG			1	2	3	1	7
5 Percent of GWORKTOG			14.29%	28.57%	42.86%	14.29%	100.00%
6	A	Count of GWORKTOG	0	5	1	1	7
		Percent of GWORKTOG	0.00%	71.43%	14.29%	14.29%	100.00%
6 Count of GWORKTOG			0	5	1	1	7
6 Percent of GWORKTOG			0.00%	71.43%	14.29%	14.29%	100.00%
Total Count of GWORKTOG			3	19	16	8	46
Total Percent of GWORKTOG			6.52%	41.30%	34.78%	17.39%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
0.00%	6.52%	41.30%	34.78%	17.39%



GDSS: "People worked together better than in most groups."
Figure 52

"Participation in the activities was evenly distributed." GDSS group responses again showed virtually no Disagreement (See Figure 53). Only one person (2.22%) Strongly Disagreed, and again no-one Disagreed. One third (33.33%) were Neutral or undecided, and 37.78% Agreed. Over one quarter (26.67%) Strongly Agreed that the participation was evenly distributed. There was a greater degree of disagreement with the Face-to-Face groups. They indicated that 8.70% Strongly Disagreed, and 17.34% Disagreed. The Neutral response was a lower 15.22%, and 39.13% Agreed with the statement. Almost twenty percent (19.57%) Strongly Agreed. See Figure 54.

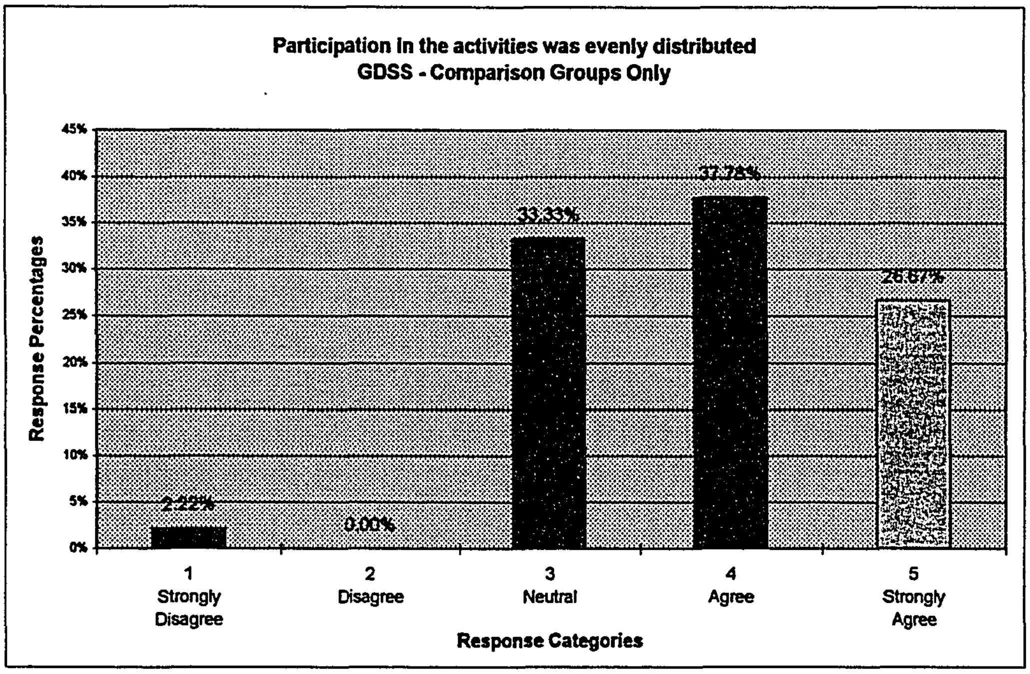
"Members were able to express opposing ideas." GDSS groups again showed limited disagreement with this statement (Figure 55). Only 4.44% Strongly Disagreed, and there was no Disagreement. Twenty percent (20.00%) had no opinion, and 46.67% Agreed. Another 28.89% Strongly Agreed that members were able to express opposition. The Face-to-Face groups showed a slightly greater degree of disagreement. One individual (2.17%) Strongly Disagreed, and 8.70% Disagreed. Only 13.04% were Neutral, but 52.17% Agreed. Another 23.91% of respondents Strongly Agreed. See Figure 56.

"The group used its time wisely." A majority of the GDSS respondents felt that their group had used its time well (Figure 57). No-one Strongly Disagreed, and only two individuals, or 4.44% Disagreed. Only 11.11% were Neutral, and 46.67% Agreed. Another 37.78% Strongly Agreed about the wise use of the group's time. Responses from the Face-to-Face groups indicated that one person (2.17%) Strongly

GDSS - Participation in the activities was evenly distributed
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Participation - Counts and Percentages for Each Cluster, Each Group and Total Participants

Group	Cluster	Data	GACTDIST 1	3	4	5	(blank)	Grand Total
2	A	Count of GACTDIST	0	3	5	1	0	9
		Percent of GACTDIST	0.00%	33.33%	55.56%	11.11%	0.00%	100.00%
	B	Count of GACTDIST	0	4	1	1	0	6
		Percent of GACTDIST	0.00%	66.67%	16.67%	16.67%	0.00%	100.00%
2 Count of GACTDIST			0	7	6	2	0	15
2 Percent of GACTDIST			0.00%	46.67%	40.00%	13.33%	0.00%	100.00%
4	A	Count of GACTDIST	0	2	1	4	0	7
		Percent of GACTDIST	0.00%	28.57%	14.29%	57.14%	0.00%	100.00%
	B	Count of GACTDIST	1	3	3	2	0	9
		Percent of GACTDIST	11.11%	33.33%	33.33%	22.22%	0.00%	100.00%
4 Count of GACTDIST			1	5	4	6	0	16
4 Percent of GACTDIST			6.25%	31.25%	25.00%	37.50%	0.00%	100.00%
5	A	Count of GACTDIST	0	2	3	2	0	7
		Percent of GACTDIST	0.00%	28.57%	42.86%	28.57%	0.00%	100.00%
5 Count of GACTDIST			0	2	3	2	0	7
5 Percent of GACTDIST			0.00%	28.57%	42.86%	28.57%	0.00%	100.00%
6	A	Count of GACTDIST	0	1	4	2	0	7
		Percent of GACTDIST	0.00%	14.29%	57.14%	28.57%	0.00%	100.00%
6 Count of GACTDIST			0	1	4	2	0	7
6 Percent of GACTDIST			0.00%	14.29%	57.14%	28.57%	0.00%	100.00%
Total Count of GACTDIST			1	15	17	12	0	45
Total Percent of GACTDIST			2.22%	33.33%	37.78%	26.67%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
2.22%	0.00%	33.33%	37.78%	26.67%	0.00%

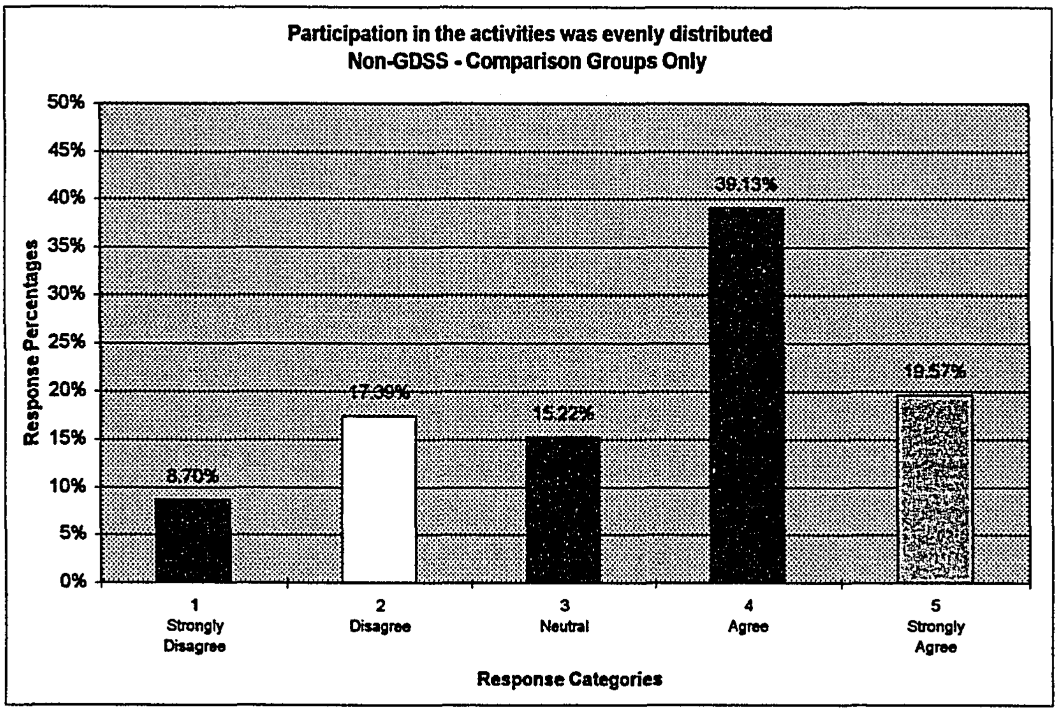


GDSS: "Participation in the activities was evenly distributed."
Figure 53

Non-GDSS - Participation in the activities was evenly distributed
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Participation - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GACTDIST					
Group	Cluster	Data	1	2	3	4	5	Grand Total
2	A	Count of GACTDIST	0	2	1	3	3	9
		Percent of GACTDIST	0.00%	22.22%	11.11%	33.33%	33.33%	100.00%
	B	Count of GACTDIST	1	0	1	4	0	6
		Percent of GACTDIST	16.67%	0.00%	16.67%	66.67%	0.00%	100.00%
2 Count of GACTDIST			1	2	2	7	3	15
2 Percent of GACTDIST			6.67%	13.33%	13.33%	46.67%	20.00%	100.00%
4	A	Count of GACTDIST	0	1	0	5	2	8
		Percent of GACTDIST	0.00%	12.50%	0.00%	62.50%	25.00%	100.00%
	B	Count of GACTDIST	2	2	2	3	0	9
		Percent of GACTDIST	22.22%	22.22%	22.22%	33.33%	0.00%	100.00%
4 Count of GACTDIST			2	3	2	8	2	17
4 Percent of GACTDIST			11.76%	17.65%	11.76%	47.06%	11.76%	100.00%
5	A	Count of GACTDIST	1	1	3	2	0	7
		Percent of GACTDIST	14.29%	14.29%	42.86%	28.57%	0.00%	100.00%
5 Count of GACTDIST			1	1	3	2	0	7
5 Percent of GACTDIST			14.29%	14.29%	42.86%	28.57%	0.00%	100.00%
6	A	Count of GACTDIST	0	2	0	1	4	7
		Percent of GACTDIST	0.00%	28.57%	0.00%	14.29%	57.14%	100.00%
6 Count of GACTDIST			0	2	0	1	4	7
6 Percent of GACTDIST			0.00%	28.57%	0.00%	14.29%	57.14%	100.00%
Total Count of GACTDIST			4	8	7	18	9	46
Total Percent of GACTDIST			8.70%	17.39%	15.22%	39.13%	19.57%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
8.70%	17.39%	15.22%	39.13%	19.57%

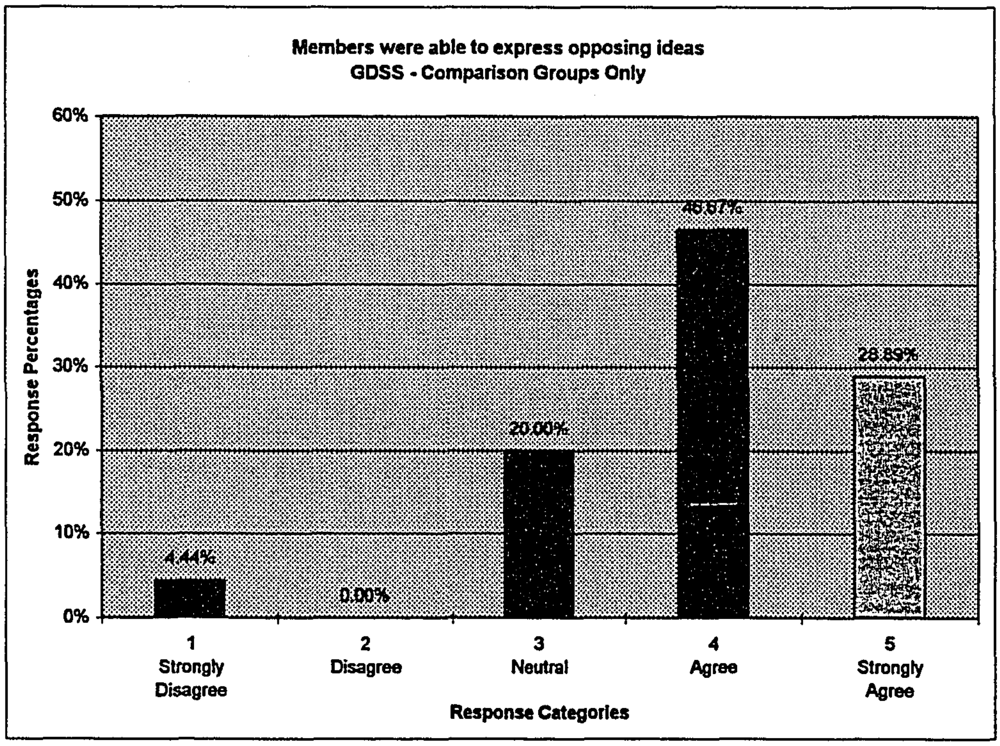


Non-GDSS: "Participation in the activities was evenly distributed."
Figure 54

GDSS - Members were able to express opposing ideas
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Opposing Ideas - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GOPPOSIDEA					
Group	Cluster	Data	1	3	4	5	(blank)	Grand Total
2	A	Count of GOPPOSIDEA	1	2	3	3	0	9
		Count of GOPPOSIDEA2	11.11%	22.22%	33.33%	33.33%	0.00%	100.00%
	B	Count of GOPPOSIDEA	0	0	5	1	0	6
		Count of GOPPOSIDEA2	0.00%	0.00%	83.33%	16.67%	0.00%	100.00%
2 Count of GOPPOSIDEA			1	2	8	4	0	15
2 Count of GOPPOSIDEA2			6.67%	13.33%	53.33%	26.67%	0.00%	100.00%
4	A	Count of GOPPOSIDEA	0	1	3	3	0	7
		Count of GOPPOSIDEA2	0.00%	14.29%	42.86%	42.86%	0.00%	100.00%
	B	Count of GOPPOSIDEA	1	2	3	3	0	9
		Count of GOPPOSIDEA2	11.11%	22.22%	33.33%	33.33%	0.00%	100.00%
4 Count of GOPPOSIDEA			1	3	6	6	0	16
4 Count of GOPPOSIDEA2			6.25%	18.75%	37.50%	37.50%	0.00%	100.00%
5	A	Count of GOPPOSIDEA	0	3	2	2	0	7
		Count of GOPPOSIDEA2	0.00%	42.86%	28.57%	28.57%	0.00%	100.00%
5 Count of GOPPOSIDEA			0	3	2	2	0	7
5 Count of GOPPOSIDEA2			0.00%	42.86%	28.57%	28.57%	0.00%	100.00%
6	A	Count of GOPPOSIDEA	0	1	5	1	0	7
		Count of GOPPOSIDEA2	0.00%	14.29%	71.43%	14.29%	0.00%	100.00%
6 Count of GOPPOSIDEA			0	1	5	1	0	7
6 Count of GOPPOSIDEA2			0.00%	14.29%	71.43%	14.29%	0.00%	100.00%
Total Count of GOPPOSIDEA			2	9	21	13	0	45
Total Count of GOPPOSIDEA2			4.44%	20.00%	46.67%	28.89%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
4.44%	0.00%	20.00%	46.67%	28.89%	0.00%

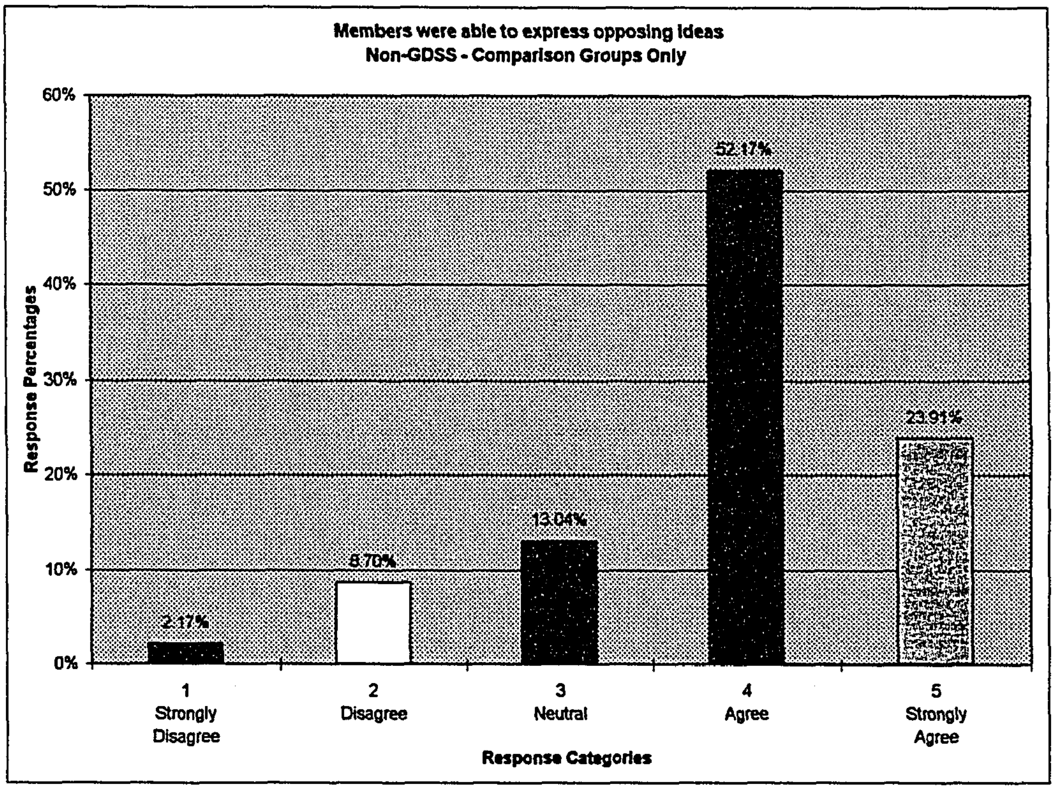


GDSS: "Members were able to express opposing ideas."
Figure 55

Non-GDSS - Members were able to express opposing ideas
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Opposing Ideas - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GOPPOSIDEA					
Group	Cluster	Data	1	2	3	4	5	Grand Total
2	A	Count of GOPPOSIDEA	0	0	2	5	2	9
		Percent of GOPPOSIDEA	0.00%	0.00%	22.22%	55.56%	22.22%	100.00%
	B	Count of GOPPOSIDEA	0	0	1	5	0	6
		Percent of GOPPOSIDEA	0.00%	0.00%	16.67%	83.33%	0.00%	100.00%
2 Count of GOPPOSIDEA			0	0	3	10	2	15
2 Percent of GOPPOSIDEA			0.00%	0.00%	20.00%	66.67%	13.33%	100.00%
4	A	Count of GOPPOSIDEA	0	0	0	2	6	8
		Percent of GOPPOSIDEA	0.00%	0.00%	0.00%	25.00%	75.00%	100.00%
	B	Count of GOPPOSIDEA	0	2	2	4	1	9
		Percent of GOPPOSIDEA	0.00%	22.22%	22.22%	44.44%	11.11%	100.00%
4 Count of GOPPOSIDEA			0	2	2	6	7	17
4 Percent of GOPPOSIDEA			0.00%	11.76%	11.76%	35.29%	41.18%	100.00%
5	A	Count of GOPPOSIDEA	1	2	0	3	1	7
		Percent of GOPPOSIDEA	14.29%	28.57%	0.00%	42.86%	14.29%	100.00%
5 Count of GOPPOSIDEA			1	2	0	3	1	7
5 Percent of GOPPOSIDEA			14.29%	28.57%	0.00%	42.86%	14.29%	100.00%
6	A	Count of GOPPOSIDEA	0	0	1	5	1	7
		Percent of GOPPOSIDEA	0.00%	0.00%	14.29%	71.43%	14.29%	100.00%
6 Count of GOPPOSIDEA			0	0	1	5	1	7
6 Percent of GOPPOSIDEA			0.00%	0.00%	14.29%	71.43%	14.29%	100.00%
Total Count of GOPPOSIDEA			1	4	6	24	11	46
Total Percent of GOPPOSIDEA			2.17%	8.70%	13.04%	52.17%	23.91%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
2.17%	8.70%	13.04%	52.17%	23.91%

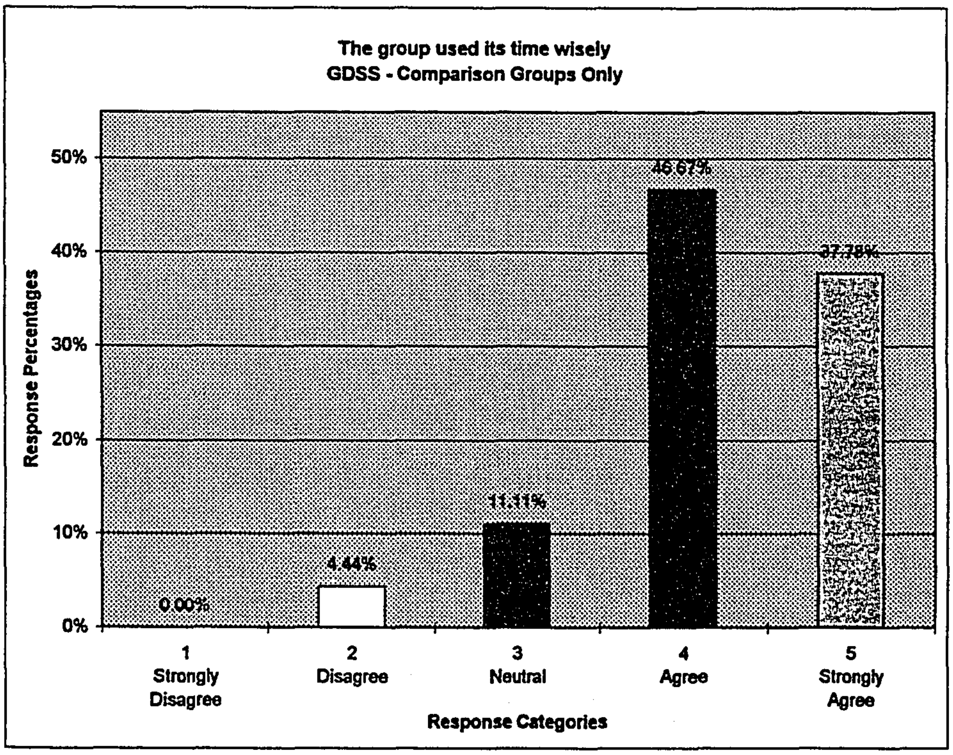


Non-GDSS: "Members were able to express opposing ideas."
Figure 56

GDSS - The group used its time wisely
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Use of Time - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GTIMEUSE					
Group	Cluster	Data	2	3	4	5	(blank)	Grand Total
2	A	Count of GTIMEUSE	0	1	5	3	0	9
		Count of GTIMEUSE2	0.00%	11.11%	55.56%	33.33%	0.00%	100.00%
	B	Count of GTIMEUSE	0	2	2	2	0	6
		Count of GTIMEUSE2	0.00%	33.33%	33.33%	33.33%	0.00%	100.00%
2 Count of GTIMEUSE			0	3	7	5	0	15
2 Count of GTIMEUSE2			0.00%	20.00%	46.67%	33.33%	0.00%	100.00%
4	A	Count of GTIMEUSE	0	0	3	4	0	7
		Count of GTIMEUSE2	0.00%	0.00%	42.86%	57.14%	0.00%	100.00%
	B	Count of GTIMEUSE	2	1	3	3	0	9
		Count of GTIMEUSE2	22.22%	11.11%	33.33%	33.33%	0.00%	100.00%
4 Count of GTIMEUSE			2	1	6	7	0	16
4 Count of GTIMEUSE2			12.50%	6.25%	37.50%	43.75%	0.00%	100.00%
5	A	Count of GTIMEUSE	0	0	4	3	0	7
		Count of GTIMEUSE2	0.00%	0.00%	57.14%	42.86%	0.00%	100.00%
5 Count of GTIMEUSE			0	0	4	3	0	7
5 Count of GTIMEUSE2			0.00%	0.00%	57.14%	42.86%	0.00%	100.00%
6	A	Count of GTIMEUSE	0	1	4	2	0	7
		Count of GTIMEUSE2	0.00%	14.29%	57.14%	28.57%	0.00%	100.00%
6 Count of GTIMEUSE			0	1	4	2	0	7
6 Count of GTIMEUSE2			0.00%	14.29%	57.14%	28.57%	0.00%	100.00%
Total Count of GTIMEUSE			2	5	21	17	0	45
Total Count of GTIMEUSE2			4.44%	11.11%	46.67%	37.78%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
0.00%	4.44%	11.11%	46.67%	37.78%	0.00%



GDSS: "The group used its time wisely."
Figure 57

Disagreed, and 8.70% Disagreed. Neutral responses comprised 10.87%, and 34.78% Agreed. Finally, 43.48% of respondents Strongly Agreed. See Figure 58.

"Ideas expressed in the group were critically examined." GDSS participants responded with a 2.22% of Strong Disagreement, and a 17.78% of Disagreement (See Figure 59). Almost forty percent (37.78%) had no opinion on this issue. Another 37.78% Agreed with the statement, and 4.44% were in Strong Agreement. Face-to-Face groups indicated a 10.87% response for both Strongly Disagree and Disagree. A large 36.96% responded with Neutral, or no opinion, and 34.78% were in Agreement. Another 6.52% Strongly Agreed that the ideas in their groups were critically examined. See Figure 60.

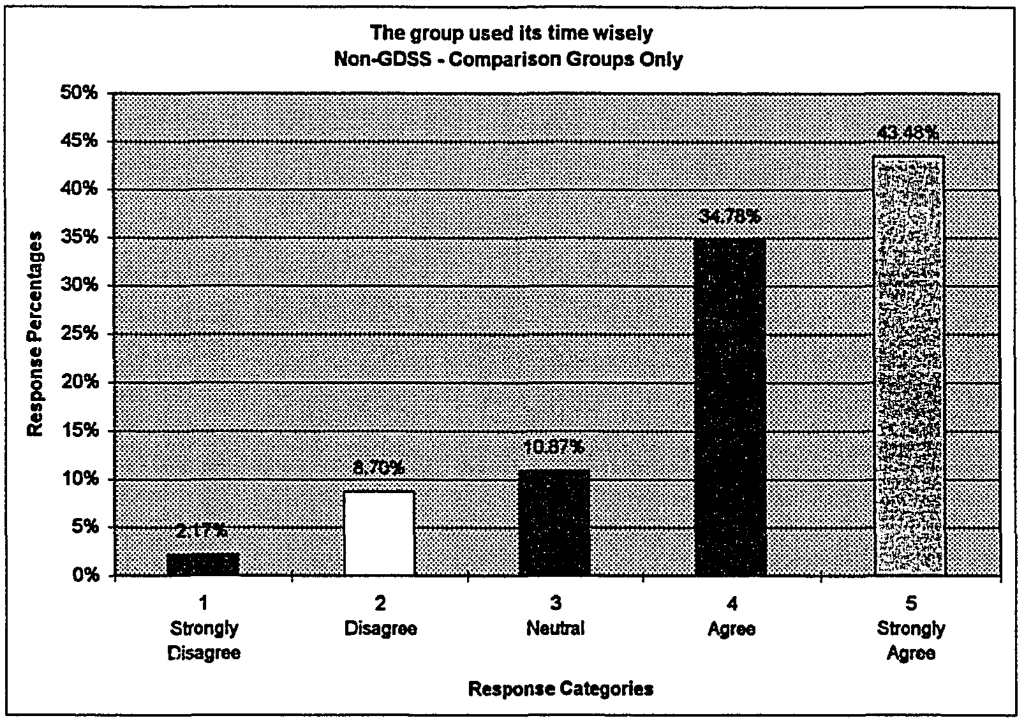
"One or two members strongly influenced the group's decisions." Responses to this statement were very dramatic. The GDSS groups indicated a strong degree of disagreement with this statement. One third (33.33%) Strongly Disagreed, and 22.22% Disagreed. A very high 37.78% responded with Neutral. Only 6.67% Agreed with the statement, and no-one Strongly Agreed (See Figure 61). Responses from the Face-to-Face groups indicated a greater degree of agreement. Only two people, or 4.35% Strongly Disagreed, and 17.39% Disagreed. Another 34.78% of responses were Neutral. Respondents indicated a 34.78% Agreement, and finally, 8.70% Strongly Agreed. See Figure 62.

"The facilitator effectively guided the group toward its goal." The GDSS groups worked with a facilitator, or chauffeur, in following the GDSS agenda (See Figure 63). Their responses indicated major agreement with this statement. Only two

Non-GDSS - The group used its time wisely
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Use of Time - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GTIMEUSE					
Group	Cluster	Data	1	2	3	4	5	Grand Total
2	A	Count of GTIMEUSE	0	0	0	1	8	9
		Percent of GTIMEUSE	0.00%	0.00%	0.00%	11.11%	88.89%	100.00%
	B	Count of GTIMEUSE	0	0	1	4	1	6
		Percent of GTIMEUSE	0.00%	0.00%	16.67%	66.67%	16.67%	100.00%
2 Count of GTIMEUSE			0	0	1	5	9	15
2 Percent of GTIMEUSE			0.00%	0.00%	6.67%	33.33%	60.00%	100.00%
4	A	Count of GTIMEUSE	0	0	1	1	6	8
		Percent of GTIMEUSE	0.00%	0.00%	12.50%	12.50%	75.00%	100.00%
	B	Count of GTIMEUSE	0	0	2	5	2	9
		Percent of GTIMEUSE	0.00%	0.00%	22.22%	55.56%	22.22%	100.00%
4 Count of GTIMEUSE			0	0	3	6	8	17
4 Percent of GTIMEUSE			0.00%	0.00%	17.65%	35.29%	47.06%	100.00%
5	A	Count of GTIMEUSE	1	4	1	0	1	7
		Percent of GTIMEUSE	14.29%	57.14%	14.29%	0.00%	14.29%	100.00%
5 Count of GTIMEUSE			1	4	1	0	1	7
5 Percent of GTIMEUSE			14.29%	57.14%	14.29%	0.00%	14.29%	100.00%
6	A	Count of GTIMEUSE	0	0	0	5	2	7
		Percent of GTIMEUSE	0.00%	0.00%	0.00%	71.43%	28.57%	100.00%
6 Count of GTIMEUSE			0	0	0	5	2	7
6 Percent of GTIMEUSE			0.00%	0.00%	0.00%	71.43%	28.57%	100.00%
Total Count of GTIMEUSE			1	4	5	16	20	46
Total Percent of GTIMEUSE			2.17%	8.70%	10.87%	34.78%	43.48%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
2.17%	8.70%	10.87%	34.78%	43.48%

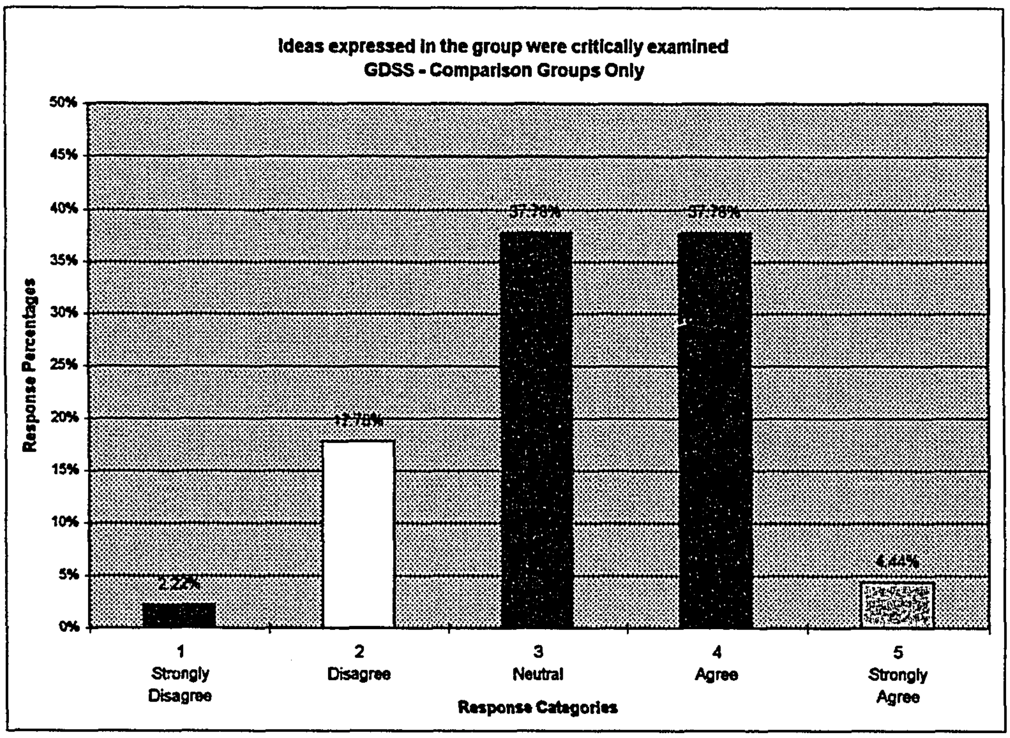


Non-GDSS: "The group used its time wisely."
Figure 58

GDSS - Ideas expressed in the group were critically examined
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Ideas Critically Examined - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GIDEAXAM						
Group	Cluster	Data	1	2	3	4	5	(blank)	Grand Total
2	A	Count of GIDEAXAM	0	2	3	3	1	0	9
		Percent of GIDEAXAM	0.00%	22.22%	33.33%	33.33%	11.11%	0.00%	100.00%
	B	Count of GIDEAXAM	0	0	2	4	0	0	6
		Percent of GIDEAXAM	0.00%	0.00%	33.33%	66.67%	0.00%	0.00%	100.00%
2 Count of GIDEAXAM			0	2	5	7	1	0	15
2 Percent of GIDEAXAM			0.00%	13.33%	33.33%	46.67%	6.67%	0.00%	100.00%
4	A	Count of GIDEAXAM	1	0	3	3	0	0	7
		Percent of GIDEAXAM	14.29%	0.00%	42.86%	42.86%	0.00%	0.00%	100.00%
	B	Count of GIDEAXAM	0	2	4	2	1	0	9
		Percent of GIDEAXAM	0.00%	22.22%	44.44%	22.22%	11.11%	0.00%	100.00%
4 Count of GIDEAXAM			1	2	7	5	1	0	16
4 Percent of GIDEAXAM			6.25%	12.50%	43.75%	31.25%	6.25%	0.00%	100.00%
5	A	Count of GIDEAXAM	0	4	2	1	0	0	7
		Percent of GIDEAXAM	0.00%	57.14%	28.57%	14.29%	0.00%	0.00%	100.00%
5 Count of GIDEAXAM			0	4	2	1	0	0	7
5 Percent of GIDEAXAM			0.00%	57.14%	28.57%	14.29%	0.00%	0.00%	100.00%
6	A	Count of GIDEAXAM	0	0	3	4	0	0	7
		Percent of GIDEAXAM	0.00%	0.00%	42.86%	57.14%	0.00%	0.00%	100.00%
6 Count of GIDEAXAM			0	0	3	4	0	0	7
6 Percent of GIDEAXAM			0.00%	0.00%	42.86%	57.14%	0.00%	0.00%	100.00%
Total Count of GIDEAXAM			1	8	17	17	2	0	45
Total Percent of GIDEAXAM			2.22%	17.78%	37.78%	37.78%	4.44%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
2.22%	17.78%	37.78%	37.78%	4.44%	0.00%

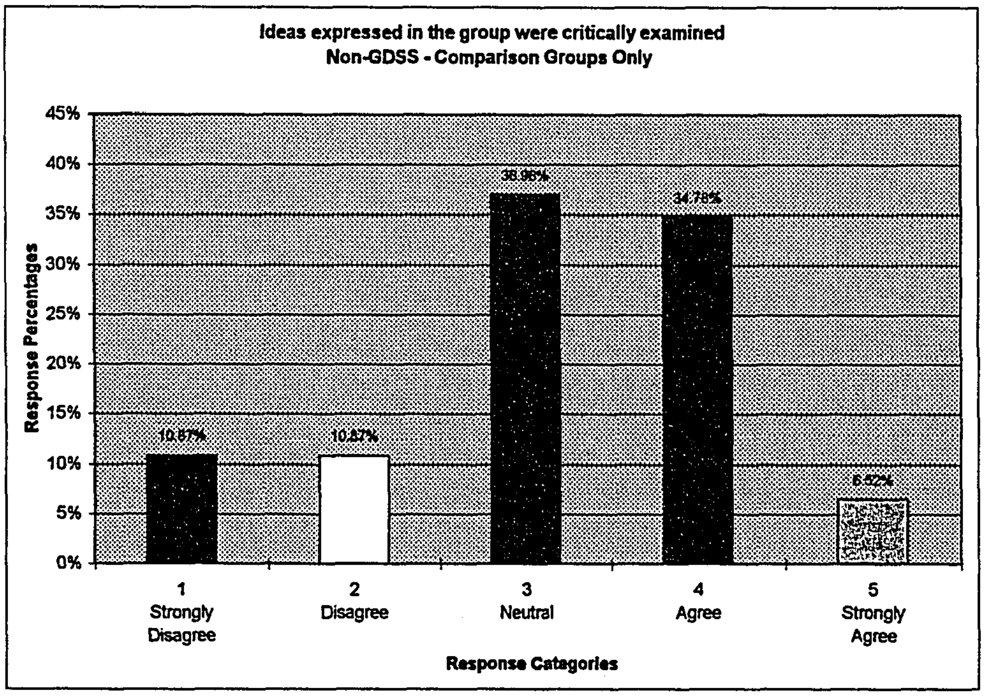


GDSS: "Ideas expressed in the group were critically examined."
Figure 59

Non-GDSS - Ideas expressed in the group were critically examined
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Ideas Critically Examined - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GIDEAXAM					
Group	Cluster	Data	1	2	3	4	5	Grand Total
2	A	Count of GIDEAXAM	0	0	2	4	3	9
		Percent of GIDEAXAM	0.00%	0.00%	22.22%	44.44%	33.33%	100.00%
	B	Count of GIDEAXAM	0	0	5	1	0	6
		Percent of GIDEAXAM	0.00%	0.00%	83.33%	16.67%	0.00%	100.00%
2 Count of GIDEAXAM			0	0	7	5	3	15
2 Percent of GIDEAXAM			0.00%	0.00%	46.67%	33.33%	20.00%	100.00%
4	A	Count of GIDEAXAM	1	1	2	4	0	8
		Percent of GIDEAXAM	12.50%	12.50%	25.00%	50.00%	0.00%	100.00%
	B	Count of GIDEAXAM	1	1	5	2	0	9
		Percent of GIDEAXAM	11.11%	11.11%	55.56%	22.22%	0.00%	100.00%
4 Count of GIDEAXAM			2	2	7	6	0	17
4 Percent of GIDEAXAM			11.76%	11.76%	41.18%	35.29%	0.00%	100.00%
5	A	Count of GIDEAXAM	3	1	2	1	0	7
		Percent of GIDEAXAM	42.86%	14.29%	28.57%	14.29%	0.00%	100.00%
5 Count of GIDEAXAM			3	1	2	1	0	7
5 Percent of GIDEAXAM			42.86%	14.29%	28.57%	14.29%	0.00%	100.00%
6	A	Count of GIDEAXAM	0	2	1	4	0	7
		Percent of GIDEAXAM	0.00%	28.57%	14.29%	57.14%	0.00%	100.00%
6 Count of GIDEAXAM			0	2	1	4	0	7
6 Percent of GIDEAXAM			0.00%	28.57%	14.29%	57.14%	0.00%	100.00%
Total Count of GIDEAXAM			5	5	17	16	3	46
Total Percent of GIDEAXAM			10.87%	10.87%	36.96%	34.78%	6.52%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
10.87%	10.87%	36.96%	34.78%	6.52%

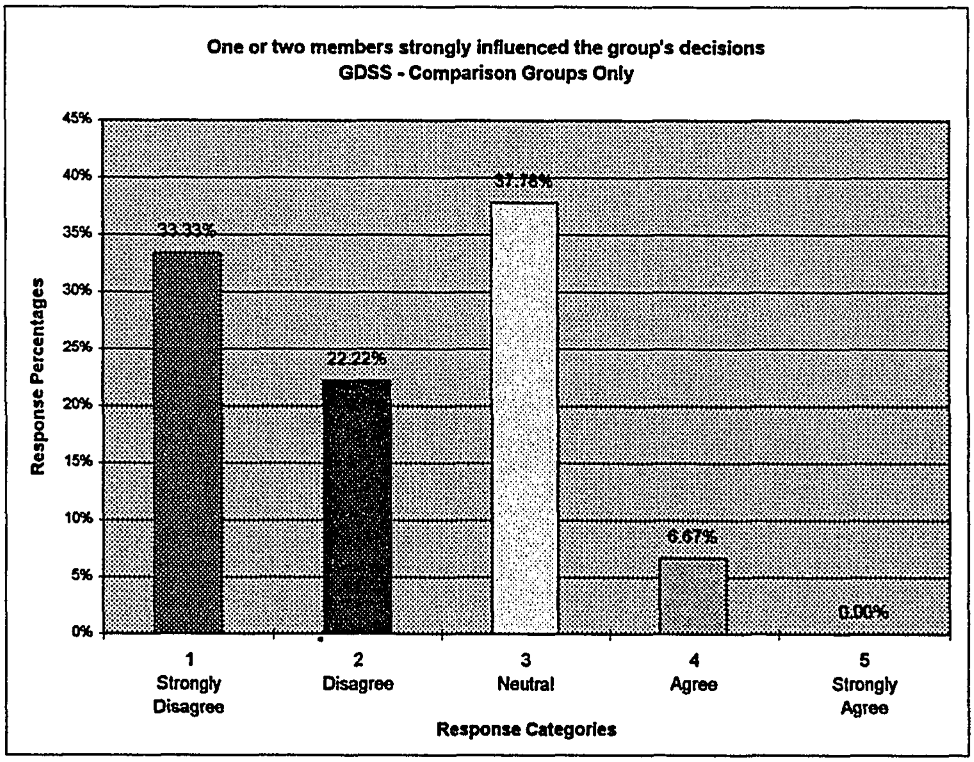


Non-GDSS: "Ideas expressed in the group were critically examined."
Figure 60

GDSS - One or two members strongly influenced the group's decisions
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Member Influence - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GMEMINFL					
Group	Cluster	Data	1	2	3	4	(blank)	Grand Total
2	A	Count of GMEMINFL	2	1	5	1	0	9
		Count of GMEMINFL2	22.22%	11.11%	55.56%	11.11%	0.00%	100.00%
	B	Count of GMEMINFL	2	2	2	0	0	6
		Count of GMEMINFL2	33.33%	33.33%	33.33%	0.00%	0.00%	100.00%
2 Count of GMEMINFL			4	3	7	1	0	15
2 Count of GMEMINFL2			26.67%	20.00%	46.67%	6.67%	0.00%	100.00%
4	A	Count of GMEMINFL	4	2	1	0	0	7
		Count of GMEMINFL2	57.14%	28.57%	14.29%	0.00%	0.00%	100.00%
	B	Count of GMEMINFL	3	0	4	2	0	9
		Count of GMEMINFL2	33.33%	0.00%	44.44%	22.22%	0.00%	100.00%
4 Count of GMEMINFL			7	2	5	2	0	16
4 Count of GMEMINFL2			43.75%	12.50%	31.25%	12.50%	0.00%	100.00%
5	A	Count of GMEMINFL	3	3	1	0	0	7
		Count of GMEMINFL2	42.86%	42.86%	14.29%	0.00%	0.00%	100.00%
5 Count of GMEMINFL			3	3	1	0	0	7
5 Count of GMEMINFL2			42.86%	42.86%	14.29%	0.00%	0.00%	100.00%
6	A	Count of GMEMINFL	1	2	4	0	0	7
		Count of GMEMINFL2	14.29%	28.57%	57.14%	0.00%	0.00%	100.00%
6 Count of GMEMINFL			1	2	4	0	0	7
6 Count of GMEMINFL2			14.29%	28.57%	57.14%	0.00%	0.00%	100.00%
Total Count of GMEMINFL			15	10	17	3	0	45
Total Count of GMEMINFL2			33.33%	22.22%	37.78%	6.67%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
33.33%	22.22%	37.78%	6.67%	0.00%	0.00%

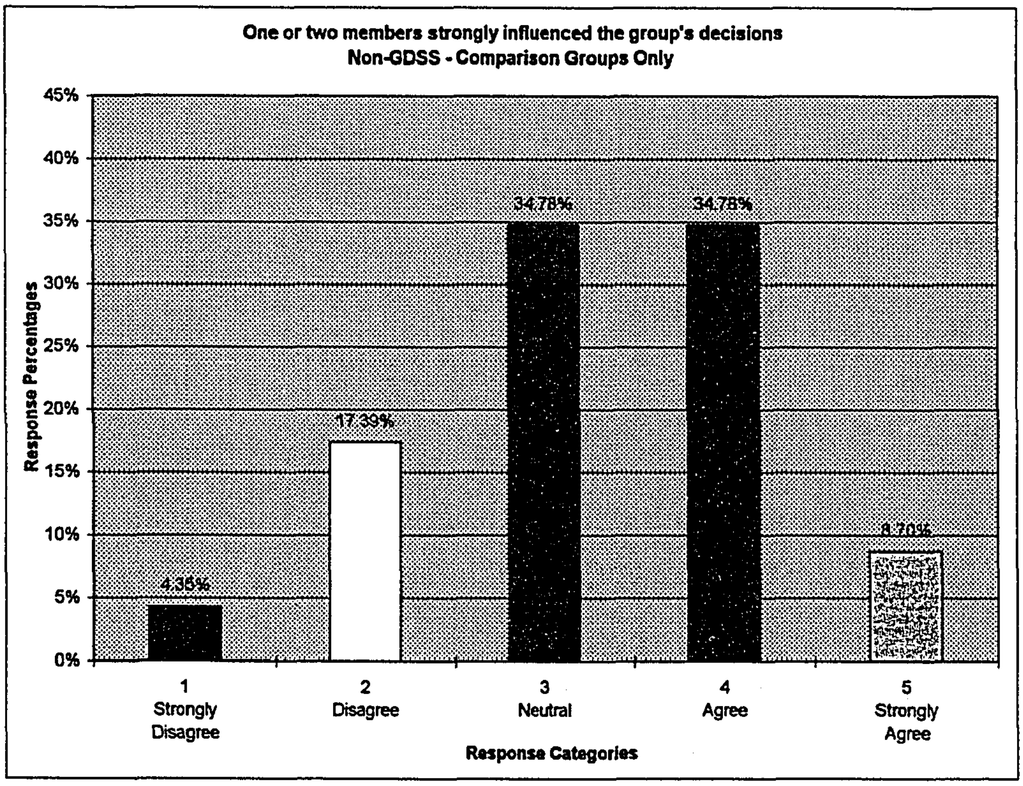


GDSS: "One or two members strongly influenced the group's decisions."
Figure 61

Non-GDSS - One or two members strongly influenced the group's decisions
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Member Influence - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GMEMINFL					
Group	Cluster	Data	1	2	3	4	5	Grand Total
2	A	Count of GMEMINFL	0	1	1	6	1	9
		Percent of GMEMINFL	0.00%	11.11%	11.11%	66.67%	11.11%	100.00%
	B	Count of GMEMINFL	0	0	3	1	2	6
		Percent of GMEMINFL	0.00%	0.00%	50.00%	16.67%	33.33%	100.00%
2 Count of GMEMINFL			0	1	4	7	3	15
2 Percent of GMEMINFL			0.00%	6.67%	26.67%	46.67%	20.00%	100.00%
4	A	Count of GMEMINFL	2	3	1	2	0	8
		Percent of GMEMINFL	25.00%	37.50%	12.50%	25.00%	0.00%	100.00%
	B	Count of GMEMINFL	0	2	3	4	0	9
		Percent of GMEMINFL	0.00%	22.22%	33.33%	44.44%	0.00%	100.00%
4 Count of GMEMINFL			2	5	4	6	0	17
4 Percent of GMEMINFL			11.76%	29.41%	23.53%	35.29%	0.00%	100.00%
5	A	Count of GMEMINFL	0	1	5	1	0	7
		Percent of GMEMINFL	0.00%	14.29%	71.43%	14.29%	0.00%	100.00%
5 Count of GMEMINFL			0	1	5	1	0	7
5 Percent of GMEMINFL			0.00%	14.29%	71.43%	14.29%	0.00%	100.00%
6	A	Count of GMEMINFL	0	1	3	2	1	7
		Percent of GMEMINFL	0.00%	14.29%	42.86%	28.57%	14.29%	100.00%
6 Count of GMEMINFL			0	1	3	2	1	7
6 Percent of GMEMINFL			0.00%	14.29%	42.86%	28.57%	14.29%	100.00%
Total Count of GMEMINFL			2	8	16	16	4	46
Total Percent of GMEMINFL			4.35%	17.39%	34.78%	34.78%	8.70%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
4.35%	17.39%	34.78%	34.78%	8.70%

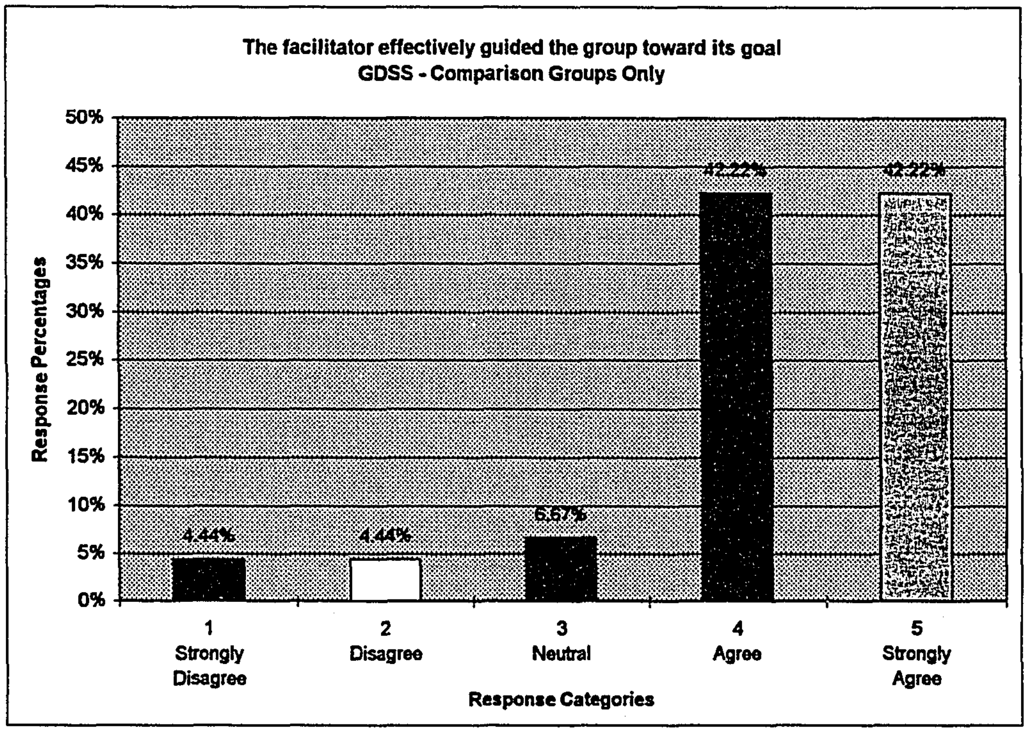


Non-GDSS: "One or two members strongly influenced the group's decisions."
Figure 62

GDSS - The facilitator effectively guided the group toward its goal
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Facilitator - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GFACIL						
Group	Cluster	Data	1	2	3	4	5	(blank)	Grand Total
2	A	Count of GFACIL	0	0	2	4	3	0	9
		Percent of GFACIL2	0.00%	0.00%	22.22%	44.44%	33.33%	0.00%	100.00%
	B	Count of GFACIL	1	0	0	4	1	0	6
		Percent of GFACIL2	16.67%	0.00%	0.00%	66.67%	16.67%	0.00%	100.00%
2 Count of GFACIL			1	0	2	8	4	0	15
2 Percent of GFACIL2			6.67%	0.00%	13.33%	53.33%	26.67%	0.00%	100.00%
4	A	Count of GFACIL	1	0	0	2	4	0	7
		Percent of GFACIL2	14.29%	0.00%	0.00%	28.57%	57.14%	0.00%	100.00%
	B	Count of GFACIL	0	2	0	3	4	0	9
		Percent of GFACIL2	0.00%	22.22%	0.00%	33.33%	44.44%	0.00%	100.00%
4 Count of GFACIL			1	2	0	5	8	0	16
4 Percent of GFACIL2			6.25%	12.50%	0.00%	31.25%	50.00%	0.00%	100.00%
5	A	Count of GFACIL	0	0	1	4	2	0	7
		Percent of GFACIL2	0.00%	0.00%	14.29%	57.14%	28.57%	0.00%	100.00%
5 Count of GFACIL			0	0	1	4	2	0	7
5 Percent of GFACIL2			0.00%	0.00%	14.29%	57.14%	28.57%	0.00%	100.00%
6	A	Count of GFACIL	0	0	0	2	5	0	7
		Percent of GFACIL2	0.00%	0.00%	0.00%	28.57%	71.43%	0.00%	100.00%
6 Count of GFACIL			0	0	0	2	5	0	7
6 Percent of GFACIL2			0.00%	0.00%	0.00%	28.57%	71.43%	0.00%	100.00%
Total Count of GFACIL			2	2	3	19	19	0	45
Total Percent of GFACIL2			4.44%	4.44%	6.67%	42.22%	42.22%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
4.44%	4.44%	6.67%	42.22%	42.22%	0.00%



GDSS: "The facilitator effectively guided the group toward its goal."

Figure 63

individuals, or 4.44%, responded Strongly Disagree or Disagree. Only three people, or 6.67%, were Neutral. Another 42.22% each responded both for Agree and for Strongly Agree. Responses from the Face-to-Face groups, who also worked with facilitators, were even more positive. No-one Strongly Disagreed, and only two individuals, or 4.35% Disagreed. Another 8.70% were Neutral. In Agreement were 34.78%, and a full half, or 50.00%, Strongly Agreed. See Figure 64.

Professional Satisfaction

As student "experts", the subjects were asked to give their perceptions of their professional satisfaction after their respective GDSS and Face-to-Face group experiences. Four statements were offered for their reaction.

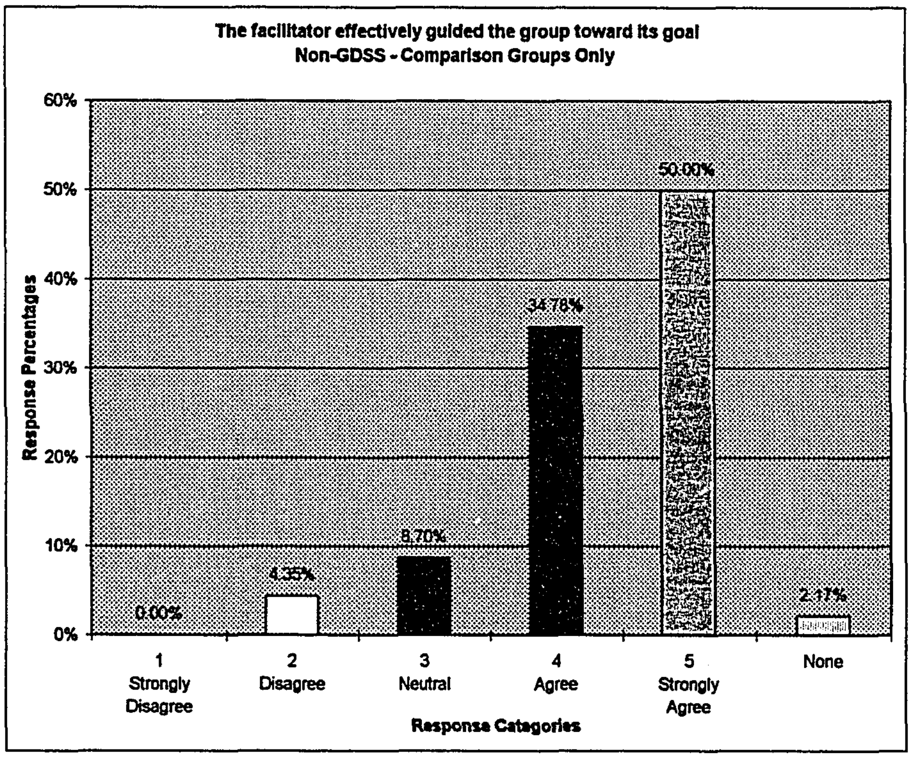
"I now have a much better understanding of how other members of my group view this issue." GDSS respondents showed minimum disagreement, as only one person each (2.22%) expressed Strong Disagreement or Disagreement (Figure 65). The Neutral responses amounted to 13.33%, and a high 53.33% Agreed. A final 26.67% Strongly Agreed. The Face-to-Face groups indicated an even higher degree of agreement. No-one Strongly Disagreed, and only two individuals, or 4.35%, Disagreed. Approximately ten percent (10.87%) were Neutral. Over two-thirds of respondents (67.39%) Agreed with the statement, and another 17.39% Strongly Agreed. See Figure 66.

"This meeting made me critically reevaluate my own thoughts on the topic." The responses from the GDSS groups on this issue were somewhat indecisive (Figure

Non-GDSS - The facilitator effectively guided the group toward its goal
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Facilitator - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GFACIL					
Group	Cluster	Data	2	3	4	5	NONE	Grand Total
2	A	Count of GFACIL	0	0	4	5	0	9
		Percent of GFACIL	0.00%	0.00%	44.44%	55.56%	0.00%	100.00%
	B	Count of GFACIL	0	1	3	2	0	6
		Percent of GFACIL	0.00%	16.67%	50.00%	33.33%	0.00%	100.00%
2 Count of GFACIL			0	1	7	7	0	15
2 Percent of GFACIL			0.00%	6.67%	46.67%	46.67%	0.00%	100.00%
4	A	Count of GFACIL	0	0	3	5	0	8
		Percent of GFACIL	0.00%	0.00%	37.50%	62.50%	0.00%	100.00%
	B	Count of GFACIL	0	0	4	4	1	9
		Percent of GFACIL	0.00%	0.00%	44.44%	44.44%	11.11%	100.00%
4 Count of GFACIL			0	0	7	9	1	17
4 Percent of GFACIL			0.00%	0.00%	41.18%	52.94%	5.88%	100.00%
5	A	Count of GFACIL	2	3	1	1	0	7
		Percent of GFACIL	28.57%	42.86%	14.29%	14.29%	0.00%	100.00%
5 Count of GFACIL			2	3	1	1	0	7
5 Percent of GFACIL			28.57%	42.86%	14.29%	14.29%	0.00%	100.00%
6	A	Count of GFACIL	0	0	1	6	0	7
		Percent of GFACIL	0.00%	0.00%	14.29%	85.71%	0.00%	100.00%
6 Count of GFACIL			0	0	1	6	0	7
6 Percent of GFACIL			0.00%	0.00%	14.29%	85.71%	0.00%	100.00%
Total Count of GFACIL			2	4	16	23	1	46
Total Percent of GFACIL			4.35%	8.70%	34.78%	50.00%	2.17%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
1	2	3	4	5	None
0.00%	4.35%	8.70%	34.78%	50.00%	2.17%

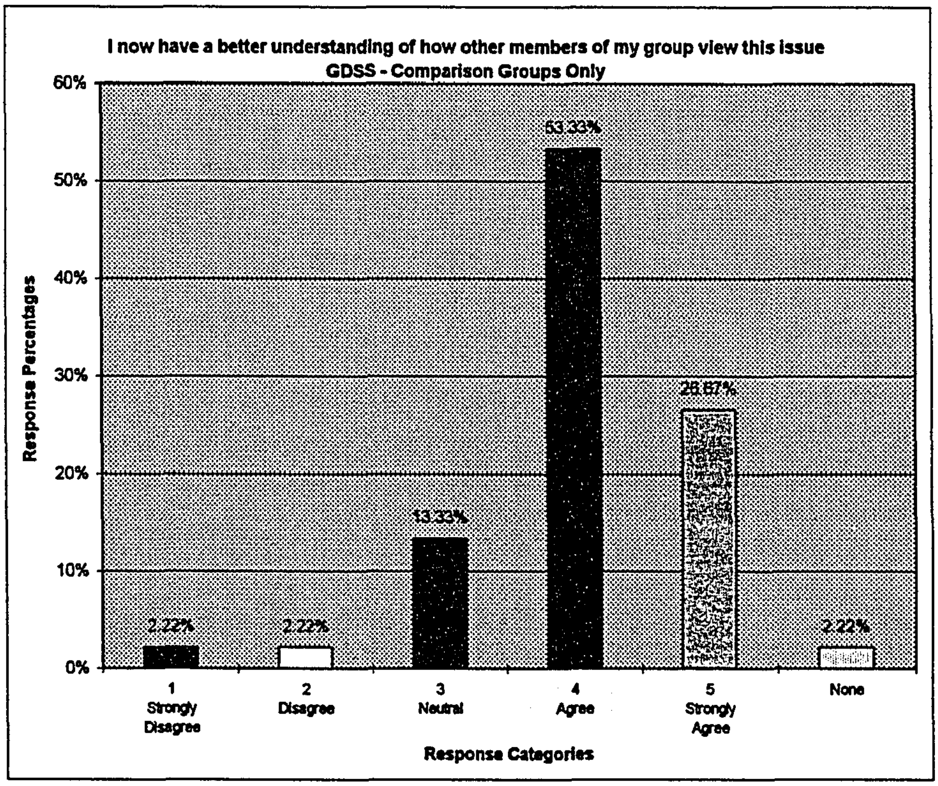


Non-GDSS: "The facilitator effectively guided the group toward its goal."
Figure 64

GDSS - I now have a better understanding of how other members of my group view this issue
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Understanding Views - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GOTHVIEW							
Group	Cluster	Data	1	2	3	4	5	NONE	(blank)	Grand Total
2	A	Count of GOTHVIEW	0	1	1	4	3	0	0	9
		Percent of GOTHVIEW2	0.00%	11.11%	11.11%	44.44%	33.33%	0.00%	0.00%	100.00%
	B	Count of GOTHVIEW	0	0	1	4	1	0	0	6
		Percent of GOTHVIEW2	0.00%	0.00%	16.67%	66.67%	16.67%	0.00%	0.00%	100.00%
2 Count of GOTHVIEW			0	1	2	8	4	0	0	15
2 Percent of GOTHVIEW2			0.00%	6.67%	13.33%	53.33%	26.67%	0.00%	0.00%	100.00%
4	A	Count of GOTHVIEW	0	0	0	4	2	1	0	7
		Percent of GOTHVIEW2	0.00%	0.00%	0.00%	57.14%	28.57%	14.29%	0.00%	100.00%
	B	Count of GOTHVIEW	1	0	1	4	3	0	0	9
		Percent of GOTHVIEW2	11.11%	0.00%	11.11%	44.44%	33.33%	0.00%	0.00%	100.00%
4 Count of GOTHVIEW			1	0	1	8	5	1	0	16
4 Percent of GOTHVIEW2			6.25%	0.00%	6.25%	50.00%	31.25%	6.25%	0.00%	100.00%
5	A	Count of GOTHVIEW	0	0	1	5	1	0	0	7
		Percent of GOTHVIEW2	0.00%	0.00%	14.29%	71.43%	14.29%	0.00%	0.00%	100.00%
5 Count of GOTHVIEW			0	0	1	5	1	0	0	7
5 Percent of GOTHVIEW2			0.00%	0.00%	14.29%	71.43%	14.29%	0.00%	0.00%	100.00%
6	A	Count of GOTHVIEW	0	0	2	3	2	0	0	7
		Percent of GOTHVIEW2	0.00%	0.00%	28.57%	42.86%	28.57%	0.00%	0.00%	100.00%
6 Count of GOTHVIEW			0	0	2	3	2	0	0	7
6 Percent of GOTHVIEW2			0.00%	0.00%	28.57%	42.86%	28.57%	0.00%	0.00%	100.00%
Total Count of GOTHVIEW			1	1	6	24	12	1	0	45
Total Percent of GOTHVIEW2			2.22%	2.22%	13.33%	53.33%	26.67%	2.22%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
1	2	3	4	5	None
2.22%	2.22%	13.33%	53.33%	26.67%	2.22%

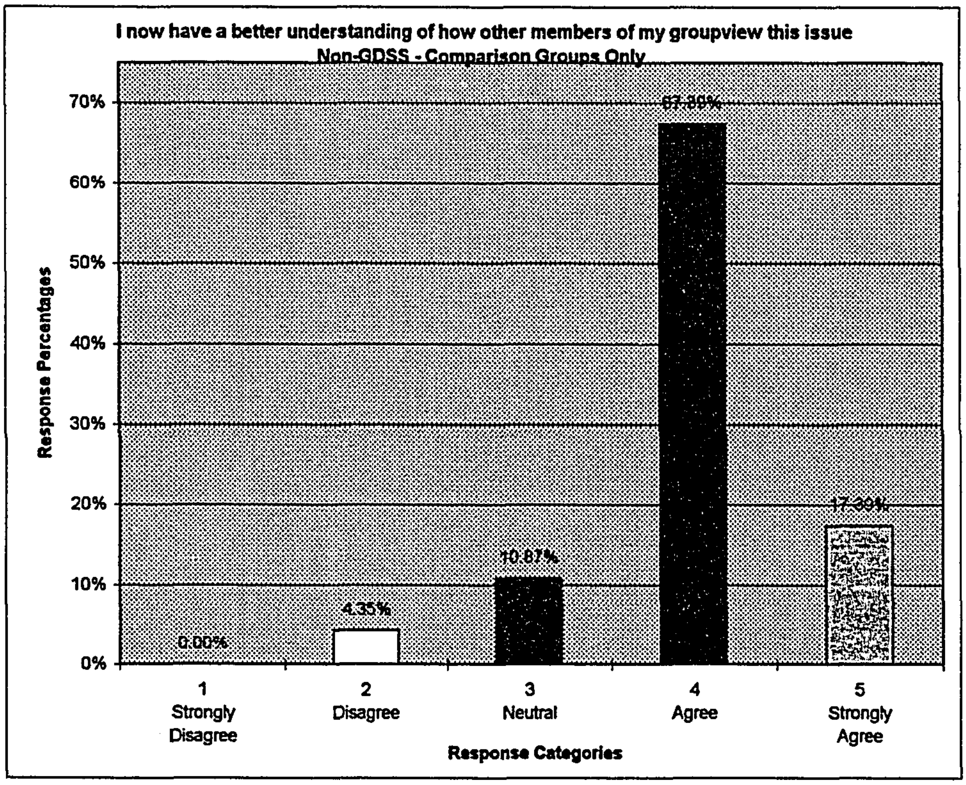


GDSS: "I now have a much better understanding of how other members of my group view this issue."
Figure 65

Non-GDSS - I now have a better understanding of how other members of my group view this issue
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Understanding Views - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GOTHVIEW				
Group	Cluster	Data	2	3	4	5	Grand Total
2	A	Count of GOTHVIEW	0	1	4	4	9
		Percent of GOTHVIEW	0.00%	11.11%	44.44%	44.44%	100.00%
	B	Count of GOTHVIEW	0	0	6	0	6
		Percent of GOTHVIEW	· 0.00%	0.00%	100.00%	0.00%	100.00%
2 Count of GOTHVIEW			0	1	10	4	15
2 Percent of GOTHVIEW			0.00%	6.67%	66.67%	26.67%	100.00%
4	A	Count of GOTHVIEW	0	2	6	0	8
		Percent of GOTHVIEW	0.00%	25.00%	75.00%	0.00%	100.00%
	B	Count of GOTHVIEW	1	1	5	2	9
		Percent of GOTHVIEW	11.11%	11.11%	55.56%	22.22%	100.00%
4 Count of GOTHVIEW			1	3	11	2	17
4 Percent of GOTHVIEW			5.88%	17.65%	64.71%	11.76%	100.00%
5	A	Count of GOTHVIEW	1	0	5	1	7
		Percent of GOTHVIEW	14.29%	0.00%	71.43%	14.29%	100.00%
5 Count of GOTHVIEW			1	0	5	1	7
5 Percent of GOTHVIEW			14.29%	0.00%	71.43%	14.29%	100.00%
6	A	Count of GOTHVIEW	0	1	5	1	7
		Percent of GOTHVIEW	0.00%	14.29%	71.43%	14.29%	100.00%
6 Count of GOTHVIEW			0	1	5	1	7
6 Percent of GOTHVIEW			0.00%	14.29%	71.43%	14.29%	100.00%
Total Count of GOTHVIEW			2	5	31	8	46
Total Percent of GOTHVIEW			4.35%	10.87%	67.39%	17.39%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
1	2	3	4	5	None
0.00%	4.35%	10.87%	67.39%	17.39%	0.00%



Non-GDSS: "I now have a much better understanding of how other members of my group view this issue."
Figure 66

67). Two individuals, or 4.44% indicated Strong Disagreement, and 11.11% Disagreed. The largest group, 37.78% were Neutral or undecided. Another third (33.33%) Agreed with the statement, and 13.33% Strongly Agreed. Face-to-Face groups responded more positively. Only 6.52% Strongly Disagreed, and 10.87% Disagreed. The Neutral response was 30.43%, and 41.30% Agreed. A final 10.87% Strongly Agreed with the statement. See Figure 68.

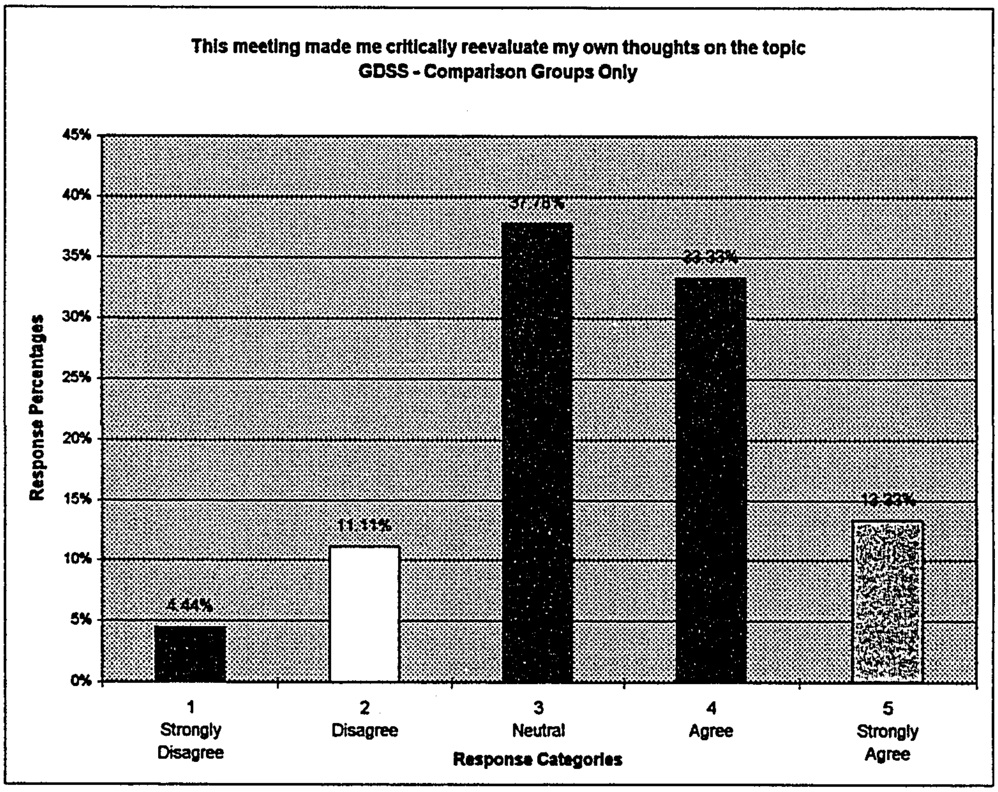
"The meeting uncovered ideas that I had not thought of individually." The GDSS groups responded positively to this statement (See Figure 69). Only 6.67% Strongly Disagreed, and 11.11% Disagreed. A relatively small group of 8.89% were Neutral, and 48.89% Agreed. Finally, almost a quarter of responses, or 24.44%, Strongly Agreed. Again, the Face-to-Face groups were even more positive. Two individuals, or 4.35%, responded with Strongly Disagree, with Disagree, and with Neutral. Another 47.83% Agreed with the statement, and 39.13% Strongly Agreed. See Figure 70.

"Members were able to provide enough information about their ideas." GDSS groups responses indicated that 8.89% Strongly Disagreed with this statement, and that 17.78% Disagreed (See Figure 71). Only 6.67% were Neutral. A group of 46.67% were in Agreement with the statement, and a final 20.00% Strongly Agreed that members were able to provide enough information. Face-to-Face respondents indicated that only two individuals, or 4.35% Strongly Disagreed. Another 8.70% Disagreed. Neutral responses amounted to 21.74%. Agreement was 47.83%, and a final 17.39% Strongly Agreed. See Figure 72.

GDSS - This meeting made me critically reevaluate my own thoughts on the topic
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Reevaluate My Thoughts - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GEVALMY						
Group	Cluster	Data	1	2	3	4	5	(blank)	Grand Total
2	A	Count of GEVALMY	0	1	3	4	1	0	9
		Percent of GEVALMY2	0.00%	11.11%	33.33%	44.44%	11.11%	0.00%	100.00%
	B	Count of GEVALMY	0	0	3	3	0	0	6
		Percent of GEVALMY2	0.00%	0.00%	50.00%	50.00%	0.00%	0.00%	100.00%
2 Count of GEVALMY			0	1	6	7	1	0	15
2 Percent of GEVALMY2			0.00%	6.67%	40.00%	46.67%	6.67%	0.00%	100.00%
4	A	Count of GEVALMY	0	3	3	0	1	0	7
		Percent of GEVALMY2	0.00%	42.86%	42.86%	0.00%	14.29%	0.00%	100.00%
	B	Count of GEVALMY	1	1	4	1	2	0	9
		Percent of GEVALMY2	11.11%	11.11%	44.44%	11.11%	22.22%	0.00%	100.00%
4 Count of GEVALMY			1	4	7	1	3	0	16
4 Percent of GEVALMY2			6.25%	25.00%	43.75%	6.25%	18.75%	0.00%	100.00%
5	A	Count of GEVALMY	1	0	3	2	1	0	7
		Percent of GEVALMY2	14.29%	0.00%	42.86%	28.57%	14.29%	0.00%	100.00%
5 Count of GEVALMY			1	0	3	2	1	0	7
5 Percent of GEVALMY2			14.29%	0.00%	42.86%	28.57%	14.29%	0.00%	100.00%
6	A	Count of GEVALMY	0	0	1	5	1	0	7
		Percent of GEVALMY2	0.00%	0.00%	14.29%	71.43%	14.29%	0.00%	100.00%
6 Count of GEVALMY			0	0	1	5	1	0	7
6 Percent of GEVALMY2			0.00%	0.00%	14.29%	71.43%	14.29%	0.00%	100.00%
Total Count of GEVALMY			2	5	17	15	6	0	45
Total Percent of GEVALMY2			4.44%	11.11%	37.78%	33.33%	13.33%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	None
4.44%	11.11%	37.78%	33.33%	13.33%	0.00%

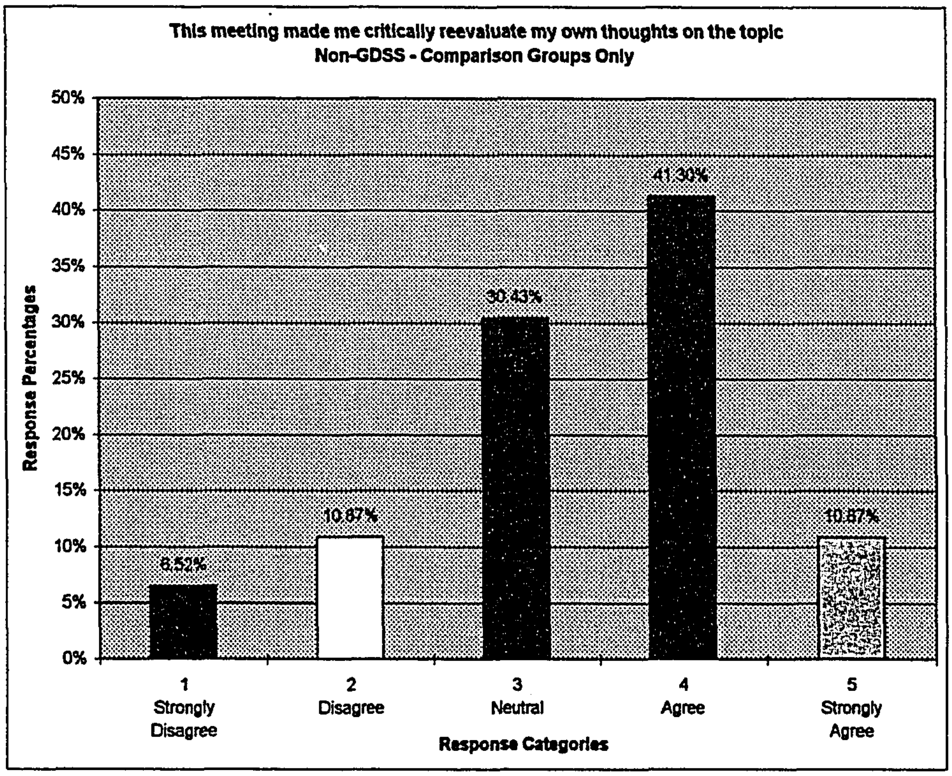


GDSS: "This meeting made me critically reevaluate my own thoughts on the topic."
Figure 67

Non-GDSS - This meeting made me critically reevaluate my own thoughts on the topic
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Reevaluate My Thoughts - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GEVALMY					
Group	Cluster	Data	1	2	3	4	5	Grand Total
2	A	Count of GEVALMY	0	1	0	5	3	9
		Percent of GEVALMY	0.00%	11.11%	0.00%	55.56%	33.33%	100.00%
	B	Count of GEVALMY	0	0	3	3	0	6
		Percent of GEVALMY	0.00%	0.00%	50.00%	50.00%	0.00%	100.00%
2 Count of GEVALMY			0	1	3	8	3	15
2 Percent of GEVALMY			0.00%	6.67%	20.00%	53.33%	20.00%	100.00%
4	A	Count of GEVALMY	1	1	3	3	0	8
		Percent of GEVALMY	12.50%	12.50%	37.50%	37.50%	0.00%	100.00%
	B	Count of GEVALMY	0	1	3	4	1	9
		Percent of GEVALMY	0.00%	11.11%	33.33%	44.44%	11.11%	100.00%
4 Count of GEVALMY			1	2	6	7	1	17
4 Percent of GEVALMY			5.88%	11.76%	35.29%	41.18%	5.88%	100.00%
5	A	Count of GEVALMY	1	1	3	2	0	7
		Percent of GEVALMY	14.29%	14.29%	42.86%	28.57%	0.00%	100.00%
5 Count of GEVALMY			1	1	3	2	0	7
5 Percent of GEVALMY			14.29%	14.29%	42.86%	28.57%	0.00%	100.00%
6	A	Count of GEVALMY	1	1	2	2	1	7
		Percent of GEVALMY	14.29%	14.29%	28.57%	28.57%	14.29%	100.00%
6 Count of GEVALMY			1	1	2	2	1	7
6 Percent of GEVALMY			14.29%	14.29%	28.57%	28.57%	14.29%	100.00%
Total Count of GEVALMY			3	5	14	19	5	46
Total Percent of GEVALMY			6.52%	10.87%	30.43%	41.30%	10.87%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
1	2	3	4	5	None
6.52%	10.87%	30.43%	41.30%	10.87%	0.00%

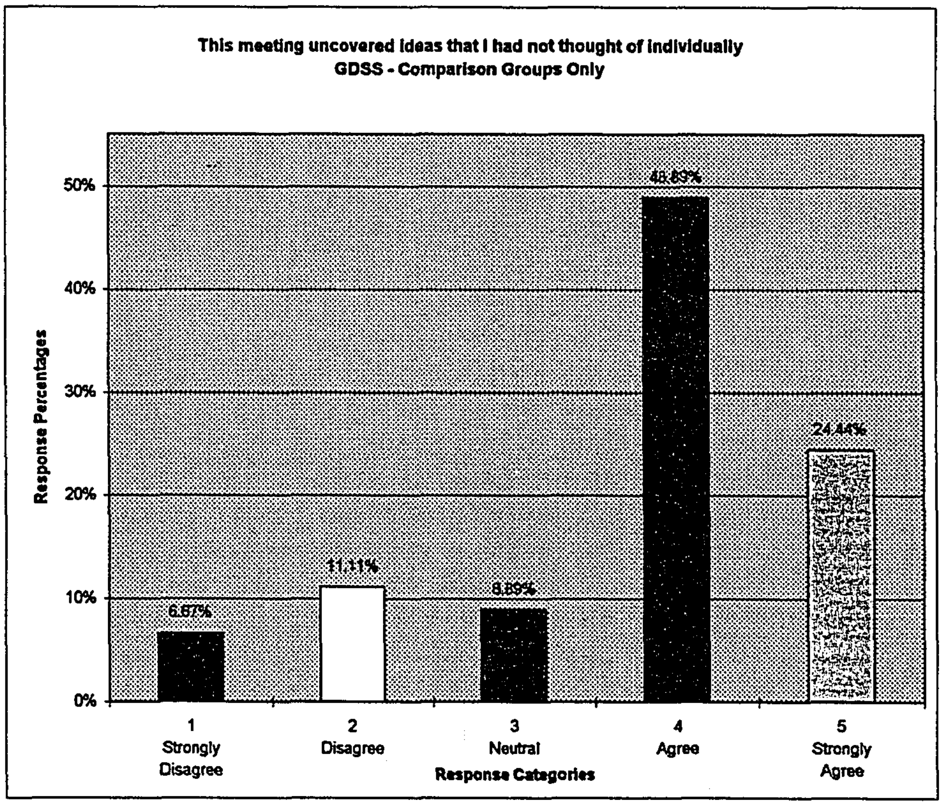


Non-GDSS: "This meeting made me critically reevaluate my own thoughts on the topic."
Figure 68

GDSS - This meeting uncovered ideas that I had not thought of individually
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Uncovering Ideas - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GNEWIDEA						
Group	Cluster	Data	1	2	3	4	5	(blank)	Grand Total
2	A	Count of GNEWIDEA	0	1	0	5	3	0	9
		Percent of GNEWIDEA2	0.00%	11.11%	0.00%	55.56%	33.33%	0.00%	100.00%
	B	Count of GNEWIDEA	0	0	1	4	1	0	6
		Percent of GNEWIDEA2	0.00%	0.00%	16.67%	66.67%	16.67%	0.00%	100.00%
2 Count of GNEWIDEA			0	1	1	9	4	0	15
2 Percent of GNEWIDEA2			0.00%	6.67%	6.67%	60.00%	26.67%	0.00%	100.00%
4	A	Count of GNEWIDEA	0	0	1	5	1	0	7
		Percent of GNEWIDEA2	0.00%	0.00%	14.29%	71.43%	14.29%	0.00%	100.00%
	B	Count of GNEWIDEA	3	1	2	1	2	0	9
		Percent of GNEWIDEA2	33.33%	11.11%	22.22%	11.11%	22.22%	0.00%	100.00%
4 Count of GNEWIDEA			3	1	3	6	3	0	16
4 Percent of GNEWIDEA2			18.75%	6.25%	18.75%	37.50%	18.75%	0.00%	100.00%
5	A	Count of GNEWIDEA	0	2	0	3	2	0	7
		Percent of GNEWIDEA2	0.00%	28.57%	0.00%	42.86%	28.57%	0.00%	100.00%
5 Count of GNEWIDEA			0	2	0	3	2	0	7
5 Percent of GNEWIDEA2			0.00%	28.57%	0.00%	42.86%	28.57%	0.00%	100.00%
6	A	Count of GNEWIDEA	0	1	0	4	2	0	7
		Percent of GNEWIDEA2	0.00%	14.29%	0.00%	57.14%	28.57%	0.00%	100.00%
6 Count of GNEWIDEA			0	1	0	4	2	0	7
6 Percent of GNEWIDEA2			0.00%	14.29%	0.00%	57.14%	28.57%	0.00%	100.00%
Total Count of GNEWIDEA			3	5	4	22	11	0	45
Total Percent of GNEWIDEA2			6.67%	11.11%	8.89%	48.89%	24.44%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
6.67%	11.11%	8.89%	48.89%	24.44%	0.00%



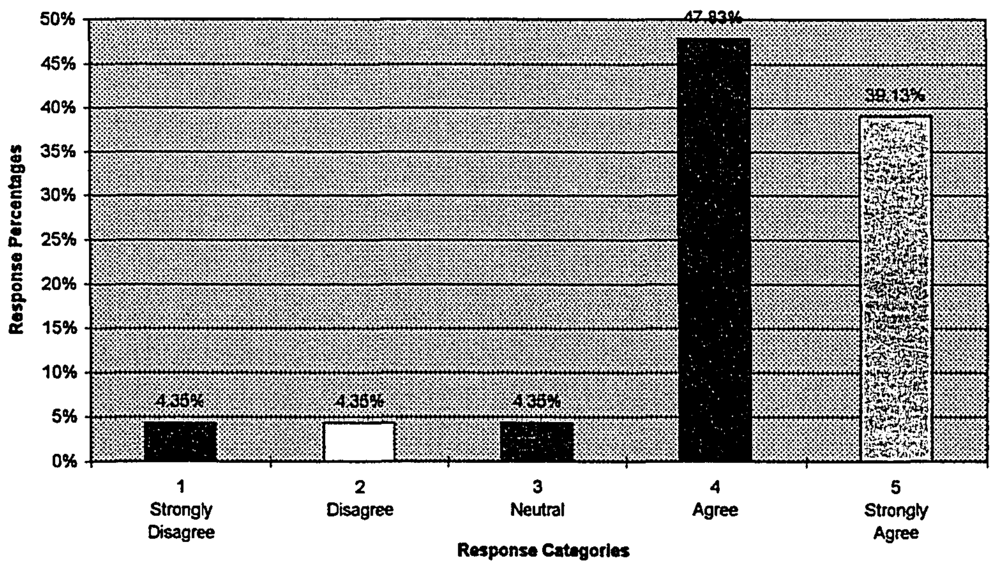
GDSS: "The meeting uncovered ideas that I had not thought of individually."
Figure 69

Non-GDSS - This meeting uncovered ideas that I had not thought of individually
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Uncovering Ideas - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GNEWIDEA					
Group	Cluster	Data	1	2	3	4	5	Grand Total
2	A	Count of GNEWIDEA	0	0	0	2	7	9
		Percent of GNEWIDEA	0.00%	0.00%	0.00%	22.22%	77.78%	100.00%
	B	Count of GNEWIDEA	0	1	0	3	2	6
		Percent of GNEWIDEA	0.00%	16.67%	0.00%	50.00%	33.33%	100.00%
2 Count of GNEWIDEA			0	1	0	5	9	15
2 Percent of GNEWIDEA			0.00%	6.67%	0.00%	33.33%	60.00%	100.00%
4	A	Count of GNEWIDEA	0	0	1	4	3	8
		Percent of GNEWIDEA	0.00%	0.00%	12.50%	50.00%	37.50%	100.00%
	B	Count of GNEWIDEA	0	1	0	7	1	9
		Percent of GNEWIDEA	0.00%	11.11%	0.00%	77.78%	11.11%	100.00%
4 Count of GNEWIDEA			0	1	1	11	4	17
4 Percent of GNEWIDEA			0.00%	5.88%	5.88%	64.71%	23.53%	100.00%
5	A	Count of GNEWIDEA	1	0	1	3	2	7
		Percent of GNEWIDEA	14.29%	0.00%	14.29%	42.86%	28.57%	100.00%
5 Count of GNEWIDEA			1	0	1	3	2	7
5 Percent of GNEWIDEA			14.29%	0.00%	14.29%	42.86%	28.57%	100.00%
6	A	Count of GNEWIDEA	1	0	0	3	3	7
		Percent of GNEWIDEA	14.29%	0.00%	0.00%	42.86%	42.86%	100.00%
6 Count of GNEWIDEA			1	0	0	3	3	7
6 Percent of GNEWIDEA			14.29%	0.00%	0.00%	42.86%	42.86%	100.00%
Total Count of GNEWIDEA			2	2	2	22	18	46
Total Percent of GNEWIDEA			4.35%	4.35%	4.35%	47.83%	39.13%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
1	2	3	4	5	None
4.35%	4.35%	4.35%	47.83%	39.13%	0.00%

This meeting uncovered ideas that I had not thought of individually
Non-GDSS - Comparison Groups Only

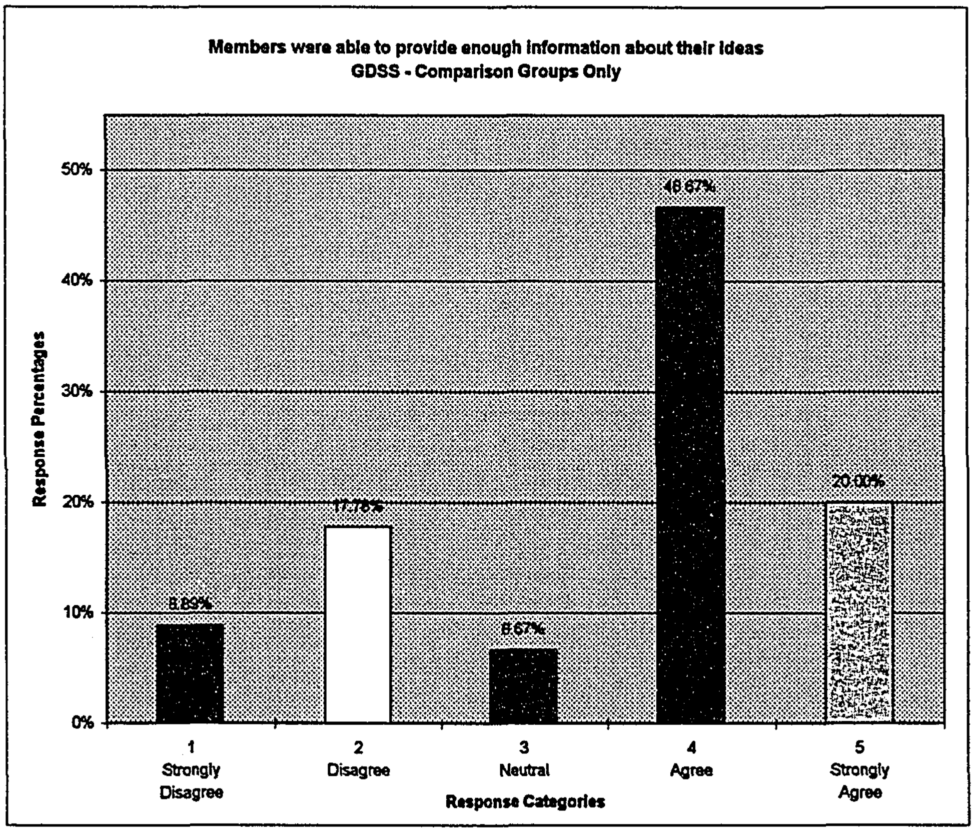


Non-GDSS: "The meeting uncovered ideas that I had not thought of individually."
Figure 70

GDSS - Members were able to provide enough information about their ideas
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Providing Ideas - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GCOMPIDEA						
Group	Cluster	Data	1	2	3	4	5	(blank)	Grand Total
2	A	Count of GCOMPIDEA	1	1	0	4	3	0	9
		Percent of GCOMPIDEA2	11.11%	11.11%	0.00%	44.44%	33.33%	0.00%	100.00%
	B	Count of GCOMPIDEA	0	1	0	5	0	0	6
		Percent of GCOMPIDEA2	0.00%	16.67%	0.00%	83.33%	0.00%	0.00%	100.00%
2 Count of GCOMPIDEA			1	2	0	9	3	0	15
2 Percent of GCOMPIDEA2			6.67%	13.33%	0.00%	60.00%	20.00%	0.00%	100.00%
4	A	Count of GCOMPIDEA	2	0	2	2	1	0	7
		Percent of GCOMPIDEA2	28.57%	0.00%	28.57%	28.57%	14.29%	0.00%	100.00%
	B	Count of GCOMPIDEA	1	2	1	3	2	0	9
		Percent of GCOMPIDEA2	11.11%	22.22%	11.11%	33.33%	22.22%	0.00%	100.00%
4 Count of GCOMPIDEA			3	2	3	5	3	0	16
4 Percent of GCOMPIDEA2			18.75%	12.50%	18.75%	31.25%	18.75%	0.00%	100.00%
5	A	Count of GCOMPIDEA	0	2	0	4	1	0	7
		Percent of GCOMPIDEA2	0.00%	28.57%	0.00%	57.14%	14.29%	0.00%	100.00%
5 Count of GCOMPIDEA			0	2	0	4	1	0	7
5 Percent of GCOMPIDEA2			0.00%	28.57%	0.00%	57.14%	14.29%	0.00%	100.00%
6	A	Count of GCOMPIDEA	0	2	0	3	2	0	7
		Percent of GCOMPIDEA2	0.00%	28.57%	0.00%	42.86%	28.57%	0.00%	100.00%
6 Count of GCOMPIDEA			0	2	0	3	2	0	7
6 Percent of GCOMPIDEA2			0.00%	28.57%	0.00%	42.86%	28.57%	0.00%	100.00%
Total Count of GCOMPIDEA			4	8	3	21	9	0	45
Total Percent of GCOMPIDEA2			8.89%	17.78%	6.67%	46.67%	20.00%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
8.89%	17.78%	6.67%	46.67%	20.00%	0.00%

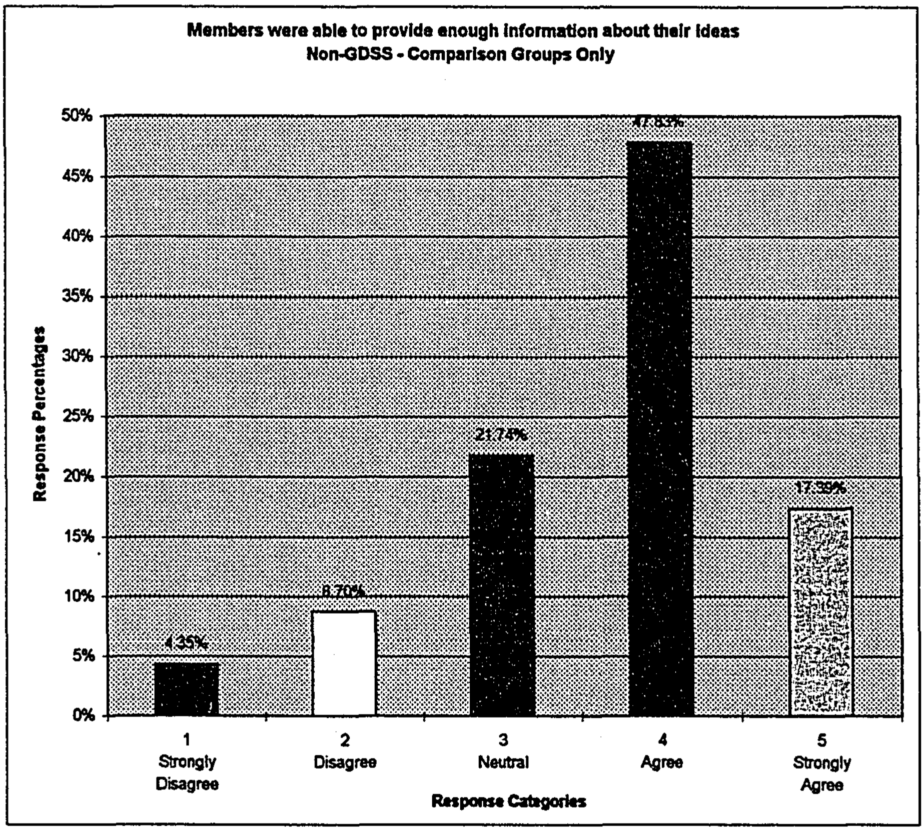


GDSS: "Members were able to provide enough information about their ideas."
Figure 71

Non-GDSS - Members were able to provide enough information about their ideas
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Providing Ideas - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GCOMPIDEA					
Group	Cluster	Data	1	2	3	4	5	Grand Total
2	A	Count of GCOMPIDEA	0	0	1	4	4	9
		Percent of GCOMPIDEA	0.00%	0.00%	11.11%	44.44%	44.44%	100.00%
	B	Count of GCOMPIDEA	0	1	2	3	0	6
		Percent of GCOMPIDEA	0.00%	16.67%	33.33%	50.00%	0.00%	100.00%
2 Count of GCOMPIDEA			0	1	3	7	4	15
2 Percent of GCOMPIDEA			0.00%	6.67%	20.00%	46.67%	26.67%	100.00%
4	A	Count of GCOMPIDEA	2	0	1	4	1	8
		Percent of GCOMPIDEA	25.00%	0.00%	12.50%	50.00%	12.50%	100.00%
	B	Count of GCOMPIDEA	0	0	1	7	1	9
		Percent of GCOMPIDEA	0.00%	0.00%	11.11%	77.78%	11.11%	100.00%
4 Count of GCOMPIDEA			2	0	2	11	2	17
4 Percent of GCOMPIDEA			11.76%	0.00%	11.76%	64.71%	11.76%	100.00%
5	A	Count of GCOMPIDEA	0	2	3	2	0	7
		Percent of GCOMPIDEA	0.00%	28.57%	42.86%	28.57%	0.00%	100.00%
5 Count of GCOMPIDEA			0	2	3	2	0	7
5 Percent of GCOMPIDEA			0.00%	28.57%	42.86%	28.57%	0.00%	100.00%
6	A	Count of GCOMPIDEA	0	1	2	2	2	7
		Percent of GCOMPIDEA	0.00%	14.29%	28.57%	28.57%	28.57%	100.00%
6 Count of GCOMPIDEA			0	1	2	2	2	7
6 Percent of GCOMPIDEA			0.00%	14.29%	28.57%	28.57%	28.57%	100.00%
Total Count of GCOMPIDEA			2	4	10	22	8	46
Total Percent of GCOMPIDEA			4.35%	8.70%	21.74%	47.83%	17.39%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
1	2	3	4	5	None
4.35%	8.70%	21.74%	47.83%	17.39%	0.00%



Non-GDSS: "Members were able to provide enough information about their ideas."

Figure 72

Future Commitment

One of the bases for developing expert systems is incremental prototyping, which demands a long-term commitment from its experts. Accordingly, this study looked at how the two meeting experiences affected the participants' commitment to group and task. The subjects were asked to respond to four such statements.

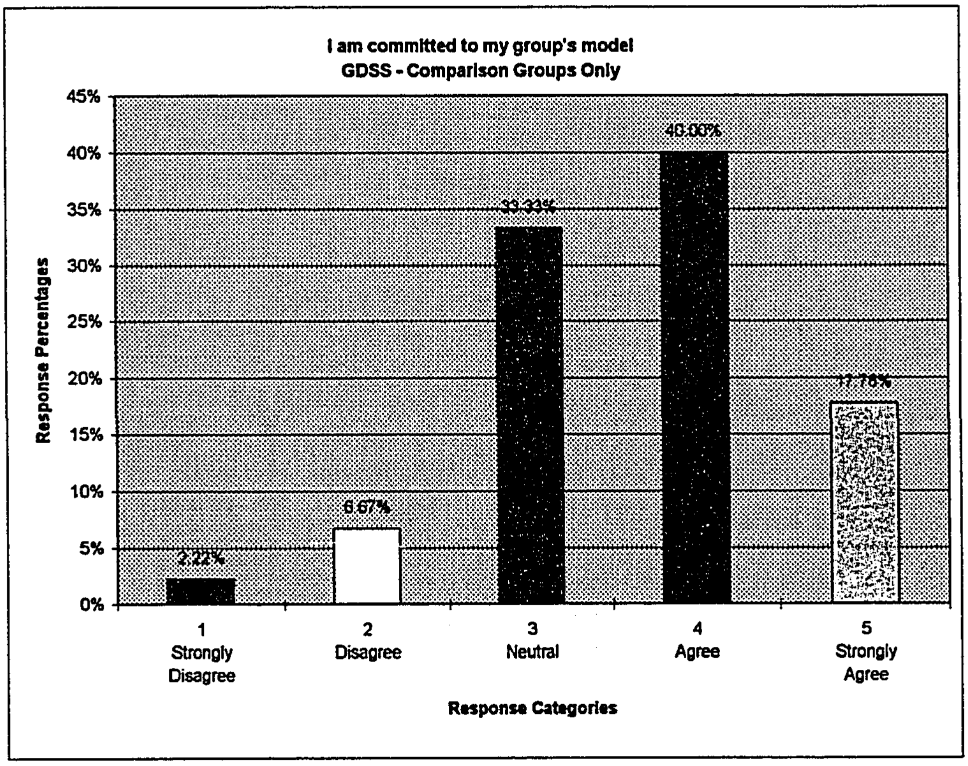
"I am committed to my group's model." Responses from the GDSS groups showed limited disagreement (See Figure 73). One person, or 2.22% Strongly Disagreed, and 3 persons, or 6.67% Disagreed. One third of responses, or 33.33% were Neutral, or undecided. In Agreement were 40.00% of respondents, and a final 17.78% Strongly Agreed that they were committed to their group's model. The responses from the Face-to-Face groups indicated that only one person (2.17%) Strongly Disagreed, and 10.87% Disagreed. A more moderate 19.57% were Neutral, and 46.65% Agreed that they were committed. A final 21.74% Strongly Agreed. See Figure 74.

"I would be willing to participate in the group's next task in developing this model." GDSS respondents revealed a clear willingness to continue with the task and group (See Figure 75). One person (2.22%) Strongly Disagreed, and two persons (4.44%) Disagreed. Only three persons (6.67%) were Neutral. A high 64.44% Agreed with the statement, and a final 22.22% Strongly Agreed. The Face-to-Face groups were only slightly less positive. No-one Strongly Disagreed, and only two persons (4.35%) Disagreed. Five individuals (10.87%) gave Neutral responses. Face-

GDSS - I am committed to my group's model
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Committed to Model - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GCOMMIT						
Group	Cluster	Data	1	2	3	4	5	(blank)	Grand Total
2	A	Count of GCOMMIT	0	1	1	4	3	0	9
		Percent of GCOMMIT2	0.00%	11.11%	11.11%	44.44%	33.33%	0.00%	100.00%
	B	Count of GCOMMIT	0	0	5	1	0	0	6
		Percent of GCOMMIT2	0.00%	0.00%	83.33%	16.67%	0.00%	0.00%	100.00%
2 Count of GCOMMIT			0	1	6	5	3	0	15
2 Percent of GCOMMIT2			0.00%	6.67%	40.00%	33.33%	20.00%	0.00%	100.00%
4	A	Count of GCOMMIT	0	0	3	3	1	0	7
		Percent of GCOMMIT2	0.00%	0.00%	42.86%	42.86%	14.29%	0.00%	100.00%
	B	Count of GCOMMIT	1	1	2	3	2	0	9
		Percent of GCOMMIT2	11.11%	11.11%	22.22%	33.33%	22.22%	0.00%	100.00%
4 Count of GCOMMIT			1	1	5	6	3	0	16
4 Percent of GCOMMIT2			6.25%	6.25%	31.25%	37.50%	18.75%	0.00%	100.00%
5	A	Count of GCOMMIT	0	1	2	3	1	0	7
		Percent of GCOMMIT2	0.00%	14.29%	28.57%	42.86%	14.29%	0.00%	100.00%
5 Count of GCOMMIT			0	1	2	3	1	0	7
5 Percent of GCOMMIT2			0.00%	14.29%	28.57%	42.86%	14.29%	0.00%	100.00%
6	A	Count of GCOMMIT	0	0	2	4	1	0	7
		Percent of GCOMMIT2	0.00%	0.00%	28.57%	57.14%	14.29%	0.00%	100.00%
6 Count of GCOMMIT			0	0	2	4	1	0	7
6 Percent of GCOMMIT2			0.00%	0.00%	28.57%	57.14%	14.29%	0.00%	100.00%
Total Count of GCOMMIT			1	3	15	18	8	0	45
Total Percent of GCOMMIT2			2.22%	6.67%	33.33%	40.00%	17.78%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
2.22%	6.67%	33.33%	40.00%	17.78%	0.00%

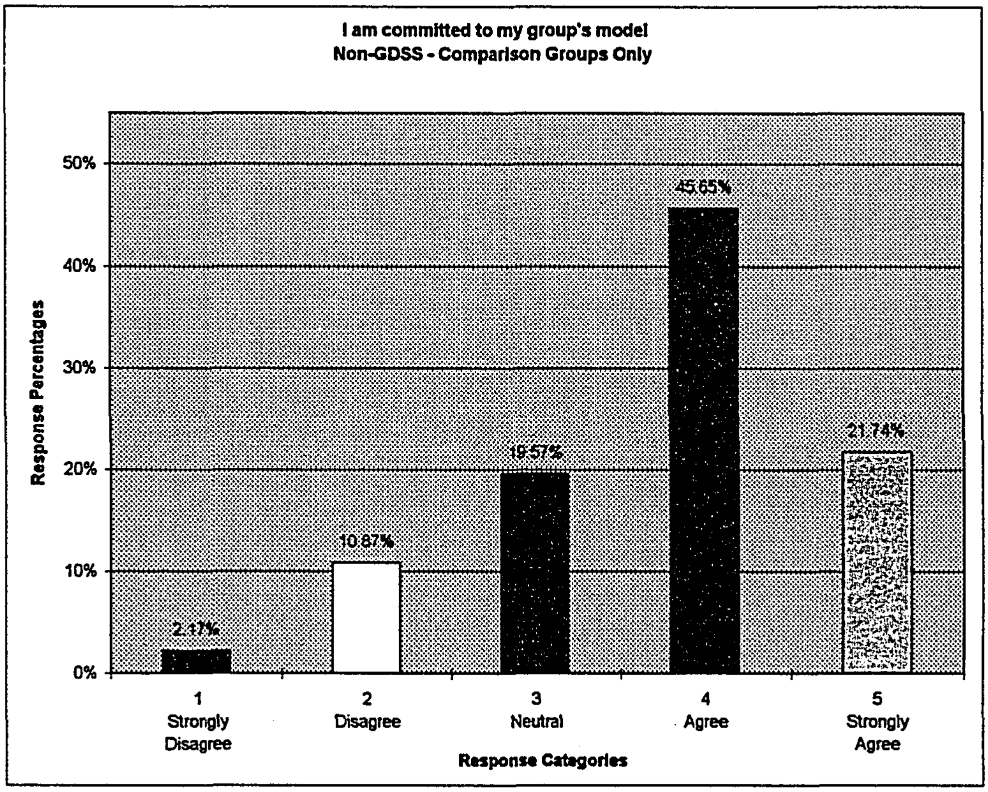


Non-GDSS: "I am committed to my group's model."
Figure 73

Non-GDSS - I am committed to my group's model
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Committed to Model - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GCOMMIT					
Group	Cluster	Data	1	2	3	4	5	Grand Total
2	A	Count of GCOMMIT	0	0	0	5	4	9
		Percent of GCOMMIT	0.00%	0.00%	0.00%	55.56%	44.44%	100.00%
	B	Count of GCOMMIT	0	1	3	1	1	6
		Percent of GCOMMIT	0.00%	16.67%	50.00%	16.67%	16.67%	100.00%
2 Count of GCOMMIT			0	1	3	6	5	15
2 Percent of GCOMMIT			0.00%	6.67%	20.00%	40.00%	33.33%	100.00%
4	A	Count of GCOMMIT	0	2	2	3	1	8
		Percent of GCOMMIT	0.00%	25.00%	25.00%	37.50%	12.50%	100.00%
	B	Count of GCOMMIT	1	0	1	4	3	9
		Percent of GCOMMIT	11.11%	0.00%	11.11%	44.44%	33.33%	100.00%
4 Count of GCOMMIT			1	2	3	7	4	17
4 Percent of GCOMMIT			5.88%	11.76%	17.65%	41.18%	23.53%	100.00%
5	A	Count of GCOMMIT	0	0	1	6	0	7
		Percent of GCOMMIT	0.00%	0.00%	14.29%	85.71%	0.00%	100.00%
5 Count of GCOMMIT			0	0	1	6	0	7
5 Percent of GCOMMIT			0.00%	0.00%	14.29%	85.71%	0.00%	100.00%
6	A	Count of GCOMMIT	0	2	2	2	1	7
		Percent of GCOMMIT	0.00%	28.57%	28.57%	28.57%	14.29%	100.00%
6 Count of GCOMMIT			0	2	2	2	1	7
6 Percent of GCOMMIT			0.00%	28.57%	28.57%	28.57%	14.29%	100.00%
Total Count of GCOMMIT			1	5	9	21	10	46
Total Percent of GCOMMIT			2.17%	10.87%	19.57%	45.65%	21.74%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
1	2	3	4	5	None
2.17%	10.87%	19.57%	45.65%	21.74%	0.00%

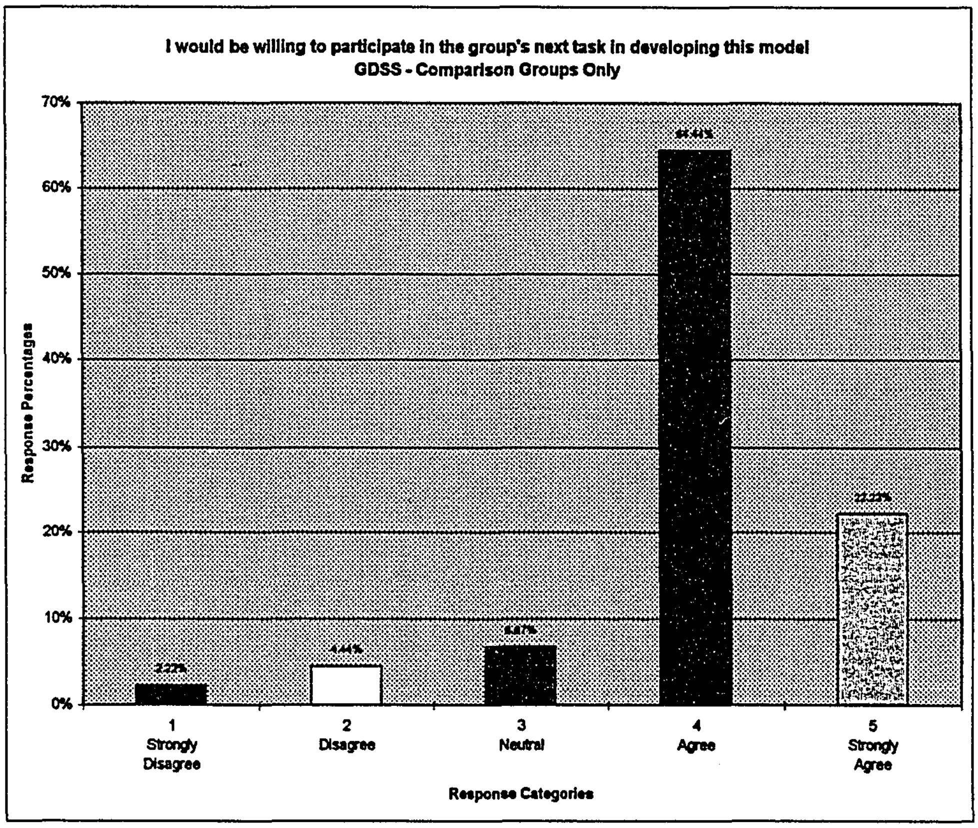


Non-GDSS: "I am committed to my group's model."
Figure 74

GDSS - I would be willing to participate in the group's next task in developing this model
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Participating in Group's Next Task - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GDOMORE						
Group	Cluster	Data	1	2	3	4	5	(blank)	Grand Total
2	A	Count of GDOMORE	0	0	1	5	3	0	9
		Percent of GDOMORE2	0.00%	0.00%	11.11%	55.56%	33.33%	0.00%	100.00%
	B	Count of GDOMORE	0	1	0	5	0	0	6
		Percent of GDOMORE2	0.00%	16.67%	0.00%	83.33%	0.00%	0.00%	100.00%
2 Count of GDOMORE			0	1	1	10	3	0	15
2 Percent of GDOMORE2			0.00%	6.67%	6.67%	66.67%	20.00%	0.00%	100.00%
4	A	Count of GDOMORE	0	0	0	5	2	0	7
		Percent of GDOMORE2	0.00%	0.00%	0.00%	71.43%	28.57%	0.00%	100.00%
	B	Count of GDOMORE	1	1	1	3	3	0	9
		Percent of GDOMORE2	11.11%	11.11%	11.11%	33.33%	33.33%	0.00%	100.00%
4 Count of GDOMORE			1	1	1	8	5	0	16
4 Percent of GDOMORE2			6.25%	6.25%	6.25%	50.00%	31.25%	0.00%	100.00%
5	A	Count of GDOMORE	0	0	1	5	1	0	7
		Percent of GDOMORE2	0.00%	0.00%	14.29%	71.43%	14.29%	0.00%	100.00%
5 Count of GDOMORE			0	0	1	5	1	0	7
5 Percent of GDOMORE2			0.00%	0.00%	14.29%	71.43%	14.29%	0.00%	100.00%
6	A	Count of GDOMORE	0	0	0	6	1	0	7
		Percent of GDOMORE2	0.00%	0.00%	0.00%	85.71%	14.29%	0.00%	100.00%
6 Count of GDOMORE			0	0	0	6	1	0	7
6 Percent of GDOMORE2			0.00%	0.00%	0.00%	85.71%	14.29%	0.00%	100.00%
Total Count of GDOMORE			1	2	3	29	10	0	45
Total Percent of GDOMORE2			2.22%	4.44%	6.67%	64.44%	22.22%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
2.22%	4.44%	6.67%	64.44%	22.22%	0.00%



GDSS: "I would be willing to participate in the group's next task in developing this model."
Figure 75

to-Face respondents also indicated that 52.17% Agreed with the statement, and that a further 30.43% Strongly Agreed. See Figure 76.

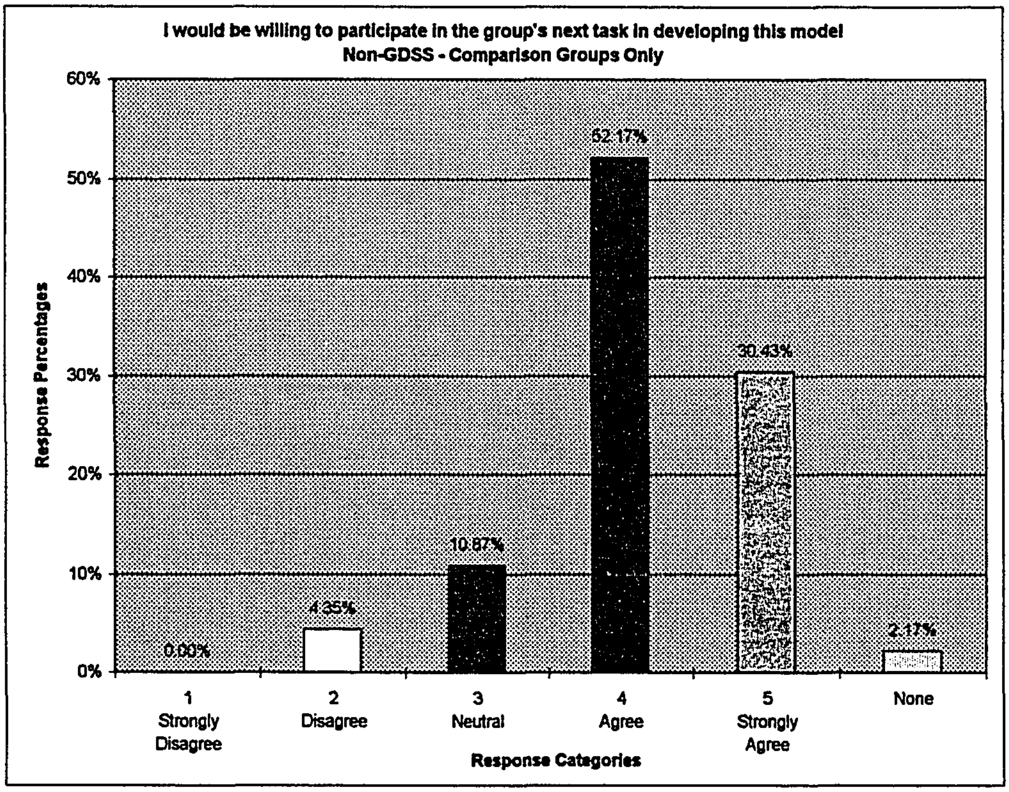
"I would be willing to work with this group again on another task." The GDSS group responses to this statement again were very positive (See Figure 77). Only 2.22% Strongly Disagreed, and 4.44% Disagreed. Again, only 6.67% were Neutral. Over half, or 53.33%, indicated Agreement. Finally, one third, or 33.33% indicated Strong Agreement that they would work with their GDSS groups again. Responses from the Face-to-Face groups were not as positive. While there were no Strong Disagreements, and only 2 (4.35%) Disagreements, the Neutral response was 17.39%. Agreement was 45.65%, and 32.61% Strongly Agreed that they would be willing to work with their groups again. See Figure 78.

"I would be willing to work with another group of people to refine this expert system." GDSS groups indicated a high percentage of agreement with this statement (See Figure 79). Two individuals (4.44%) Strongly Disagreed, and no-one Disagreed. Only four people (8.89%) were Neutral. Over half (51.11%) Agreed with the statement, and 35.56% Strongly Agreed that they would work with another group to continue the task. Again, the Face-to-Face groups indicated a lower measure of commitment. While no-one Strongly Disagreed, and only one person (2.17%) Disagreed, almost twenty percent (19.57%) were Neutral. An Agreement of 47.83% was indicated, and 30.43% Strongly Agreed that they would work with another group to continue the task. See Figure 80.

Non-GDSS - I would be willing to participate in the group's next task in developing this model
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Participating in Group's Next Task - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GDOMORE					
Group	Cluster	Data	2	3	4	5	NONE	Grand Total
2	A	Count of GDOMORE	0	0	3	6	0	9
		Percent of GDOMORE	0.00%	0.00%	33.33%	66.67%	0.00%	100.00%
	B	Count of GDOMORE	1	1	3	1	0	6
		Percent of GDOMORE	16.67%	16.67%	50.00%	16.67%	0.00%	100.00%
2 Count of GDOMORE			1	1	6	7	0	15
2 Percent of GDOMORE			6.67%	6.67%	40.00%	46.67%	0.00%	100.00%
4	A	Count of GDOMORE	0	0	6	2	0	8
		Percent of GDOMORE	0.00%	0.00%	75.00%	25.00%	0.00%	100.00%
	B	Count of GDOMORE	1	1	4	2	1	9
		Percent of GDOMORE	11.11%	11.11%	44.44%	22.22%	11.11%	100.00%
4 Count of GDOMORE			1	1	10	4	1	17
4 Percent of GDOMORE			5.88%	5.88%	58.82%	23.53%	5.88%	100.00%
5	A	Count of GDOMORE	0	1	4	2	0	7
		Percent of GDOMORE	0.00%	14.29%	57.14%	28.57%	0.00%	100.00%
5 Count of GDOMORE			0	1	4	2	0	7
5 Percent of GDOMORE			0.00%	14.29%	57.14%	28.57%	0.00%	100.00%
6	A	Count of GDOMORE	0	2	4	1	0	7
		Percent of GDOMORE	0.00%	28.57%	57.14%	14.29%	0.00%	100.00%
6 Count of GDOMORE			0	2	4	1	0	7
6 Percent of GDOMORE			0.00%	28.57%	57.14%	14.29%	0.00%	100.00%
Total Count of GDOMORE			2	5	24	14	1	46
Total Percent of GDOMORE			4.35%	10.87%	52.17%	30.43%	2.17%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
1	2	3	4	5	None
0.00%	4.35%	10.87%	52.17%	30.43%	2.17%

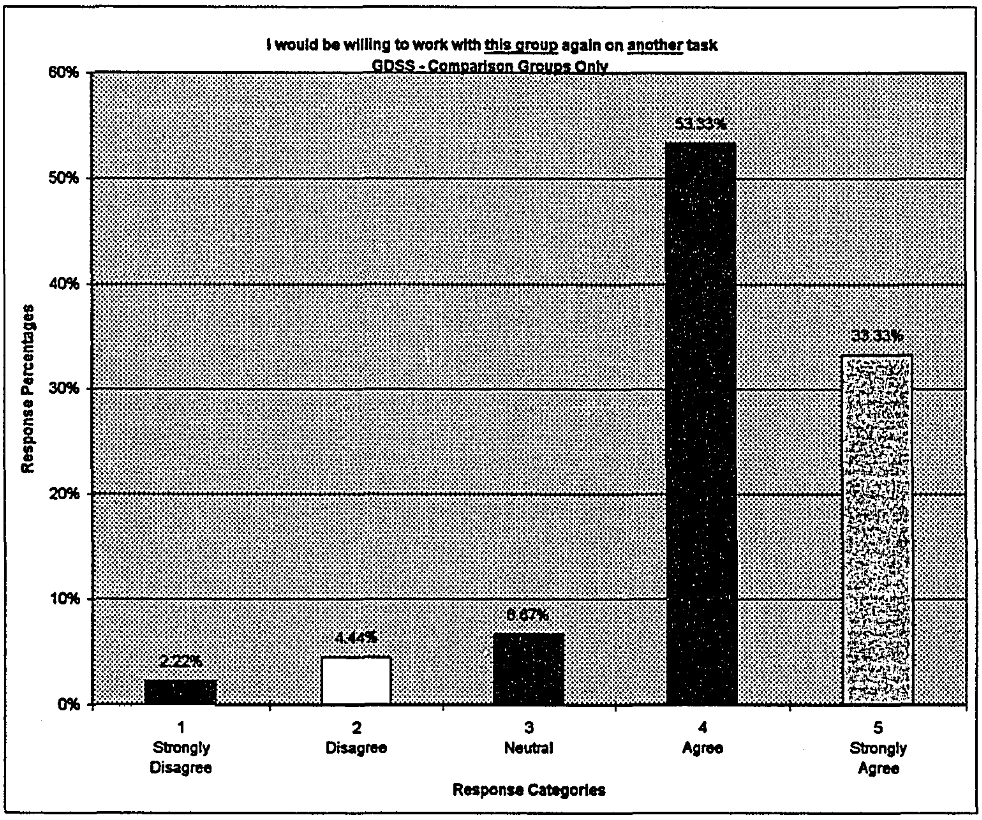


Non-GDSS: "I would be willing to participate in the group's next task in developing this model."
Figure 76

GDSS - I would be willing to work with this group again on another task
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Working With This Group Again on Another Task - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GDOANOTHR						
Group	Cluster	Data	1	2	3	4	5	(blank)	Grand Total
2	A	Count of GDOANOTHR	0	0	1	3	5	0	9
		Percent of GDOANOTHR2	0.00%	0.00%	11.11%	33.33%	55.56%	0.00%	100.00%
	B	Count of GDOANOTHR	0	1	1	4	0	0	6
		Percent of GDOANOTHR2	0.00%	16.67%	16.67%	66.67%	0.00%	0.00%	100.00%
2 Count of GDOANOTHR			0	1	2	7	5	0	15
2 Percent of GDOANOTHR2			0.00%	6.67%	13.33%	46.67%	33.33%	0.00%	100.00%
4	A	Count of GDOANOTHR	0	0	0	3	4	0	7
		Percent of GDOANOTHR2	0.00%	0.00%	0.00%	42.86%	57.14%	0.00%	100.00%
	B	Count of GDOANOTHR	1	1	1	3	3	0	9
		Percent of GDOANOTHR2	11.11%	11.11%	11.11%	33.33%	33.33%	0.00%	100.00%
4 Count of GDOANOTHR			1	1	1	6	7	0	16
4 Percent of GDOANOTHR2			6.25%	6.25%	6.25%	37.50%	43.75%	0.00%	100.00%
5	A	Count of GDOANOTHR	0	0	0	6	1	0	7
		Percent of GDOANOTHR2	0.00%	0.00%	0.00%	85.71%	14.29%	0.00%	100.00%
5 Count of GDOANOTHR			0	0	0	6	1	0	7
5 Percent of GDOANOTHR2			0.00%	0.00%	0.00%	85.71%	14.29%	0.00%	100.00%
6	A	Count of GDOANOTHR	0	0	0	5	2	0	7
		Percent of GDOANOTHR2	0.00%	0.00%	0.00%	71.43%	28.57%	0.00%	100.00%
6 Count of GDOANOTHR			0	0	0	5	2	0	7
6 Percent of GDOANOTHR2			0.00%	0.00%	0.00%	71.43%	28.57%	0.00%	100.00%
Total Count of GDOANOTHR			1	2	3	24	15	0	45
Total Percent of GDOANOTHR2			2.22%	4.44%	6.67%	53.33%	33.33%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
2.22%	4.44%	6.67%	53.33%	33.33%	0.00%

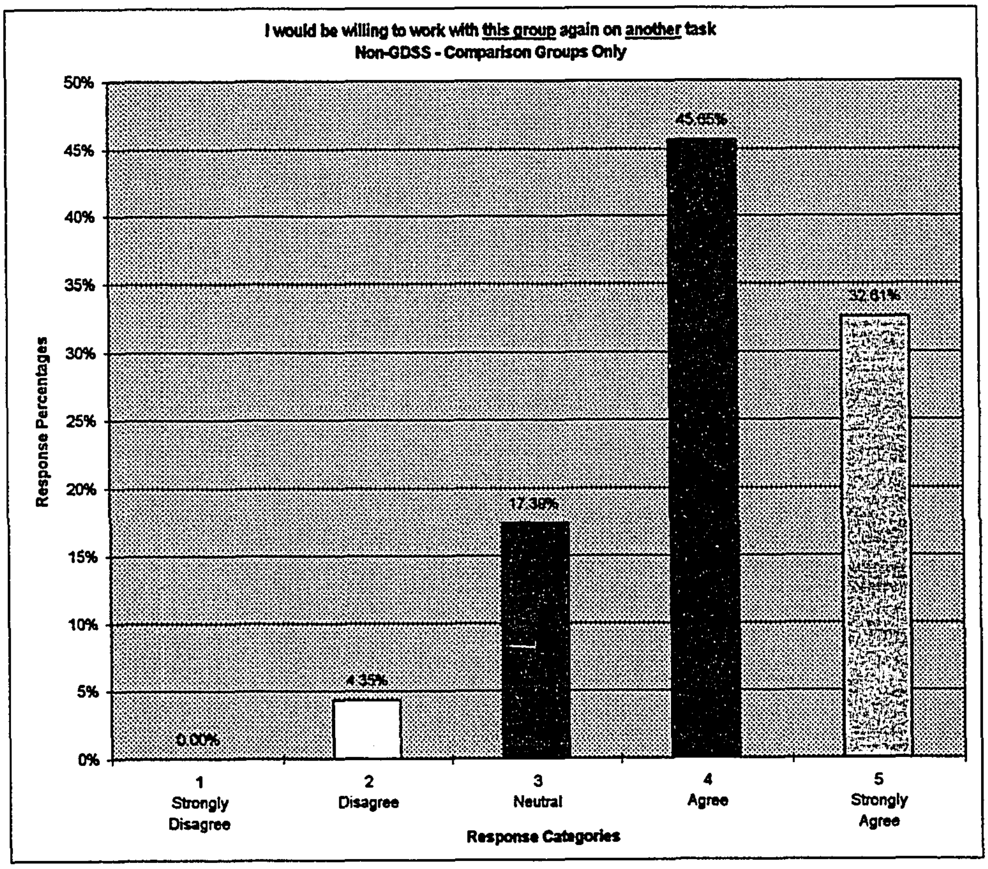


GDSS: "I would be willing to work with this group again on another task."
Figure 77

Non-GDSS - I would be willing to work with this group again on another task
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Working With This Group Again on Another Task - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GDOANOTHR				
Group	Cluster	Data	2	3	4	5	Grand Total
2	A	Count of GDOANOTHR	0	0	3	6	9
		Percent of GDOANOTHR	0.00%	0.00%	33.33%	66.67%	100.00%
	B	Count of GDOANOTHR	1	2	2	1	6
		Percent of GDOANOTHR	16.67%	33.33%	33.33%	16.67%	100.00%
2 Count of GDOANOTHR			1	2	5	7	15
2 Percent of GDOANOTHR			6.67%	13.33%	33.33%	46.67%	100.00%
4	A	Count of GDOANOTHR	0	0	5	3	8
		Percent of GDOANOTHR	0.00%	0.00%	62.50%	37.50%	100.00%
	B	Count of GDOANOTHR	1	3	3	2	9
		Percent of GDOANOTHR	11.11%	33.33%	33.33%	22.22%	100.00%
4 Count of GDOANOTHR			1	3	8	5	17
4 Percent of GDOANOTHR			5.88%	17.65%	47.06%	29.41%	100.00%
5	A	Count of GDOANOTHR	0	1	4	2	7
		Percent of GDOANOTHR	0.00%	14.29%	57.14%	28.57%	100.00%
5 Count of GDOANOTHR			0	1	4	2	7
5 Percent of GDOANOTHR			0.00%	14.29%	57.14%	28.57%	100.00%
6	A	Count of GDOANOTHR	0	2	4	1	7
		Percent of GDOANOTHR	0.00%	28.57%	57.14%	14.29%	100.00%
6 Count of GDOANOTHR			0	2	4	1	7
6 Percent of GDOANOTHR			0.00%	28.57%	57.14%	14.29%	100.00%
Total Count of GDOANOTHR			2	8	21	15	46
Total Percent of GDOANOTHR			4.35%	17.39%	45.65%	32.61%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
1	2	3	4	5	None
0.00%	4.35%	17.39%	45.65%	32.61%	0.00%

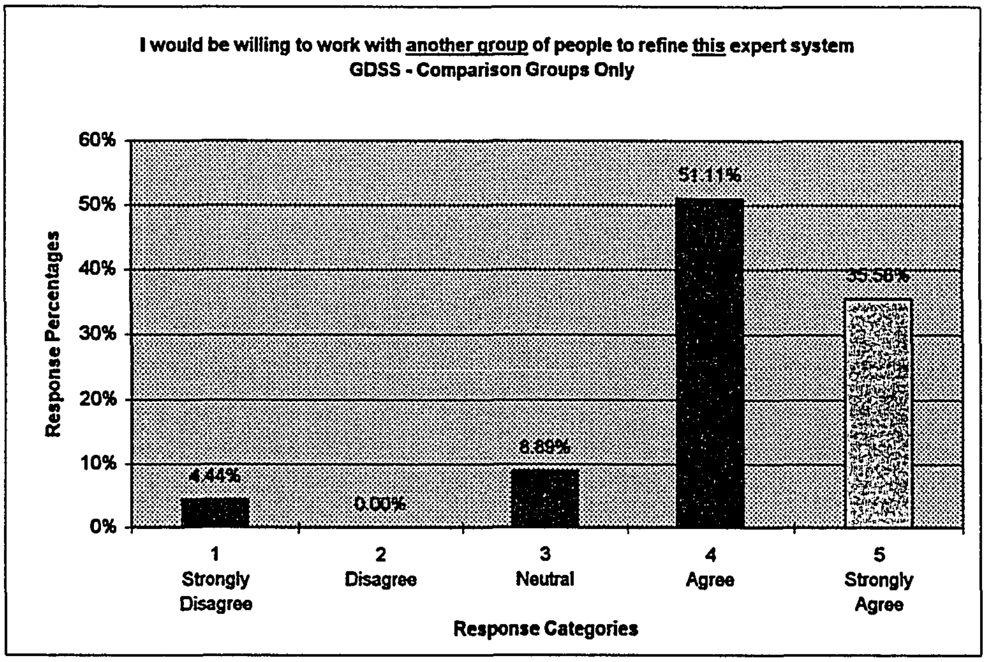


Non-GDSS: "I would be willing to work with this group again on another task."
Figure 78

GDSS - I would be willing to work with another group of people to refine this expert system
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
GDSS and Working With Another Group on This Expert System - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GDIFGRP					
Group	Cluster	Data	1	3	4	5	(blank)	Grand Total
2	A	Count of GDIFGRP	1	0	3	5	0	9
		Percent of GDIFGRP2	11.11%	0.00%	33.33%	55.56%	0.00%	100.00%
	B	Count of GDIFGRP	0	1	4	1	0	6
		Percent of GDIFGRP2	0.00%	16.67%	66.67%	16.67%	0.00%	100.00%
2 Count of GDIFGRP			1	1	7	6	0	15
2 Percent of GDIFGRP2			6.67%	6.67%	46.67%	40.00%	0.00%	100.00%
4	A	Count of GDIFGRP	0	0	4	3	0	7
		Percent of GDIFGRP2	0.00%	0.00%	57.14%	42.86%	0.00%	100.00%
	B	Count of GDIFGRP	1	0	4	4	0	9
		Percent of GDIFGRP2	11.11%	0.00%	44.44%	44.44%	0.00%	100.00%
4 Count of GDIFGRP			1	0	8	7	0	16
4 Percent of GDIFGRP2			6.25%	0.00%	50.00%	43.75%	0.00%	100.00%
5	A	Count of GDIFGRP	0	0	5	2	0	7
		Percent of GDIFGRP2	0.00%	0.00%	71.43%	28.57%	0.00%	100.00%
5 Count of GDIFGRP			0	0	5	2	0	7
5 Percent of GDIFGRP2			0.00%	0.00%	71.43%	28.57%	0.00%	100.00%
6	A	Count of GDIFGRP	0	3	3	1	0	7
		Percent of GDIFGRP2	0.00%	42.86%	42.86%	14.29%	0.00%	100.00%
6 Count of GDIFGRP			0	3	3	1	0	7
6 Percent of GDIFGRP2			0.00%	42.86%	42.86%	14.29%	0.00%	100.00%
Total Count of GDIFGRP			2	4	23	16	0	45
Total Percent of GDIFGRP2			4.44%	8.89%	51.11%	35.56%	0.00%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	No Response
1	2	3	4	5	Blank
4.44%	0.00%	8.89%	51.11%	35.56%	0.00%

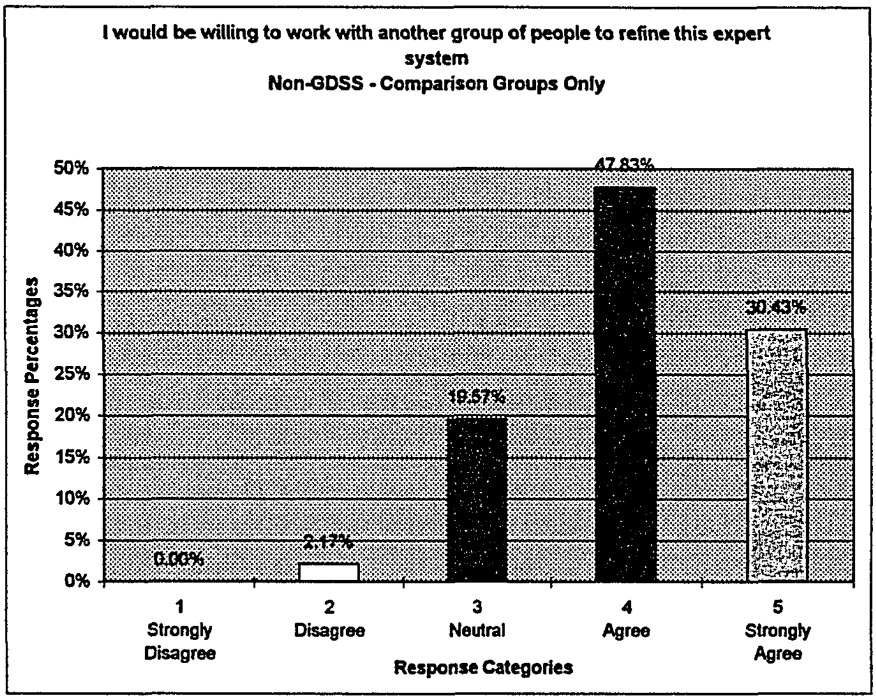


GDSS: "I would be willing to work with another group of people to refine this expert system."
Figure 79

Non-GDSS - I would be willing to work with <u>another group</u> of people to refine <u>this</u> expert system
1, Strongly Disagree
2, Disagree
3, Neutral
4, Agree
5, Strongly Agree
Non-GDSS and Working With Another Group on This Expert System - Counts and Percentages for Each Cluster, Each Group and Total Participants

			GDIFGRP				
Group	Cluster	Data	2	3	4	5	Grand Total
2	A	Count of GDIFGRP	0	1	4	4	9
		Percent of GDIFGRP	0.00%	11.11%	44.44%	44.44%	100.00%
	B	Count of GDIFGRP	0	2	3	1	6
		Percent of GDIFGRP	0.00%	33.33%	50.00%	16.67%	100.00%
2 Count of GDIFGRP			0	3	7	5	15
2 Percent of GDIFGRP			0.00%	20.00%	46.67%	33.33%	100.00%
4	A	Count of GDIFGRP	0	1	3	4	8
		Percent of GDIFGRP	0.00%	12.50%	37.50%	50.00%	100.00%
	B	Count of GDIFGRP	0	2	5	2	9
		Percent of GDIFGRP	0.00%	22.22%	55.56%	22.22%	100.00%
4 Count of GDIFGRP			0	3	8	6	17
4 Percent of GDIFGRP			0.00%	17.65%	47.06%	35.29%	100.00%
5	A	Count of GDIFGRP	1	1	4	1	7
		Percent of GDIFGRP	14.29%	14.29%	57.14%	14.29%	100.00%
5 Count of GDIFGRP			1	1	4	1	7
5 Percent of GDIFGRP			14.29%	14.29%	57.14%	14.29%	100.00%
6	A	Count of GDIFGRP	0	2	3	2	7
		Percent of GDIFGRP	0.00%	28.57%	42.86%	28.57%	100.00%
6 Count of GDIFGRP			0	2	3	2	7
6 Percent of GDIFGRP			0.00%	28.57%	42.86%	28.57%	100.00%
Total Count of GDIFGRP			1	9	22	14	46
Total Percent of GDIFGRP			2.17%	19.57%	47.83%	30.43%	100.00%

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
1	2	3	4	5	None
0.00%	2.17%	19.57%	47.83%	30.43%	0.00%



Non-GDSS: "I would be willing to work with another group of people to refine this expert system."
Figure 80

Final Perceptions

Immediately after completing their last experience, the clusters that had both GDSS and Face-to-Face sessions were asked for their final perceptions as to the comparative value of the two approaches. Four statements were used to elicit reactions.

"Based on what you know at this moment, how would you rate your attitude toward using conferencing groupware technology?" Responses to this question were very positive. There were no extremely negative responses, and only two persons (4.44%) were somewhat negative. One person (2.22%) remained Neutral, but 64.44% were somewhat positive, and 28.89% extremely positive (See Figure 81). An almost identical question was asked prior to beginning both experiences. The responses before and after the GDSS and Face-to-Face sessions show a very perceptible movement from Neutral to positive. See Figure 82 for a comparison of results.

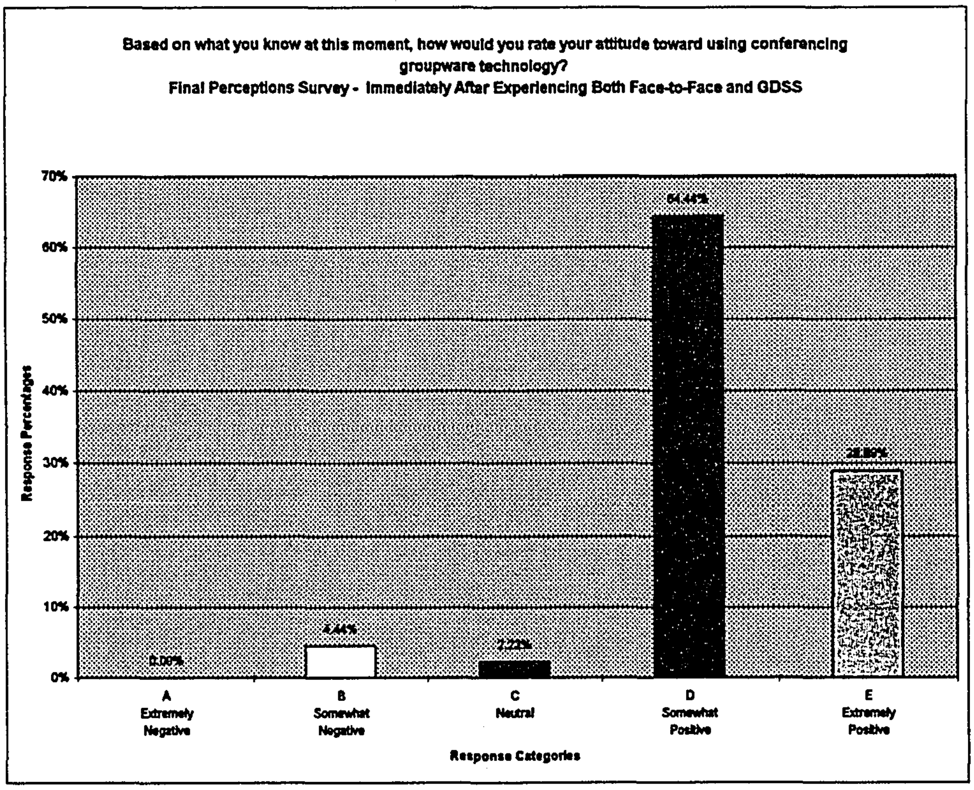
"Based on what you know at this moment, how would you rate your attitude toward using conferencing groupware for developing expert systems?" Again, there were no extremely negative responses, and only one (2.22%) negative response. The Neutral response was 17.78%, and the positive response was 57.78%. Over twenty percent (22.22%) of student experts responded extremely positively (See Figure 83).

"Which of these two experiences was most helpful in evaluating your ideas for an expert system?" Almost seventy percent of respondents (68.89%) selected GDSS as being most helpful, in comparison to 31.11% who chose their Face-to-Face experiences (See Figure 84).

Final Perceptions Survey
Immediately After Experiencing Both Face-to-Face and GDSS
Based on what you know at this moment, how would you rate your attitude toward using conferencing groupware technology?
1, Extremely Negative
2, Somewhat Negative
3, Neutral
4, Somewhat Positive
5, Extremely Positive
Rating of Attitude Toward GDSS - Counts and Percentages for Each Cluster, Each Group and Total Participants

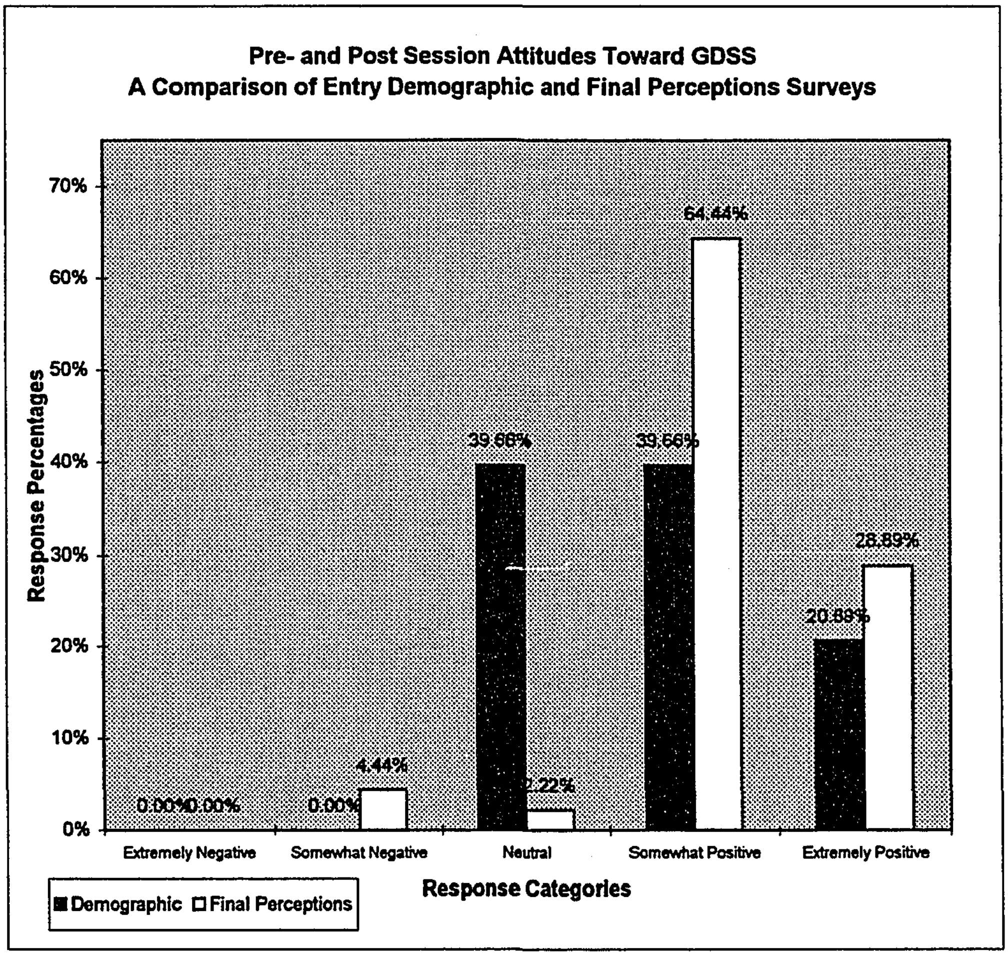
			ATTITUDE_GDSS				
Group	Cluster	Data	B	C	D	E	Grand Total
2	A	Count of ATTITUDE_GDSS	1	0	3	5	9
		Percent of ATTITUDE_GDSS	11.11%	0.00%	33.33%	55.56%	100.00%
	B	Count of ATTITUDE_GDSS	0	0	5	1	6
		Percent of ATTITUDE_GDSS	0.00%	0.00%	83.33%	16.67%	100.00%
2 Count of ATTITUDE_GDSS			1	0	8	6	15
2 Percent of ATTITUDE_GDSS			6.67%	0.00%	53.33%	40.00%	100.00%
3	A	Count of ATTITUDE_GDSS	0	0	1	0	1
		Percent of ATTITUDE_GDSS	0.00%	0.00%	100.00%	0.00%	100.00%
3 Count of ATTITUDE_GDSS			0	0	1	0	1
3 Percent of ATTITUDE_GDSS			0.00%	0.00%	100.00%	0.00%	100.00%
4	A	Count of ATTITUDE_GDSS	0	0	5	2	7
		Percent of ATTITUDE_GDSS	0.00%	0.00%	71.43%	28.57%	100.00%
	B	Count of ATTITUDE_GDSS	0	0	8	1	9
		Percent of ATTITUDE_GDSS	0.00%	0.00%	88.89%	11.11%	100.00%
4 Count of ATTITUDE_GDSS			0	0	13	3	16
4 Percent of ATTITUDE_GDSS			0.00%	0.00%	81.25%	18.75%	100.00%
5	A	Count of ATTITUDE_GDSS	1	1	4	0	6
		Percent of ATTITUDE_GDSS	16.67%	16.67%	66.67%	0.00%	100.00%
5 Count of ATTITUDE_GDSS			1	1	4	0	6
5 Percent of ATTITUDE_GDSS			16.67%	16.67%	66.67%	0.00%	100.00%
6	A	Count of ATTITUDE_GDSS	0	0	3	4	7
		Percent of ATTITUDE_GDSS	0.00%	0.00%	42.86%	57.14%	100.00%
6 Count of ATTITUDE_GDSS			0	0	3	4	7
6 Percent of ATTITUDE_GDSS			0.00%	0.00%	42.86%	57.14%	100.00%
Total Count of ATTITUDE_GDSS			2	1	29	13	45
Total Percent of ATTITUDE_GDSS			4.44%	2.22%	64.44%	28.89%	100.00%

Extremely Negative	Somewhat Negative	Neutral	Somewhat Positive	Extremely Positive
A	B	C	D	E
0.00%	4.44%	2.22%	64.44%	28.89%



Final Perceptions: Attitude Toward using Groupware Conferencing Technology
Figure 81

Survey	A Extremely Negative	B Somewhat Negative	C Neutral	D Somewhat Positive	E Extremely Positive
Demographic	0.00%	0.00%	39.66%	39.66%	20.69%
Final Perceptions	0.00%	4.44%	2.22%	64.44%	28.89%

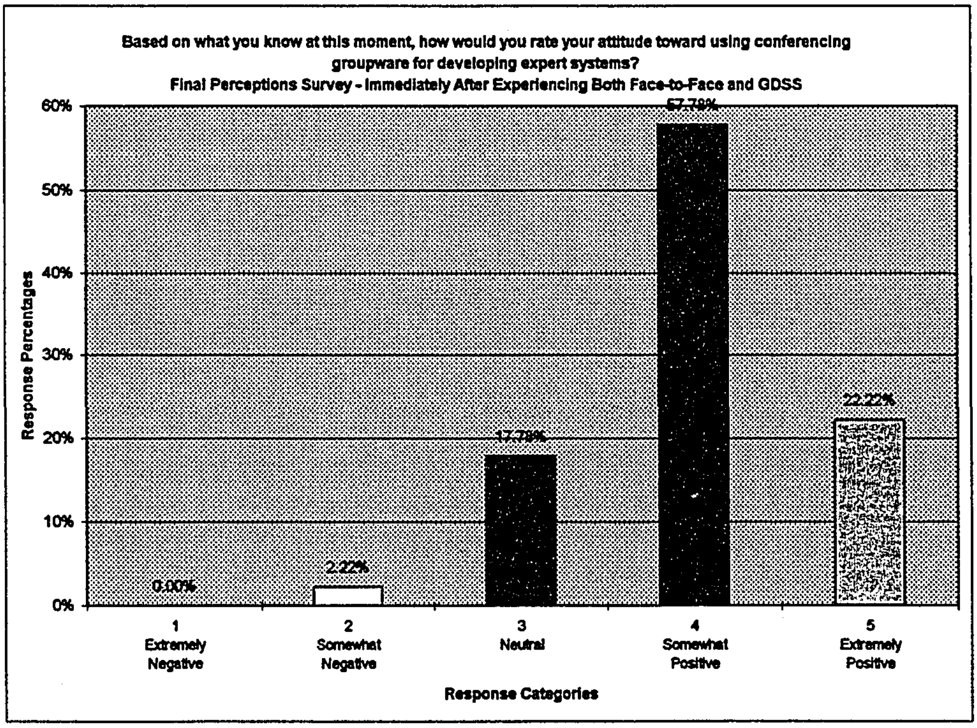


Final Perceptions: Pre- and Post Scores on Attitude Toward GDSS
Figure 82

Final Perceptions Survey
Immediately After Experiencing Both Face-to-Face and GDSS
Based on what you know at this moment, how would you rate your attitude toward using conferencing groupware for developing expert systems?
1, Extremely Negative
2, Somewhat Negative
3, Neutral
4, Somewhat Positive
5, Extremely Positive
Rating of Attitude Toward GDSS for Expert Systems - Counts and Percentages for Each Cluster, Each Group and Total Participants

			ATTITUDE_ES				
Group	Cluster	Data	B	C	D	E	Grand Total
2	A	Count of ATTITUDE_ES	0	2	2	5	9
		Percent of ATTITUDE_ES2	0.00%	22.22%	22.22%	55.56%	100.00%
	B	Count of ATTITUDE_ES	0	2	3	1	6
		Percent of ATTITUDE_ES2	0.00%	33.33%	50.00%	16.67%	100.00%
2 Count of ATTITUDE_ES			0	4	5	6	15
2 Percent of ATTITUDE_ES2			0.00%	26.67%	33.33%	40.00%	100.00%
3	A	Count of ATTITUDE_ES	0	1	0	0	1
		Percent of ATTITUDE_ES2	0.00%	100.00%	0.00%	0.00%	100.00%
3 Count of ATTITUDE_ES			0	1	0	0	1
3 Percent of ATTITUDE_ES2			0.00%	100.00%	0.00%	0.00%	100.00%
4	A	Count of ATTITUDE_ES	0	0	6	1	7
		Percent of ATTITUDE_ES2	0.00%	0.00%	85.71%	14.29%	100.00%
	B	Count of ATTITUDE_ES	0	2	5	2	9
		Percent of ATTITUDE_ES2	0.00%	22.22%	55.56%	22.22%	100.00%
4 Count of ATTITUDE_ES			0	2	11	3	16
4 Percent of ATTITUDE_ES2			0.00%	12.50%	68.75%	18.75%	100.00%
5	A	Count of ATTITUDE_ES	1	1	4	0	6
		Percent of ATTITUDE_ES2	16.67%	16.67%	66.67%	0.00%	100.00%
5 Count of ATTITUDE_ES			1	1	4	0	6
5 Percent of ATTITUDE_ES2			16.67%	16.67%	66.67%	0.00%	100.00%
6	A	Count of ATTITUDE_ES	0	0	6	1	7
		Percent of ATTITUDE_ES2	0.00%	0.00%	85.71%	14.29%	100.00%
6 Count of ATTITUDE_ES			0	0	6	1	7
6 Percent of ATTITUDE_ES2			0.00%	0.00%	85.71%	14.29%	100.00%
Total Count of ATTITUDE_ES			1	8	26	10	45
Total Percent of ATTITUDE_ES2			2.22%	17.78%	57.78%	22.22%	100.00%

Extremely Negative	Somewhat Negative	Neutral	Somewhat Positive	Extremely Positive
1	2	3	4	5
0.00%	2.22%	17.78%	57.78%	22.22%



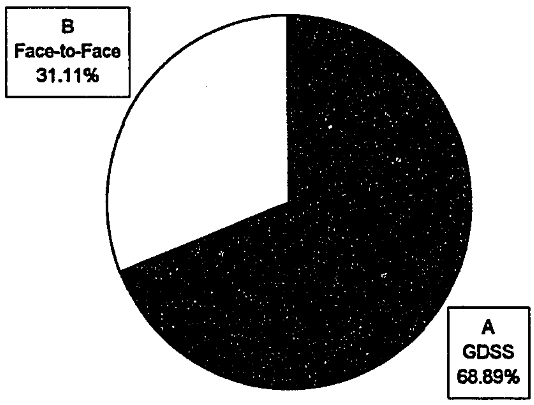
Final Perceptions: Attitude Toward Using Conferencing Groupware for Developing Expert Systems
Figure 83

Final Perceptions Survey
Immediately After Experiencing Both Face-to-Face and GDSS
Which of these two experiences was the most helpful in evaluating your ideas for an expert system?
1, GDSS
2, Face-to-Face
Most Helpful for Expert Systems - Counts and Percentages for Each Cluster, Each Group and Total Participants

			BEST_FOR_ES		
Group	Cluster	Data	A	B	Grand Total
2	A	Count of BEST_FO	7	2	9
		Percent of BEST_F	77.78%	22.22%	100.00%
	B	Count of BEST_FO	5	1	6
		Percent of BEST_F	83.33%	16.67%	100.00%
2 Count of BEST_FOR_ES			12	3	15
2 Percent of BEST_FOR_ES			80.00%	20.00%	100.00%
3	A	Count of BEST_FO	0	1	1
		Percent of BEST_F	0.00%	100.00%	100.00%
3 Count of BEST_FOR_ES			0	1	1
3 Percent of BEST_FOR_ES			0.00%	100.00%	100.00%
4	A	Count of BEST_FO	4	3	7
		Percent of BEST_F	57.14%	42.86%	100.00%
	B	Count of BEST_FO	5	4	9
		Percent of BEST_F	55.56%	44.44%	100.00%
4 Count of BEST_FOR_ES			9	7	16
4 Percent of BEST_FOR_ES			56.25%	43.75%	100.00%
5	A	Count of BEST_FO	6	0	6
		Percent of BEST_F	100.00%	0.00%	100.00%
5 Count of BEST_FOR_ES			6	0	6
5 Percent of BEST_FOR_ES			100.00%	0.00%	100.00%
6	A	Count of BEST_FO	4	3	7
		Percent of BEST_F	57.14%	42.86%	100.00%
6 Count of BEST_FOR_ES			4	3	7
6 Percent of BEST_FOR_ES			57.14%	42.86%	100.00%
Total Count of BEST_FOR_ES			31	14	45
Total Percent of BEST_FOR_ES			68.89%	31.11%	100.00%

GDSS	Face-to-Face
A	B
68.89%	31.11%

Which of these two experiences was the most helpful in evaluating your ideas for an expert system?
Final Perceptions Survey - Immediately After Experiencing Both Face-to-Face and GDSS



Final Perceptions: Most Helpful in Evaluating Ideas for an Expert System
Figure 84

"Of the three structuring tools used which was the most helpful?" Among the three tools used in the GDSS agenda were rating (used to rank ideas against specific criteria), subgrouping (used to select each individual's top ideas), and compactor (used to categorize which ideas were related). Over three quarters of respondents (75.56%) selected rating as the most useful tool. Another 11.11% selected subgrouping, and 8.89% chose Compactor. One individual (2.22%) selected all three choices, and another (2.22%) indicated none (See Figure 85).

Follow-up Survey

In order to look at perceptions over time, a selected group of student experts were asked to respond to a follow-up survey, administered two weeks after their last experience and after their final perceptions survey. Again, four questions were asked.

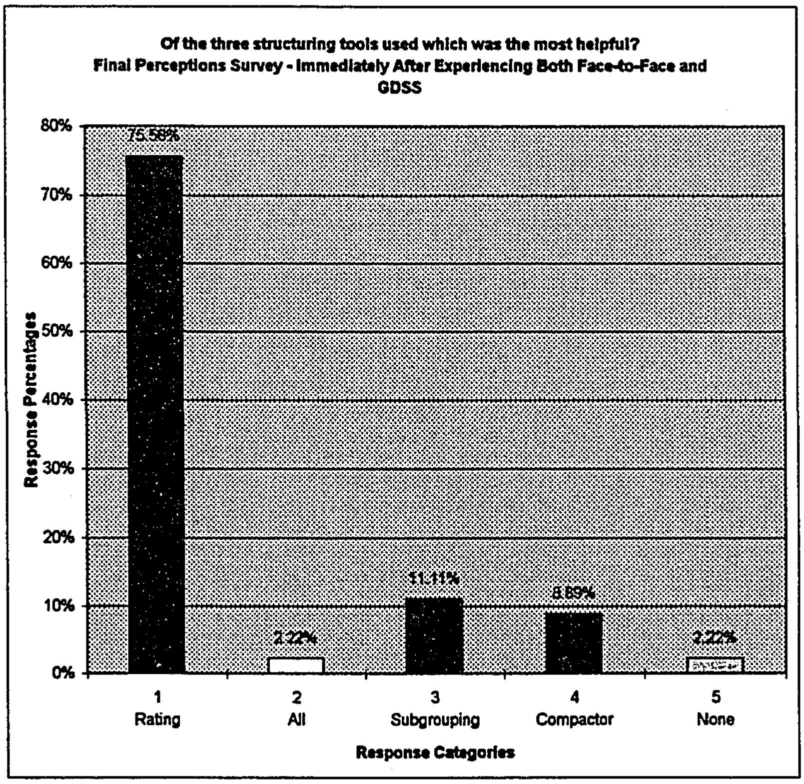
"Which of the two experiences did you personally enjoy more?" This question addressed personal satisfaction, which was presumed to relate to commitment to task and group. Of the thirty student experts responding, 70.00% indicated that they had enjoyed the GDSS experience more. See Figure 86.

The last three questions in the follow-up survey addressed which process led to the strongest satisfaction with the product, process, and structure. For each, the process was operationalized as the problem. Students identified the problem with which they were most satisfied; the analysis identified which process had been used to address the problem.

Final Perceptions Survey
Completed Immediately After Experiencing Both Face-to-Face and GDSS
Of the three structuring tools used which was the most helpful?
1, Rating
2, Subgrouping
3, Compactor (Categorizing)
Most Helpful Structuring Tool - Counts and Percentages for Each Cluster, Each Group and Total Participants

			BEST_TOOL					
Group	Cluster	Data	A	ALL	B	C	NONE	Grand Total
2	A	Count of BEST_TOOL	6	0	1	2	0	9
		Percent of BEST_TOOL	66.67%	0.00%	11.11%	22.22%	0.00%	100.00%
	B	Count of BEST_TOOL	3	0	1	1	1	6
		Percent of BEST_TOOL	50.00%	0.00%	16.67%	16.67%	16.67%	100.00%
2 Count of BEST_TOOL			9	0	2	3	1	15
2 Percent of BEST_TOOL			60.00%	0.00%	13.33%	20.00%	6.67%	100.00%
3	A	Count of BEST_TOOL	1	0	0	0	0	1
		Percent of BEST_TOOL	100.00%	0.00%	0.00%	0.00%	0.00%	100.00%
3 Count of BEST_TOOL			1	0	0	0	0	1
3 Percent of BEST_TOOL			100.00%	0.00%	0.00%	0.00%	0.00%	100.00%
4	A	Count of BEST_TOOL	7	0	0	0	0	7
		Percent of BEST_TOOL	100.00%	0.00%	0.00%	0.00%	0.00%	100.00%
	B	Count of BEST_TOOL	7	1	1	0	0	9
		Percent of BEST_TOOL	77.78%	11.11%	11.11%	0.00%	0.00%	100.00%
4 Count of BEST_TOOL			14	1	1	0	0	16
4 Percent of BEST_TOOL			87.50%	6.25%	6.25%	0.00%	0.00%	100.00%
5	A	Count of BEST_TOOL	5	0	0	1	0	6
		Percent of BEST_TOOL	83.33%	0.00%	0.00%	16.67%	0.00%	100.00%
5 Count of BEST_TOOL			5	0	0	1	0	6
5 Percent of BEST_TOOL			83.33%	0.00%	0.00%	16.67%	0.00%	100.00%
6	A	Count of BEST_TOOL	5	0	2	0	0	7
		Percent of BEST_TOOL	71.43%	0.00%	28.57%	0.00%	0.00%	100.00%
6 Count of BEST_TOOL			5	0	2	0	0	7
6 Percent of BEST_TOOL			71.43%	0.00%	28.57%	0.00%	0.00%	100.00%
Total Count of BEST_TOOL			34	1	5	4	1	45
Total Percent of BEST_TOOL			75.56%	2.22%	11.11%	8.89%	2.22%	100.00%

Rating	All	Subgrouping	Compactor	None
1	2	3	4	5
75.56%	2.22%	11.11%	8.89%	2.22%

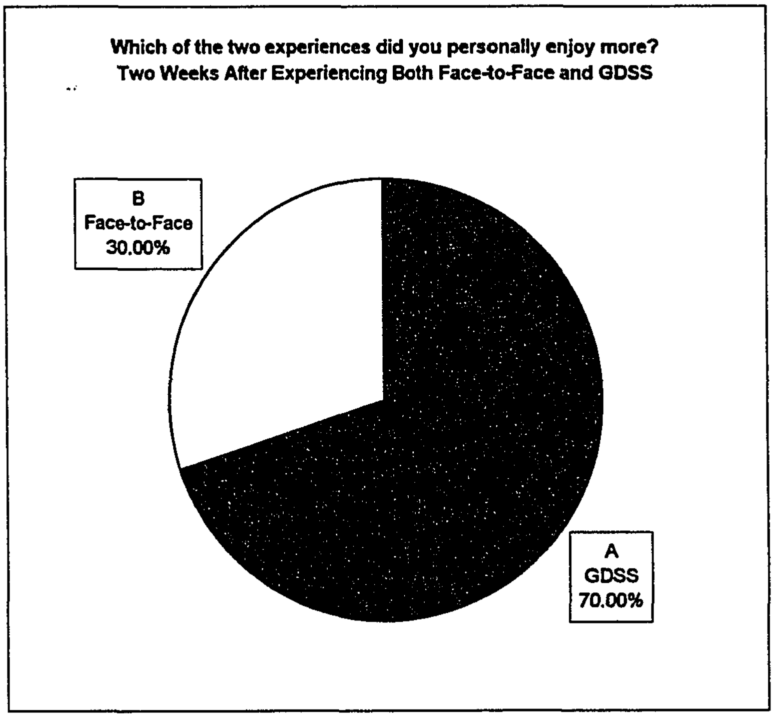


Final Perceptions: "Of the three structuring tools used which was the most helpful?"
Figure 85

Follow-up Survey
Two Weeks After Experiencing Both Face-to-Face and GDSS
Which of the two experiences did you personally enjoy more?
1, GDSS
2, Face-to-Face
Comparison of Personal Enjoyment - Counts and Percentages for Each Cluster, Each Group and Total Participants

			Personally Enjoy		
Group	Cluster	Data	A	B	Grand Total
2	A	Count of Personally Enjoy	6	3	9
		Percent of Personally Enjoy	66.67%	33.33%	100.00%
	B	Count of Personally Enjoy	4	1	5
		Percent of Personally Enjoy	80.00%	20.00%	100.00%
2 Count of Personally Enjoy			10	4	14
2 Percent of Personally Enjoy			71.43%	28.57%	100.00%
4	A	Count of Personally Enjoy	1	0	1
		Percent of Personally Enjoy	100.00%	0.00%	100.00%
	B	Count of Personally Enjoy	2	1	3
		Percent of Personally Enjoy	66.67%	33.33%	100.00%
4 Count of Personally Enjoy			3	1	4
4 Percent of Personally Enjoy			75.00%	25.00%	100.00%
5	A	Count of Personally Enjoy	4	2	6
		Percent of Personally Enjoy	66.67%	33.33%	100.00%
5 Count of Personally Enjoy			4	2	6
5 Percent of Personally Enjoy			66.67%	33.33%	100.00%
6	A	Count of Personally Enjoy	4	2	6
		Percent of Personally Enjoy	66.67%	33.33%	100.00%
6 Count of Personally Enjoy			4	2	6
6 Percent of Personally Enjoy			66.67%	33.33%	100.00%
Total Count of Personally Enjoy			21	9	30
Total Percent of Personally Enjoy			70.00%	30.00%	100.00%

GDSS	Face-to-Face
A	B
70.00%	30.00%



"Which of the two experiences did you personally enjoy more?"
Figure 86

"Which of the two organized lists of ideas would you more strongly recommend to others?" This question addressed professional satisfaction with the products derived from the relative experiences, and thus also related to commitment to product. The question addressed the problem, rather than the process, but since equal numbers of respondents did not participate in both problems using both treatments, their responses by problem are not given. Responses are given by process, but care should be taken not to put excessive weight on these responses, since the intervening variable of problem did exist in the phrasing of the question. Responses indicated that approximately half, or 54.33% of respondents would more strongly recommend the results of their Face-to-Face process, versus 46.67% who preferred the work from the GDSS group. See Figure 87.

"My best ideas came from the experience in:" Again, this question spoke to professional satisfaction and trust in the process. Although individual respondents did not answer each of these first two questions in the same way, the final breakdown was the same - 53.33% felt that their best ideas came from the Face-to-Face meetings. See Figure 88.

"I was most satisfied with the way we organized ideas in:" A major part of building expert systems relates to how ideas are related and organized. Here also, 66.67% of respondents indicated that they were most satisfied with the organization of ideas stemming from GDSS. See Figure 89.

Follow-up Survey (Treatment Operationalized as Problem)
Two Weeks After Experiencing Both Face-to-Face and GDSS
Which of the two organized lists of ideas would you more strongly recommend to others?
1, Safety and Security at ODU
2, Landing a Job in My Field
Comparison of Organized Lists of Ideas - Counts and Percentages for Each Cluster, Each Group and Total Participants

			Recommend Ideas		
Group	Cluster	Data	GDSS	Meeting	Grand Total
2	A	Count of Recommend Ideas	2	7	9
		Percent of Recommend Ideas	22.22%	77.78%	100.00%
	B	Count of Recommend Ideas	3	2	5
		Percent of Recommend Ideas	60.00%	40.00%	100.00%
2 Count of Recommend Ideas			5	9	14
2 Percent of Recommend Ideas			35.71%	64.29%	100.00%
4	A	Count of Recommend Ideas	1	0	1
		Percent of Recommend Ideas	100.00%	0.00%	100.00%
	B	Count of Recommend Ideas	1	2	3
		Percent of Recommend Ideas	33.33%	66.67%	100.00%
4 Count of Recommend Ideas			2	2	4
4 Percent of Recommend Ideas			50.00%	50.00%	100.00%
5	A	Count of Recommend Ideas	4	2	6
		Percent of Recommend Ideas	66.67%	33.33%	100.00%
5 Count of Recommend Ideas			4	2	6
5 Percent of Recommend Ideas			66.67%	33.33%	100.00%
6	A	Count of Recommend Ideas	3	3	6
		Percent of Recommend Ideas	50.00%	50.00%	100.00%
6 Count of Recommend Ideas			3	3	6
6 Percent of Recommend Ideas			50.00%	50.00%	100.00%
Total Count of Recommend Ideas			14	16	30
Total Percent of Recommend Ideas			46.67%	53.33%	100.00%

Operate GDSS	Operate Meeting
A	B
46.67%	53.33%

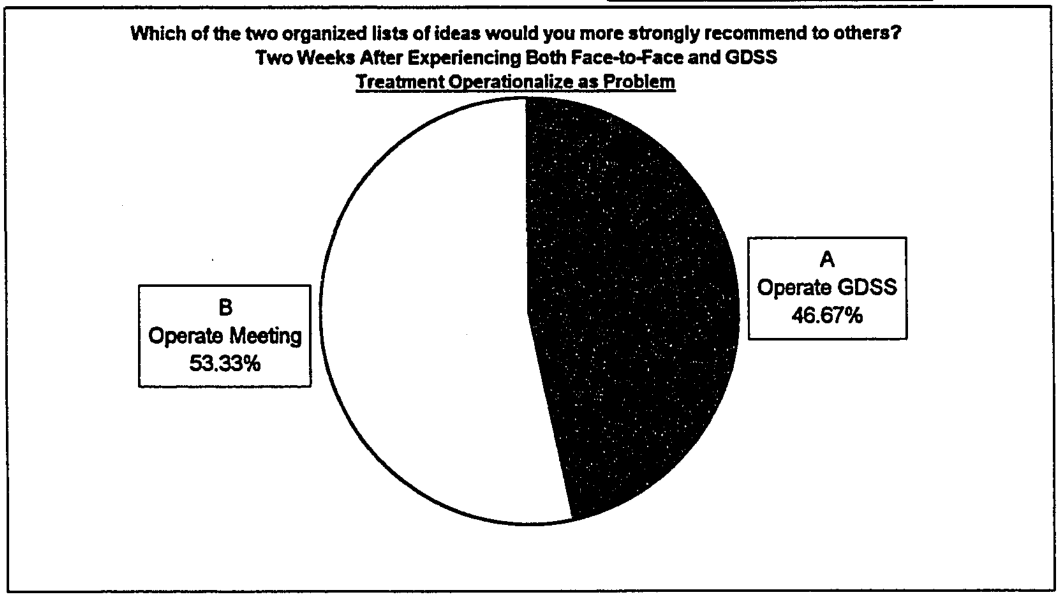


Figure 87

Follow-up Survey (Treatment Operationalized as Problem)
Two Weeks After Experiencing Both Face-to-Face and GDSS
My best ideas came from the experience in:
1, Safety and Security at ODU
2, Landing a Job in My Field
Comparison of Best Ideas - Counts and Percentages for Each Cluster, Each Group and Total Participants

			Best Ideas		
Group	Cluster	Data	GDSS	Meeting	Grand Total
2	A	Count of Best Ideas	1	8	9
		Percent of Best Ideas	11.11%	88.89%	100.00%
	B	Count of Best Ideas	3	2	5
		Percent of Best Ideas	60.00%	40.00%	100.00%
2 Count of Best Ideas			4	10	14
2 Percent of Best Ideas			28.57%	71.43%	100.00%
4	A	Count of Best Ideas	1	0	1
		Percent of Best Ideas	100.00%	0.00%	100.00%
	B	Count of Best Ideas	1	2	3
		Percent of Best Ideas	33.33%	66.67%	100.00%
4 Count of Best Ideas			2	2	4
4 Percent of Best Ideas			50.00%	50.00%	100.00%
5	A	Count of Best Ideas	5	1	6
		Percent of Best Ideas	83.33%	16.67%	100.00%
5 Count of Best Ideas			5	1	6
5 Percent of Best Ideas			83.33%	16.67%	100.00%
6	A	Count of Best Ideas	3	3	6
		Percent of Best Ideas	50.00%	50.00%	100.00%
6 Count of Best Ideas			3	3	6
6 Percent of Best Ideas			50.00%	50.00%	100.00%
Total Count of Best Ideas			14	16	30
Total Percent of Best Ideas			46.67%	53.33%	100.00%

Operate GDSS	Operate Meeting
A	B
46.67%	53.33%

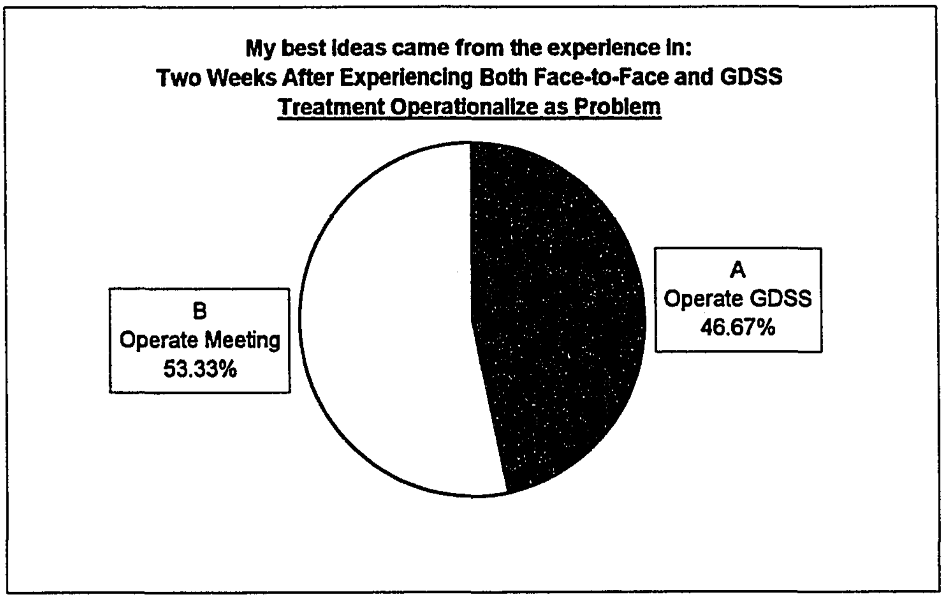
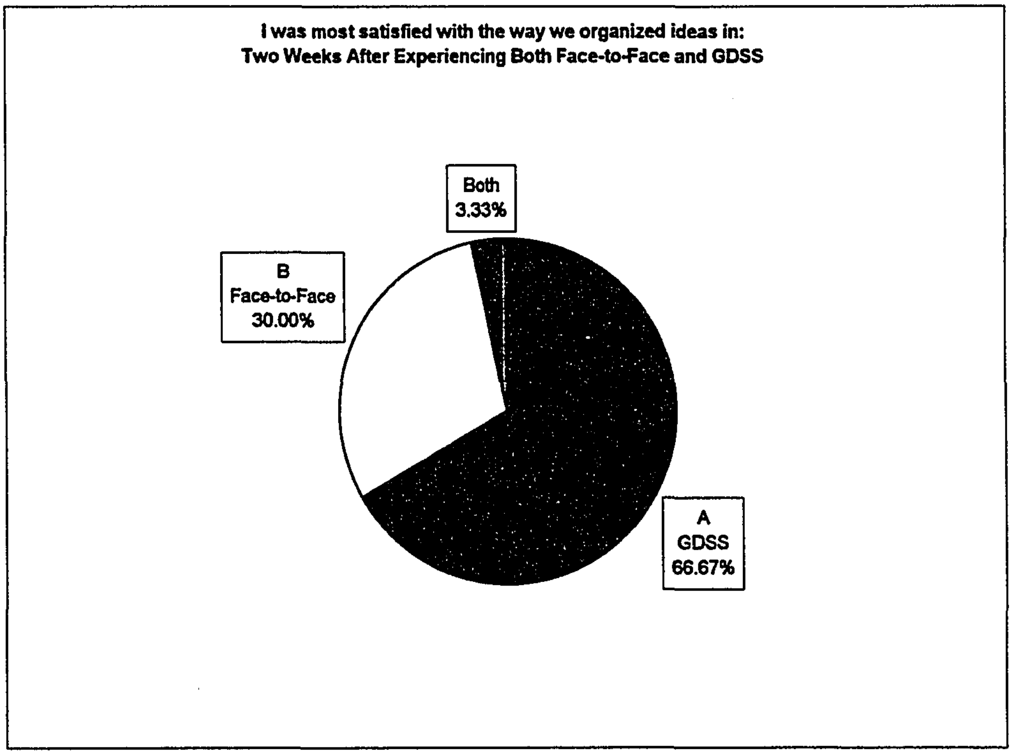


Figure 88

Follow-up Survey
Two Weeks After Experiencing Both Face-to-Face and GDSS
I was most satisfied with the way we organized ideas in:
1, GDSS
2, Face-to-Face
Comparison of Satisfaction with Organized Ideas - Counts and Percentages for Each Cluster, Each Group and Total Participants

			Satisfied w/Organization			
Group	Cluster	Data	A	B	BOTH	Grand Total
2	A	Count of Satisfied w/Organization	6	3	0	9
		Percent of Satisfied w/Organization	66.67%	33.33%	0.00%	100.00%
	B	Count of Satisfied w/Organization	3	1	1	5
		Percent of Satisfied w/Organization	60.00%	20.00%	20.00%	100.00%
2 Count of Satisfied w/Organization			9	4	1	14
2 Percent of Satisfied w/Organization			64.29%	28.57%	7.14%	100.00%
4	A	Count of Satisfied w/Organization	1	0	0	1
		Percent of Satisfied w/Organization	100.00%	0.00%	0.00%	100.00%
	B	Count of Satisfied w/Organization	2	1	0	3
		Percent of Satisfied w/Organization	66.67%	33.33%	0.00%	100.00%
4 Count of Satisfied w/Organization			3	1	0	4
4 Percent of Satisfied w/Organization			75.00%	25.00%	0.00%	100.00%
5	A	Count of Satisfied w/Organization	4	2	0	6
		Percent of Satisfied w/Organization	66.67%	33.33%	0.00%	100.00%
5 Count of Satisfied w/Organization			4	2	0	6
5 Percent of Satisfied w/Organization			66.67%	33.33%	0.00%	100.00%
6	A	Count of Satisfied w/Organization	4	2	0	6
		Percent of Satisfied w/Organization	66.67%	33.33%	0.00%	100.00%
6 Count of Satisfied w/Organization			4	2	0	6
6 Percent of Satisfied w/Organization			66.67%	33.33%	0.00%	100.00%
Total Count of Satisfied w/Organization			20	9	1	30
Total Percent of Satisfied w/Organization			66.67%	30.00%	3.33%	100.00%

GDSS	Face-to-Face	
A	B	Both
66.67%	30.00%	3.33%



"I was most satisfied with the way we organized ideas in:"
Figure 89

Knowledge Engineers' Evaluation

The subject of this exploratory study was to examine the use of GDSS in knowledge acquisition and prioritizing for building pre-prototypical expert systems. In order to evaluate the quality and usefulness of the multiple expert products produced through each approach in building expert systems, the arranged and prioritized lists of ideas were given to a panel of three practicing Knowledge Engineers to evaluate. The specific criteria used to select these Knowledge Engineers were derived from published lists of ideal qualifications and skills (White & Goldsmith, 1990; Scott, et al, 1991). These included Software Engineering skills of computer programming and software design, user-interface skills and software integrations skills, knowledge engineering skills including familiarity with expert-system shells and the inference and control mechanisms of the inference engines, and a strong background in artificial intelligence. In addition, Knowledge Engineers required strong interpersonal and listening skills, facilitation skills, and interviewing skills. The skills sought also included a multi-disciplinary background, an experiential background broad enough to allow a basis for meaningful comparisons, and an ability to pick up an understanding of the content area quickly. The Knowledge Engineers selected were able to demonstrate those skills through a long and public history in the field. It should be noted that one of the problems in knowledge acquisition is the difficulty of finding Knowledge Engineers who possess the requisite characteristics.

Each of the Knowledge Engineers were experienced in building and evaluating expert systems. Each worked with an internationally known firm, and had proposed, designed and created expert systems for both private and government use. In addition, each had published in the field, and had facilitated and consulted with other teams in building expert systems. Between them, they had over twenty-five years of experience. Due to the nature of their employment, the Knowledge Engineers requested anonymity throughout the conduct and publication of this study.

The goal of the evaluation was to provide a measure of verifiability - "building the system right." The Knowledge Engineers were asked to evaluate the products of both the GDSS and Face-to-Face clusters independently, according to several criteria. The specific evaluation criteria were chosen to reflect the normal requirements of Knowledge Engineers using the acquired knowledge from multiple experts. The Knowledge Engineers were asked to rate each product against the criteria in terms of usefulness in building expert systems. The compiled results of the GDSS and Face-to-Face groups against each criterion are reported and compared below, and the associated standard deviations are shown in the tables.

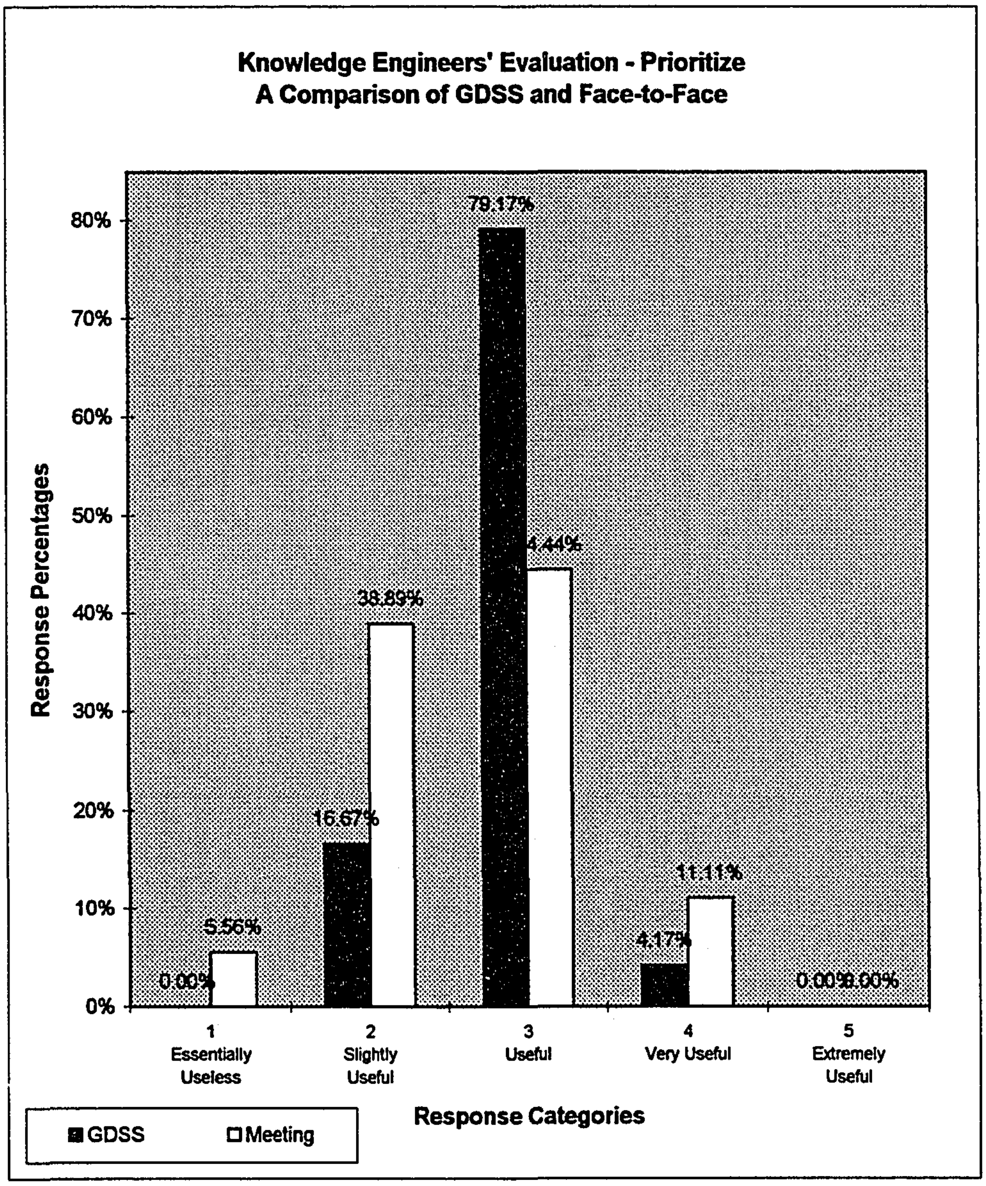
"Helps prioritize by making the relative importance of ideas clear." Products from eight GDSS clusters and six Face-to-Face were evaluated on a Likert-type scale ranging from 1, essentially useless, to 5, extremely useful. The three Knowledge Engineers assigned a mean of 2.88 to the GDSS groups, and a mean of 2.61 to the Face-to-Face See Figure 90. This indicated they found the GDSS groups more Useful in this regard. See Figure 91 for a percentage summary of the Knowledge Engineers' responses for treatment.

Descriptive Statistics
Summary of Knowledge Engineers' Evaluation
Sorted by Mean Difference

	Meeting		GDSS		Difference	
	Mean	Std Dev	Mean	Std Dev	of Means	Title
Helps to formulate follow-up <u>questions</u> for pre-prototyping	2.94	1.00	3.75	0.79	0.81	Questions
Provides sufficient complexity and perspective to create required <u>depth</u>	1.94	0.42	2.63	0.65	0.68	Depth
Provides sufficient <u>information</u> to construct a pre-prototype expert system	1.94	0.54	2.46	0.59	0.51	Information
Provides <u>breadth</u> of data, i.e., the range of ideas seems encompassing	2.50	0.62	2.88	0.80	0.38	Breadth
Allows determination of realistic <u>confidence</u> factors from this data	2.00	0.49	2.29	0.69	0.29	Confidence
Helps <u>prioritize</u> by making the relative importance of ideas clear	2.61	0.78	2.88	0.45	0.26	Prioritize
Provides necessary <u>categorizing</u> information	2.33	0.69	2.58	0.72	0.25	Categorize
Provides a clear picture of the <u>relationship</u> of ideas	2.39	0.61	2.63	0.58	0.24	Relationship
<u>Structures</u> ideas into a basic organization	2.61	0.70	2.63	0.49	0.01	Structure
Average of Means	2.36		2.75			
Average of Standard Deviations		0.65		0.64		

Knowledge Engineers' Evaluations
Descriptive Statistics
Figure 90

	Essentially Useless	Slightly Useful	Useful	Very Useful	Extremely Useful
	1	2	3	4	5
GDSS	0.00%	16.67%	79.17%	4.17%	0.00%
Meeting	5.56%	38.89%	44.44%	11.11%	0.00%



KE: "Helps prioritize by making the relative importance of ideas clear."
Figure 91

"Provides a clear picture of the relationship of ideas." Against this criteria, GDSS groups received a mean of 2.63, and Face-to-Face groups a mean of 2.39 (Figure 90). While neither groups provided a useful picture of the relationship of ideas, the GDSS products were slightly more so. See Figure 92 for a percentage distribution summary of the Knowledge Engineers' responses.

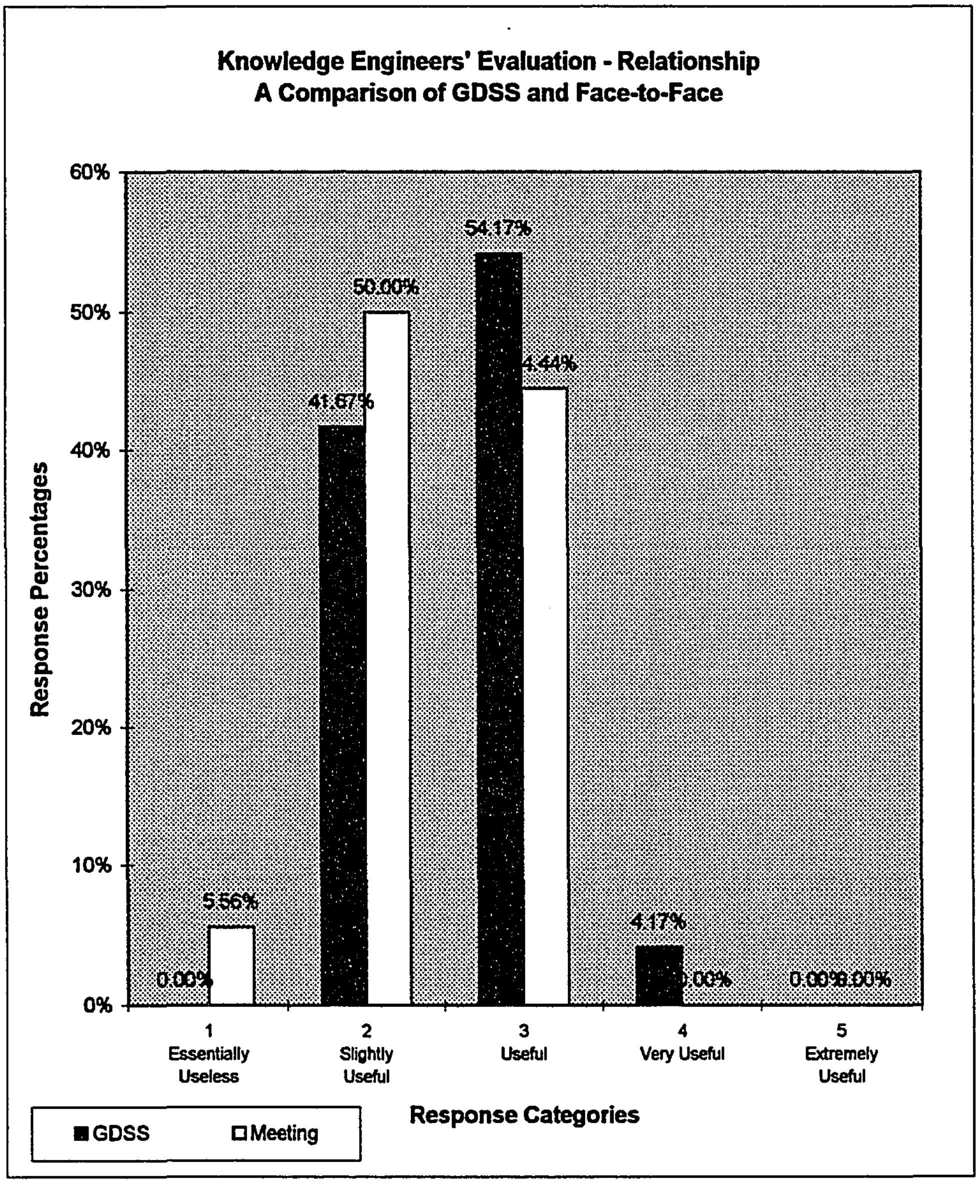
"Structures ideas into a basic organization." Again, the GDSS product was found to be slightly more Useful with a mean of 2.63 as compared to the Face-to-Face mean of 2.61 (Figure 90). See Figure 93 for a percentage distribution summary of the Knowledge Engineers' responses on this criterion.

"Provides necessary categorizing information." The GDSS mean on this criterion was 2.58, or Useful, while the Face-to-Face mean was 2.33, or slightly Useful (Figure 90). See Figure 94 for a percentage distribution summary of the Knowledge Engineers' responses.

"Provides breadth of data; i.e., the range of ideas seems encompassing." Against this criterion, the GDSS data were given a mean of 2.88, compared to a less Useful mean of 2.5 for the Face-to-Face groups (Figure 90). See Figure 95 for a percentage distribution summary of the Knowledge Engineers' responses for breadth.

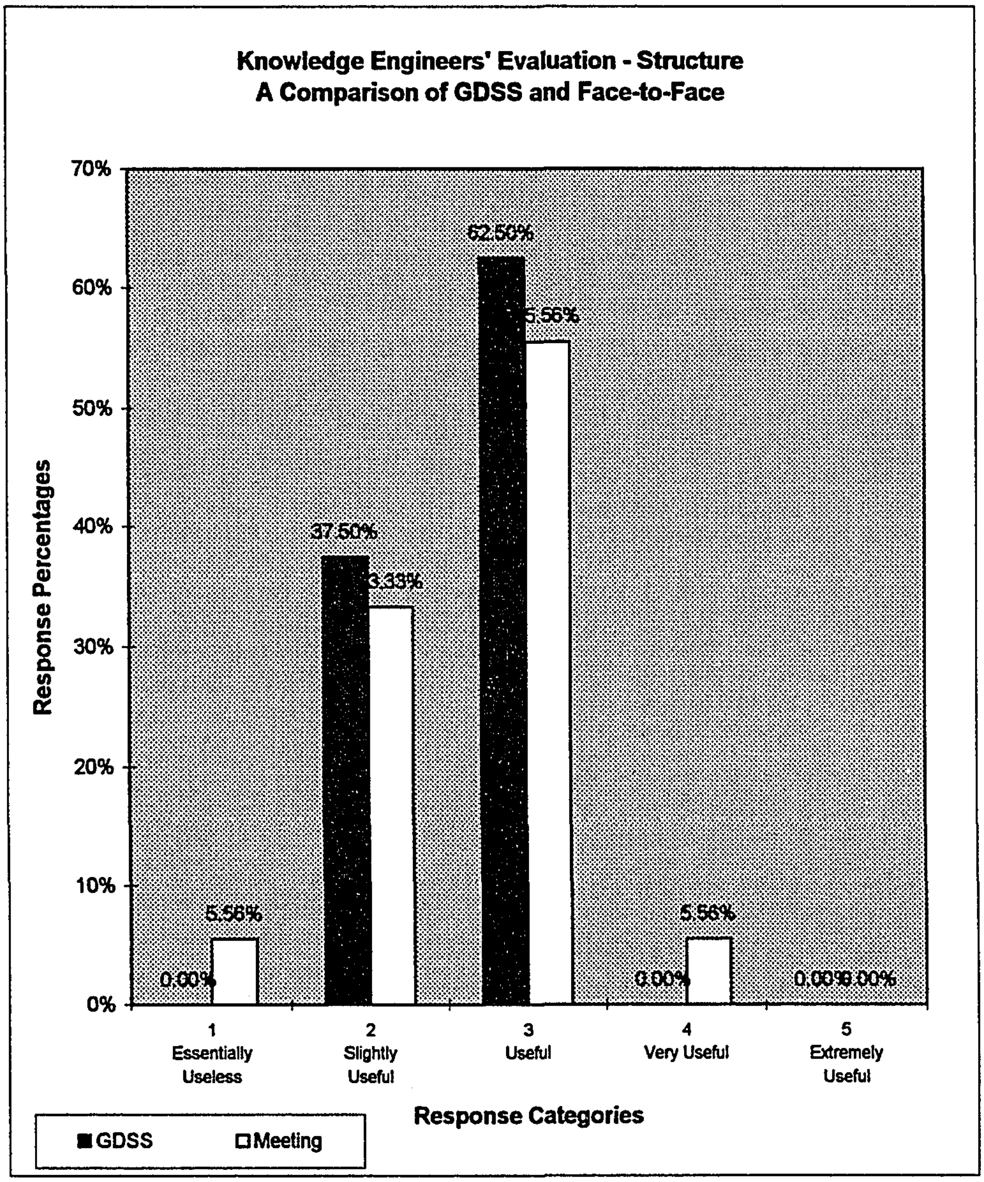
"Provides sufficient complexity and perspective to create required depth." Against this criterion, the GDSS products were clearly superior. The Knowledge Engineers assigned a mean of 2.63 to the GDSS clusters (Figure 90), and a mean of 1.94, below Slightly Useful, to the Face-to-Face products. See Figure 96 for a percentage distribution summary of the Knowledge Engineers' responses for depth.

	Essentially Useless	Slightly Useful	Useful	Very Useful	Extremely Useful
	1	2	3	4	5
GDSS	0.00%	41.67%	54.17%	4.17%	0.00%
Meeting	5.56%	50.00%	44.44%	0.00%	0.00%



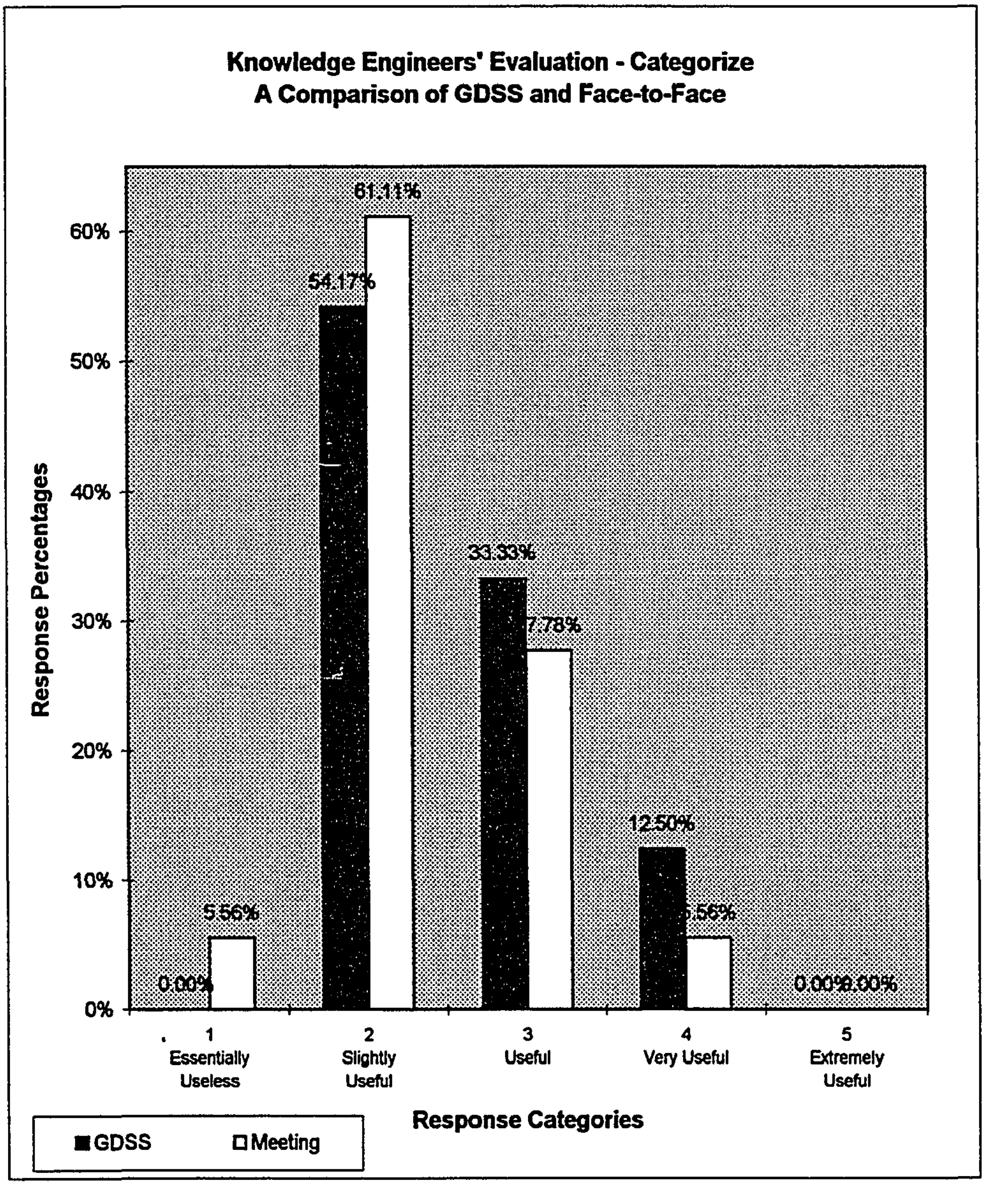
KE: "Provides a clear picture of the relationship of ideas."
Figure 92

	Essentially Useless	Slightly Useful	Useful	Very Useful	Extremely Useful
	1	2	3	4	5
GDSS	0.00%	37.50%	62.50%	0.00%	0.00%
Meeting	5.56%	33.33%	55.56%	5.56%	0.00%



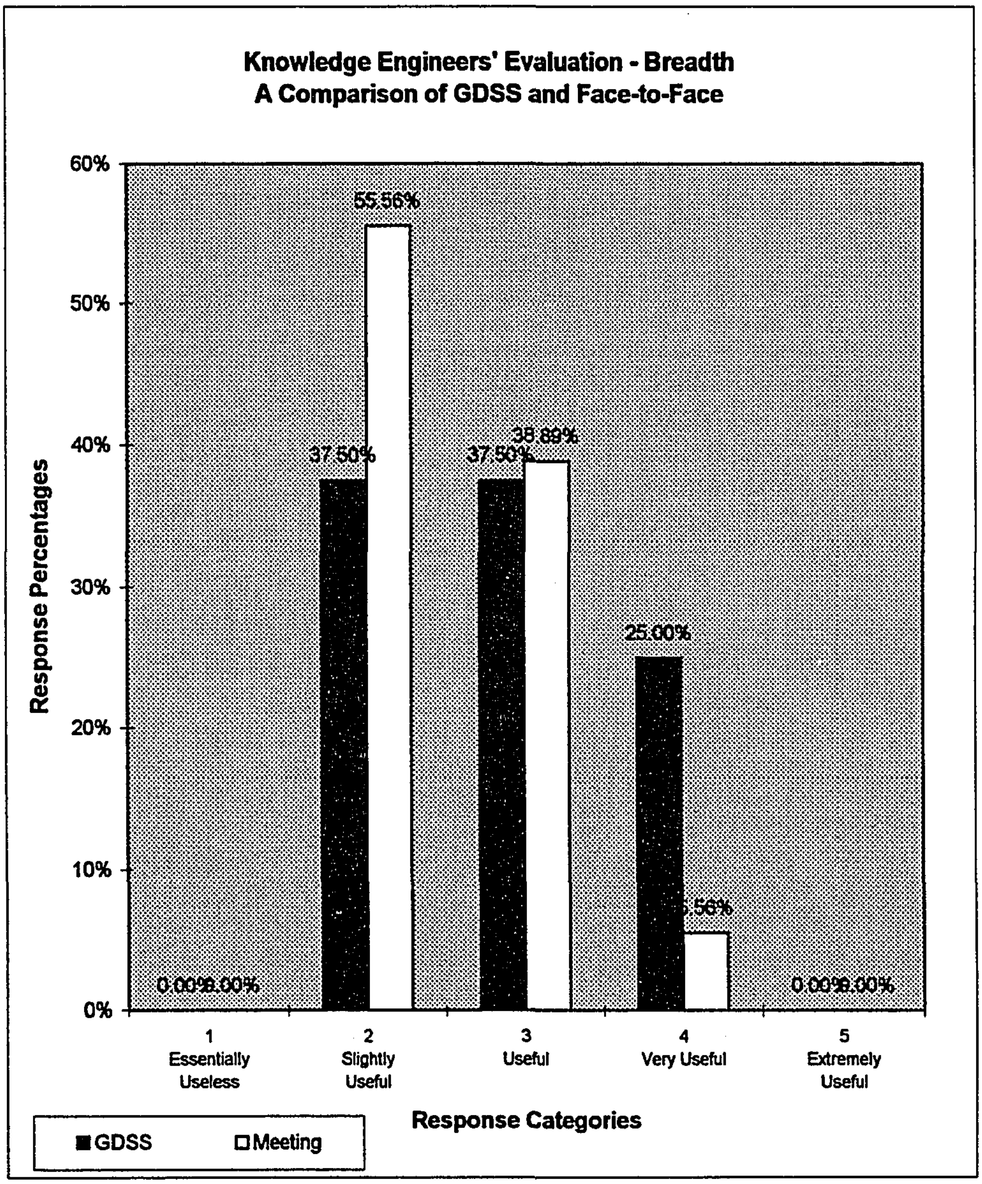
KE: "Structures ideas into a basic organization."
Figure 93

	Essentially Useless	Slightly Useful	Useful	Very Useful	Extremely Useful
	1	2	3	4	5
GDSS	0.00%	54.17%	33.33%	12.50%	0.00%
Meeting	5.56%	61.11%	27.78%	5.56%	0.00%



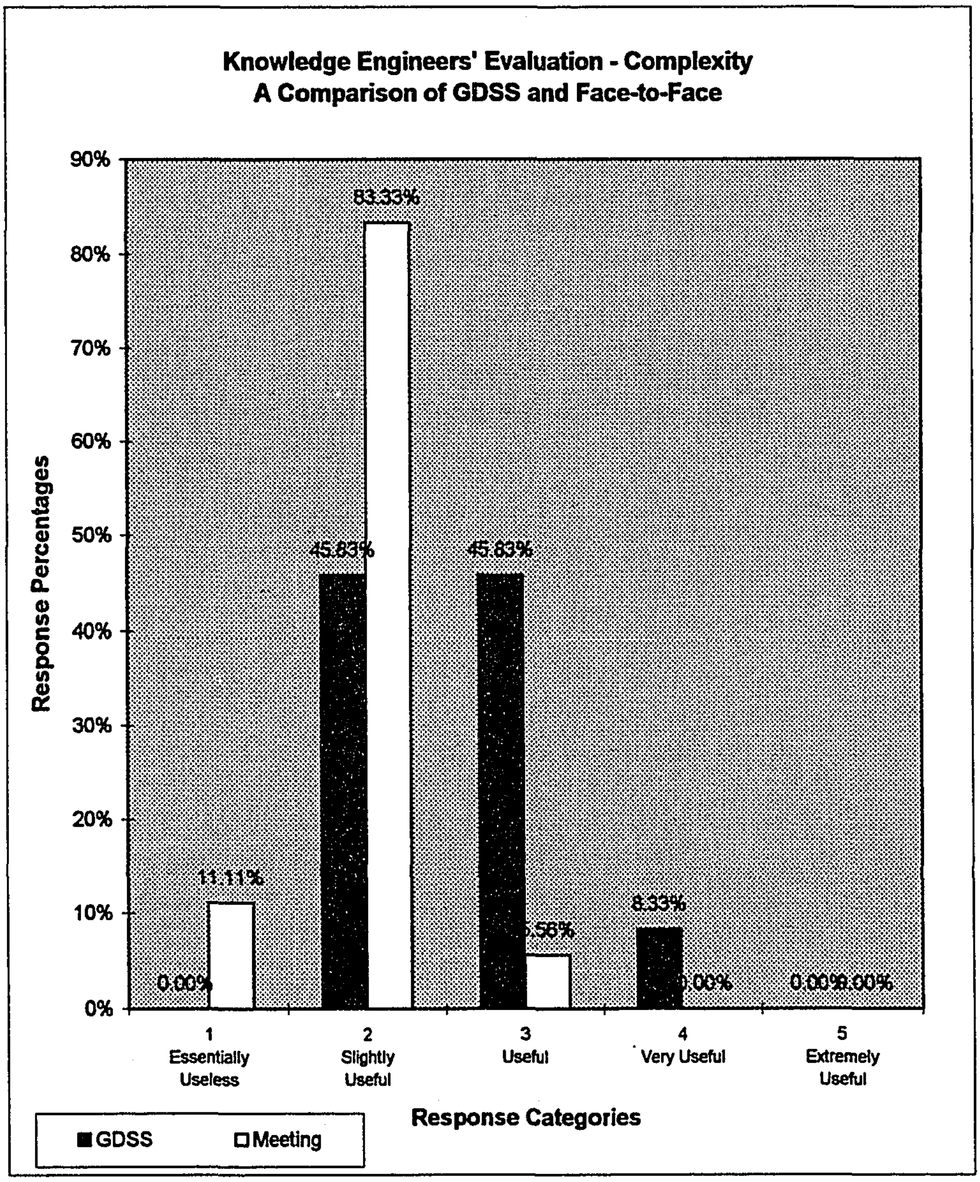
KE: "Provides categorizing information."
Figure 94

	Essentially Useless	Slightly Useful	Useful	Very Useful	Extremely Useful
	1	2	3	4	5
GDSS	0.00%	37.50%	37.50%	25.00%	0.00%
Meeting	0.00%	55.56%	38.89%	5.56%	0.00%



KE: "Provides breadth of data."
Figure 95

	Essentially Useless	Slightly Useful	Useful	Very Useful	Extremely Useful
	1	2	3	4	5
GDSS	0.00%	45.83%	45.83%	8.33%	0.00%
Meeting	11.11%	83.33%	5.56%	0.00%	0.00%



KE: "Provides sufficient depth."
Figure 96

"Provides sufficient information to construct a pre-prototype expert system." Again, the Knowledge Engineers gained more information from the GDSS than from the Face-to-Face products. The mean for the GDSS groups was 2.46; that for the Face-to-Face 1.94 - only Slightly Useful (Figure 90). See Figure 97 for a percentage distribution summary of the Knowledge Engineers' responses on this criterion.

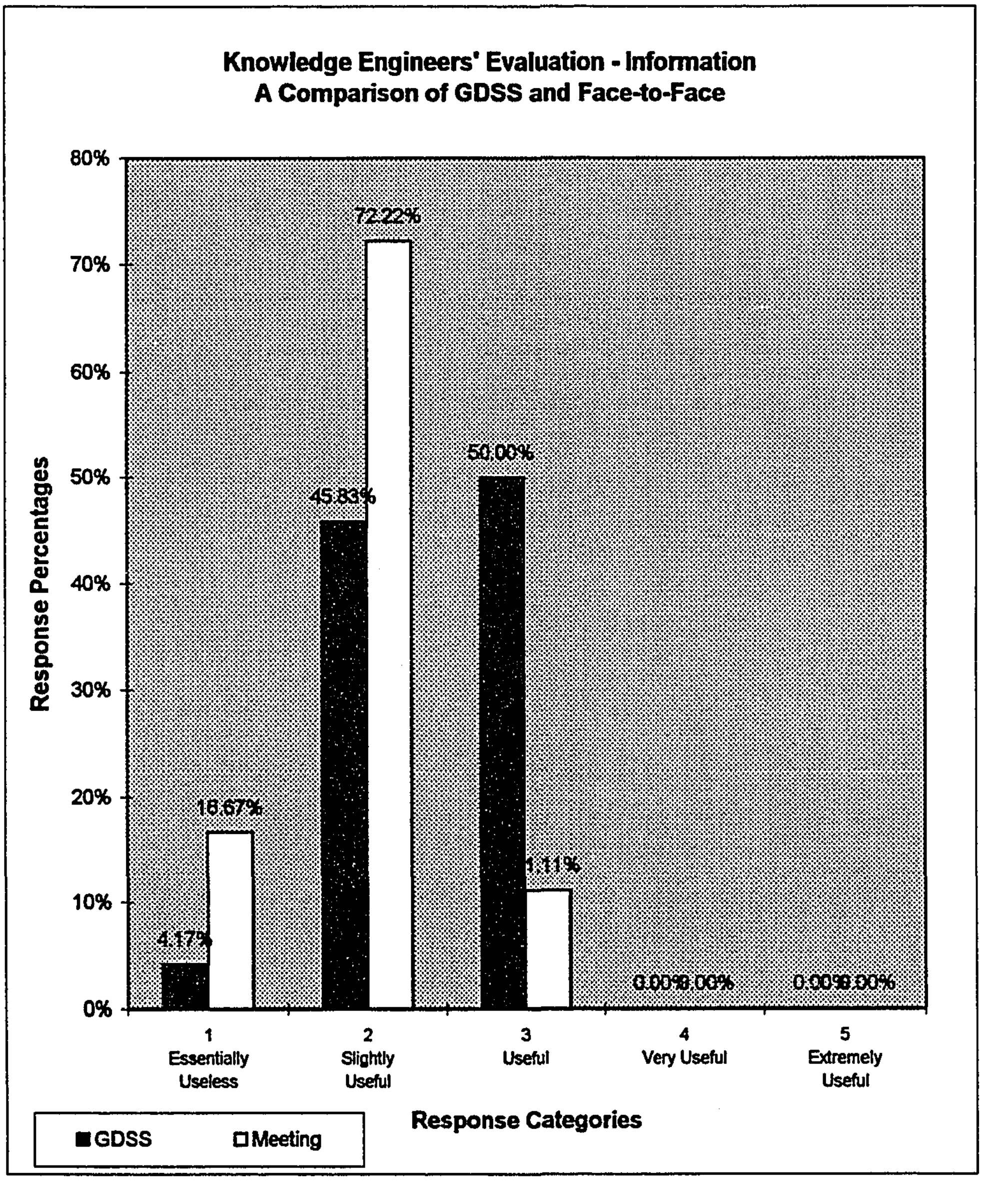
"Allows determination of realistic confidence factors from this data." Here, the GDSS mean was 2.29; the mean for the Face-to-Face products only 2.00 (Figure 90). Figure 98 gives a percentage distribution summary of the Knowledge Engineers' responses.

"Helps to formulate follow-up questions for pre-prototyping." A large difference was seen in the Knowledge Engineer ratings for the two approaches on this criterion. The GDSS mean was 3.75, approaching Very Useful (Figure 90). The mean for the Face-to-Face products was 2.94, or just below Useful. See Figure 99 for a percentage distribution summary of the Knowledge Engineers' responses.

Domain Experts' Evaluation

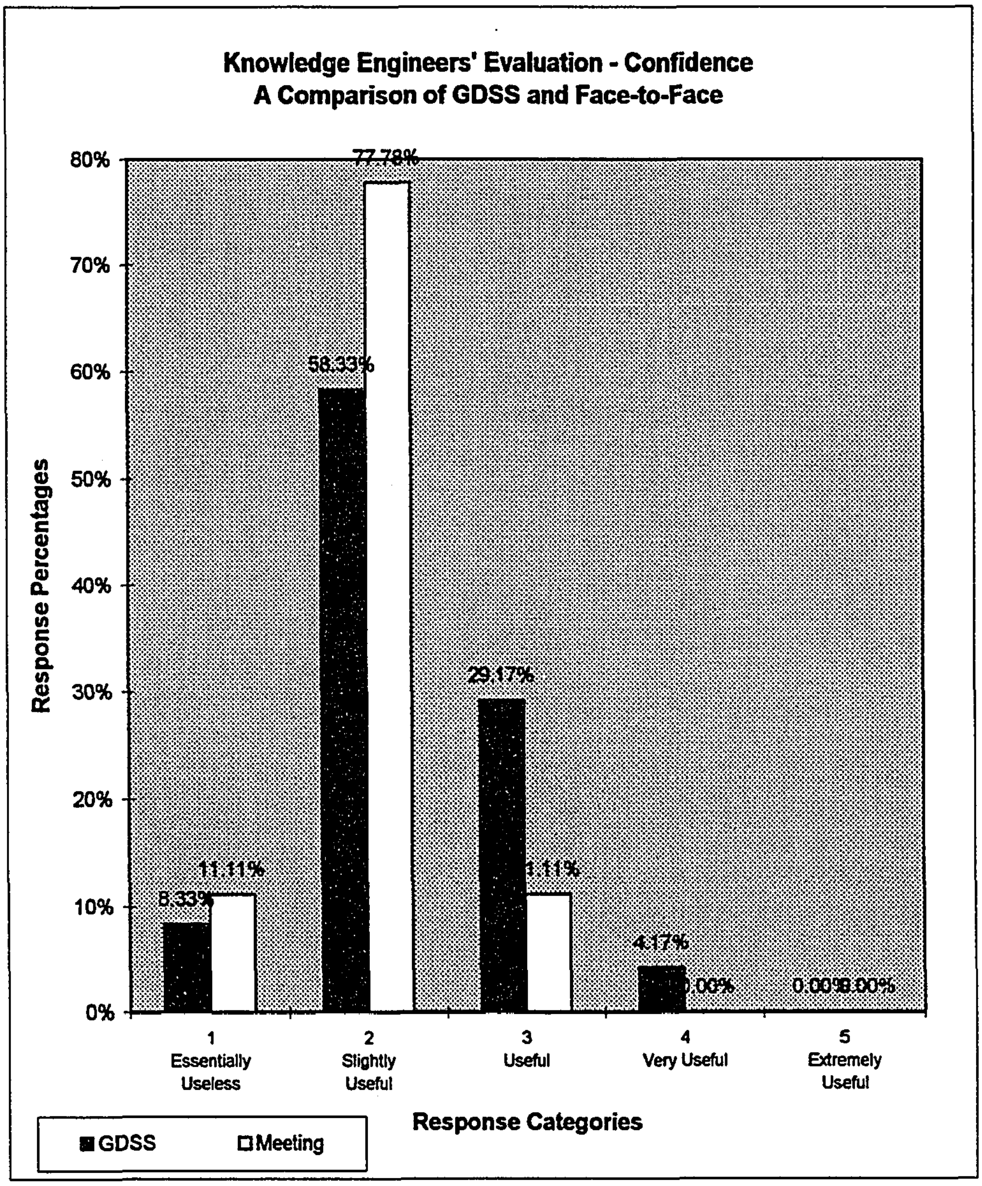
Expert systems are created in order to encapsulate and make available the knowledge and heuristics of specialists, or Domain Experts, in the fields addressed. To evaluate the comparative quality of recommendations produced through GDSS and Face-to-Face groups, Domain Experts in the respective problem areas were asked to rate each product in terms of validity - "the right system." The Domain Experts were carefully chosen for long-term or intensive experience in the specific domain, an ability

	Essentially Useless	Slightly Useful	Useful	Very Useful	Extremely Useful
	1	2	3	4	5
GDSS	4.17%	45.83%	50.00%	0.00%	0.00%
Meeting	16.67%	72.22%	11.11%	0.00%	0.00%



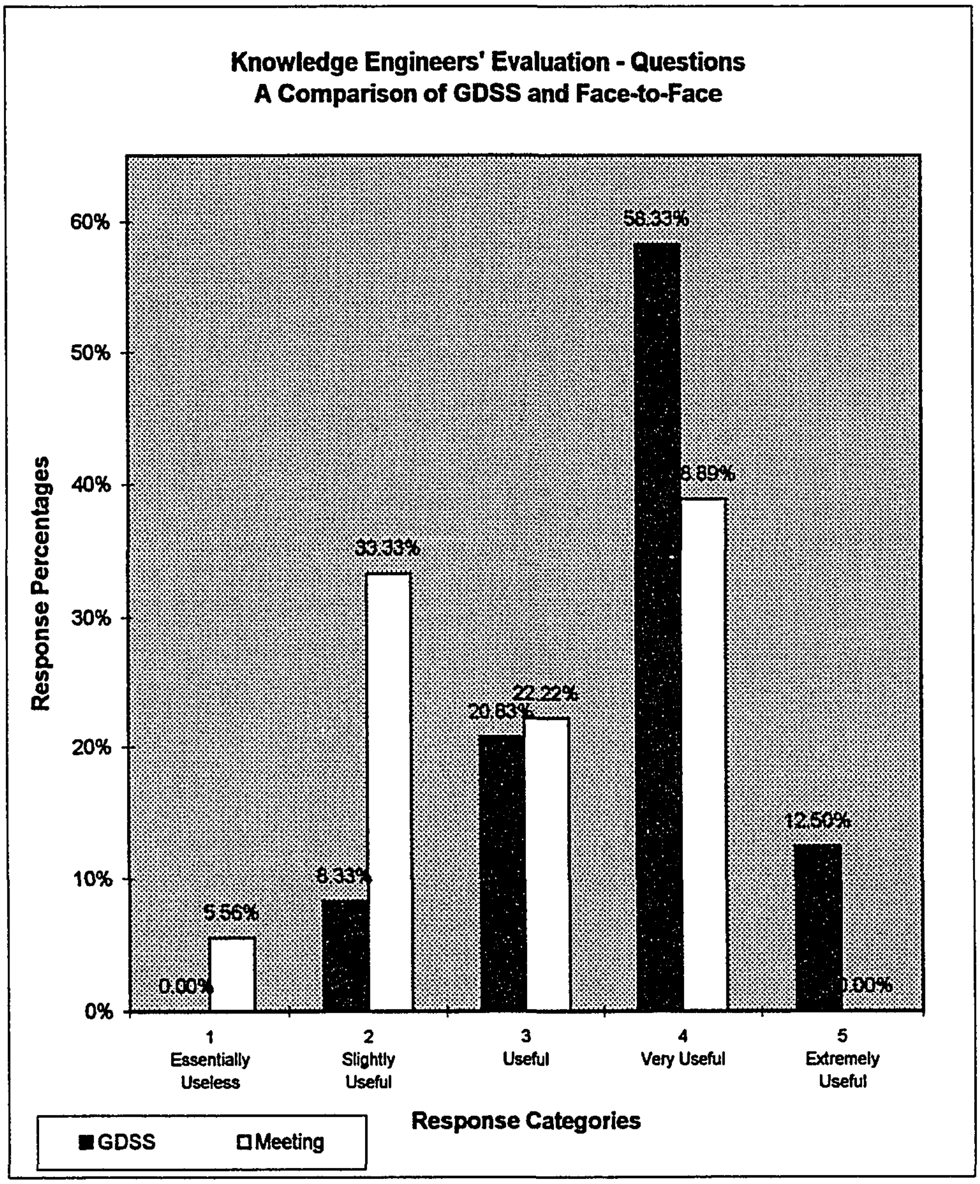
KE: "Provides sufficient information to construct a pre-prototypical expert system."
Figure 97

	Essentially Useless	Slightly Useful	Useful	Very Useful	Extremely Useful
	1	2	3	4	5
GDSS	8.33%	58.33%	29.17%	4.17%	0.00%
Meeting	11.11%	77.78%	11.11%	0.00%	0.00%



KE: "Allows determination of realistic confidence factors."
Figure 98

	Essentially Useless	Slightly Useful	Useful	Very Useful	Extremely Useful
	1	2	3	4	5
GDSS	0.00%	8.33%	20.83%	58.33%	12.50%
Meeting	5.56%	33.33%	22.22%	38.89%	0.00%



KE: "Helps to formulate follow-up questions for pre-prototyping."
Figure 99

to understand and represent differing points of view in the field, and distance and objectivity from the student "experts" who provided the products for their review. The Domain Expert selected to evaluate the responses to "How To Improve the Personal Safety and Security of Students at ODU" was the official with Old Dominion Campus Security Service who was charged with that specific responsibility. A nationally-known expert, he has received several awards for contributions to the field of security. The two Domain Experts chosen to evaluate "How to Obtain a Job in Your Field for After Graduation" represent two different points of view. One expert hired and advised candidates throughout a professional career lasting thirty years; she has taught personnel classes, and staffed two major institutions from the ground up, hiring professional and classified staff. The other Domain Expert was first an unsuccessful candidate before obtaining a job in her field. In pursuit of a position, she utilized many of the suggestions found in the groups' products. Her experience - unsuccessful and successful - all took place within three years of this study.

The Domain Experts were provided with a Likert-type scale to use in agreeing or disagreeing with a series of statements. The five-point scale ranged from a low of 1 for Strongly Disagree to a high of 5 for Strongly Agree. Each reviewed the results of all the GDSS and Face-to-Face groups addressing their particular problem. Their responses are listed and compared below. Responses are reported first by process according to problem; then as a combined rating for GDSS and Face-to-Face.

"Improving the Personal Safety and Security of Students at ODU"

The products from three GDSS groups and three Face-to-Face groups were compared. The means given below are the combined ratings for all groups using each respective process. Since only one Domain Expert was involved, standard deviations are not included. See Figure 100 for the data discussed below.

"These ideas are *effective* in reaching the desired goal. Against this criteria, the GDSS groups received a mean rating of 2.67, and the Face-to-Face Meeting groups received a mean rating of 2.33. Both ratings indicated a degree of Disagreement, with the GDSS rating being more positive.

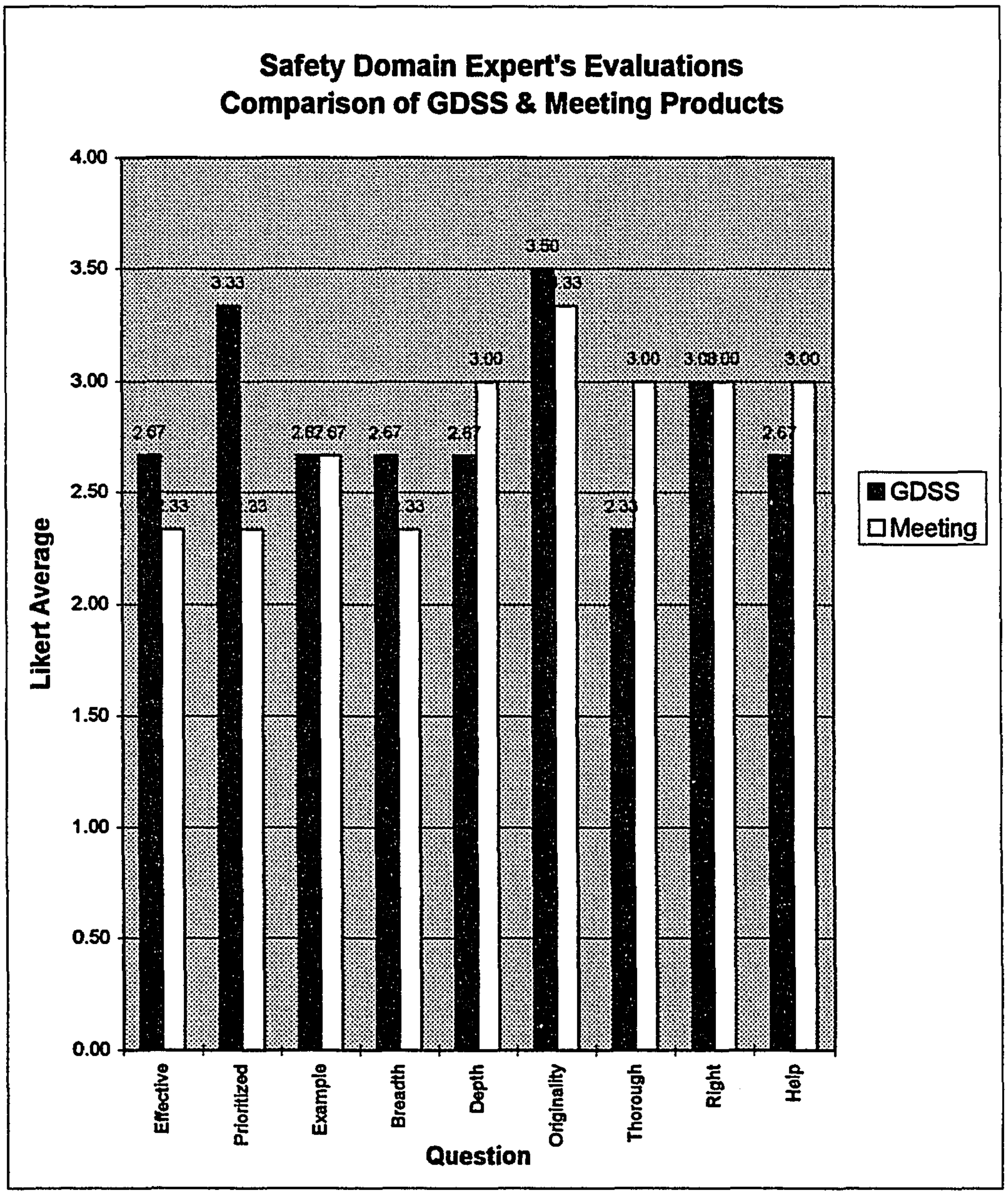
"These ideas are *well-prioritized*. The GDSS mean on prioritization was 3.33, indicating slight Agreement. This was in contrast to the mean of 2.33 for the Face-to-Face meeting groups, indicating Disagreement.

"These ideas together provide a *good example* to follow." Both the GDSS and Face-to-Face groups products received the same mean, of 2.67. This indicates Disagreement with the statement.

"The range of these ideas is exhaustive and complete, i.e., *provide breadth*." The mean rating for the GDSS products was 2.67, the mean for the Face-to-Face group products was 2.33.

"These ideas provide sufficient detail and perspective, i.e. *depth*." On this category, the GDSS mean was only 2.67, indicating Disagreement, while the mean for the Face-to-Face groups was a 3.00.

	Effective	Prioritized	Example	Breadth	Depth	Originality	Thorough	Right	Help
GDSS	2.67	3.33	2.67	2.67	2.67	3.50	2.33	3.00	2.67
Meeting	2.33	2.33	2.67	2.33	3.00	3.33	3.00	3.00	3.00



Safety DE's Evaluation
Comparison of GDSS Non-GDSS Means
Figure 100

"These ideas show *originality and diversity*." The mean assigned to the GDSS group products was 3.50 indicating Agreement; the mean for the Face-to-Face meeting groups a slightly less positive 3.33.

"These ideas are very *thorough*, i.e., exhaustive and complex." The mean for the GDSS groups was 2.33, indicating a degree of Disagreement. The mean for the Face-to-Face meeting groups was 3.00.

"These ideas are the *right ideas*, i.e., exhaustive and complete." On this measure, the products of both the GDSS and the Face-to-Face meeting groups were rated identically. Both received a mean of 3.00.

"The ideas in this group *help me*, as an authority in the field, by presenting new information, understanding or perspectives." The mean accorded to the GDSS groups was 2.67; that for the Face-to-Face meeting groups was a 3.00.

Overall, the Domain Expert evaluating the products of the various groups did not rate either groups positively. The lowest rankings were given to the Face-to-Face groups in effectiveness in reaching the goal, prioritizing, and range of ideas, and to the GDSS groups in thoroughness of ideas. The highest rankings were given to the GDSS groups in originality and diversity of ideas. The GDSS rankings were higher than those given to the Face-to-Face groups. Again, see Figure 100 for a comparison of means.

"Landing a Job in Your Major Area of Study for After Graduation"

Two Domain Experts reacted to the group products for this problem. Their evaluations are given separately, and then as a combined rating.

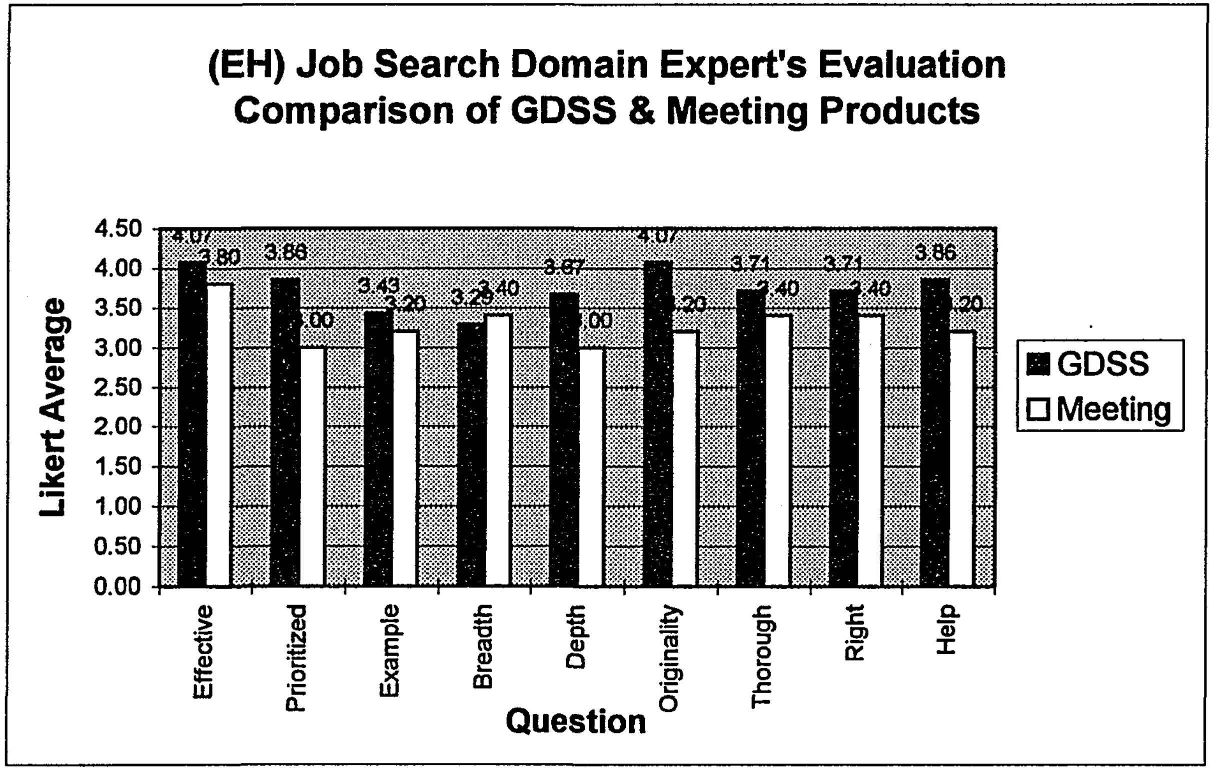
"These ideas are *effective* in reaching the desired goal. Against this criteria, the first Domain Expert (long term professional) gave the GDSS groups a mean rating of 4.07, and the Face-to-Face Meeting groups received a mean rating of 3.80 (Figure 101). The second Domain Expert (recently successful) gave the GDSS groups a mean of 3.00 and the Face-to-Face meeting groups a mean of 2.80 (Figure 102). Again, since only one Domain Expert is involved in each evaluation, no standard deviations are noted.

"These ideas are *well-prioritized*. The GDSS mean on prioritization from the first Domain Expert was 3.86, in contrast to the mean of 3.00 for the Face-to-Face meeting groups. The second Domain Expert gave the GDSS groups a mean of 3.20, again in contrast to the mean of 2.40 for the Face-to-Face meeting groups.

"These ideas together provide a *good example* to follow." The first Domain Expert rated both the GDSS and Face-to-Face groups products positively, with respective means of 3.43 and 3.20. The second Domain Expert indicated Disagreement with the statement for both, with means of 2.80 for the GDSS groups and 2.40 for the Face-to-Face Meeting groups.

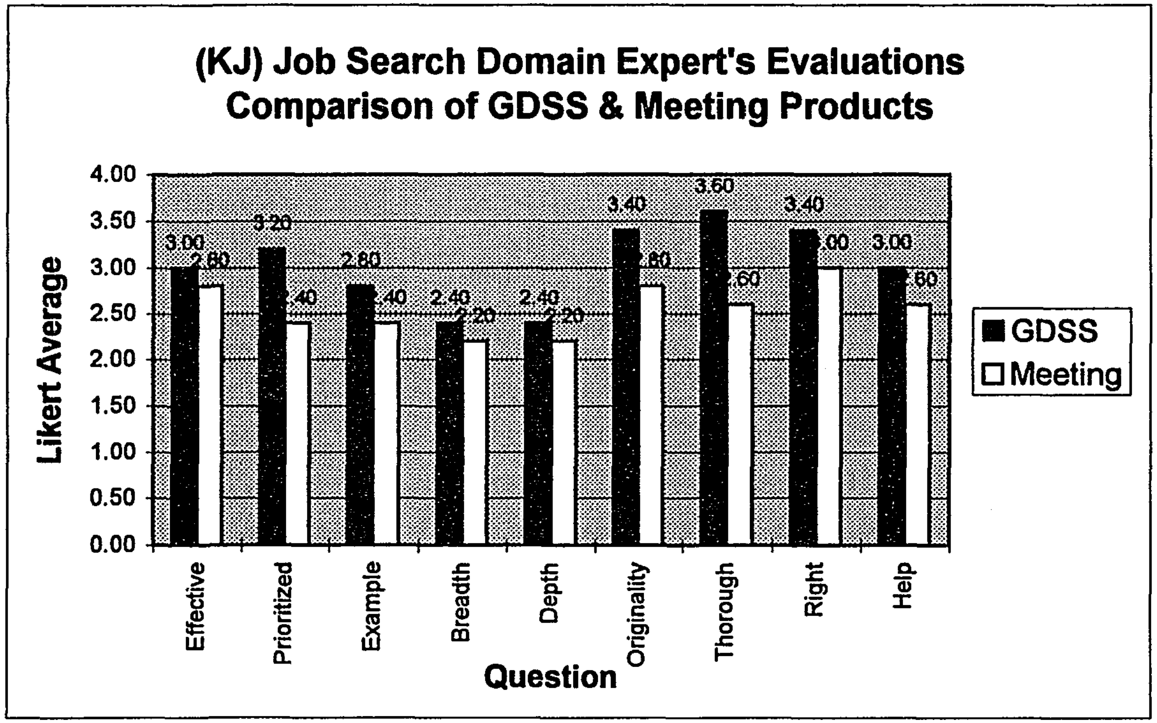
"The range of these ideas is exhaustive and complete, i.e., *provide breadth*." The means from the first Domain Expert were again positive, at 3.29 for the GDSS groups and 3.40 for the Face-to-Face Meeting groups. The means from the second

	Effective	Prioritized	Example	Breadth	Depth	Originality	Thorough	Right	Help
GDSS	4.07	3.86	3.43	3.29	3.67	4.07	3.71	3.71	3.86
Meeting	3.80	3.00	3.20	3.40	3.00	3.20	3.40	3.40	3.20



First Job Search DE's Evaluation
Comparison of GDSS Non-GDSS Means
Figure 101

	Effective	Prioritized	Example	Breadth	Depth	Originality	Thorough	Right	Help
GDSS	3.00	3.20	2.80	2.40	2.40	3.40	3.60	3.40	3.00
Meeting	2.80	2.40	2.40	2.20	2.20	2.80	2.60	3.00	2.60



Second Job Search DE's Evaluation
Comparison of GDSS Non-GDSS Means
Figure 102

Domain Expert again indicated slight Disagreement with the statement, at means of 2.40 and 2.20 respectively.

"These ideas provide sufficient detail and perspective, i.e. *depth*." On this category, the GDSS mean for the first expert was 3.67, and the mean for the Face-to-Face Groups 3.00. The means given by the second expert were only 2.40 for the GDSS groups, and 2.20 for the Face-to-Face groups.

"These ideas show *originality and diversity*." The mean assigned to the GDSS group by the first Domain Expert was 4.07; the mean for the Face-to-Face meeting groups a less positive 3.20. The second Domain Expert rated the GDSS groups at a mean of 3.40, and the Face-to-Face Meeting Groups at 2.80.

"These ideas are very *thorough*, i.e., exhaustive and complex." The means given by the first Domain Expert were 3.71 for the GDSS groups and 3.40 for the Face-to-Face groups. The second Domain Expert gave a mean of 3.60 to the GDSS groups, and of 2.60 for the Face-to-Face Meeting Groups.

"These ideas are the *right ideas*, i.e., exhaustive and complete." On this measure, the products of both the GDSS and the Face-to-Face meeting groups were rated positively. The first Domain Expert rated the GDSS groups at a mean of 3.71 and the Face-to-Face groups at 3.40. The second Domain Expert rated the GDSS groups at a mean of 3.40, and the Face-to-Face groups at 3.00.

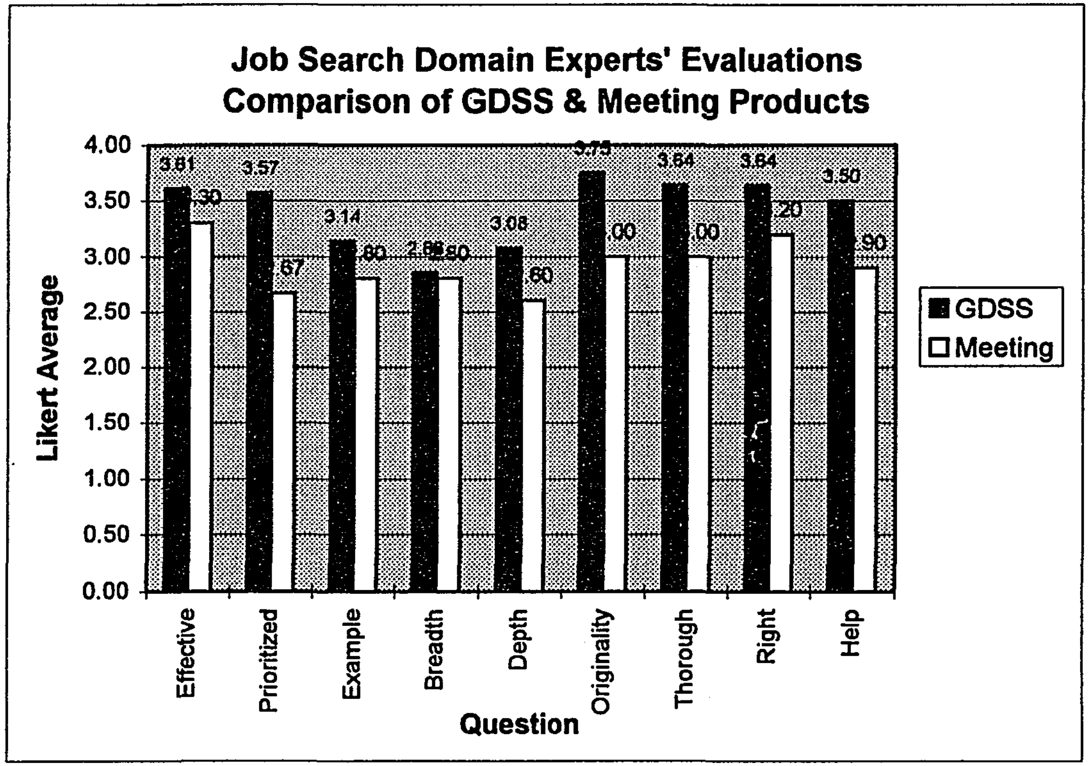
"The ideas in this group *help me*, as an authority in the field, by presenting new information, understanding or perspectives." The mean accorded to the GDSS groups by the first Domain Expert was 3.86; that for the Face-to-Face meeting groups was a

3.20. The means given by the second Domain Expert were 3.00 and 2.60, respectively.

The combined ratings of the two Domain Experts evaluating the Job Search problem for each of the criteria were uniformly in favor of the GDSS groups. Figure 103 shows the comparative ratings for each type of group meeting. The Domain Experts gave the GDSS products a mean of 3.61 for effectiveness, compared to a mean of 3.30 for the Face-to-Face groups' ideas. They rated the priority rankings from the GDSS groups at a mean of 3.57, in comparison to 2.67 for the Face-to-Face groups. As an example to follow, the work from the GDSS groups were rated at a mean of 3.14, in contrast to the 2.80 for the Face-to-Face groups. The Domain Experts gave a mean to the GDSS groups of 2.86 for breadth, and 3.08 for depth, in comparison to 2.80 and 2.60 for the Face-to-Face groups. In terms of originality, the mean given to the products of the GDSS groups was 3.75, and 3.00 for the Face-to-Face groups. The GDSS groups earned a mean of 3.64 for thoroughness, in comparison to the mean of 3.00 for the Face-to-Face groups. In evaluating whether the products contained the right ideas, the Domain Experts gave a mean of 3.64 to the GDSS groups, and 3.20 to the Face-to-Face groups. Finally, when asked if the groups' products contained ideas that could help them as Domain Experts, the means given for the GDSS groups was 3.50, and those for the Face-to-Face groups, 2.90.

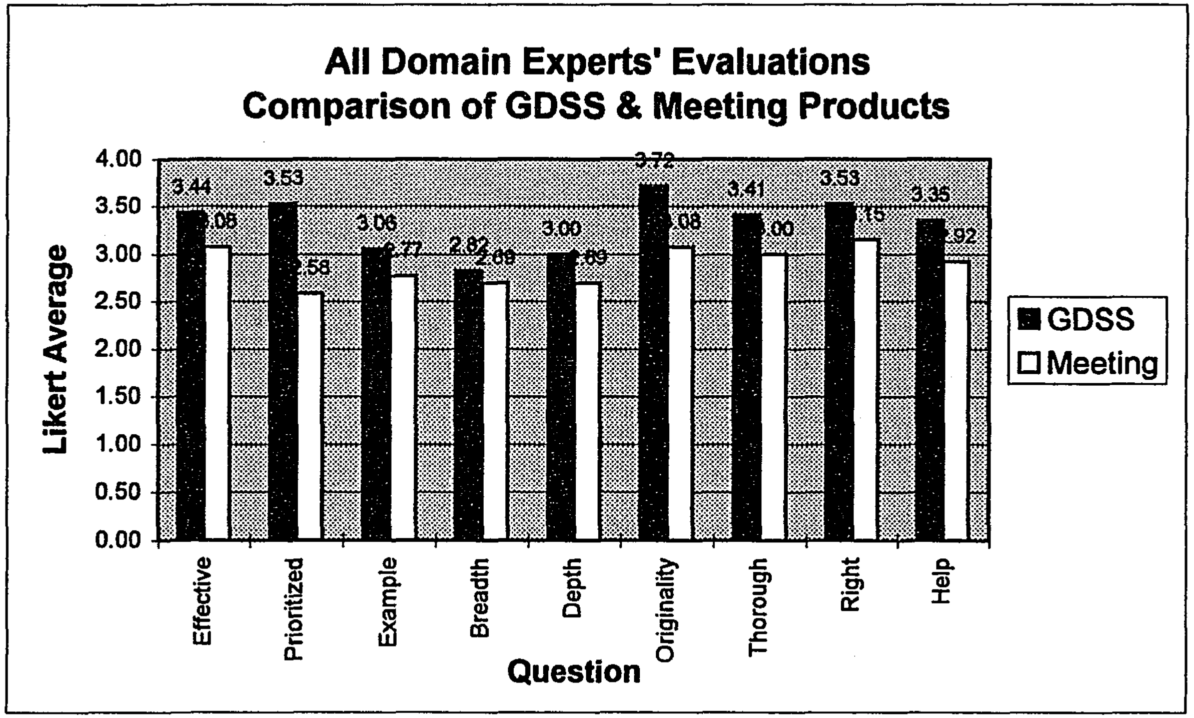
As a final measure of the quality of the respective GDSS and Face-to-Face groups, a mean was ascertained for all three Domain Experts, regardless of the problem. A graphical representation of the results are found in Figure 104. For all

	Effective	Prioritized	Example	Breadth	Depth	Originality	Thorough	Right	Help
GDSS	3.61	3.57	3.14	2.86	3.08	3.75	3.64	3.64	3.50
Meeting	3.30	2.67	2.80	2.80	2.60	3.00	3.00	3.20	2.90



Job Search DE's Evaluations
Comparison of GDSS Non-GDSS Means
Figure 103

	Effective	Prioritized	Example	Breadth	Depth	Originality	Thorough	Right	Help
GDSS	3.44	3.53	3.06	2.82	3.00	3.72	3.41	3.53	3.35
Meeting	3.08	2.58	2.77	2.69	2.69	3.08	3.00	3.15	2.92



All DE's Evaluations
Comparison of GDSS and Non-GDSS Means
Figure 104

criteria, the Domain Experts rated the GDSS products at a higher mean than those of the Face-to-Face groups. The highest ratings were for originality, at 3.72, for prioritizing and listing the right ideas, at 3.53, and for the effectiveness of the GDSS products, at a mean of 3.44. The lowest GDSS means were for breadth of ideas, at 2.82, depth of ideas, at 3.00, and providing a good example to follow, at 3.06. The highest Face-to-Face means were for the right ideas (3.15), and for effectiveness and originality (both at 3.08). The lowest Face-to-Face means were for prioritizing, at 2.58, and for breadth and depth, both at means of 2.69. The Domain Experts indicated that GDSS provided a higher quality product than did the Face-to-Face groups.

Extended Sessions

As part of this study, two groups of like subjects participated in two GDSS meetings, rather than one GDSS and one Face-to-Face meeting. The two GDSS sessions followed the same time-lines as those of the other groups, occurring several days apart. The groups worked with the same facilitator in the same GDSS environment each time. At their first meeting, the groups worked with the Safety and Security problem - at the second session, the task was Finding a Job in Their Field. In this manner, they followed the same order as all other groups. The difference was in two areas: first, the groups were more familiar with the setting, technology, and facilitator the second time; second, the facilitator introduced an additional GDSS tool, CommentCards, that allowed the groups to comment on one another's ideas without restraint.

When the data from the extended groups was analyzed, it became apparent that, due to attendance policies for one group, the same participants did not return for the second session. This invalidated its use as an extended group; therefore, the data from these two meetings were used as two single-session groups. Thus, in this section, the comparison is based on one extended group of seven participants, meeting twice.

Group Process Parametric Results

This section reports the number of ideas and degree of completion for each of the extended sessions. See Figure 105 for a comparison of data for the extended sessions. Note that since only one group is addressed at a time, no standard deviations are given.

Ideas Generated, Time Taken and Degree of Completion

The extended group generated 5.57 ideas per participant in its first (Safety) session, and a higher 6.43 per person in its second session (Finding a Job). In each session, the groups completed 100% of its agenda. It should be noted that the agenda was longer the second time, due to the addition of CommentCards (a GDSS tool), but the time allowed for each session was the same. Therefore, the extended group generated more ideas and completed a longer agenda the second time it met in the GDSS environment.

GDSS Extended Sessions
Session Parameters - Completion & Ideas Generated
Problems: Safety on Campus & Finding a Job in Your Field

				Idea Generation	
Group & Cluster	Type Session	Problem Type	Number of Participants	Total No. of Ideas	Number of Ideas/Participant
9A	GDSS	Safety	7	39	5.57
9AR	Extended GDSS	Job	7	45	6.43

		Phase Completion (Yes = Completion, No = Incomplete)				
Group & Cluster	Type Session	Brain Writing	Rating	Sub-Group	Compactor	Percent
9A	GDSS	YES	YES	YES	YES	100%
9AR	Extended GDSS	YES	YES	YES	YES	100%

Extended Sessions
Comparison of Idea Generation and Phase Completion
Figure 105

Responses to Exit Survey

After each session, the extended group participants also responded to exit surveys addressing the factors under study. The surveys were identical to those given to the one-shot groups, and were the same for each session. The purpose was to ascertain whether repeated exposure to the GDSS environment affected the participants' perceptions. In this section, responses to the questions from both sessions are reported and compared.

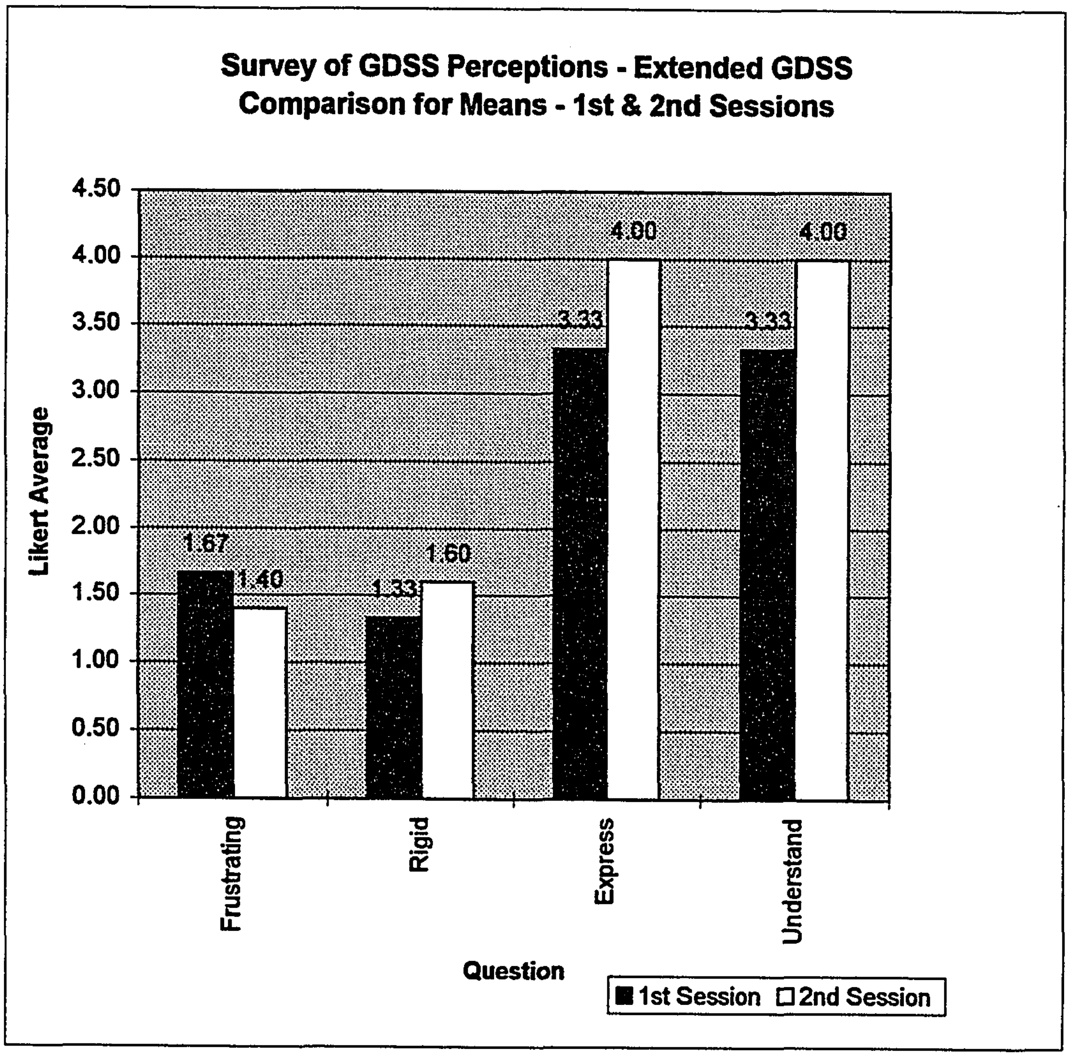
Perceptions of Group Decision Support Systems

As the majority of these participants were also unfamiliar with GDSS, and reported themselves as using personal computers only occasionally, the subjects were asked about their perceptions of the systems' ease of use in communication. The subjects responded to a series of statements, using a five point Likert-type scale. On this scale, 1 corresponded to Strongly Disagree, and 5 corresponded to Strongly Agree, with 3 indicating a Neutral attitude. In comparing the differences between sessions, it was thought most appropriate to report the data in means. The responses to four statements are described below, and are grouped graphically in Figure 106.

"Working with GDSS is often frustrating." The responses indicated Disagreement with this statement both times. After the first session, the mean response was 1.67, between Strongly Disagree and Disagree. The second response was a mean of 1.40, indicating even Stronger Disagreement.

GDSS PERCEPTIONS - Survey Means

	Frustrating	Rigid	Express	Understand
1st Session	1.67	1.33	3.33	3.33
2nd Session	1.40	1.60	4.00	4.00



Extended Sessions: Perceptions of GDSS
Comparison of 1st and 2nd Session Survey Means
Figure 106

"The GDSS is rigid and inflexible to use." The responses to this statement also indicated Disagreement after both sessions. The mean response after the first session was 1.33, again indicating Strong Disagreement. In the second session, the mean response was 1.60, indicating slightly lower Disagreement. This may be because the new tool used in the second session, CommentCards, is more difficult to use than the previously utilized GDSS tools.

"It is easy for me to express myself using GDSS." Responses to this statement indicated a degree of Agreement. The mean response was 3.33 after the first session, slightly above Neutral. Agreement rose to 4.00 after the second session.

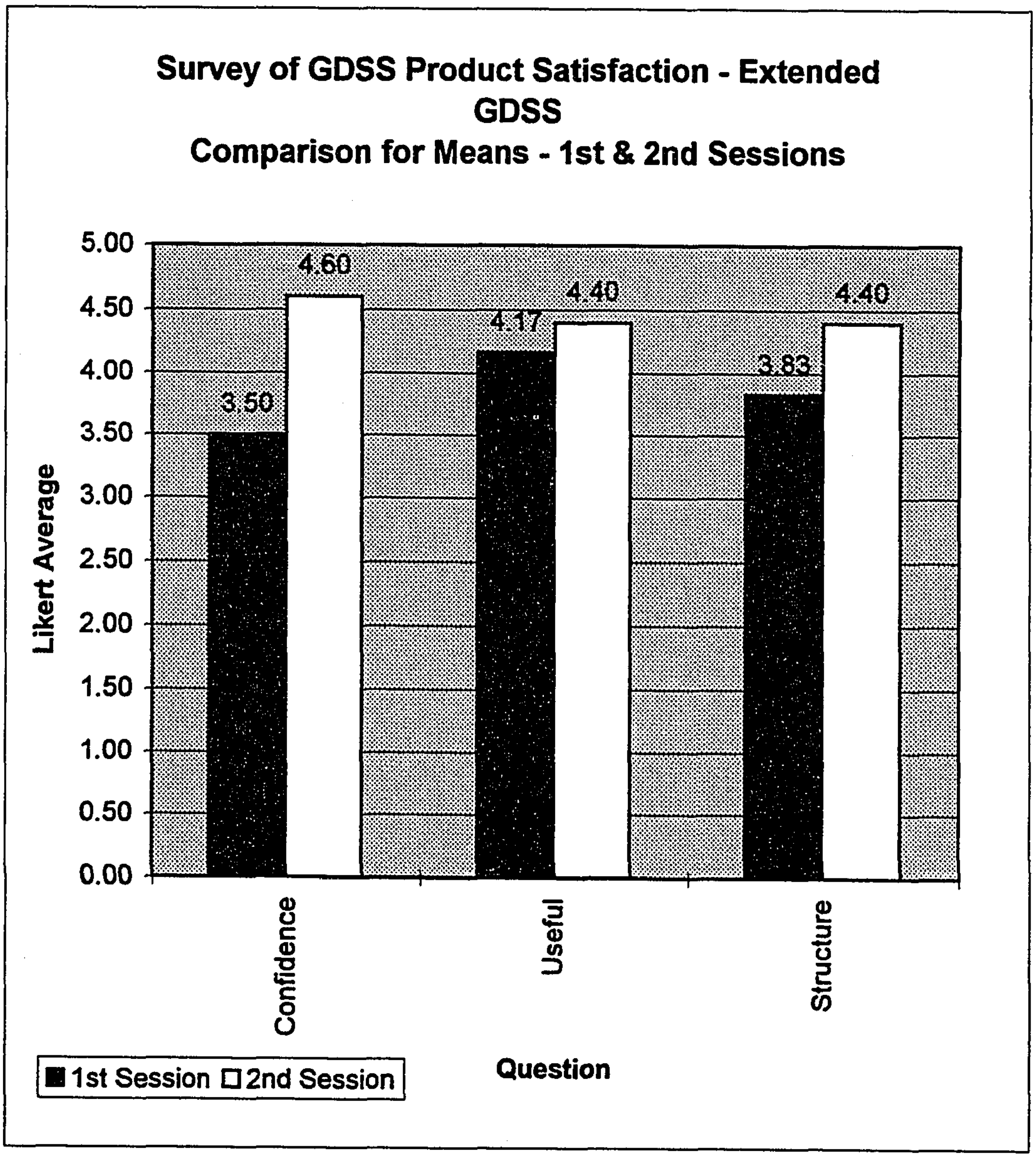
"It is easy to understand what others think using GDSS." Again, responses to this statement showed a positive change toward Agreement after the second session. The mean response for the first meeting was 3.33, and it rose to 4.00 the second time.

Satisfaction with Product

Participants were asked to respond to a series of statements designed to measure their satisfaction with their cluster's product. Three statements were offered. (Figure 107)

"I have confidence in our group's recommendations." Again, Agreement rose between the first and second GDSS session. The mean of Agreement after the first session was 3.50, showing slight Agreement. After the second session, the mean was 4.60, between Agree and Strongly Agree.

GDSS PRODUCT SATISFACTION - Survey Means	Confidence	Useful	Structure
1st Session	3.50	4.17	3.83
2nd Session	4.60	4.40	4.40



Extended Sessions: Product Satisfaction
Comparison of 1st and 2nd Session Survey Means
Figure 107

"I am sure our model will be useful for others to follow." The Agreement was high after both GDSS experiences, and rose slightly after the second session. The first mean was 4.17; the second rose to 4.40.

"Our rating, subgrouping and categorizing were thorough enough for good recommendations." Again, responses after the second session rose in a positive direction. The rating after the first experience was 3.83, indicating Agreement. The mean after the second session was 4.40, moving toward Strong Agreement.

Personal Satisfaction

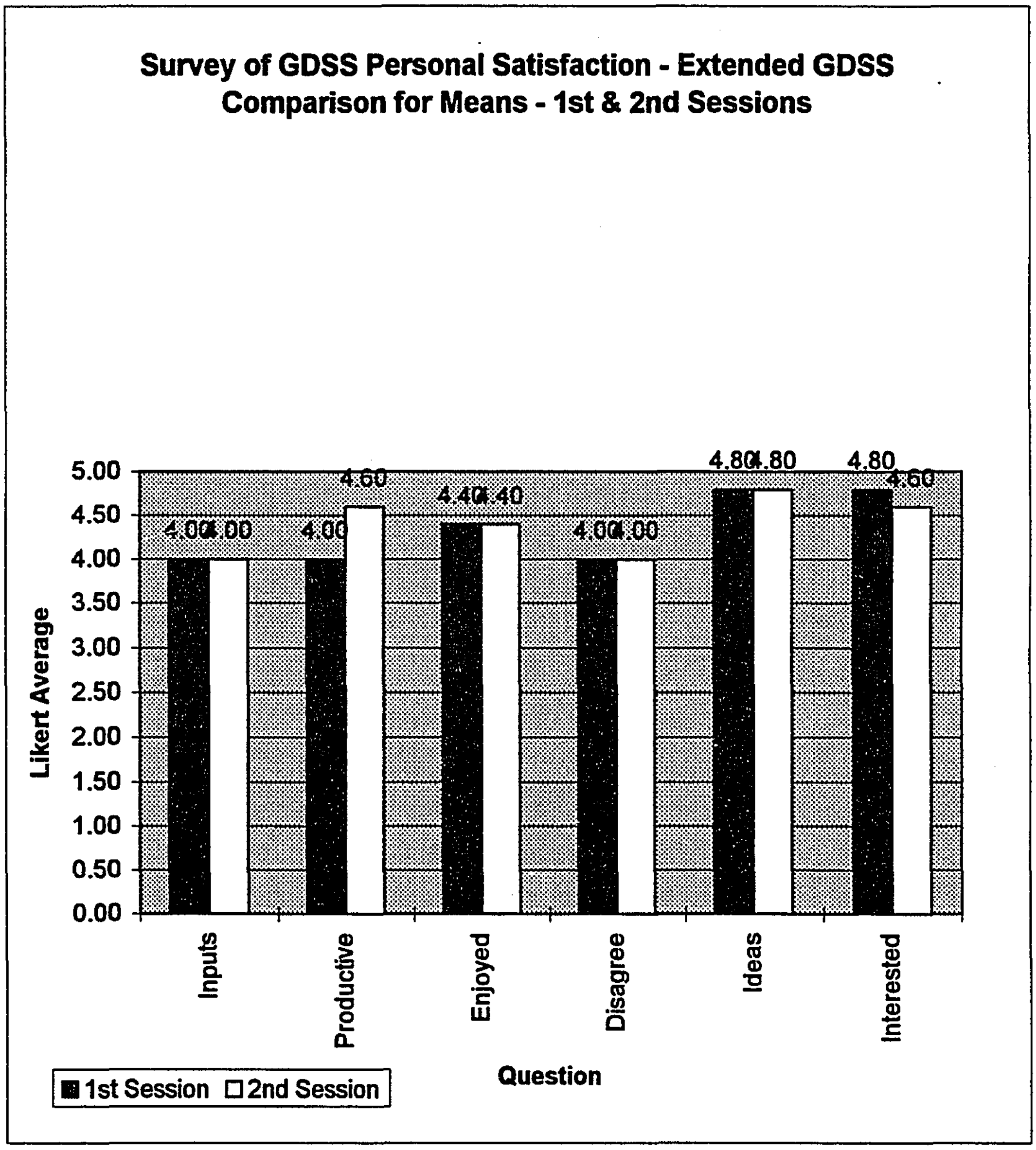
In order to measure the personal satisfaction that the participants derived from their respective GDSS experiences, the subjects were asked to respond to six different statements. Again, responses were elicited immediately after each session. Figure 108 graphs the changes in the response means.

"I feel that the final model reflects my inputs." Responses from the group indicated the same Agreement after both sessions. The mean Agreement was 4.00, showing no change after either session.

"I feel that my time in the group was productive." Responses to this statement indicated an obvious positive movement after the second session. Agreement was 4.00 in the first responses. After the second session, the mean rose to 4.60, indicating Strong Agreement.

GDSS PERSONAL SATISFACTION - Survey Means

	Inputs	Productive	Enjoyed	Disagree	Ideas	Interested
1st Session	4.00	4.00	4.40	4.00	4.80	4.80
2nd Session	4.00	4.60	4.40	4.00	4.80	4.60



Extended Sessions: Personal Satisfaction
Comparison of 1st and 2nd Session Survey Means
Figure 108

"I enjoyed working with this group." While the responses from the two surveys indicated high Agreement (4.40), there was again no change after the second session. This may be because the group makeup was essentially the same each time.

"I felt comfortable to disagree with other members' ideas." Again, the mean response after both GDSS sessions was positive, but there was no change after the second session. The mean response was 4.00 in each case.

"I freely offered my own ideas." The mean response after both sessions was very positive, indicating Strong Agreement. The mean response was 4.80 after the first session, and it remained the same after the second session.

"I remained interested and attentive to the group's activities." While again, Agreement was very high for each session, the mean Agreement declined after the second session. After the first session, the mean was 4.80, indicating Strong Agreement. After the second session, the rating declined slightly, to 4.60.

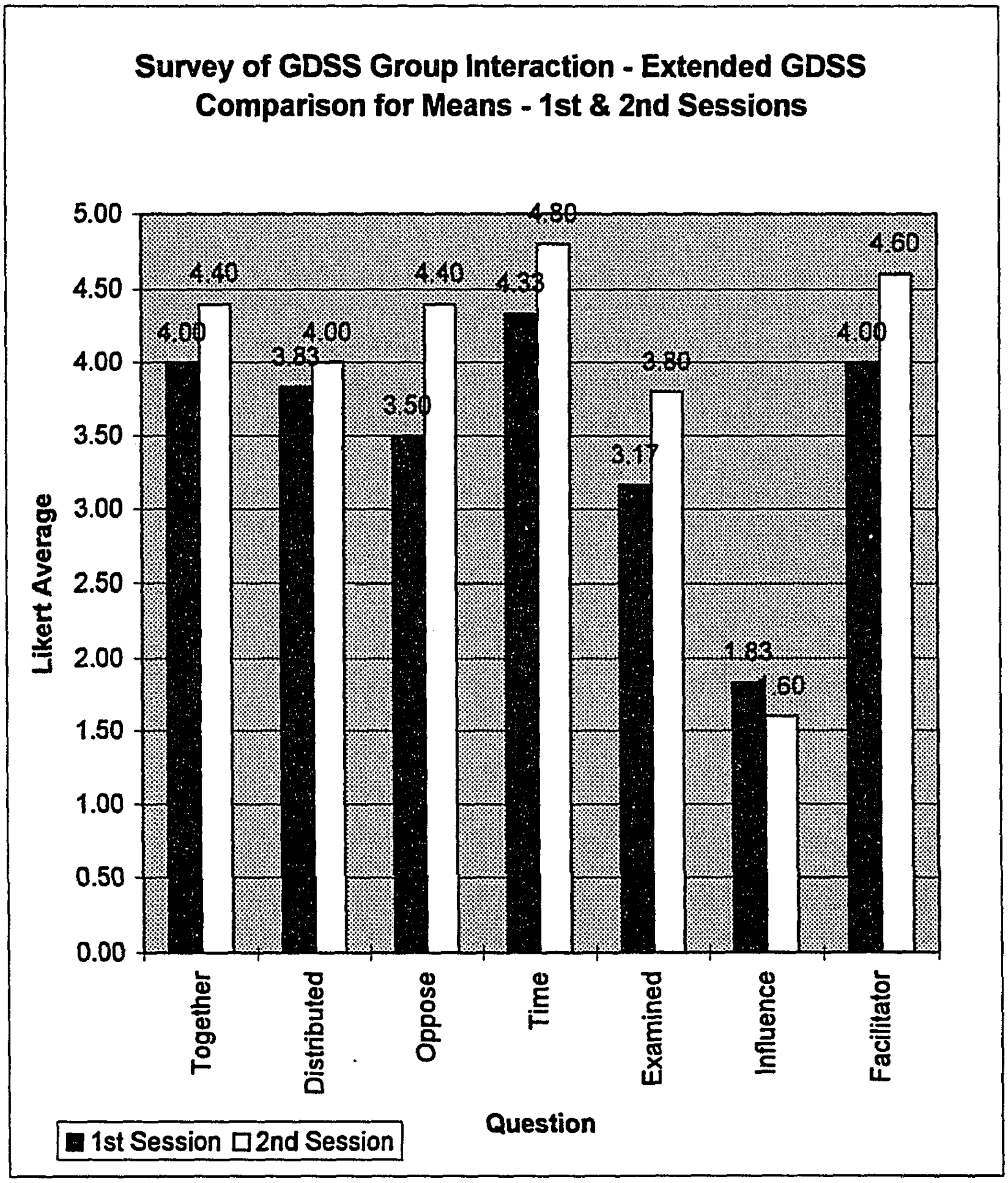
Perception of Group Interaction

Respondents were asked to comment on how their group worked together. Seven statements were offered for their reaction. It is interesting to note that, even though the group was the same each time, the subjects' perceptions of how they worked together was uniformly more positive after the second session.

"People worked together better than in most groups." Responses from the GDSS group indicated Agreement after the first session, with a mean of 4.00. Agreement rose after the second session, to a mean of 4.40. See Figure 109.

GDSS GROUP INTERACTION - Survey Means

	Together	Distributed	Oppose	Time	Examined	Influence	Facilitator
1st Session	4.00	3.83	3.50	4.33	3.17	1.83	4.00
2nd Session	4.40	4.00	4.40	4.80	3.80	1.60	4.60



Extended Sessions: Perception of Group Interaction
Comparison of 1st and 2nd Session Survey Means
Figure 109

"Participation in the activities was evenly distributed." There was a slight positive movement in the group responses between the first and second sessions. The first response was a mean of 3.83, indicating slight Agreement. The second mean was 4.00.

"Members were able to express opposing ideas." The group again showed a positive movement after the second session. While after the first session, the mean was 3.50, the positive perception rose to 4.40 after the second session.

"The group used its time wisely." The GDSS respondents felt that their group had used its time well after both sessions. The mean after the first group meeting was 4.33 indicating Strong Agreement. After the second group session, the mean was even higher, at 4.80.

"Ideas expressed in the group were critically examined." Again, there was positive movement in the responses of the group after the first and second session. A relatively Neutral mean of 3.17 was obtained after the first meeting; the mean rose to 3.80 after the second session, indicating Agreement.

"One or two members strongly influenced the group's decisions." Responses from the group indicated Disagreement with this statement, becoming stronger after the second session. The mean response was 1.83 after the first session, moving to a mean of 1.60 after the second meeting.

"The facilitator effectively guided the group toward its goal." The GDSS groups worked with a facilitator, or chauffeur, in following the GDSS agenda. The role of the facilitator was to clarify how the technology worked, assist in using the material, and operate the GDSS system. In each of the two extended meetings, the facilitator was the same. Interestingly, the group's perception of the effectiveness of the facilitator rose after the second session. The first mean was 4.00, indicating solid Agreement with the statement. After the second session, the mean rose to 4.60, indicating Strong Disagreement.

Professional Satisfaction

As student "experts", the subjects were asked to give their perceptions of their professional satisfaction after their group experiences. Four statements were offered for their reaction. See Figure 110.

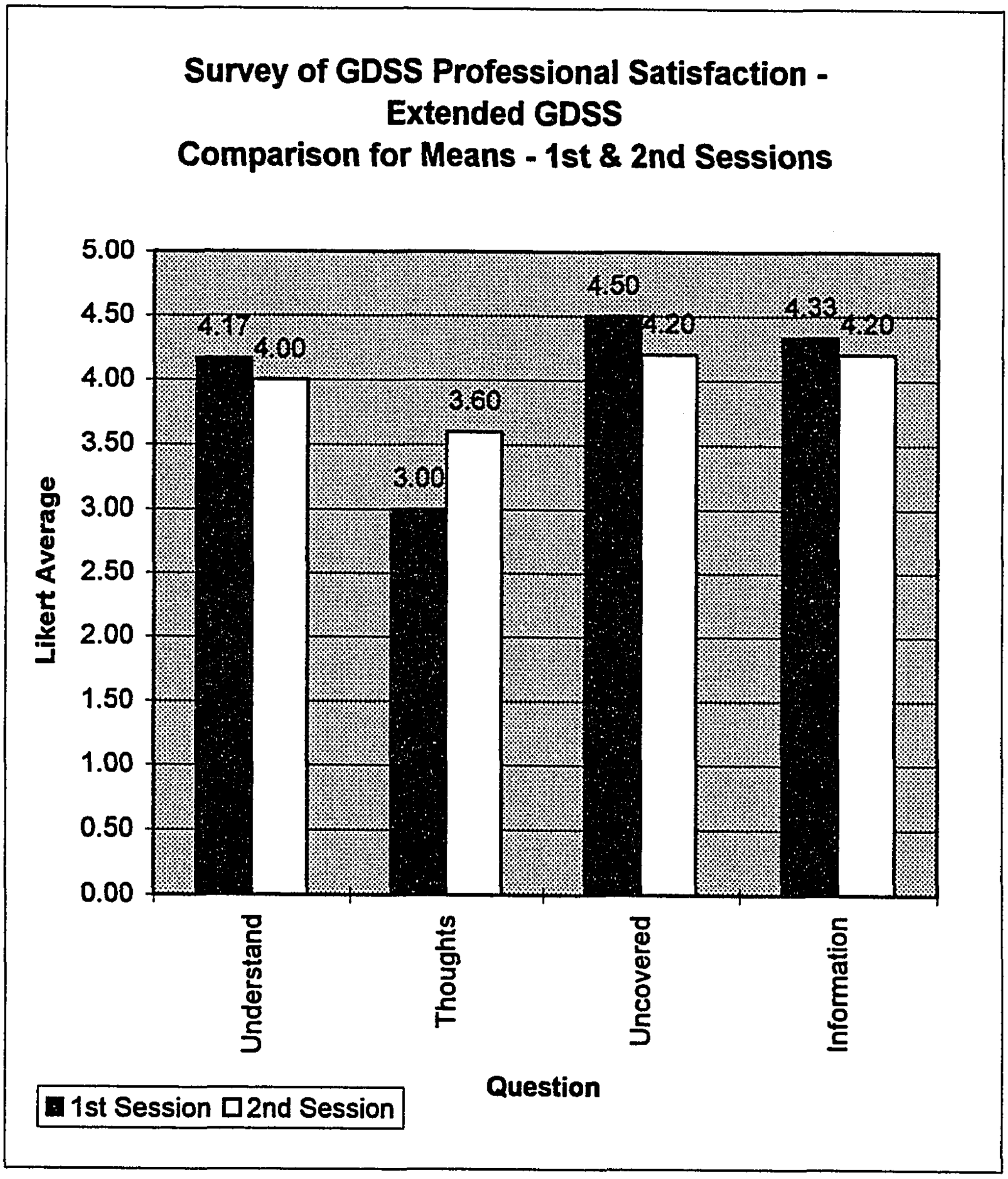
"I now have a much better understanding of how other members of my group view this issue." The GDSS respondents showed Agreement with this statement after both sessions; however, the degree of Agreement declined from 4.17 to 4.00 after the second session. It is possible that the phrasing of the statement, "I now have a much better understanding", affected the second set of responses. Since the group was unchanged, the understanding might not have improved after the second session.

"This meeting made me critically reevaluate my own thoughts on the topic." Responses to this statement indicated a rise in Agreement between the first and second session. The mean after the first session was a Neutral 3.00. After the second meeting, the mean rose to 3.60, indicating Agreement.

"The meeting uncovered ideas that I had not thought of individually." The group responded positively to this statement both times, with a slight decline between

GDSS PROFESSIONAL SATISFACTION - Survey Means

	Understand	Thoughts	Uncovered	Information
1st Session	4.17	3.00	4.50	4.33
2nd Session	4.00	3.60	4.20	4.20



Extended Sessions: Professional Satisfaction
Comparison of 1st and 2nd Session Survey Means
Figure 110

the first and second surveys. The mean after the first session was 4.50, and the second mean was 4.20.

"Members were able to provide enough information about their ideas." The group responses were again positive, and again showed a slight decline in the means after the second session. The mean from the first exit survey was 4.33, the second 4.20.

Future Commitment

One of the purposes for looking at the effect of repeated GDSS experiences was to see whether commitment to the product, group, or process was affected. The subjects were asked to respond to four evaluative statements. Figure 111 shows the grouped responses for this factor.

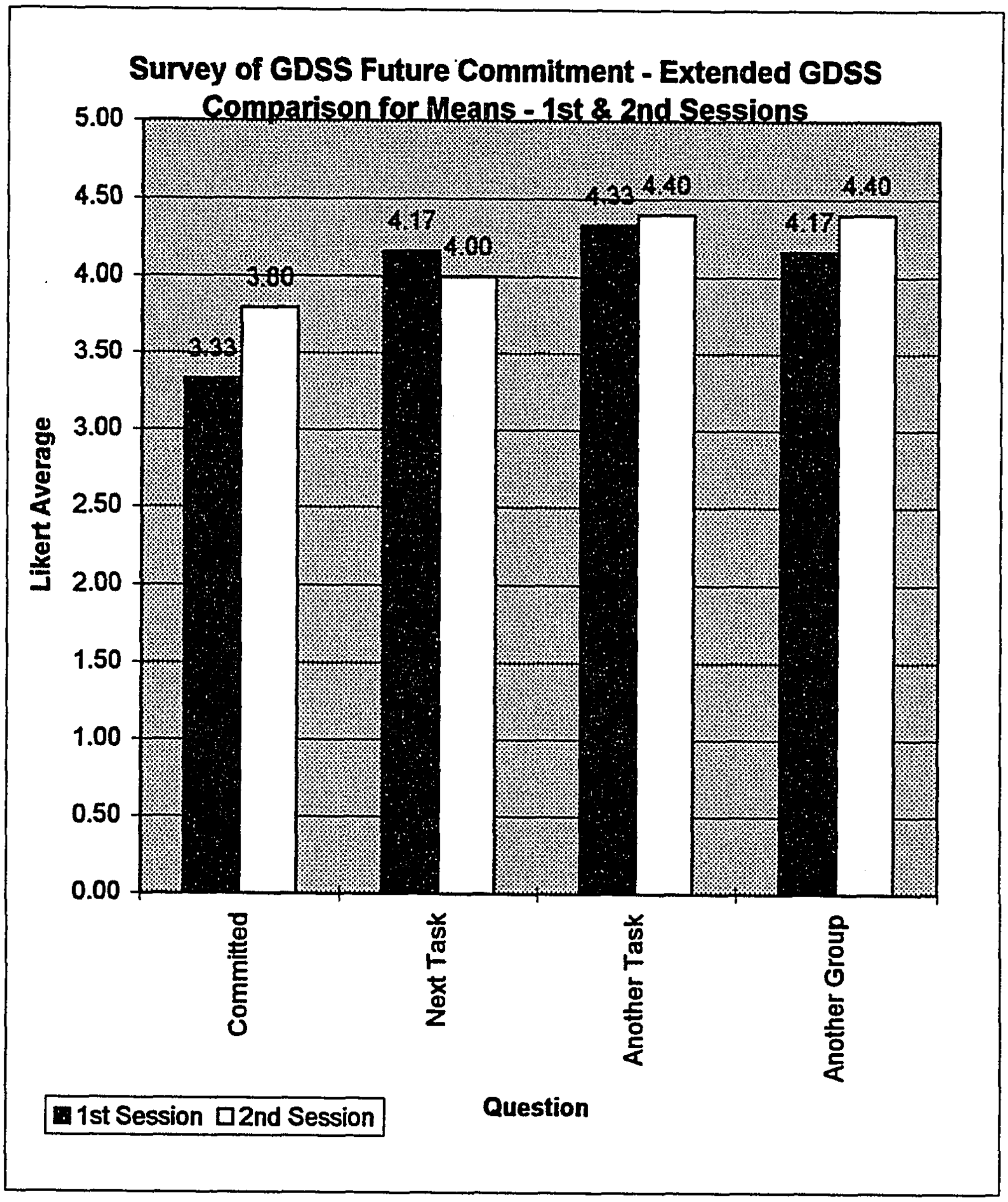
"I am committed to my group's model." Responses from the groups showed an obvious growth between the two sessions. The mean after the first session was a mildly positive 3.33. This mean rose to 3.80 after the second session.

"I would be willing to participate in the group's next task in developing this model." While the extended group Agreed with the statement after both sessions, there was no increase in commitment as measured by the two means. Rather, the means declined from 4.17 to 4.00.

"I would be willing to work with this group again on another task." The GDSS group's responses to this statement again were very positive. The mean for the first

GDSS FUTURE COMMITMENT - Survey Means

	Committed	Next Task	Another Task	Another Group
1st Session	3.33	4.17	4.33	4.17
2nd Session	3.80	4.00	4.40	4.40



Extended Sessions: Future Commitment
Comparison of 1st and 2nd Session Survey Means
Figure 111

survey was 4.33. After the second session, the mean response rose only slightly, to 4.40.

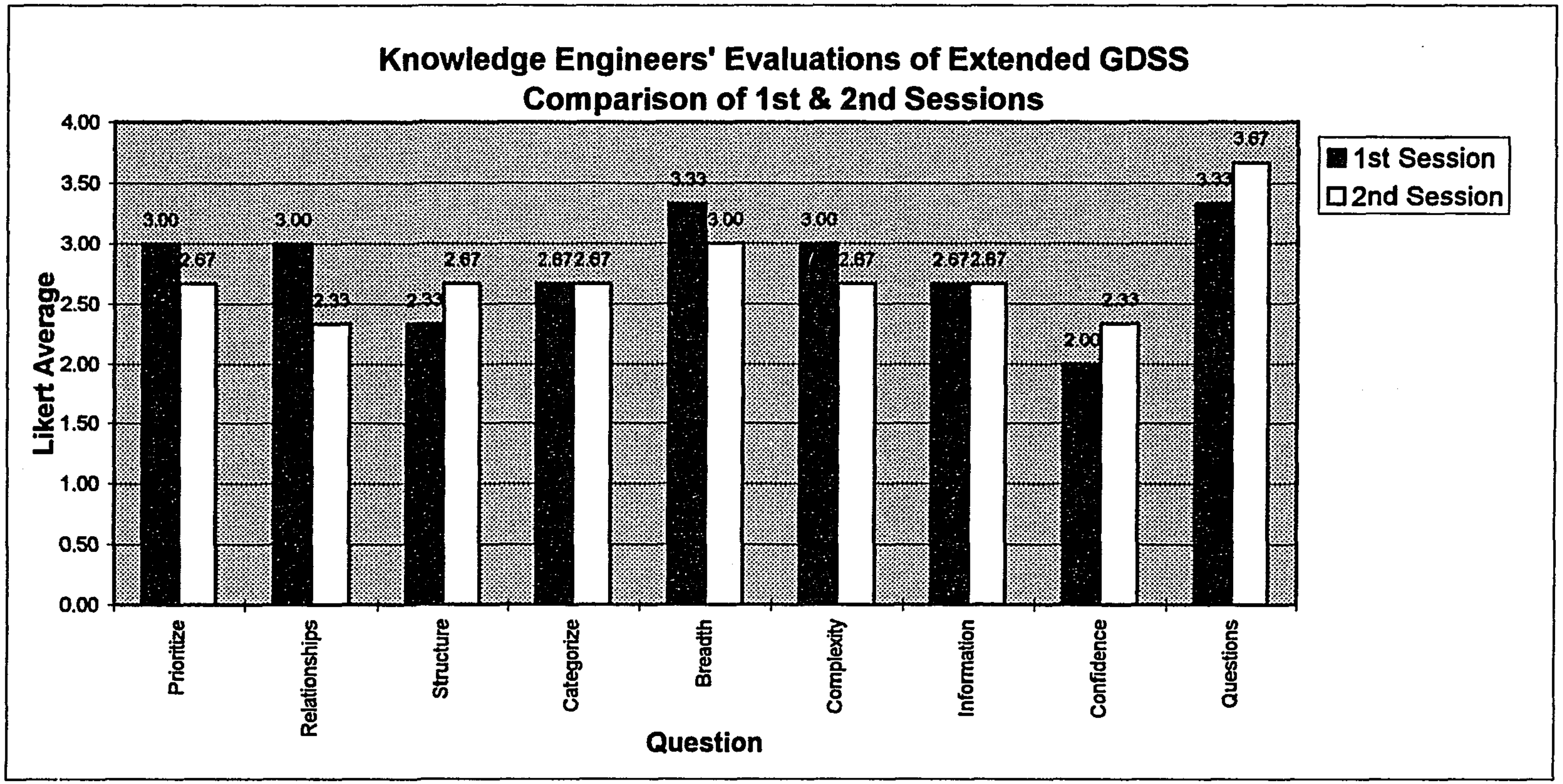
"I would be willing to work with another group of people to refine this expert system." The extended group indicated Agreement with this statement after the first session, with a mean response of 4.17. The Agreement rose after the second session, to 4.40.

Knowledge Engineers' Evaluation

The products of each session completed by the extended group were also evaluated by the Knowledge Engineers. The purpose was to ascertain if familiarity with GDSS affected the quality and usefulness of the products produced. The same specific evaluation criteria were chosen to reflect the normal requirements of Knowledge Engineers using the acquired knowledge for multiple experts. The Knowledge Engineers were asked to rank each product against the criteria in terms of usefulness in building expert systems. Their evaluations were compared for each criteria by session. The result of this comparison can be seen in Figure 112. Again, since there was only one group evaluated at a time, no standard deviations are provided.

There was no consistent pattern indicating that the second session produced more useful results than the first as far as the Knowledge Engineers were concerned. Second session results were rated more positively for three of the criteria - "Structures ideas into a basic organization", "Helps to formulate follow-up questions for pre-prototyping, and "Allows determination of realistic confidence factors". These moved

	Prioritize	Relationships	Structure	Categorize	Breadth	Complexity	Information	Confidence	Questions
1st Session	3.00	3.00	2.33	2.67	3.33	3.00	2.67	2.00	3.33
2nd Session	2.67	2.33	2.67	2.67	3.00	2.67	2.67	2.33	3.67



Extended Sessions: Knowledge Engineers' Evaluations
Comparison of 1st and 2nd Session Survey Means
Figure 112

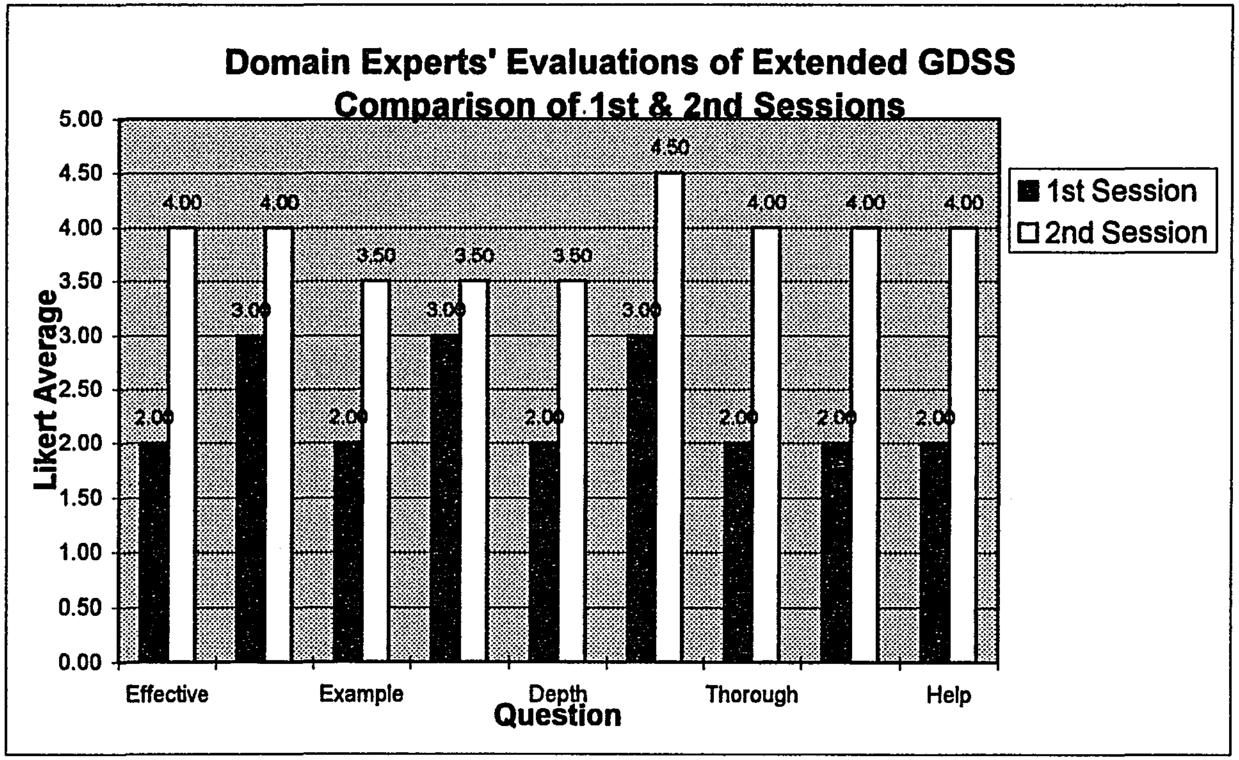
from means of 2.33 to 2.67, 3.33 to 3.67, and 2.00 to 2.33, respectively. There was no movement at all for two other of the criteria - "Provides necessary categorizing information" and "Provides sufficient information to construct a pre-prototype expert system." These were both rated at 2.67 for both sessions' products. The evaluations on the remaining criteria went down for the second session. "Helps prioritize by making the relative importance of ideas clear" went from a mean of 3.00 to 2.67. The evaluation means for "Provides a clear picture of the relationship of ideas" fell from 3.00 to 2.33. The usefulness of the products for "Provides breadth of data" and "Provides sufficient complexity and perspective to create required depth" also fell. The mean for breadth fell from 3.33 to 3.00; the means for complexity (depth) went from 3.00 to 2.67.

Domain Experts' Evaluation

To ascertain whether the products of the second session improved in quality or validity, the Domain Experts' evaluations for both sessions were also compared. This comparison produced a very consistent pattern of improvement. The Domain Experts' ratings for each session can be seen in Figure 113. Again, due to the limited number of evaluators, standard deviations are not meaningful and are not provided.

The first session addressed the problem of "Improving the Personal Safety and Security of Students at ODU", the second problem was "Landing a Job in Your Major Area of Study for After Graduation". Considerable improvement was noted between the first and second session for every criteria addressed. It should be noted that both

	Effective	Prioritized	Example	Breadth	Depth	Originality	Thorough	Right	Help
1st Session	2.00	3.00	2.00	3.00	2.00	3.00	2.00	2.00	2.00
2nd Session	4.00	4.00	3.50	3.50	3.50	4.50	4.00	4.00	4.00



Extended Sessions: Domain Experts' Evaluations
Comparison of 1st and 2nd Session Survey Means
Figure 113

the problem and the Domain Experts changed between sessions, and may have affected the evaluations discussed below.

"These ideas are *effective* in reaching the desired goal. The mean for the first session was 2.00, indicating Disagreement; the mean for the second moved to 4.00 - solid Agreement.

"These ideas are *well-prioritized*. Here, the means moved from a Neutral 3.00 to a positive 4.00, again indicating Agreement.

"These ideas together provide a *good example* to follow." The mean received for the product of the first session was 2.00 - again showing Disagreement. In evaluating the second product, the Domain Experts provided a positive mean of 3.50.

"The range of these ideas is exhaustive and complete, i.e., *provide breadth*." The mean rating for the first session was a Neutral 3.00; the mean for the second product moved to 3.50.

"These ideas provide sufficient detail and perspective, i.e. *depth*." The Domain Experts Disagreed with this statement for the first session product with a mean of 2.00. The mean for the second session was a much higher 3.50.

"These ideas show *originality and diversity*." The mean assigned to the first group product was 3.00, indicating a Neutral opinion; the mean for the second meeting product was 4.50, indicating Strong Agreement.

"These ideas are very *thorough*, i.e., exhaustive and complex." Again, there was a positive change between sessions against this criteria. The mean for the first session was 2.00; that for the second product 4.00.

"These ideas are the *right ideas*, i.e., exhaustive and complete." The ratings and movement against this criteria were identical to the above - means of 2.00 to 4.00, from Disagree to Agree.

"The ideas in this group *help me*, as an authority in the field, by presenting new information, understanding or perspectives." Again, the Domain Experts saw great improvement between the first and second session. The means moved from 2.00 to 4.00.

Results of Three-on-a-Station

An additional opportunity for exploration occurred during a planned single session with an otherwise unrelated MS/DS undergraduate class. While the session was intended to be a "one-shot" GDSS session, it became evident that the computer laboratory operating and VisionQuest systems were degrading, and two-thirds of the individual computer stations became inoperative. It seemed necessary to cancel the session, but at the suggestion of several of the disappointed students, it was decided to group participants, three to a terminal, at least to demonstrate how the GDSS software would normally work in building expert systems using multiple experts. It proved to be a fortuitous suggestion. The students quickly moved to form informal groups at each terminal, apparently joining others whom they already knew.

Despite the crowded setting, the GDSS facilitator followed the same script as those used in previous sessions. The problem was explained, the use of the software demonstrated, and the students invited to enter their ideas in the first step of the agenda, Brainwriting. At that point, it became evident that the students were not entering their thoughts on the terminals. Rather, they were talking among themselves. Observation revealed that the groups of three were brainstorming, discussing, evaluating, and weighing ideas. Some individuals were even taking notes. The students were animated, excited, and involved. Finally, after several minutes, the groups began to enter their ideas. They kept persisting until time was called.

It was noted that at this point, the ideas were entered in "clumps", five and six at a time. When the next tool was introduced, the pattern repeated itself. Again, the small groups conferred among themselves, discussing their ideas, before they began to use the GDSS tool. Each time a new tool was used, the group interacted before turning to the keyboard. Each time, students used all the time available.

When the session was over, the students were unusually vocal in their appreciative comments to the facilitator. Many stopped to express their excitement about the technology, and suggestions and wishes about how it could be used in other settings. They even asked if it would be possible to participate in another session. According to their regular instructor, they repeated their appreciation to him and to the students in the class who had not yet attended the GDSS sessions. Their enthusiasm was apparently contagious, because at the next session there was literally "standing room only", and the students entering commented on the positive reactions of their classmates. Unfortunately, the University support system continued to fail, and so many terminals became inoperative that this session concluded in lecture.

Since these sessions were outside the normal procedures and controls of the study, and since no comparison groups could be used, no formal quantitative data were collected. The facilitator did feel that the number of ideas per group and per participant was about average with all the other groups. This may have been because the small-group discussion eliminated some of the repetitive ideas seen in other groups. He noticed no off-task remarks, and that the ideas listed were of higher quality. The qualitative data gathered from facilitator observation, from participants' comments, and from the instructor's comments clearly speak to the increased enthusiasm and commitment generated by the groups' interactions among themselves.

Qualitative Data Analysis

Qualitative data were gathered from several sources, and form the basis for many of the findings and final hypotheses and conclusions of this study. The qualitative data were used for several purposes: to support findings already gathered quantitatively, to highlight and allow reflection on elements of the study that are not otherwise addressed, to provide evidence on purely qualitative factors, to provide findings and substantiate final conclusions not otherwise supported, to address fortuitous and unexpected events, and to provide data about factors affected by intervening variables. The qualitative data addressed below is an important component of this exploratory study.

Participants' Comments

In order to elicit additional and unrestricted perceptions from the student "expert" participants, they were asked to provide their thoughts about their experience through comments. Their thoughts gave further support to the findings of the qualitative analysis.

Participants were generally positive about the GDSS experience, its usefulness, and usability. Their comments included, "Enjoyed using the computer!!", "...I felt it could be very helpful because of its anonymous nature", "It's a good idea and easy to participate", "It is easy to see the applications of GDSS. It is very effective", "I hope to have the opportunity to work with GDSS in my future jobs", "Very good, helps you to put ideas without being influenced by others self evaluation in comparison with the group. Do not have to be coerced into group thinking pattern", "The face to face became boring. My mind began to drift a little," and "A good management tool."

The participants' comments also reflected some concerns. "Although it is more discrete to use GDSS, it didn't allow further discussion of each idea." "You lost the opportunity to argue with idiots about the meaning of the terms...so everyone had their own misguided view of these terms, which seriously affected their ability to critically rate the suggestions. Also, people are more willing to vote for their own stupid ideas, as no one is there to make them realize their idea sucks." "I feel it is too technical and takes away from ideas which may be presented in face-to-face meetings." "The face to face meeting allowed for comments and explanations. I am aware that the GDSS also allows for this, but we did not use that option and I feel this took away from the experience." "I am a lot more vocal than most people when I have ideas. Although the computer was very efficient, I felt as if I was rushed. I benefitted from both (experiences). For me individually, though, I like face to face because I have a tendency to be able to persuade others with my ideas."

While the demographic data reflected that most subjects felt comfortable with technology, and the survey responses indicated that the actual technology was not a problem in using GDSS, some of the comments do reflect some discomfort at using the new technology. Some participants did not feel that they had sufficient opportunities for interaction, or for critical evaluation. Most subjects felt that they were influential in groups, and the comments reflect their sense of loss of influence in an anonymous environment. The survey results are very clear in that GDSS limits the ability of one or two members to influence the group, and the comments of participants reflect this awareness.

The comments obtained from the Three-on-a-Terminal session were particularly striking. In many ways, they seemed much more thoughtful and in-depth. They were also very positive. The comments were as follows: "I think the GDSS allows people to brainstorm much more effectively. It allows people who otherwise would not contribute in a face to face meeting to freely express themselves thru (sic) GDSS. It also encourages more ideas." "This is my first experience with GDSS and I thought it was very interesting. I can see, just from this one session, how useful this tool can be in the real work world!!" "GDSS is great in that everyone is anonymous- so any idea can be given without concern of embarrassment. It seems very effective in exposing everyone's ideas without the chaos of talking over one another. I was able to look at each idea one at a time and give more thought to each." "GDSS is wonderful! I look forward in utilizing GDSS in my job!" "The system seems very flexible and effective in avoiding 'group think' caused by influence of superiors. Anonymity creates an atmosphere that is not intimidating and promotes free expression of ideas." "Allowing people to fully brainstorm, and have their ideas critiqued anonymously, allows for freer thought and less animosity. I think that this system allows people to be more attentive and interactive to answering questions and suggesting ideas. Being able to build on anothers (sic) without having to say it aloud as in face-to-face meetings may allow more people to add their thoughts that were provoked by anothers idea without anyone else thinking that they are being infringed on." "I really enjoyed being a part of our GDSS project. It is really exciting to see how people can socially interact through GDSS. It seems faster and more efficient than a normal group meeting (where people sit together and generate ideas through speech). I look forward to having a chance to use GDSS in my career."

While the majority of the Three-to-a-Terminal comments were only positive, and indicated a great deal of personal comfort with the process and product, thoughtful comments about potential problems and suggested improvement were also made. "My only concern is that the same users can influence a decision by inputting his views several times; and, therefore, make an impact on the average. If there could be a way to limit synonymous inputs from each user, this drawback could be avoided." "Does the Agenda have an area of MISCELLANEOUS IDEAS? For example, a manager had an idea at home that does not relate to anything currently listed. Perhaps can create a little more user friendly (for those computer illiterate). Example, mouse, touch screen to point to the actual topic then when needed they can use the keyboard."

Role of the Facilitators

It should be noted that there were three levels of facilitation among the clusters. The GDSS facilitator acted more in the role of "Chauffeur". In this role, he operated the mechanism that allowed the agenda to run, and gave directions on how to use the program, rather than on how to work with others in the group. His activities were often invisible to the participants, who only saw the result of the tool in the next activity. His interaction with the group was therefore limited to technology. In this role, however, he exerted a good deal of control on the pace and structure of the meeting. In controlling the environment, the task, the technology, and the pace, he imposed the greatest degree of structuration.

One of the Face-to-Face facilitators worked with only one subject group each time. He had the same tools and tasks as the others, but chose to work in a very directive role with the group. He interacted directly with each group member, and directed the structure and method of each task, even determining who would speak at what point. The group worked in a circle facing him, and he acted as recorder and group leader. In this instance, he imposed the second greatest degree of structuration. He controlled the group's method of interaction, their task and structure, and the type of technology used.

The other Face-to-Face facilitator followed the same script and attempted to meet the same time lines as the GDSS facilitator. Due to the size of the groups, however, she was forced to divide the group into two clusters that worked independently. This meant that each group was free to select a leader or recorder, to interact freely, and to decide on the way they would handle steps within the procedures. The facilitator explained the tasks, provided the materials, answered appropriate questions, monitored progress, and kept track of time. She controlled the agenda and the environment, but exercised the least amount of structuration.

Facilitators' Comments

Many of the facilitators' comments arose from the role they played. The GDSS facilitator noted that some individuals in his groups did not seem to be on task at all. In one session, an individual student read the sports pages throughout the introduction, and apparently during the activities as well. In another, two male students egged each other on to enter off-task comments, such as "I'm hungry. Let's go to lunch after this class". These off-task comments and suggestions were recorded, supporting his observation. The facilitator noted that this could be regarded as a positive sign, indicating experimentation with the software. During yet another session, a female student was apparently experimenting with the word processing package also found on the menu in the GDSS laboratory. The sound of her clicking could be heard throughout the introductory session. When activity began, and all students were entering, it became impossible to note whether the student was actively engaged with the agenda, or still using the word processing. The facilitator noted, however, that these individuals were in the minority. As the groups worked with the lists of ideas, the inappropriate ones "sank to the bottom", and were not part of the final considerations. The GDSS facilitator noted that the anonymity and spontaneity afforded by GDSS appeared to be a novelty to many of the subjects, and that it took a few moments for them to become completely involved. The facilitator also noted that once engaged, the participants stayed very much on task. He found them quick and compliant to follow directions.

The GDSS facilitator was particularly struck by the responsiveness and enthusiasm of the Three-on-a-Terminal group. As each terminal failed and the participant moved to join someone at a new terminal, there did not seem to be any delay in their interaction. Students began to work immediately. When the groups first began to respond to the agenda, there was a period when they merely spent time talking. Their heads were down, and they were not addressing the keyboard. He could not tell if they were on- or off-task. Since the planned process had already been compromised, he decided to let the groups proceed to see what would happen. When one person from each group began to enter ideas, he saw several ideas entered at a time. He noted that the subjects stood, waiting to talk to him, after the session was completed, with questions, compliments, and suggestions. This reaction was far more intense than those of the other GDSS groups.

The first, more directive non-GDSS facilitator had fewer observations about the individual group members. Acting as leader and "cheerleader", he was very positive about the responsiveness of his groups. As all worked together, all stayed on task and involved. The facilitator used a technique in which all subjects were required to contribute one idea at a time, in order. In this way, all members were required to participate. In the later phase, when open discussion of the best ideas was encouraged, he noted that some individuals were quite reserved, or tacit. He felt that, when they were forced to express an opinion, they were feeling pressure to go along with the majority view of the group.

This facilitator also noted that although he had a student timekeeper, and had designated the time he planned to spend on each phase, he was unable to complete the activities within the time allotted. He stated that his procedure was more time-consuming, and in retrospect, he did not believe he would organize the group meeting in the same way, since neither of his groups completed the entire agenda. He also commented on several occasions that the way he organized the voting activities, directing each person to vote on each item according to each criteria, turned out to be both time-consuming and tedious. It became very mechanical, and he felt that his groups lost their energy and enthusiasm during this phase.

This facilitator did feel that when open discussion was allowed, there were moments of rich interaction and debate. Comments dealt with the need to clarify and understand, and one group went back and regrouped their ideas. He noted that in one session, a single student began to dominate the discussion, leading the conversation in a direction that the facilitator felt was off-task and counter-productive. The facilitator noted that he did firmly re-direct the discussion at that point, again exercising a degree of direct control. He noted that it was difficult to bring the group back on task, and that the group "never recaptured the energy that was lost."

This facilitator also said that he was surprised by the seriousness with which the groups approached their task, and the earnestness of their attitude.

The second Face-to-Face facilitator noted that the effectiveness of the groups she worked with seemed to depend on who assumed leadership in the groups. In one or two instances, a strong and motivated group member stood up to record, and assumed the role of cheerleader, group leader, and summarizer. In others, no one assumed leadership at first, and the group was nonproductive until one or two members took the lead in offering suggestions. Since the groups were more independent, a wider variety of on-task and off-task activity was noted. One group finished very quickly because the recorder put down the first thing he heard, cutting off tentative discussion and argument. The most productive groups were those in which all members participated. The facilitator noted that the smaller the group, the less interaction was observed.

Domain Experts Comments

The Domain Experts were struck by several of the suggestions made by the groups. They evaluated the products blindly, and were not told which were GDSS and which were Face-to-Face. The results of their evaluations, however, were significantly more positive for the GDSS than the Face-to-Face groups. Their positive comments can, therefore, be seen to apply more to the GDSS than the Face-to-Face groups. The experts evaluating How to Find a Job in Your Field After Graduation were interested in the creativity of the products. They felt that the ideas were more innovative and daring than those usually espoused. According to one expert, "I was interested to see that the old 'stand-bys', including good grades and a polished resume were not necessarily the top suggestion or the number one priority anymore". The other expert noted a sophisticated recognition of the usefulness of contacts and networking over pursuing more staid approaches.

The Domain Experts also noted "marked differences between what students considered to be practical (to accomplish) and what they felt would actually work". The expert on Safety and Security was, in fact, somewhat dubious about the real practicality of some of the student "experts" suggestions. This may be due to the difference in perceptions between an experienced expert and student subjects, even those familiar with the problem. It may also be due to the difference in an expert referring to accepted practice and the less fettered and perhaps more effective ideas stemming from a new approach. The Domain Expert was also looking for a broader spectrum of ideas than the student experts provided - again, perhaps a difference in their perceptions of the nature of the problem occurred, based on experience.

Knowledge Engineers Comments

The Knowledge Engineers were solely interested in the usefulness of the products for building a pre-prototypical expert system. Their comments were directed to improvements that would help them in their jobs. All Knowledge Engineers were given the products from every single tool. They therefore had the total list of brainstormed ideas as well as the final, prioritized list of suggestions. Some of the comments concerned the preliminary data, rather than the final recommendations made by the groups. For example, one KE commented, "Data would be more useful if first grouped by category; for example, there were several "lighting items". Again, because all data were provided to them, another Knowledge Engineer commented, "Many responses are not serious and generally detract from an otherwise important effort". The same KE commented that "English Grammar needs to be cleaned up." Other comments provided insights into how a GDSS agenda could be improved for the use of the Knowledge Engineer. "A summary matrix showing each line item and scores for each evaluation would go a long way to improve usefulness of data." Interestingly, all comments were directed to the GDSS products.

Video-Tape Data

To preserve a record of the group meetings, and to give some insight into the nature of the communication among group members, the sessions were video-taped. In many cases, the value of the tapes was limited, in that they showed only the back of subjects' heads, and a view of the facilitator moving around. This was particularly true of the tapes of the GDSS sessions. Because the monitors hid the facial expressions and body language of the participants, the tapes did little to provide insights through nonverbal communication. The tapes confirmed the comments of the various facilitators. The videos of the GDSS sessions showed the facilitator primarily discussing the nature of the software, giving direction for its use, and calling time for each stage. Questions that were asked and answered dealt with the software, rather than the task. Because each participant was seated at an individual workstation, there was limited interaction among them, except through the GDSS network. In order to operate the GDSS agenda from the master terminal, the facilitator had to remain at the front of the GDSS lab, and his movement among the group was also limited. The atmosphere was very quiet, and somewhat formal. The videotape showed the back of the student "experts" heads, as they bent to their work.

In the session with the first, more directive Face-to-Face facilitator, the videotape showed a very different picture. The participants were seated in a circle facing the facilitator, who acted as leader and director. The agenda, task, rating criteria and potential categories were all posted on the blackboard. The facilitator stated the problem, and then asked each member to respond individually on paper, allowing some quiet time for this purpose. Then the facilitator required each member to give one idea in turn, moving around the circle as often as necessary until all ideas were out. He never had the group work together to decide on a common rating, but rather had each person rate each idea against each rating criteria individually. The total for each was the total of individual scores. The videotape showed that the facilitator did the majority of the talking, that all participants were focused and on task, and that each phase took some time to complete.

The videotape for the second Face-to-Face facilitator showed two groups, organized in circles in the opposite sides of the room. Each had an easel with the task problem printed. The facilitator gave the background and reason for the task, and then explained the agenda. Each group was then directed to select a recorder, and to begin the various agenda items. The tape showed the facilitator moving from group to group to observe, answer questions, and occasionally comment. Each group proceeded at very different paces. Some off-task body language was evident in the tape, but no single participant remained totally uninvolved for the whole session. The room was noisy, and some groups had to be reminded to stop their work, while others sat without activity for several seconds. The facilitator spoke between agenda items, and the groups then interacted independently.

Analysis of Findings By Factor

The above data allows for findings which support or reject the various predictions made prior to the beginning of the study. These findings are reported and analyzed in the following section.

Group Efficiency Factors

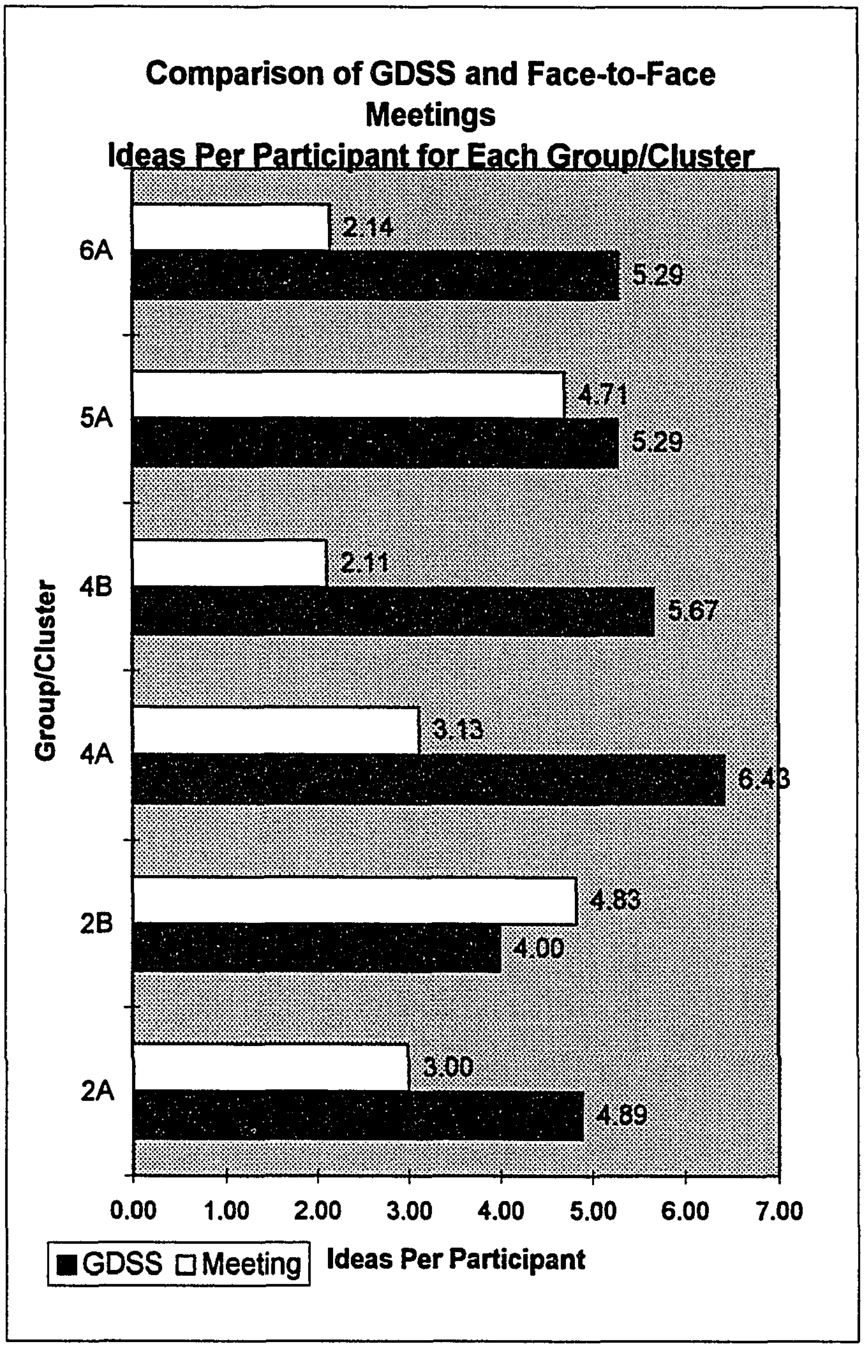
Variable 1, Number of ideas. It was anticipated that the GDSS groups would generate more ideas than the non-GDSS groups during the idea generation phase. A review of the results indicated that this did in fact happen. Figure 114 graphs the number of ideas, per person, for all comparison groups. In all but one instance (Group 2B), the GDSS groups clearly were more productive than the Face-to-Face groups in terms of idea generation.

Variable 2, Time needed for each stage. Based upon the findings of previous studies, it was anticipated that the GDSS group would take less time than the non-GDSS group for all stages. A review of the results from each group showed that this also occurred. As previously noted, only the GDSS groups completed all steps in the agendas each time. The difference in the completion rate was very obvious (see Figure 115). This was true even of the extended groups, which, as previously noted, included an additional tool in the agenda.

To evaluate the respective success of the GDSS and Face-to-Face Groups in meeting the group efficiency goals of idea generation and task completion, an Idea-Completion Factor was figured for each cluster and process. Figure 116 shows the comparative factors for each group. Dramatically significant differences can be noted. For all clusters, the GDSS groups showed far more success.

Group/Cluster Means

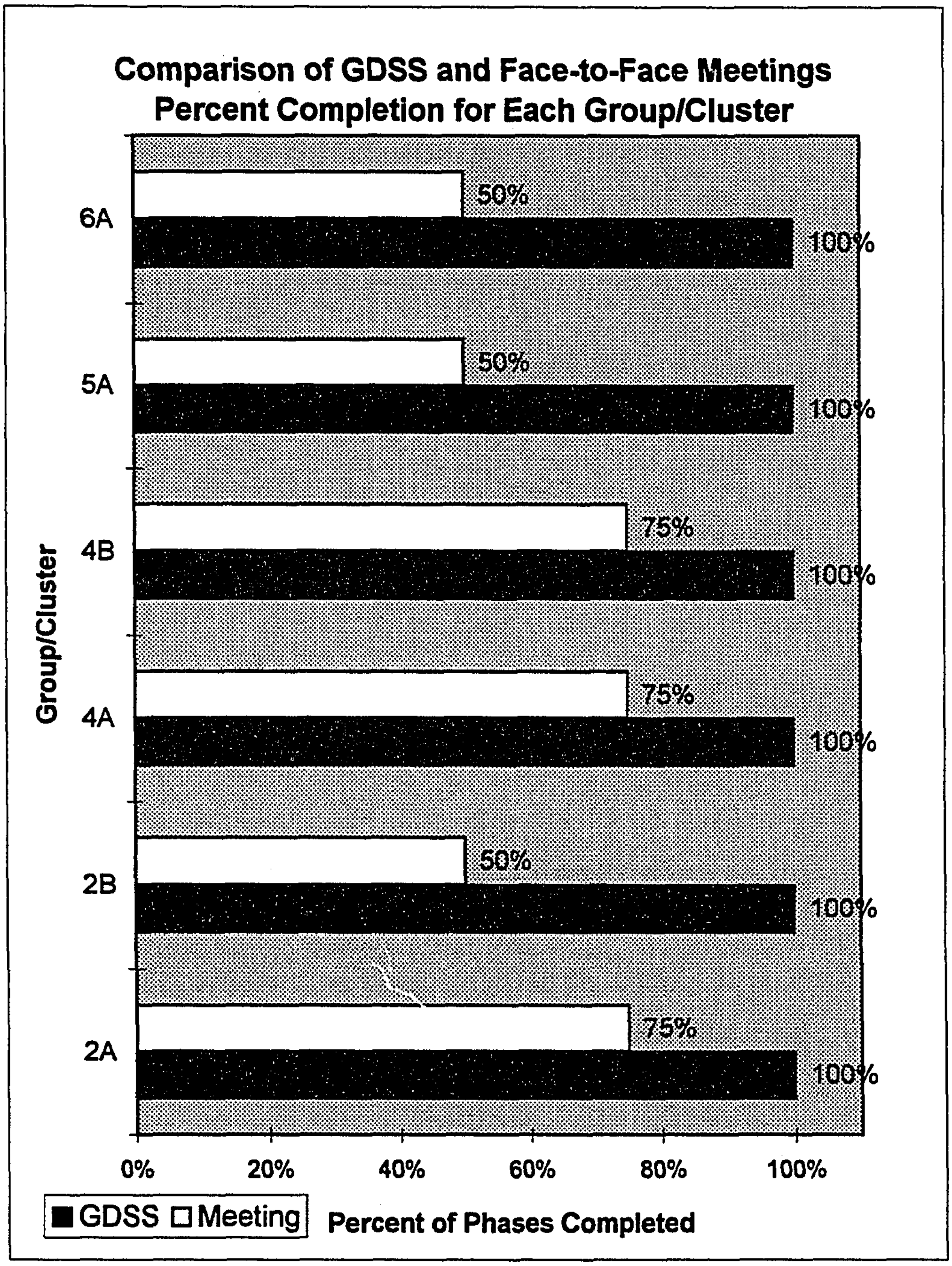
	2A	2B	4A	4B	5A	6A
GDSS	4.89	4.00	6.43	5.67	5.29	5.29
Meeting	3.00	4.83	3.13	2.11	4.71	2.14



Group Efficiency Factors: Ideas Per Participant
Comparison of Means
Figure 114

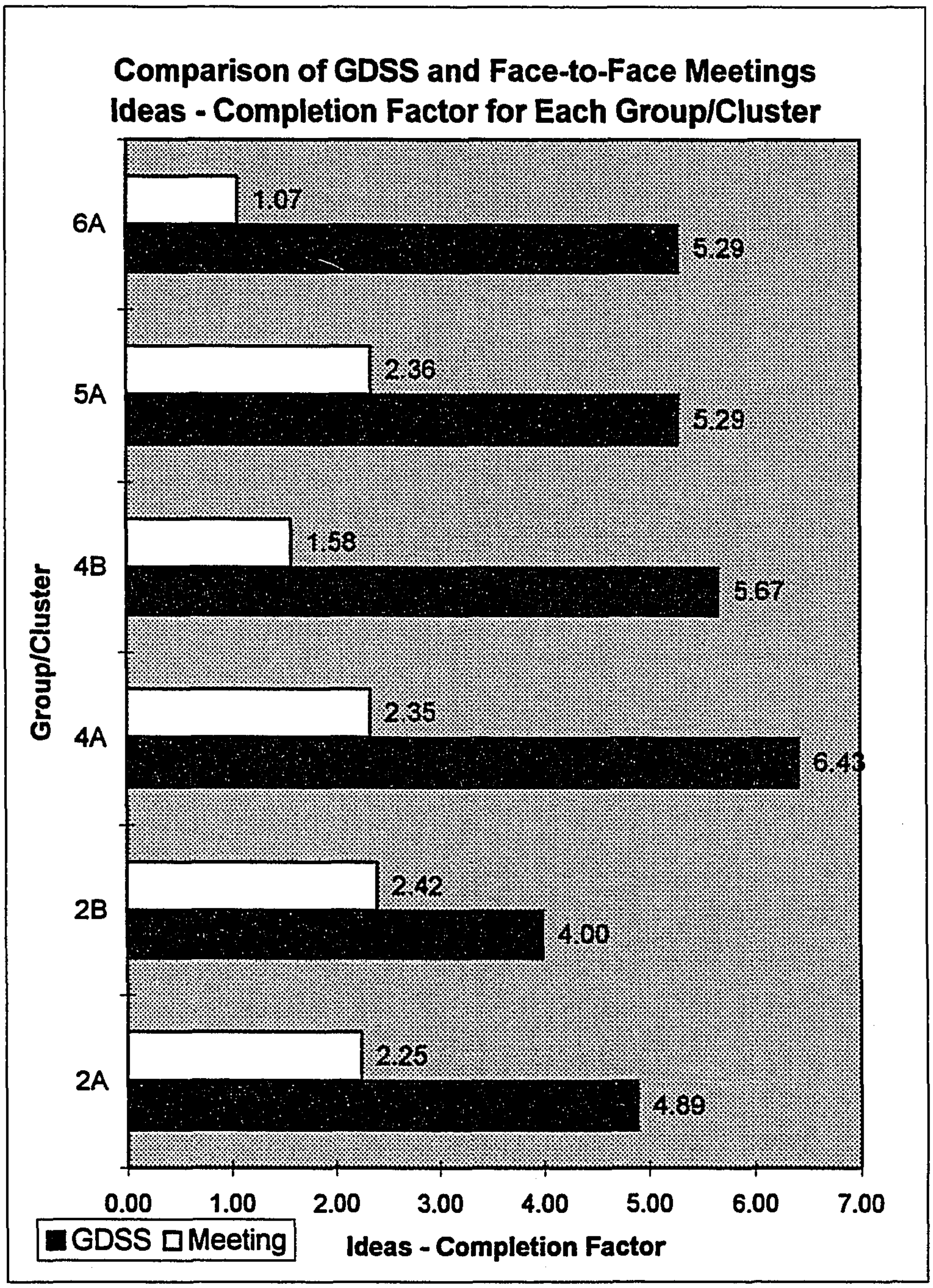
Group/Cluster Percentages

	2A	2B	4A	4B	5A	6A
GDSS	100%	100%	100%	100%	100%	100%
Meeting	75%	50%	75%	75%	50%	50%



Group Efficiency Factors: Percent Completion
Comparison of GDSS and Face-to-Face by Group
Figure 115

Ideas-Completion Factor	2A	2B	4A	4B	5A	6A
GDSS	4.89	4.00	6.43	5.67	5.29	5.29
Meeting	2.25	2.42	2.35	1.58	2.36	1.07



Group Efficiency Factors: Idea-Completion Factor
Comparison of Means
Figure 116

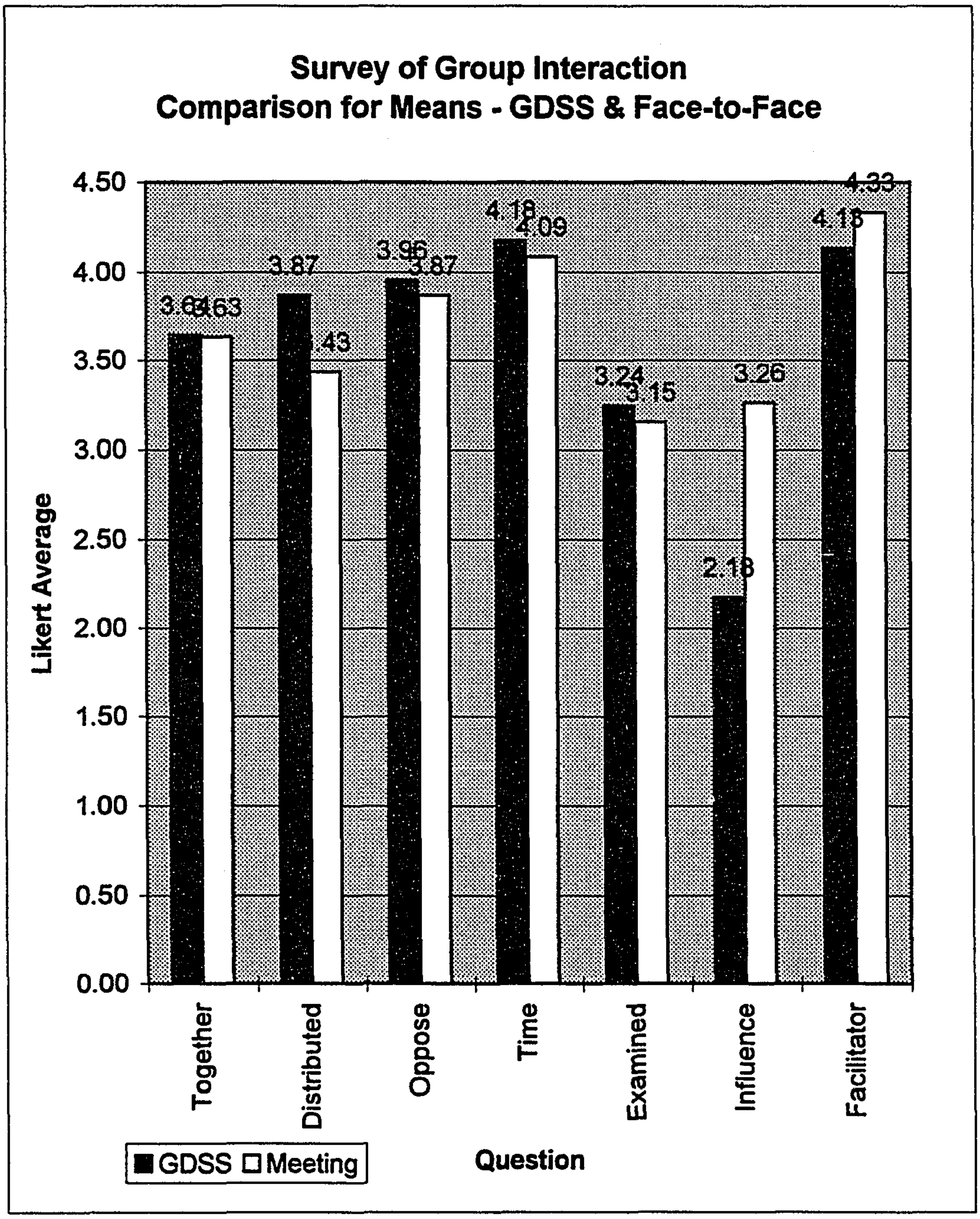
Group Process Factors

Variable 3, Nature of interactions of group members. It was anticipated that the nature of the interactions of the GDSS group would be more focused and on-task than those of the non-GDSS group. There were two types of measures for this Variable. First, the participants themselves commented on the way the groups worked, through exit and follow-up surveys. Secondly, the facilitators commented on what they saw in the groups they worked with.

Based on the subject responses, there was only a minor perception that the Face-to-Face groups were more focused or on task. Figure 117 graphs the data from the pertinent survey questions. There was no real difference between the group responses on whether the group worked better together than most groups, whether it was easier to offer opposing ideas in either type of groups, whether the groups used their time wisely, or whether the interaction in the groups caused members to examine their own ideas. The responses were generally favorable for both processes, with the responses from the GDSS groups being marginally more positive. The GDSS responses were clearly more positive for whether participation was more evenly distributed among members, and even more significant on whether one or two members dominated the group. The GDSS groups indicated Disagreement with that statement, the Face-to-Face groups positive Agreement. It should be noted that the Face-to-Face groups also felt that their facilitators had been more effective in assisting the group toward their goals. Overall, Figure 117 indicates a relatively insignificant difference between GDSS and the more positively rated Face-to-Face responses on Group Interaction. In looking

GROUP INTERACTION - Survey Means

	Together	Distributed	Oppose	Time	Examined	Influence	Facilitator
GDSS	3.64	3.87	3.96	4.18	3.24	2.18	4.13
Meeting	3.63	3.43	3.87	4.09	3.15	3.26	4.33



Group Process Factors: Group Interaction
Comparison of GDSS and Face-to-Face Survey Means
Figure 117

t the variation among responses, the greatest variability (standard deviation) was found among the Face-to-Face meeting responses to the statement "Participation was evenly distributed" (See Figure 117A).

Attitudinal Factors

Variable 4, Personal satisfaction. Based upon a more restricted level of human interaction, it was anticipated that there would be less personal satisfaction expressed by the GDSS group members than by those in the non-GDSS group. A comparison of results from the GDSS and Face-to-Face groups on the six survey questions evaluating personal satisfaction marginally supports this prediction (Figure 118). Only two of the pertinent questions evoked responses that were more positive for the GDSS group - subjects felt more free to disagree with opposing ideas, and also more free to offer their own ideas using GDSS. All of the responses to the other questions were slightly more positive for the Face-to-Face groups, and the overall means for personal satisfaction were almost identical for both types of groups. The greatest variability as measured by standard deviation was noted in the GDSS responses to "I enjoyed working with this group (see Figure 118A)."

Variable 5, Professional satisfaction. It was anticipated that the GDSS group would be more willing to repeat the experience than would the group working without GDSS, based on their satisfaction with their experience on a professional level. The survey questions that addressed professional satisfaction and future commitment did not support this prediction (Figure 119). Out of the four professional satisfaction

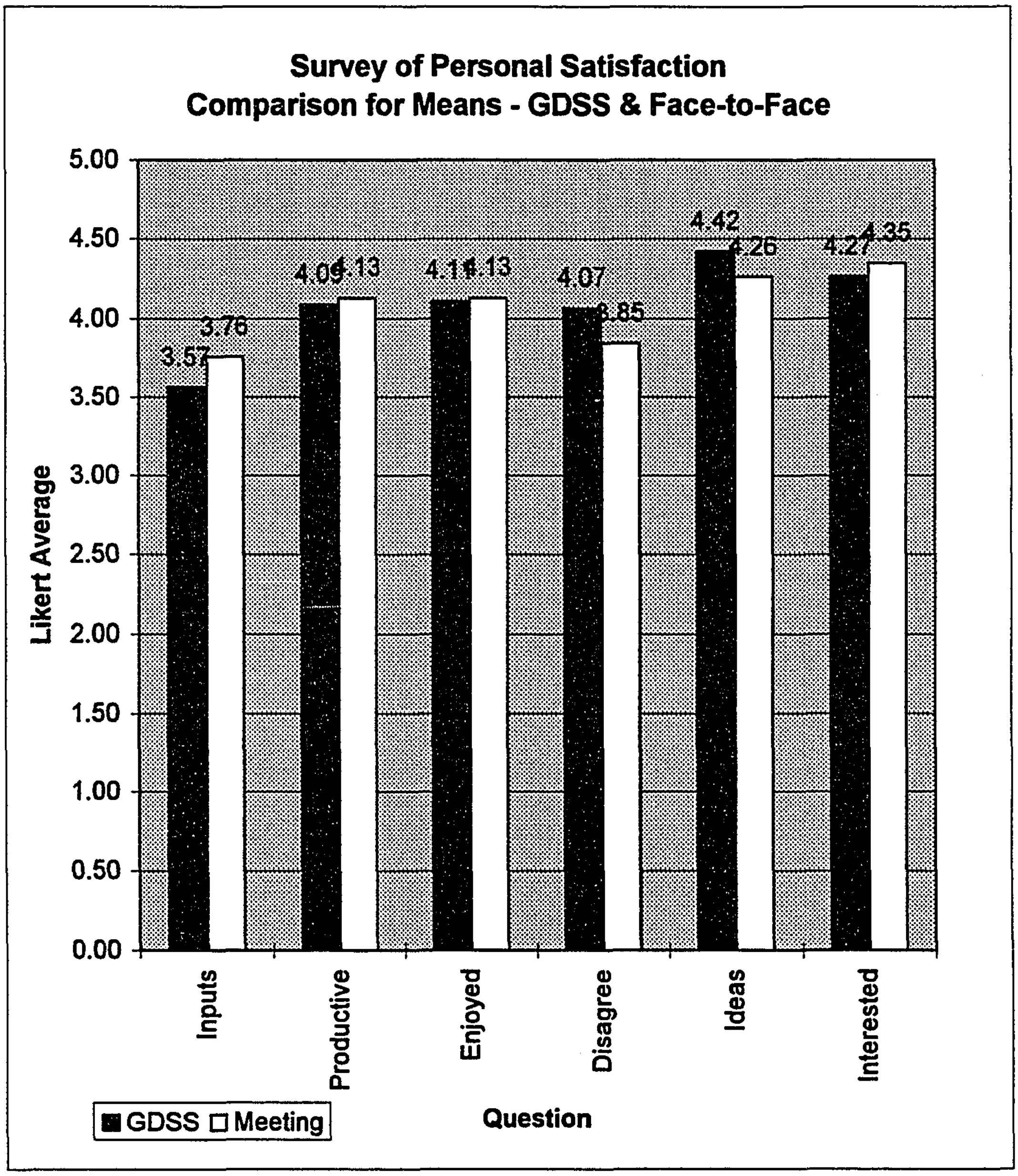
Descriptive Statistics - Perception of Group Interaction
Comparison of GDSS and Face-to-Face Sessions
Excludes Pilot and Extended Groups

	Meeting		GDSS		Difference of Means	
	Mean	Std Dev	Mean	Std Dev	GDSS - Meeting	Higher Mean
People worked together better than in most groups	3.630	0.853	3.644	0.883	0.01	GDSS
Participation in the activities was evenly distributed	3.435	1.241	3.867	0.894	0.43	GDSS
Members were able to express opposing ideas	3.870	0.957	3.956	0.952	0.09	GDSS
The group used its time wisely	4.087	1.050	4.178	0.806	0.09	GDSS
Ideas expressed in the group were critically examined	3.152	1.074	3.244	0.883	0.09	GDSS
One or two members strongly influenced the group's decisions	3.261	0.999	2.178	0.984	-1.08	Lower Mean: GDSS
The facilitator effectively guided the group toward its goal	4.333	0.826	4.133	1.036	-0.20	Meeting
Average of Means	3.681		3.600			
Average of Standard Deviations		1.000		0.920		
Sum of Differences					-0.57	Meeting

Figure 117A

PERSONAL SATISFACTION - Survey Means

	Inputs	Productive	Enjoyed	Disagree	Ideas	Interested
GDSS	3.57	4.09	4.11	4.07	4.42	4.27
Meeting	3.76	4.13	4.13	3.85	4.26	4.35



Attitudinal Factors: Personal Satisfaction
Comparison of GDSS and Face-to-Face Survey Means
Figure 118

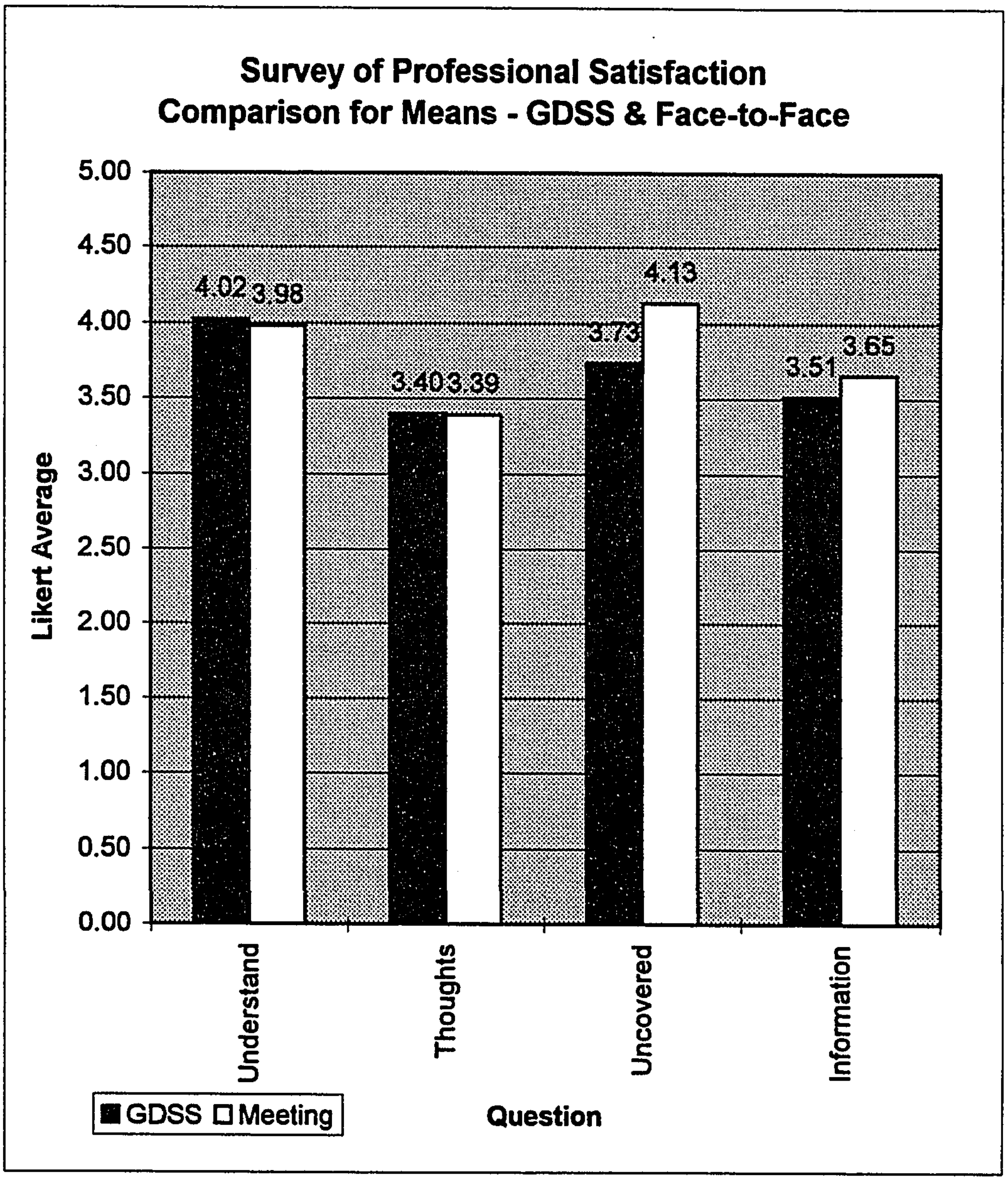
Descriptive Statistics - Personal Satisfaction
Comparison of GDSS and Face-to-Face Sessions
Excludes Pilot and Extended Groups

	Meeting		GDSS		Difference of Means	
	Mean	Std Dev	Mean	Std Dev	GDSS - Meeting	Higher Mean
I feel that the final model reflects my inputs	3.761	0.993	3.568	0.873	-0.19	Meeting
I feel that my time in the group was productive	4.130	0.718	4.089	0.848	-0.04	Meeting
I enjoyed working with this group	4.130	0.653	4.111	0.910	-0.02	Meeting
I felt comfortable to disagree with other members'	3.848	0.918	4.067	0.889	0.22	GDSS
I freely offered my own ideas	4.261	0.648	4.422	0.783	0.16	GDSS
I remained interested and attentive to the group's activities	4.348	0.737	4.267	0.654	-0.08	Meeting
Average of Means	4.080		4.09			
Average of Standard Deviations		0.778		0.83		
Sum of Differences					0.05	GDSS

Figure 118A

PROFESSIONAL SATISFACTION - Survey Means

	Understand	Thoughts	Uncovered	Information
GDSS	4.02	3.40	3.73	3.51
Meeting	3.98	3.39	4.13	3.65



Attitudinal Factors: Professional Satisfaction
Comparison of GDSS and Face-to-Face Survey Means
Figure 119

questions, two clearly showed a more positive response after the Face-to-Face experience. Participants felt that the traditional group meeting was more productive in helping them come up with new ideas, and in providing enough information about members' ideas. The responses of the GDSS groups were again almost identical to those of the Face-to-Face groups on gaining a better understanding of how others view the problems, and superior on uncovering ideas they had not thought of individually. Overall, responses for professional satisfaction were slightly higher for the Face-to-Face groups. The greatest variability as measured by standard deviation was from the GDSS response to "Members were able to provide enough information about their ideas (Figure 119A)." The same held true for the questions evaluating future commitment. The GDSS responses were marginally more positive for working with the same group on another task and for working with a different group on the same task; the Face-to-Face responses marginally stronger on commitment to the group's model and to working with the same group further on the model. As Figure 120 shows, there is no difference in the overall responses between the two groups in terms of future commitment. There was also no major difference in variability among responses in this category between the treatment and control groups (Figure 120A).

Product Quality Factors

Variable 6, Satisfaction with the product. It was anticipated that the GDSS group would feel more strongly that the final product reflects their thinking, and that there would be a greater feeling of ownership of the results than with the non-GDSS group.

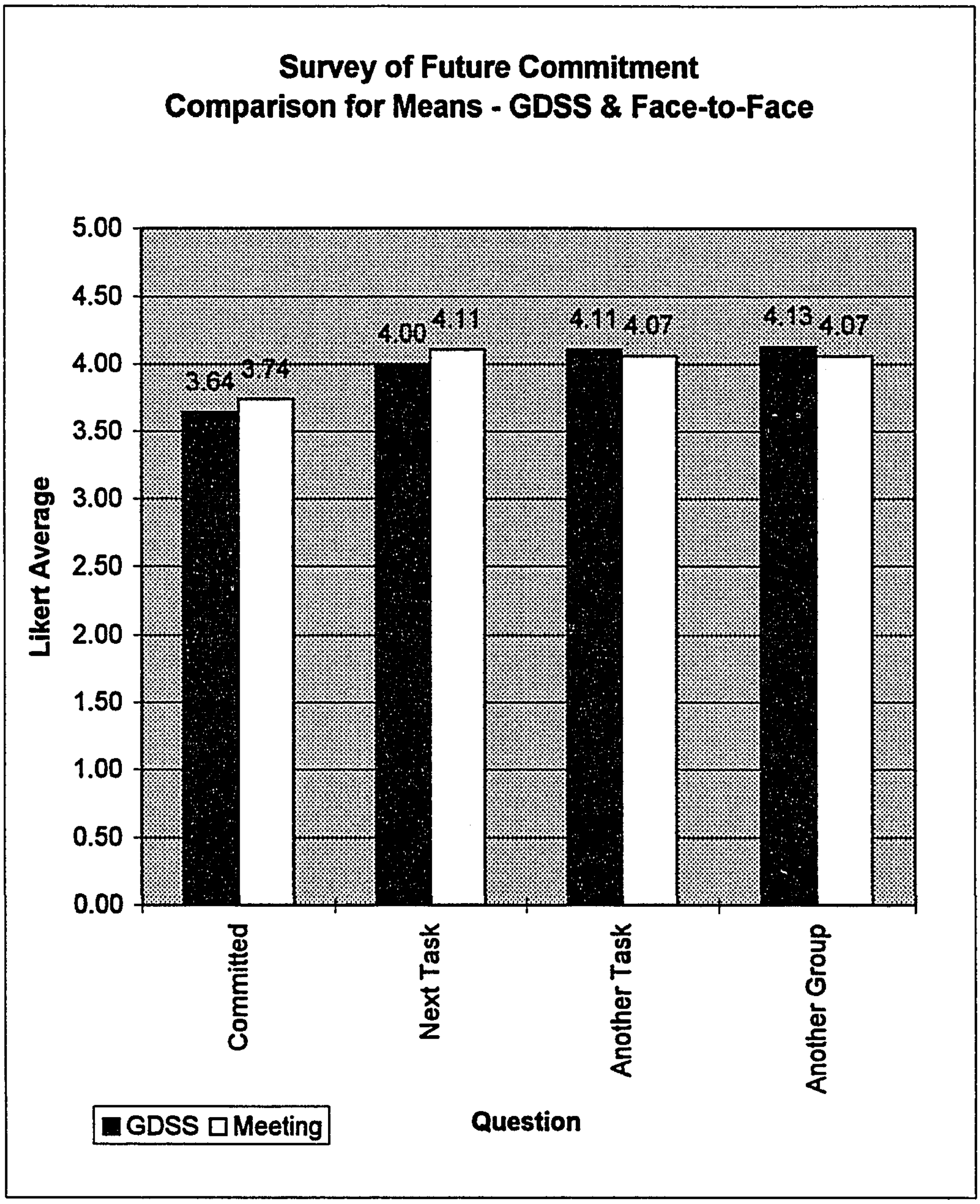
Descriptive Statistics - Professional Satisfaction
Comparison of GDSS and Face-to-Face Sessions
Excludes Pilot and Extended Groups

	Meeting		GDSS		Difference of Means	
	Mean	Std Dev	Mean	Std Dev	GDSS - Meeting	Higher Mean
I now have a better understanding of how other members of my group view this issue	3.98	0.683	4.023	0.849	0.04	GDSS
This meeting made me critically reevaluate my own thoughts on the topic	3.39	1.043	3.400	1.009	0.01	GDSS
This meeting uncovered ideas that I had not thought of individually	4.13	1.002	3.733	1.156	-0.40	Meeting
Members were able to provide enough information about their ideas	3.65	1.016	3.511	1.254	-0.14	Meeting
Average of Means	3.79		3.667			
Average of Standard Deviations		0.936		1.067		
Sum of Differences					-0.49	Meeting

Figure 119A

FUTURE COMMITMENT - Survey Means

	Committed	Next Task	Another Task	Another Group
GDSS	3.64	4.00	4.11	4.13
Meeting	3.74	4.11	4.07	4.07



Attitudinal Factors: Future Commitment
Comparison of GDSS and Face-to-Face Survey Means
Figure 120

Descriptive Statistics - Future Commitment
Comparison of GDSS and Face-to-Face Sessions
Excludes Pilot and Extended Groups

	Meeting		GDSS		Difference of Means	
	Mean	Std Dev	Mean	Std Dev	GDSS - Meeting	Higher Mean
I am committed to my group's model	3.739	0.999	3.644	0.933	-0.09	Meeting
I would be willing to participate in the group's next task in developing this model	4.111	0.775	4.000	0.826	-0.11	Meeting
I would be willing to work with this group again on another task	4.065	0.827	4.111	0.885	0.05	GDSS
I would be willing to work with another group of people to refine this expert system	4.065	0.772	4.133	0.919	0.07	GDSS
Average of Means	3.995		3.972			
Average of Standard Deviations		0.843		0.891		
Sum of Differences					-0.09	Meeting

Figure 120A

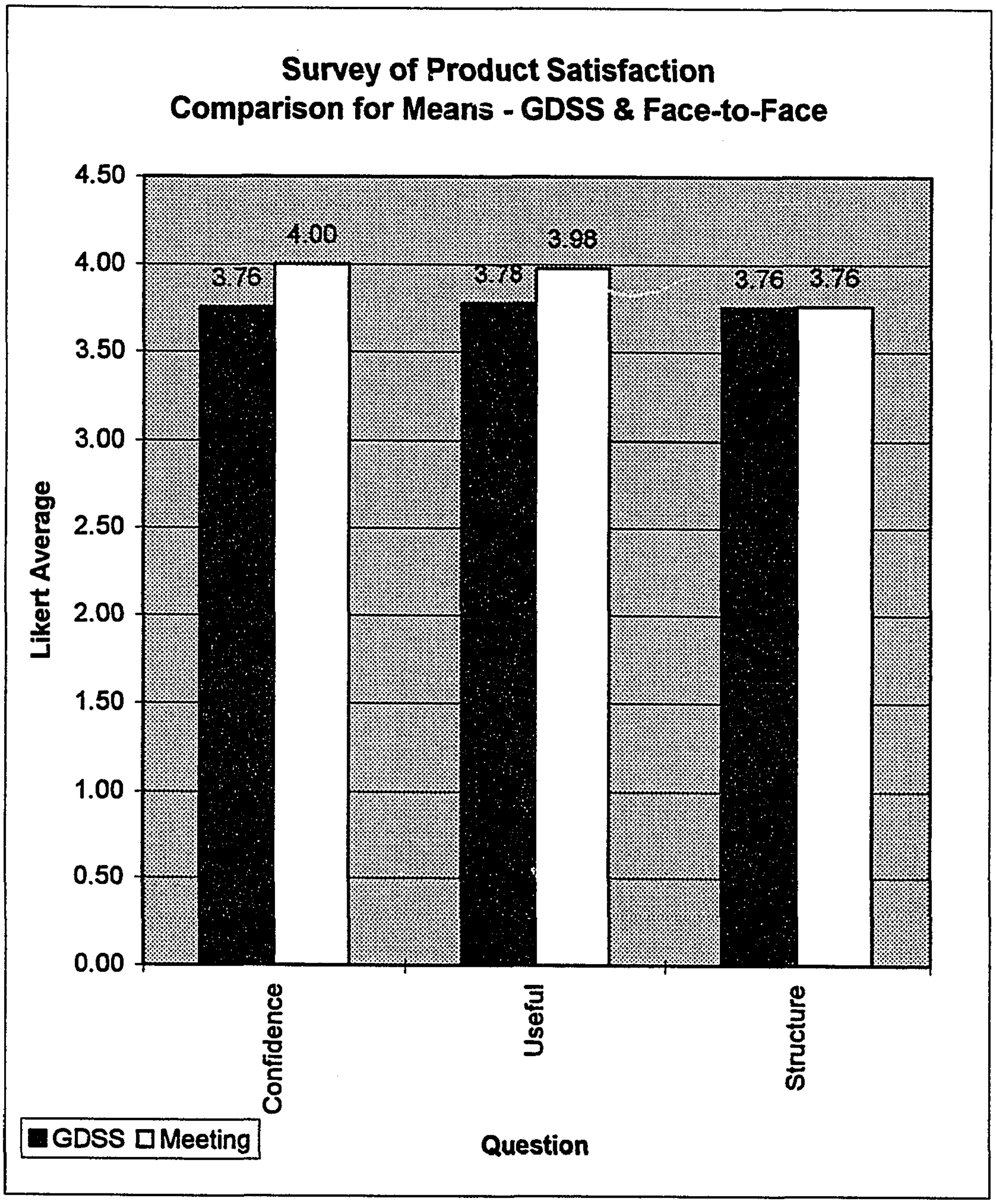
Again, the results did not confirm this prediction (see Figure 121). There was greater confidence in the Face-to-Face group's recommendations, and in their usefulness as a model for others to follow. The confidence in the structuring of the product were almost identical for both the Face-to-Face and GDSS groups. As Figure 121 shows, the Face-to-Face groups had slightly more faith in their products. Again, little variability was noted among group responses, as measured by standard deviation (Figure 121A).

Variable 7, Verifiability of the product derived. It was anticipated that there would be no difference between the two groups on this factor, which was evaluated by the independent Knowledge Engineers. Overall, however, the Knowledge Engineers found the GDSS products more useful in building an expert system. As Figure 122 shows, means on all criteria were more positive for the GDSS products. The greatest positive differences existed between GDSS and Face-to-Face scores on Providing a basis for further questions, Depth of ideas, and Usefulness of information.

Variable 8, Validity of the product derived. It was anticipated that the GDSS group might generate less useful ideas than those of the non-GDSS group, as the anonymity inherent in the GDSS lab might lead to some creative thinking that was not directly useful for an expert system. The results of this evaluation, however, showed a highly significant difference in favor of the GDSS products (Figure 123). The Domain Experts rated every single criteria higher for the GDSS products.

Variable 9, Breadth and Depth. It was anticipated that the number of levels described in each category would be greater in the GDSS group than in the non-GDSS

PRODUCT SATISFACTION - Survey Means	Confidence	Useful	Structure
GDSS	3.76	3.78	3.76
Meeting	4.00	3.98	3.76



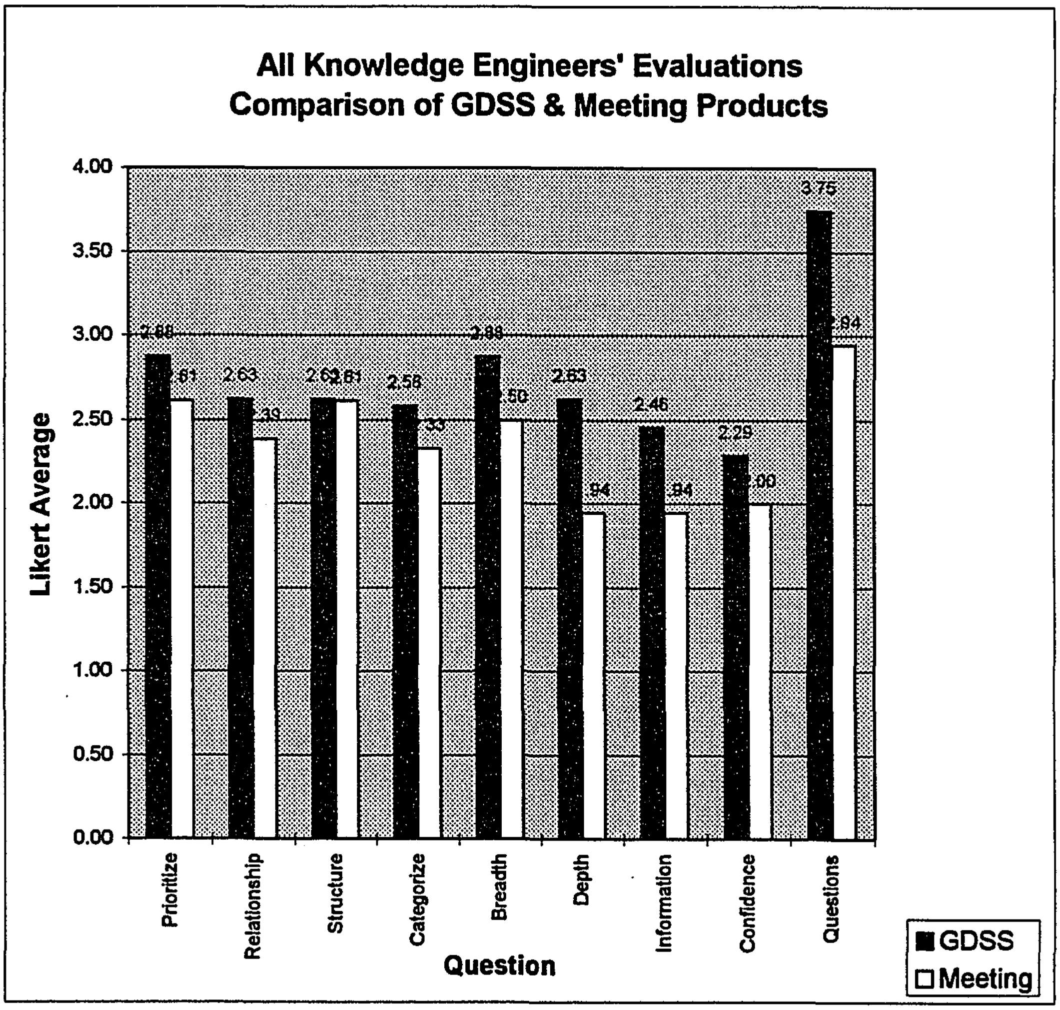
Product Quality Factors: Product Satisfaction
Comparison of GDSS and Face-to-Face Survey Means
Figure 121

Descriptive Statistics - Satisfaction with Product
Comparison of GDSS and Face-to-Face Sessions
Excludes Pilot and Extended Groups

	Meeting		GDSS		Difference of Means	
	Mean	Std Dev	Mean	Std Dev	GDSS - Meeting	Higher Mean
I have confidence in our group's recommendations	4.000	0.7888	3.756	0.802	-0.244	Meeting
I am sure our model will be useful for others to follow	3.978	0.9307	3.778	0.823	-0.200	Meeting
Our rating, subgrouping and categorizing were thorough enough for good recommendations	3.76	0.9234	3.756	0.933	-0.005	Meeting
Average of Means	3.913		3.763			
Average of Standard Deviations		0.881		0.853		
Sum of Differences					-0.450	Meeting

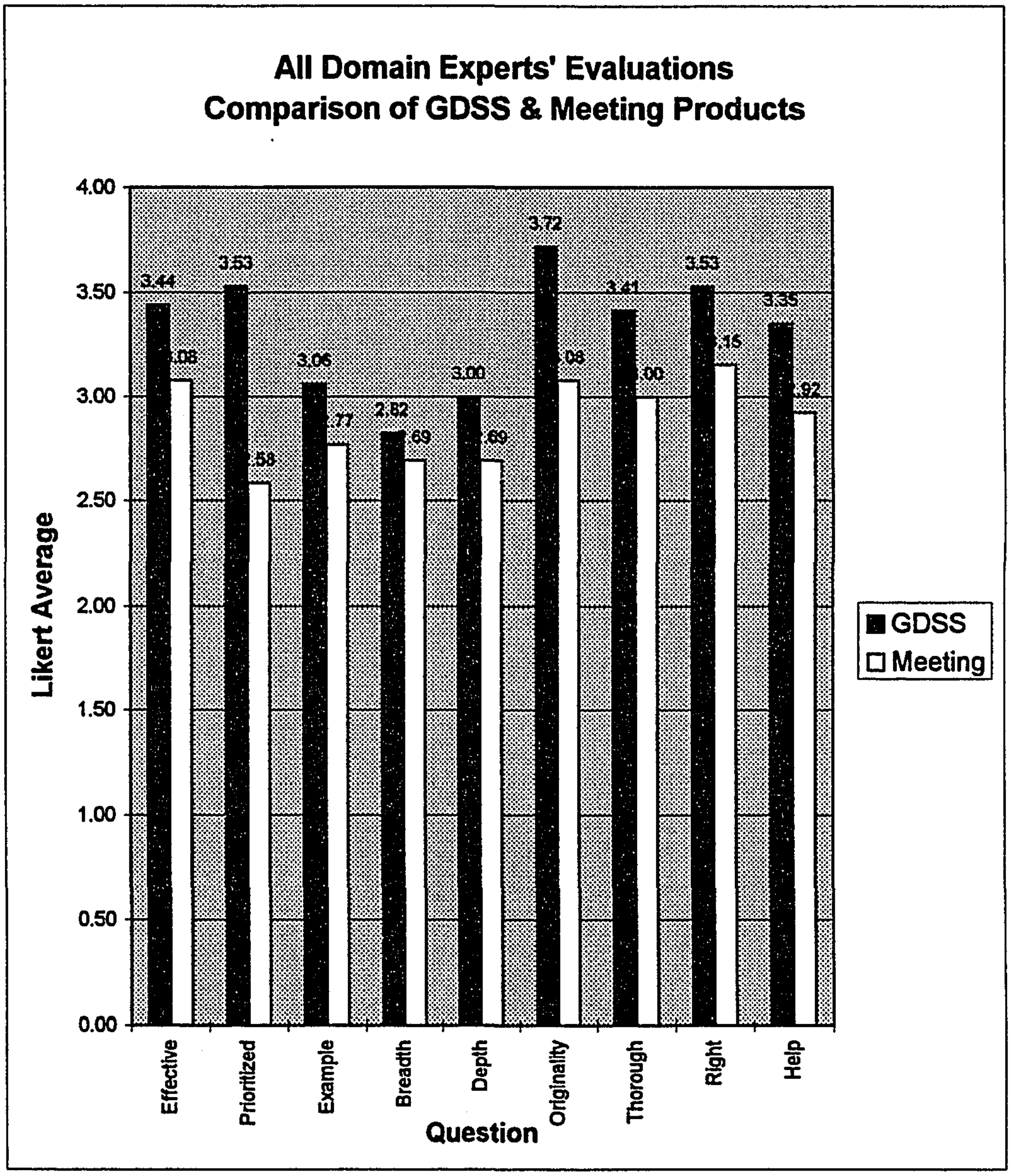
Figure 121A

Comparison of Means		
Title	GDSS	Meeting
Prioritize	2.88	2.61
Relationship	2.63	2.39
Structure	2.63	2.61
Categorize	2.58	2.33
Breadth	2.88	2.50
Depth	2.63	1.94
Information	2.46	1.94
Confidence	2.29	2.00
Questions	3.75	2.94



Product Verifiability
Summary of Knowledge Engineers' Evaluations
Figure 122

	Effective	Prioritized	Example	Breadth	Depth	Originality	Thorough	Right	Help
GDSS	3.44	3.53	3.06	2.82	3.00	3.72	3.41	3.53	3.35
Meeting	3.08	2.58	2.77	2.69	2.69	3.08	3.00	3.15	2.92



Product Validity
Summary of Domain Experts' Evaluations
Figure 123

group. As noted, both the Knowledge Engineers and the Domain Experts evaluated the GDSS products more highly on Depth. The Domain Experts also rated the Breadth of ideas slightly higher for the GDSS products.

Variable 10, Thoroughness of ideas. It was anticipated that the GDSS groups would generate a greater originality and thoroughness of ideas than the non-GDSS groups. The Domain Experts' evaluations strongly supported this prediction (see Figure 123).

CHAPTER SIX

DISCUSSION AND CONCLUSIONS

Reflection and Discussion

Effect of the GDSS Process

Participants's Perceptions

The perceptions of the student "experts" toward their respective GDSS and Face-to-Face Experiences, as measured by exit surveys, final perceptions, and follow-up surveys, did not present a consistent pattern. As noted, the participants found the GDSS system easy and rewarding to use. Narrative comments indicated a clear understanding of the advantages and value of the GDSS. However, responses from the exit surveys from each session indicated that, overall, the participants rated their individual Face-to-Face meetings slightly more highly. They felt that the interactions of the group members were marginally superior, and that they derived slightly more personal satisfaction from the Face-to-Face meetings than the GDSS sessions. There was greater confidence in the products of the Face-to-Face meetings, as well. In terms of professional satisfaction, participants again felt that the Face-to-Face meetings were more productive and illuminating. This led to a slightly greater commitment for future activity from the Face-to-Face participants. This was true in spite of some very significant responses in which the subjects recognized that GDSS kept one or two persons from dominating the discussion, and allowed for greater distribution of involvement. It is interesting to note, also, that the initial impressions were that the Face-to-Face products included more of each person's input than the GDSS. Clearly, the GDSS software required that all inputs be considered equally, while the Face-to-Face groups often ignored suggestions from group members. Participants did not seem to recognize this immediately after their initial experiences.

In contrast to the responses to the exit surveys, responses to the final perceptions questions were very positive about GDSS. The great majority of responses indicated a very positive attitude toward GDSS and its use for developing Expert Systems. These responses, collected after both experiences, indicated a growth from the base-line demographic responses. More significantly, almost seventy percent selected the GDSS experience as being more valuable in evaluating their ideas for an expert system. The exit surveys were taken immediately after each separate experience, and measured subjective responses to each individual meeting only. The final perception questions took place after both experiences, and forced the respondents to compare and evaluate. It would therefore seem that although both experiences were deemed to be satisfying and valuable, with the Face-to-Face slightly more so, the GDSS is preferred for reaching the specific goal.

The responses to the follow-up survey further substantiate this perception. While the final perceptions questions were administered to everyone immediately after the second experience, the follow-up survey was given to a smaller group, one week after the end of the study. The purpose was to evaluate the impressions of the GDSS and Expert Meetings after enough time had passed to allow more objectivity. The responses were very different from those of the exit surveys. At least two thirds of the respondents to the follow-up survey indicated that they enjoyed the GDSS experience more, and were more strongly satisfied with the organization of ideas stemming from GDSS. Less than half would more strongly recommend the results of their GDSS session, however, or felt they gained their best ideas through the GDSS.

Based upon the results of the three kinds of subject surveys, it would appear that the student "experts" thought highly of both experiences. The initial enjoyment, comfort, and appreciation of the meeting experiences was higher for the Face-to-Face groups, when each experience was considered alone. When the two processes were compared, however, it was clear that the GDSS experience was preferred in terms of quality, personal enjoyment, professional satisfaction, and willingness to commit to future work (based on personal satisfaction).

Production Quality Measurements

In contrast to the subjective responses of the survey participants, the measures of the production and quality of the products were more objective. These were measured by the specific number of ideas and amount of task completion each group achieved, and by evaluations from unrelated and objective Knowledge Engineers and Domain Experts. All of these measurements indicated that the GDSS products were superior to those obtained through Face-to-Face Meetings.

As the Idea-Completion Factor developed from the raw data showed, the GDSS groups were very significantly superior to the Face-to-Face Groups in terms of numbers of ideas generated and degree of agenda completion. Further, as previously noted, the Knowledge Engineers also found significant quality differences in favor of the GDSS products. This was an unexpected finding. The KE's found the GDSS products to be superior in all instances, with very significant differences in the quality of information provided, and in providing a basis for asking further questions. In any GDSS session, the agenda is carefully planned for the task at hand. Although the same agenda was followed by all groups, the GDSS environment clearly better supported the tools used, providing more useful products for the Knowledge Engineers. It should be noted that time was a constraint for all the groups, as the facilitators did not allow the experts to take all the time they wished. The quality of the products may have differed if time had not been an element.

The Domain Experts also found the GDSS products to be superior in terms of quality of ideas. Very significant differences existed in terms of originality and priority of ideas. It may be that the anonymity of GDSS encourages creative thought, while the objectivity of the GDSS tools used in rating lead to increased quality.

Contributing Factors

Effects of Repeated Experience

As the analysis showed, the repetition of the GDSS experience increased the satisfaction of the participants, and the perceived quality of their products. The second GDSS session produced more ideas, and the extended agenda was completed in the same amount of time. Participants were generally more satisfied with their second experience and had more confidence in their product. This supports suggestions in the previous literature suggesting that the greater the familiarity with the GDSS, the more productive the sessions. The Domain Experts showed very significant differences in their evaluations, with the second sessions being much more highly rated. It should be noted that the problems as well as the Domain Experts used to evaluate them were different in each session, so it is difficult to state with confidence whether the superiority was due to the problem or the extended experience. This is particularly true in light of the Knowledge Engineer evaluations, which rate the first sessions higher on four out of the nine criteria, and show no difference on another two. On the items that the two sets of experts evaluated in common, there was disagreement. The Domain Experts evaluated the second session more highly on priority and depth; the Knowledge Engineers rated the first more highly. The repetition of the GDSS experience, therefore, seemed to have the greatest impact on the perceptions of the participants themselves, and on the number of ideas and use of time in the second session.

It is possible that the agenda, itself, limited any growth between the first and second session. Because the agenda did not change significantly between sessions, there was little opportunity for growth, or for the group to show increased ability to structure the material in a way that had meaning to the Knowledge Engineers. The agenda, in this case, can be seen to have made it difficult for the group to show any adaptation to the technology. If there was change in the group, the unchanged agenda did not allow it to show beyond the increased number of ideas.

Effect of the Group

According to the theoretical model used for this study, one of the factors affecting group task success is the makeup of the group. Accordingly, results of each session were tracked and reported by group. Since the scores of the groups did not indicate consistent high or low scores independent of process or problem, there was no empirical reason to take the analysis further. It did not appear that the composition of the groups affected their effectiveness in this study.

Effect of the Problem

The nature of the task has also been cited as a factor in group success. Although each problem was selected to have the same degree of urgency and familiarity to the subject groups, it does appear that one problem may have elicited slightly stronger responses than another. The Domain Experts rated the first problem, How to Improve the Safety and Security of Students at ODU as less successful than the second, How to Land a Job in Your Field After Graduation. While the differences are apparent, it should be noted that different Domain Experts were, of necessity, used for each different task problem. It is therefore difficult to tell whether the difference in evaluations stems from the problem or the Domain Experts.

Effect of the Facilitator and Effect of Structuration

The facilitator for each group also functioned as part of the environment, and exercised an effect on the degree of structuration shaping each group. To evaluate the impact of the facilitator, participants were asked for their responses. The Face-to-Face groups rated the effectiveness of their facilitators more highly than the GDSS facilitator. As has already been noted, the GDSS facilitator functioned more as a Chauffeur than a facilitator, and was the most removed. Also as previously noted, the GDSS facilitator imposed the greatest degree of structuration on the groups. Therefore, it appears that the participants did not recognize the role of the GDSS facilitator or the imposed structure in contributing to their groups' performance.

Since there were two different Face-to-Face facilitators, it was necessary to see if respondents rated them differently, and if the difference in group perceptions was related to differences in productivity and quality. The idea-completion factor for each facilitator did not reflect a clear pattern between the facilitators. A comparison of the evaluations of the Domain Experts and the Knowledge Engineers also were inconclusive. Since each facilitator also represented a differing degree of structuration, no conclusions could be drawn about its effect on task completion in this study.

Effect of Three-on-a-Terminal

Although the session featuring small groups working together was not planned, the qualitative data gathered were rich and suggestive. It was clear that the opportunity to offer suggestions and talk among themselves lent greater excitement and a degree of synergy to the groups. The ideas gathered appeared on the screen for all to see, and the agenda that followed remained feasible, but the degree of interest and commitment seemed much higher. In the standard GDSS sessions, each participant was somewhat isolated behind his or her individual terminal - with several people on a terminal, there was a clear, happy buzz of discussion that more closely resembled the Face-to-Face groups. The small groups took their responsibility seriously, but seemed to enjoy themselves more than the single terminal participants.

It is also interesting to note that the groups formed informally, and independently. Students had the choice of whom they would work with. In all other settings, they were assigned to groups. It may be that the enthusiasm and synergy generated among the small groups was due to a sense of familiarity and comfort with their group members. If so, this should be considered in forming future groups. Since all members participated in one group or another, the diversity of the individuals' background and experience was not lost, but their comfort level and interaction was much higher. It was clear from their comments, that the small groups did not feel that they had lost the protection of anonymity in any way. Clearly, there was trust among the three member groups.

The spontaneous formation of the groups working together on the terminal in response to the weakening of the system support network may also be looked at as adaptive structuration, as the groups modified their initial arrangements to deal productively with the new technology and still complete the task.

Effect of Demographics

The results of the demographic survey indicated that, as intended and controlled for, the group of student "experts" was generally homogeneous in terms of age, background, and experience with GDSS and Expert System Technology. The great majority were between 18 and 25 years old, considered themselves to be full-time students, and did some kind of part-time work outside of their studies. Basically, the group had little or no experience with either approach. The introductory lesson on Expert Systems gave all participants a common background, and the session facilitators stressed the purpose of the activities. It was noteworthy both that so few used computers on a daily basis, and that they were not, as a group, very adept keyboard typists. Contrary to some findings in the previous literature, their inexperience seemed to have little impact on their perceived ease of use and enjoyment of the GDSS as measured by their response to the GDSS perceptions questions. Respondents indicated that they did not find the GDSS frustrating or inflexible to use.

The same is true of the participants' perceived comfort and influence in normal Face-to-Face groups. The demographic responses indicated that the majority of participants liked to work and felt that they were influential in such groups, contributed to group discussion, and were normally satisfied with their Face-to-Face group roles. Nonetheless, they indicated that they found the GDSS easy to use and that they gained an understanding of others' ideas through the process. There did not seem to be any relationship, therefore, between previous experience and a positive response to the GDSS.

Further Reflections

For many reasons previously cited, it was decided to use undergraduate students as experimental Domain Experts in this study. For the most part, the students performed admirably. The facilitators recognized the energy and enthusiasm they brought to the topics, which were real and relevant to them, and the Domain Experts cited the range and originality of many of their ideas. However, it should be noted that occasionally the immaturity of undergraduate students did become evident. The GDSS facilitator noted off-task behaviors and occasional rudeness which probably would not have occurred in the standard class setting with the professor present. Several students missed sessions, offering well-worn excuses such as "My girlfriend's grandmother is sick", or "I told the professor I needed to switch sessions". Perhaps this behavior would not have occurred with practicing, adult Domain Experts. On the other hand, the youth and spontaneity of the subjects contributed to the range and originality of their responses, and their willingness to risk new approaches.

The GDSS facilitator also noted that some off-task behavior occurred during the instruction phase. It is probable that such "goof-off" behavior would not have been tolerated in a Face-to-Face group. In fact, in one of the Pace-to-Face groups, a member demanded that a voting activity be repeated, simply because the vote total made it obvious that one member had not voted on every factor! Due to the nature of GDSS as used in this study, it was impossible to tell whether inattentive participants did offer ideas, and whether all students participated. The anonymity offered by GDSS can, if mis-used, have a negative effect.

The unexpected success of the Three-on-a-Terminal group offers ground for further reflection. Not only did the members feel a great comfort with the process and trust in the product (as evidenced in their comments), but also they seemed to have no problem with the technology. It may be that, in other applications, this approach could be used to involve all segments of an organization. The reluctance of upper management to use computer technology with which they are uncomfortable may be lessened if at least one member of the group can use the keyboard. Like-member groups may generate far more in-depth ideas. If the participant group is carefully chosen to include all important stake-holders, breadth would ensue from the inputting of ideas from all points of view.

Of interest in reviewing the data is that the variability of experiences is much clearer from the qualitative than the quantitative data. The results of the descriptive data resulting from the surveys often show only minor differences in total scores. The facilitators' comments, participants' comments, and video-taped evidence, however, show a much wider range of variability.

The GDSS facilitator was aware that his sessions were very quiet, formal, and showed limited social interaction (with the exception of the Three-on-a-Terminal session). However, upon viewing the video-tapes of his and the other sessions, he was forcibly struck by the difference. He described the GDSS sessions as "sterile" in comparison to the excitement, discussion, and interaction evident in the Face-to-Face sessions. It was easy to see why some students enjoyed the Face-to-Face meetings more. Based on this, and on his Three-on-a-Terminal experience, the facilitator speculated that a GDSS agenda which keeps each subject interacting only with the terminal misses the synergy involved in group process. This also may apply to commitment and personal satisfaction. The GDSS technology cannot supply the spoken and non-verbal support (nods, smiles) that come from personal human interaction.

The Facilitators' comments also revealed variability in the way leadership emerged in their groups. No informal leadership was possible in the GDSS session, which was controlled by the agenda. In the single-group Face-to-Face sessions, leadership could only emerge during the limited discussion period which followed the guided brainstorming and rating phases. In the two-group Face-to-Face sessions, however, the facilitator did not interact directly with the groups, and each group was forced to select a recorder/leader themselves. She reported a very wide range in the way the groups responded, depending on how the recorder conducted himself/herself. A passive recorder did not seem to generate as many ideas as someone showing a degree of excitement.

Another area of interest is the noteworthy change in subjects' attitudes toward the GDSS over time, as shown in their responses to the final perceptions questionnaire and the follow-up survey. Responses to the latter were markedly more positive. The growth in enjoyment and satisfaction with the organization of ideas in the GDSS sessions is noteworthy, and may be worthy of further study.

Conclusions

This study was intended to examine the impact of GDSS on developing pre-prototypical expert systems. The statement of the problem was: What is the relationship between GDSS and the development and structuring of ideas for expert systems using multiple experts? As an exploratory study, its goal was to gather as much data about as many factors as possible in order to isolate those worthy of further experimental study. Based on the data gathered through a pseudo-experimental study comparing GDSS and Face-to-Face meetings involving single and repeated experiences, through three different kinds of subject surveys, and through objective evaluations by Knowledge Engineers and Domain Experts, several final hypotheses can be generated for further, more formal study. These hypotheses are based only upon the data gathered from this study. While the findings are suggestive, the analysis was descriptive, based upon a relatively small sample size, and involve qualitative as much as quantitative data. Therefore, no claims are made that any generalizable conclusions can be offered without further, more rigorous, study. Given that there were no demographic differences affecting the groups, the following hypotheses are offered.

GDSS has a significantly positive impact on knowledge acquisition and prioritizing for developing expert systems. The theoretical foundation of this study indicated that successful task completion depends upon several important criteria, as delineated by Johnson and Johnson, McGrath, and DeSanctis and Gallupe. Johnson and Johnson speak to the fact that group goals must be clearly understood - the GDSS publishes the study problems and task goals with each tool. Participation and leadership must be distributed among members. The findings from all groups speak to the fact that individual members cannot dominate the GDSS process. Johnson and Johnson also speak to the fact that appropriate decision-making procedures must be matched with the needs of the situation. The many tools available to any GDSS agenda help to provide this flexibility. McGrath, in turn, points out that groups must be able to handle conceptual as well as behavioral tasks. The GDSS groups generating and prioritizing ideas worked successfully with both kinds of tasks. The GDSS tools further helped the groups work through sub-grouping tasks that elicited debate and conflict, or passive avoidance, in the Face-to-Face groups. DeSanctis and Gallupe point out that groups will adapt to technology according to the method in which it is presented. In this study, varying degrees of control were applied. The match between control and agenda was shown to be most productive in the GDSS group, in terms of actual task completion.

All data indicates that the factors for which GDSS is valued were transferrable to this application. As previous studies indicate, the GDSS minimized the production blocking which can normally hamper group meetings. The structured, parallel electronic channel of communication appeared to allow much faster interaction among the multiple experts. Members did not have to wait their turn to contribute, nor could they interrupt, or "hold the floor." Non-verbal cues could not affect the group mood. The speed of the GDSS environment in processing data meant that the groups could move quickly and smoothly from task to task, achieving more toward the task at each sitting than did the Face-to-Face groups.

The anonymous nature of GDSS counteracted blocking among group members due to position, shyness, fear of intimidation, or discomfort with the group. Facilitator comments indicated that in the Face-to-Face groups, certain members affected the success of the group, and that some groups that were too small or whose members did not know one another sat silently. The data shows that this could not have happened in the GDSS groups, which generated significantly more ideas during knowledge acquisition.

The anonymity and spontaneity inherent in GDSS led to increased numbers of ideas, and more creative and original ideas. Based on the subject surveys, the "experts" participating appreciated strongly the difference provided by GDSS in distributing participation evenly among members, and in avoiding dominance by one or two members. The narrative comments attested to this, as well as to some occasional frustration from those formerly accustomed to dominating. "Experts" in this study also noted the usefulness of specific GDSS tools, and the easy input, which also seemed to allow equality of input and increased communication among GDSS group participants. This was true even with a population not adept with computers in general.

The structured nature of the GDSS and the tools chosen seemed to support the information sequencing and prioritizing, as evaluated by the Domain Experts and the Knowledge Engineers. Indeed, in this study, only the GDSS groups regularly completed that part of the agenda. Even when those tasks were completed and the results could be compared, the experts rated the GDSS product as more useful and reliable. Because of the nature of the electronic medium itself, and despite lack of technological expertise, GDSS clearly contributes to multiple expert meetings for knowledge acquisition and prioritizing.

GDSS does have a positive effect on the long-term feeling of ownership of the Domain Experts developing the system. Again, the theoretical framework of this study indicates how group maintenance functions and support of members contribute to this result. Feelings of ownership result from a commitment to both the group and the process. Johnson and Johnson indicate that groups that function well have a high degree of group cohesion, attend to the interpersonal effectiveness of group members, and have a high adequacy in problem solving. McGrath points out that effective group processes are a product of factors that include group structure, and the nature and needs of the individual members. He also notes that groups perform functions that include production, member support, and facilitation of group-well being. While the GDSS structure and agendas do not specifically support group and member maintenance functions, they certainly inhibit personal attacks, put-downs, intimidation, fear of reprisal, and dominance by one or two members. Participants' comments speak to this clearly, and to feelings of well-being in the GDSS groups. Adaptive Structuration

Theory, in speaking to how the group appropriates technology to support itself and to meet its goals, illuminates how a match between task and technology enhances the experience of the process itself. Positive experiences lead to commitment, commitment to on-going ownership.

Contrary to expectations, there was only a minimal difference between the personal satisfaction felt by GDSS and Face-to-Face groups. The group "experts" indicated a high degree of commitment to the group product, a willingness to continue working with the group to refine the product, a willingness to work with the group on another task, and a willingness to work with another group to complete the task. This is particularly important, since expert systems are best developed through incremental improvement, which is an ongoing process. While responses to each group process indicated a slightly higher degree of satisfaction and commitment to the product after the Face-to-Face meeting, this did not hold true when the subjects compared their experiences. Offered a choice, the "experts" felt that they had both enjoyed more and been more pleased with the organization of ideas in the GDSS sessions. Clearly, GDSS does have a positive effect on the commitment of experts to the product and the process.

<u>GDSS has a positive effect on the quality of pre-prototypical expert systems</u>. This study was evidently the first to use external professional Knowledge Engineers and Domain Experts to evaluate the quality of the product. There is little theoretical data that speaks directly to such an application. Johnson and Johnson, McGrath, and DeSanctis and Gallupe all speak to the fact that a good match between the group, the

task, and the technology contributes to quality. The data gathered though this study shows that the use of the GDSS clearly provided a higher-quality and more useful product than the Face-to-Face groups. The GDSS groups produced more ideas, and more quickly. The Knowledge Engineers evaluated the GDSS groups more highly against every quality indicator, indicating that the GDSS is preferable for use in "building the system right". The Domain Experts also evaluated the GDSS products more highly, indicating that GDSS is preferable for "building the right system." The scores, in fact, are so positive that GDSS appears to be the tool of choice for this application.

Expert Participants may be more committed if they are permitted opportunities to interact and critically discuss their issues and ideas. The theoretical framework supports the fact that the agenda and activities must be flexible enough to allow the group members to independently interact and make decisions about their activities. Again, Johnson and Johnson speak to the need for an appropriate balance between the tasks, commitment, and methods. Poole and Jackson indicate that effective groups must maintain a balance between independent thinking and coordinated work. They feel that the tools and agenda must give individuals both experiences. This can be done through carefully planning the GDSS agenda to include the appropriate tools, or by alternating GDSS and Face-to-Face activities during the meeting. The scores on several survey items showed that participants did not feel that their input was used, nor that the final product reflected their ideas when only GDSS was used. While this perception is totally incorrect (since GDSS requires that all inputs be given equal weight unless the group decided otherwise), the speed and invisibility of the data processing did not allow the experts to see how their work was used. Therefore, the commitment of the experts to the GDSS products was no greater than that for the Face-to-Face. When the experts saw how their work was used in the Face-to-Face groups, and had an active role in debate, they seemed to be more involved. Participants' comments strongly reflected their desire for more interaction, and the very positive reactions from the Three-on-a-Terminal group indicate that their balanced agenda, however inadvertently arrived at, generated much more energy and enthusiasm. The final hypothesis is, therefore, that a discussion of the process, a review of the reasoning, and a guided discussion of the results of each tool in the GDSS agenda would contribute to the commitment of the multiple experts in the groups. It should be noted that this conclusion is also supported by Poole's theories, part of the basis of this study, for desired GDSS experiences. He recommends a variety of activities that allow participants opportunities for both reflective thought and convergent thinking activities, and that group members should clearly see the result of their work.

In this experiment, the degree of imposed control through the GDSS agenda and the experimental model did not allow the groups the opportunity to interact with one another, or with the technology on an independent basis. This certainly limited the degree of adaptive structuration that took place, and the degree to which the groups actually appropriated the structure provided. Greater flexibility in the agenda and the activities in the meeting may also have increased group member commitment to the task and technology.

Recommendations for Further Study

One of the purposes of this exploratory study was to identify factors in the relationship of GDSS to the development of Expert Systems that are worthy of further, more controlled study. Based on this research, the following factors appear to warrant further study: the relationship of the specific problem to the success of multiple experts using GDSS for knowledge acquisition and structuring; the effect of repeated exposure to the GDSS on success in building expert systems; the effect of increased interaction among group members and their confidence in the product, and the relationship of imposed structure on group satisfaction and product quality. Based on the above, these specific recommendations are made for further study.

1. Repeat this study with practicing Domain Experts rather than student subjects;
2. Repeat this study comparing groups with identical problems, to eliminate the degree of influence of the exact task.
3. Conduct a study using repeated measures and multiple groups to ascertain the effect of familiarity with the technology.
4. Conduct a study combining GDSS and Face-to-Face in comparison to single treatment groups.
5. Extend this study by including a relationship-building phase modeled on Warfield's Interpretive Structural Modeling.
6. Repeat this study modifying the agenda to include Poole's model for GDSS experiences.

7. Conduct a similar study to investigate how and why participants' attitudes toward GDSS change over time.

Summary

This study was intended to investigate the impact of GDSS on developing pre-prototypical expert systems using multiple experts. For the first time, the products of the group meetings were evaluated by Knowledge Engineers and Domain Experts in order to provide a more meaningful measure of the usefulness of the process. A broad exploratory approach involved single GDSS and Face-to-Face sessions and repeated GDSS sessions. Analysis revolved around the impact of the process, the group, the task, the facilitator, and familiarity with the technology. A broad range of data were collected, all of which served to support the assumption that GDSS has a significantly positive impact on developing expert systems using multiple experts. The results of this study can be useful to universities for continued research, to Knowledge Engineers for use in developing new expert systems, and to all organizations looking for a more effective and economical method of encapsulating expert knowledge.

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INSTRUCTIONAL SESSION
APRIL 15, 1994

I. INTRODUCTION TO PROJECT

"Good afternoon. My name is Bob Lewis. I want to thank you for the help you are about to give us, and I want to tell you about some of the benefits you are about to receive. As your instructor has told you, you are going to participate in a study of the impact of Group Decision Support Systems on creating a multiple expert-developed Expert System. I know that all of these terms may not be familiar to you, so let's take a moment to explore the major concepts."

II. INTRODUCTION TO PROCESS

A. Statement of the Research Problem
B. Procedure
C. Benefits to Industry/Research
D. Benefits to Student Participants

1. Partial Course Credit
2. Familiarity with 2 state-of-the-art MIS tools
3. Intimate and Practical Knowledge of which Procedures are Useful
4. An Experience in Using GDSS and Building Expert Systems which can be used on resumes
5. A Knowledge of how Graduate Research is Conducted, to build on in own career
6. Opportunity to offer meaningful solutions to real problems affecting Old Dominion University
7. Opportunity to express opinions of professional matters that will subsequently be published

III. INTRODUCTION TO EXPERT SYSTEMS

A. Definition and purpose
B. Steps in Development

1. Knowledge Acquisition
2. Structuring
3. Coding
4. Continuous Prototyping

C. Purposes and Situations for using Multiple Experts
D. Problems with Using Multiple Experts

IV. INTRODUCTION TO GDSS

A. Definition and Purpose
B. Advantages and Successful Uses

1. Parallel Communication
2. Anonymity
3. Speed

C. Tools
1. Brainwriting
2. Rating
3. Sub-Grouping
4. Compactor

V. DISTRIBUTE CONSENT FORM AND COLLECT

VI. INTRODUCTION TO BRAINSTORMING: Success of Whole Program Rests on How Good and How Many Your Ideas Are. So Important that We'll Practice Now

A. Rules of Brainstorming:

1. As Many Ideas as Possible in a Timed Period
2. No Ideas Unacceptable - May be Anything you can think of
3. No Criticism Allowed
4. Allowed to "Piggyback"
5. Need a Recorder/Timekeeper

VII. Practice Brainstorming

A. Introduce Topic - Finding a Parking Space
B. Explain the "Whip" - Going Around the Room
C. Give Time - Three Minutes
D. Begin First Session
E. Review Ideas
F. Do Second Session

VIII. Sample Ideas

A. Use Doctor's Plates
B. Put a No-Parking Sign Where You Want to Be
C. Park on New Construction Sites
D. Park Where you Want - Accept the Tickets
E. Put Your Car in a Corporate Name- Don't Pay Tickets
F. Drive an Emergency Vehicle
G. Park Far Away and Take a Bus
H. Park at a Friend's Who Lives Nearby

IX. Distribute Demographics Questionnaire and Collect - Refer students to labels to tell where they should be on Monday. Remind to Be Prompt on Monday.

X. Introduce Facilitators for each session.

A. Dr. Lewis if A.M. - Trained educational facilitator and workshop presenter, researcher and co-author of material on both GDSS and Expert Systems.
B. Dr. Chuck Keating if P.M. - In Engineering Management Department, worked with Learning Organizations

XI. Introduce Problems for Monday and Friday

A. As student experts, represent all students. Important and desirable that know what other students think. Feel free to ask others what they think and bring ideas to the meeting.
    1. Your own input will not be evaluated, but the results of your team will be compared to other teams.

B. Monday's Problem: How to improve the personal safety and security of Old Dominion Students on and around Campus.

    1. Real problem, because of student deaths over the last few years, concerns about rapes and muggings.
    2. Know you have thought about this and have ideas.

C. Friday's Problem: How to land a job in your major area of study for after graduation

    1. Graduates passing resumes out on street corners.
    2. A meaningful problem.

CONSENT FORM FOR RESEARCH PARTICIPATION

Dear Participant,

You and your class have been asked to participate in a study of Group Decision Support Software for use in the development of Expert Systems. Both of these are subjects that you have addressed as part of your MIS coursework. As a student "expert", you will be asked to work in two one-hour meetings to develop the ideas and organization for future expert models. At each stage of your experience, you will be asked to share your perceptions and opinions by responding to brief questionnaires. The information gathered from your responses will be used for analysis of the effectiveness of GDSS in knowledge acquisition and structuring using multiple "experts".

The problems your groups will address will involve real-life issues, relevant to your daily experience as Old Dominion Students. Your ideas will carry real meaning, and may be shared with the administration of the University. The scheduled meetings will take the place of, and will be held at the same time as, your regular class meetings and you will receive partial course credit for attending the two meetings and for completing the questionnaires. In addition, this experience will expose you to state-of-the-art tools in your area of study, and will provide you with hands-on experience that will be useful to you in the future. You will have an opportunity to observe how graduate research is designed and carried out, also of possible use to you in your future studies.

All of your comments and responses to the questionnaire will be kept strictly confidential, and thus the <u>nature</u> of your participation is not being graded for credit. Video and audio records of the meetings may be made; if so, they will be used strictly for analysis of the meeting, and will also be kept confidential. Any such video records will be destroyed at the conclusion of the analysis and completion of the study. You may withdraw at any time during the course of the study without prejudice, upon notification to your instructor.

If you have any questions about the nature and conditions of your participation, please feel free to direct them to the researcher, Bernard Lewis, at the Department of Engineering Management (683-4558). Thank you for your assistance in this project.

I DO VOLUNTARILY AGREE TO PARTICIPATE IN THE ABOVE STUDY, UNDER THE ABOVE CONDITIONS AS DESCRIBED.

______________________	______________________
SIGNATURE	DATE
______________________	______________________
PRINTED NAME	COURSE INSTRUCTOR/CLASS TIME

April 9, 1994

KNOWLEDGE ACQUISITION USING GDSS
RESEARCH INTO METHODS OF ELICITATION AND STRUCTURING
STUDENT SAFETY AND SECURITY

1. INTRODUCTION

a. OVERVIEW: Welcome to the Group Decision Support Laboratory. The first thing I'd like to do is give you a brief review and overview of what we're going to do today.

i. PROBLEM: As you recall, we are going to gather from you, the assembled experts, your best thoughts as to how to solve a problem that has real meaning in your life at ODU.

ii. APPROACHES: To do that, we are going to use a series of GDSS tools that will allow us to <u>gather</u> your ideas, <u>rate</u> them against several independent criteria, <u>prioritize</u> the importance of these ideas, and finally, <u>put them in meaningful categories</u>. The final product will be handed over to a knowledge engineer who will try to incorporate them as the <u>beginnings</u> of an expert system.

b. TOOLS: I need to give you a little information about how the GDSS software is going to work. <u>Please bear with me</u>. Do not attempt to leave the screen you are on until I ask you to. The tools we are going to use have been chosen for their specific usefulness, and for their ease of use. Please understand that time is a factor here. We are going to get as much done as possible in the time allowed. Part of our evaluation will measure how much was accomplished in each problem setting. We will work as quickly as possible, but if we have to skip a planned activity, please do not worry.

(1) SIGNING-ON. In front of you is a survey that you will be completing later. On that survey is your name, class and section. Under your name is your password. You will also find a sheet with the commands for the specific GDSS tools you will need today. We will go through these together as we use each tools, but these sheets will be an additional help for you if needed. We also have another resource for you today ***(Introduce Assistant, etc.)*** If you need help at any time in today's activities, please raise your hand and he will assist you.

(2) If your screen has gone dark, press any key. On the menu on the screen in front of you, please find the words Vision Quest. You can select by typing the letter E, or by arrowing down to highlight the words. Once you have made your selection, please press Enter.

(3) The screen you now see lists all possible users of this software. Using your arrow keys, please scroll down

until you find your own name, in alphabetical order. Highlight your name and press Enter.

(4) You are now being asked to type in your password, found on your questionnaire. Please type your password and hit Enter. When you are done, please look up.

TOPIC SELECTION

(5) You are now looking at a list of possible expert system topics. Today, we are going to be working with a problem that has real-life applications to you as experts - how to improve the personal safety and security of students at Old Dominion. This is a real-life problem, brought about by the violence that has affected students here over recent years. Please move your curser down until you find the problem that says Safety. If there are two items with the same name, please check your label to see if you should highlight item Safety:A or item Safety: B. Highlight the agenda item and press Enter. If you select the wrong one, the system will not let you in. If you have a problem, please raise your hand.

(6) Next, please put your cursor on the item that says "Safety on Campus: Ways of Improving: Topic" and hit Enter. You are now looking at a clear statement of the problem

we are addressing today. This is a problem that has received a lot of attention, and we are sure that you have already given it some thought. Remember, you are the real experts, who can provide the best answers to how to build a computerized system to follow human reasoning. Your ideas, organized and evaluated, will form the basis of a future expert system.

7. Please hit Escape. You are now looking at a set of possible tools. We are going to start with Brainwriting. Please move your cursor to highlight the item that says "Improving Safety on Campus: Brainwriting", and hit Enter.

REVIEW OF THE RULES OF BRAINSTORMING: We are going to brainstorm every idea we can think of. Remember that in brainstorming or brainwriting, the goal is to come up with as many ideas as possible in as short a time as possible. No idea is wrong; no idea is too crazy or impractical. No criticism is allowed, however, you are allowed to build, or "piggyback" on each other's ideas if you wish.

Again, our problem is - "How to improve students' personal safety at ODU." Some of your ideas will be obvious, and there may be repetition. Some will be so creative that they have not been considered before. ALL ideas are acceptable.

As you enter your ideas, you will see them appear at the top of your screen, along with everyone else's. Keep an eye on the screen, to avoid wasting time in duplication and to gain ideas for Piggybacking. Again, your goal is to come up with as many good ideas as possible on how to improve student safety.

2. DIRECTED BRAINSTORMING: To enter your ideas, all you need to do is type in an idea, and hit Enter, type another idea and hit Enter, and so on. Your ideas will automatically be spaced for you.

   a. ***(1ST PHASE - 3 MINUTES:)*** You will be given 3 minutes to enter your ideas. Do not worry about format, spelling, or phrasing - just get as many ideas down as possible. At the end of the three minutes, I will call time. How do we improve student safety and security on the ODU campus? Hit Escape. Hit F2. Select Insert Alternatives. Ready? Go!

   b. TRANSITION; ***(At the end of the three minutes)*** STOP. You may finish your last ideas and then stop typing. Please take a look at the ideas we have generated. You can review these by hitting Escape, and using your arrows to scroll up or down.

   c. 2ND PHASE - 2 MINUTES. Research tells us that the most useful and creative ideas arise in a second round of brainstorming. I challenge you to come up with as many ideas in two minutes as you just did in three. Same subject. Once again, hit F2 and Insert Alternatives. Ready? Go!

3. TRANSITION: ***(Give two more minutes.)*** STOP. Finish your last idea and stop. You must now hit Enter, or F4 at this time, or your idea will not be

saved. Do so, now. Again, you can review all the ideas of your group by hitting Escape.

a. DIRECTIONS TO LEAVE BRAINWRITING This completes our idea generation phase. Please hit Escape.

4. INTRODUCTION TO RATING: We now have a wide variety of ideas to evaluate. At this point, we would normally ask you to consider what criteria are important in considering your ideas. To save time today, however, we are going to ask you to rate your ideas against three specific previously-developed criteria - effectiveness, practicality, and acceptability to students. Since rating is a very quick and efficient tool, we are going to consider each idea three separate times.

a. INSTRUCTIONS ON HOW TO USE RATING: You are now looking at a series of Agenda items. Please select the item that reads "Rating: Effectiveness", and hit Enter. You will see the directions for the Rating Tool.

b. GUIDED RATING: EFFECTIVENESS: You are going to use a scale of 1 to 10 to rate each idea according to its effectiveness - that is, how much it is going to improve Student Safety. If you think that this idea is going to be the most effective possible, enter a 10. On the other hand, if you think it will have no effect at all, enter a 1. Highly effective ideas may rate 8's or 9's, less effective ideas will have lower scores. After entering a number after each idea, arrow down to the next item. When you are done, hit F4 to submit your ideas. Do this as quickly as possible, and when you are done, please look up. Are there any questions? Hit Escape to begin. Start now.

c. ***(Give Time at 3 Minutes)***

d. GUIDED RATING: PRACTICALITY. After you have hit F4, you can review the group's ratings by hitting F5. When you are done, hit Escape. You are now again looking at the agenda menu. This time, highlight "Rating: Practicality", and hit Enter. You are now going to rate the same ideas again, this time, only considering how easy each item is to actually accomplish. Hit escape to begin. Any questions? Remember to hit F4 to submit your ideas when you are finished. Start now. When you are done, hit F5 to review what the group said, and then Escape and look up.

e. ***(Give Time at 3 Minutes)***

f. GUIDED RATING: ACCEPTABILITY. Please now select the Agenda item that reads "Rating: Acceptability" and hit Enter. You are going to evaluate all your ideas just one more time. This time, please consider each according to how well students on the ODU Campus will accept and implement them. Again, the most acceptable ideas will receive the highest scores. Be sure that you hit F4 to submit when you are done. Hit F5 for the group results, then hit Escape, and look up. Begin now.

g. ***(Give three minutes to complete)***

5. TRANSITION: We have now completed our rating evaluation of all your generated ideas. I am now going to provide you with a merged list of all the ideas that you scored at the top seven in each category. Together, they received the highest scores. We are going to decide which of these top ideas you, the experts, consider to be the highest priority.

6. DIRECTIONS TO SUB-GROUP. You should now be looking at the Agenda Menu again. Please highlight the item that reads "Sub-Group: Priority 5-7". As an individual expert, you are going to choose the five to seven items from the list that you personally most strongly recommend and support. You will do this by entering Yes or No for each item, using the arrow key to move down. You must pick 5 and may pick up to 7. When you are done, please hit F4 to submit, and then look up. You can review the group results by hitting F5. Hit Escape, and begin.

   a. ***(Give three minutes to complete)***

7. TRANSITION: Please be sure that you have submitted, and hit Escape. We are now ready to move on.

8. ***(DECISION POINT: IF THERE IS ENOUGH TIME, MOVE ON TO COMPACTOR. IF NOT, ALLOW THE GROUP TO SEE ITS WORK, AND MOVE TO THE QUESTIONNAIRE, BY SAYING:*** You may wish to see the results of the work the entire group has accomplished today. You have generated ideas, rated them according to independent criteria, and indicated which are the most important to accomplish, all in less than one half an hour.

Please hit F5 to see the final list. Are there any comments?)

9. TRANSITION: The last tool we are going to use today is designed to categorize your top ideas. This will let the Knowledge Engineer know who is most responsible for the work. In the Agenda Menu, please highlight the item that says "Compactor: Responsibility for Action" and hit Enter, then Escape. You now see in front of you the compilation of the top ideas that you as experts also felt were of the highest priority. We are now going to decide who has the greatest responsibility for implementing each item. Again, we would rather ask the group of experts to decide on the categories, but in the interest of time have also predetermined these for your use today.

10. DIRECTIONS TO COMPACTOR: On the bottom of the screen you see several groups who might have the primary responsibility for implementing each of your ideas. They are: Students, Administration, Community, University Security, the University Budget Office, and the Faculty. Each group has its own identifying number. You are to put the number of the group with the greatest responsibility for each item next to the item, arrowing down to the next idea. Remember that although several groups may share the responsibility for an item, you must decide on the ONE MOST RESPONSIBLE GROUP for each. Do this as quickly as possible. When you are done, hit F4 to submit, and then Escape. Any questions?

    a. ***(Give Time at 4 Minutes Then Check)***

11. TRANSITION: Thank you for your hard work. You have now generated your

ideas, rated them against specific criteria, prioritized them according to importance, and identified the most responsible parties, all in less than one half hour. There is only one more task before we begin final directions. We need to have your responses and opinions about the experience and tools you just used.

12. DIRECTIONS TO QUESTIONNAIRE: Next to your terminal you will find a personalized questionnaire and a pencil. Please take your time in responding to these items. The questionnaire is designed to take no more than 10 minutes, and you have ample time. When you have completed your responses, please look up. In 10 minutes, we will begin our final instructions.

    a. ***(Allow 10 minutes) (Then choose either FINAL DIRECTIONS OR FINAL FINAL DIRECTIONS)***

13. FINAL DIRECTIONS: This completes your GDSS experience. You will have an opportunity to compare your productivity and satisfaction with your experience at your next class. On Friday, you will meet back in your regular classroom, working with a trained facilitator on another problem. You will use many of the same techniques, but will not be using GDSS. Please be sure to be there as promptly as possible. I hope you enjoy that experience, and I hope that you have enjoyed this one. If, at any time, you would like to see the results of this study, would like to participate in another GDSS activity, or have questions about GDSS or Expert Systems, please feel free to contact me. Please turn in your surveys as you leave. Thank you, and have a great day.

14. ***FINAL FINAL DIRECTIONS:*** There is only one more activity for today. At the back of your questionnaire, printed in ivory, is a very brief response form directed to your impressions of your experiences with the entire study. Your responses and comments will be immensely useful to us. Please take your time in completing this page. Thank you for all of you interest and energy over these two days. If, at any time, you would like to see the results of this study, would like to participate in another GDSS activity, or have questions about GDSS or Expert Systems, please feel free to contact me. Please turn in your surveys as you leave. Thank you, and have a great day.

April 22, 1994

KNOWLEDGE ACQUISITION USING GDSS
RESEARCH INTO METHODS OF ELICITATION AND STRUCTURING
HOW TO FIND A JOB IN YOUR FIELD

1. INTRODUCTION

a. OVERVIEW: Welcome to the Group Decision Support Laboratory. The first thing I'd like to do is give you a brief review and overview of what we're going to do today.

i. PROBLEM: As you recall, we are going to gather from you, the assembled experts, your best thoughts as to how to solve a problem that has real meaning in your life at ODU.

ii. APPROACHES: To do that, we are going to use a series of GDSS tools that will allow us to gather your ideas, rate them against several independent criteria, prioritize the importance of these ideas, and finally, put them in meaningful categories. The final product will be handed over to a knowledge engineer who will try to incorporate them as the beginnings of an expert system.

b. TOOLS: I need to give you a little information about how the GDSS software is going to work. Please bear with me. Do not attempt to leave the screen you are on until I ask you to. The tools we are going to use have been chosen for their specific usefulness, and for their ease of use. Please understand that time is a factor here. We are going to get as much done as possible in the time allowed. Part of our evaluation will measure how much was accomplished in each problem setting. We will work as quickly as possible, but if we have to skip a planned activity, please do not worry.

(1) SIGNING-ON. In front of you is a survey that you will be completing later. On that survey is your name, class, cluster, and section. Under your name is your password. You will also find a sheet with the commands for the specific GDSS tools you will need today. We will go through these together as we use each tool, but these sheets will be an additional help for you if needed.

(2) If your screen has gone dark, press any key. On the menu on the screen in front of you, please find the words Vision Quest. You can select by typing the letter E, or by arrowing down to highlight the words. Once you have made your selection, please press Enter.

(3) The screen you now see lists all possible users of this software. Using your arrow keys, please scroll down until you find your own name, in alphabetical order. Highlight your name and press Enter.

(4) You are now being asked to type in your password, found on your questionnaire. Please type your password and hit Enter. When you are done, please look up.

TOPIC SELECTION

(5) You are now looking at a list of possible expert system topics. Today, we are going to be working with another problem that is of true concern to you as experts - how to find a job in your field. This is also a real-life problem, relevant because of the difficulty recent college graduates have faced in finding professional employment in their fields of study. Please move your curser down until you find the problem that says Jobs. If there are two items with the same name, please check your label to see if you should highlight item Jobs: A or item Jobs: B. Highlight the agenda item and press Enter. If you select the wrong one, the system will not let you in. If you have a problem, please raise your hand.

(6) Next, please put your cursor on the item that says "Finding a Job: Topic" and hit Enter. You are now looking at a clear statement of the problem we are addressing today. This is a problem that has received a lot of attention, and we are sure that you have already

given it some thought. Remember, you are the real experts, who can provide the best answers to how to build a computerized system to follow human reasoning. Your ideas, organized and evaluated, will form the basis of a future expert system.

7. Please hit Escape. You are now looking at a set of possible tools. We are going to start with Brainwriting. Please move your cursor to highlight the item that says "Finding a Job: Brainwriting", and hit Enter.

REVIEW OF THE RULES OF BRAINSTORMING: We are going to brainstorm every idea we can think of. Remember that in brainstorming or brainwriting, the goal is to come up with as many ideas as possible in as short a time as possible. No idea is wrong; no idea is too crazy or impractical. No criticism is allowed, however, you are allowed to build, or "piggyback" on each other's ideas if you wish.

Our problem is "How to find a job in your field." Again, some of your ideas will be obvious, and there may be repetition. Some will be so creative that they have not been considered before. ALL ideas are acceptable.

As you enter your ideas, you will see them appear at the top of your screen, along with everyone else's. Keep an eye on the screen, to avoid wasting time in duplication and to gain ideas for Piggybacking. Again, your goal is to come up with as many good ideas as possible on how to find a job in your field.

2. DIRECTED BRAINSTORMING: To enter your ideas, all you need to do is type in an idea, and hit Enter, type another idea and hit Enter, and so on. Your ideas will automatically be spaced for you.

   a. ***(1ST PHASE - 3 MINUTES:)*** You will be given 3 minutes to enter your ideas. Do not worry about format, spelling, or phrasing - just get as many ideas down as possible. At the end of the three minutes, I will call time. How do you find a professional job in your field of study? Hit Escape. Hit F2. Select Insert Alternatives. Ready? Go!

   b. TRANSITION; ***(At the end of the three minutes)*** STOP. You may finish your last ideas and then stop typing. Please take a look at the ideas we have generated. You can review these by hitting Escape, and using your arrows to scroll up or down.

   c. 2ND PHASE - 2 MINUTES. Research tells us that the most useful and creative ideas arise in a second round of brainstorming. I challenge you to come up with as many ideas in two minutes as you just did in three. Same subject. Once again, hit F2 and Insert Alternatives. Ready? Go!

3. TRANSITION: ***(Give two more minutes.)*** STOP. Finish your last idea and stop. If there are any ideas that simply must be entered, you may do so now. You must now hit Enter, or F4 at this time, or your idea will not be saved. Do so, now.

   a. DIRECTIONS TO LEAVE BRAINWRITING This completes our idea generation phase. Please hit Escape

4. INTRODUCTION TO RATING: We now have a wide variety of ideas to evaluate. At this point, we would normally ask you to consider what criteria are important in considering your ideas. To save time today, however, we are going to ask you to rate your ideas against three specific previously-developed criteria - effectiveness, practicality, and acceptability to prospective employers. Since rating is a very quick and efficient tool, we are going to consider each idea three separate times.

   a. INSTRUCTIONS ON HOW TO USE RATING: You are now looking at a series of Agenda items. Please select the item that reads "Rating: Effectiveness", and hit Enter. You will see the directions for the Rating Tool.

   b. GUIDED RATING: EFFECTIVENESS: You are going to use a scale of 1 to 10 to rate each idea according to its effectiveness - that is, how much it is going to help you to find a job. If you think that this idea is going to be the most effective possible, enter a 10. On the other hand, if you think it will have no effect at all, enter a 1. Highly effective ideas may rate 8's or 9's, less effective ideas will have lower scores. After entering a number after each idea, arrow down to the next item. When you are done, hit F4 to submit your ideas. Do this as quickly as possible, and when you are done, please look up. Are there any questions? Hit Escape to begin. Start now.

c. *(Give Time at 3 Minutes)*

d. GUIDED RATING: PRACTICALITY. After you have hit F4, hit Escape. You are now again looking at the agenda menu. This time, highlight "Rating: Practicality", and hit Enter. You are now going to rate the same ideas again, this time, only considering how easy each item is to actually accomplish. Hit escape to begin. Any questions? Remember to hit F4 to submit your ideas when you are finished. Start now. When you are done, hit Escape and look up.

e. *(Give Time at 3 Minutes)*

f. GUIDED RATING: ACCEPTABILITY. Please now select the Agenda item that reads "Rating: Acceptability" and hit Enter. You are going to evaluate all your ideas just one more time. This time, please consider each according to how well prospective employers will accept and respond to them. Again, the most acceptable ideas will receive the highest scores. Be sure that you hit F4 to submit when you are done. Then hit Escape, and look up. Begin now.

g. *(Give three minutes to complete)*

5. TRANSITION: We have now completed our rating evaluation of all your generated ideas. I am now going to provide you with a merged list of all the ideas that you scored at the top seven in each category. Together, they received the highest scores. We are going to decide which of these top ideas you, the experts, consider to be the highest priority.

6. DIRECTIONS TO SUB-GROUP. You should now be looking at the Agenda Menu again. Please highlight the item that reads "Sub-Group: Priority -5 - 7". As an individual expert, you are going to choose the five to seven items from the list that you personally most strongly recommend and support. You will do this by entering Yes or No for each item, using the arrow key to move down. You must pick 5 and may pick up to 7. When you are done, please hit F4 to submit, and then look up. Hit Escape, and begin.

   a. ***(Give three minutes to complete)***

7. TRANSITION: Please be sure that you have submitted, and hit Escape. We are now ready to move on.

8. *(DECISION POINT: IF THERE IS ENOUGH TIME, MOVE ON TO COMPACTOR. IF NOT, ALLOW THE GROUP TO SEE ITS WORK, AND MOVE TO THE QUESTIONNAIRE, BY SAYING:* You may wish to see the results of the work the entire group has accomplished today. You have generated ideas, rated them according to independent criteria, and indicated which are the most important to accomplish, all in less than one half an hour. Please hit F5 to see the final list. Are there any comments?)

9. TRANSITION: The last tool we are going to use today is designed to categorize your top ideas. This will let the Knowledge Engineer know who or what is most crucial to the success of the work. In the Agenda Menu, please highlight the item that says "Compactor: Most Needed for Action" and hit Enter, then Escape. You now see in front of you the compilation of the top

ideas that you as experts also felt were of the highest priority. We are now going to decide what factors are most crucial for the success of each of your ideas. Again, we would rather ask the group of experts to decide on the categories, but in the interest of time have also predetermined these for your use today.

10. DIRECTIONS TO COMPACTOR: On the bottom of the screen you see several groups or factors which might be most necessary in order to implement each of your ideas; that is, upon which each idea is <u>most</u> dependent. They are: Money, Contacts, Initiative, Ability, and Established Programs. Each factor has its own identifying number. You are to put the number of the factor most crucial for the success of each item next to the item, arrowing down to the next idea. Remember that although an item may depend on several factors, you must decide on the ONE MOST CRUCIAL FACTOR for each. Do this as quickly as possible. When you are done, hit <u>F4</u> to submit, and then <u>Escape</u>. Any questions?

    a. ***(Give Time at 4 Minutes Then Check)***

11. TRANSITION: Thank you for your hard work. You have now generated your ideas, rated them against specific criteria, prioritized them according to importance, and identified the most responsible parties, all in less than one half hour. There is only one more task before we begin final directions. We need to have your responses and opinions about the experience and tools you just used.

12. DIRECTIONS TO QUESTIONNAIRE: Next to your terminal you will find a personalized questionnaire and a pencil. Please take your time in responding to these items. You are to complete only the questions printed on purple paper! The questionnaire is designed to take no more than 10 minutes, and you have ample time. When you have completed your responses, please look up. In 10 minutes, we will begin our final instructions.

    a. ***(Allow 10 minutes) (Then choose either FINAL DIRECTIONS OR FINAL FINAL DIRECTIONS)***

13. ***FINAL DIRECTIONS: This completes your GDSS experience. You will have an opportunity to compare your productivity and satisfaction with your experience at your next class. On Friday, you will meet back in your regular classroom, working with a trained facilitator on another problem. You will use many of the same techniques, but will not be using GDSS. Please be sure to be there as promptly as possible. I hope you enjoy that experience, and I hope that you have enjoyed this one. If, at any time, you would like to see the results of this study, would like to participate in another GDSS activity, or have questions about GDSS or Expert Systems, please feel free to contact me. Please turn in your surveys as you leave. Thank you, and have a great day.***

14. ***FINAL FINAL DIRECTIONS:*** There is only one more activity for today. At the back of your questionnaire, printed in yellow, is a very brief response form, directed to your impressions of your experiences with the entire study. Your responses and comments will be immensely useful to us. Please take your time

in completing this page. Thank you for all of you interest and energy over these two days. If, at any time, you would like to see the results of this study, would like to participate in another GDSS activity, or have questions about GDSS or Expert Systems, please feel free to contact me. Please turn in your surveys as you leave. Thank you, and have a great day.

April 18, 1994

KNOWLEDGE ACQUISITION USING GDSS
RESEARCH INTO METHODS OF ELICITATION AND STRUCTURING
STUDENT SAFETY AND SECURITY

I. OVERVIEW

Welcome. The first thing I'd like to do is give you a brief review and overview of what we're going to do today. As you recall, we are going to gather from you, the assembled experts, your best thoughts as to how to solve a problem that has real meaning in your life at ODU. To do that, we are going to use a series of activities that will allow us to gather your ideas, rate them against several independent criteria, prioritize the importance of these ideas, and finally, put them in meaningful categories. The final product will be handed over to a knowledge engineer who will try to incorporate them as the beginnings of an expert system. Please understand that time is a factor here. We are going to get as much done as possible in the time allowed. Part of our evaluation will measure how much was accomplished in each problem setting. We will work as quickly as possible, but if we have to skip a planned activity, please do not worry.

II. INTRODUCE PROBLEM

Today, we are going to be working with a problem that has real-life applications to you as experts - how to improve the personal safety and security of students at Old Dominion. This is a real-life problem, brought about by the violence that has affected students here over recent years. This is a problem that has received a lot of attention, and we are sure that you have already given it some thought. Remember, you are the real experts, who can provide the best answers to how to build a computerized system to follow human reasoning. Your ideas, organized and evaluated, will form the basis of a future expert system.

III. REVIEW OF THE RULES OF BRAINSTORMING: We are going to brainstorm every idea we can think of. Remember that in brainstorming or brainwriting, the goal is to come up with as many ideas as possible in as short a time as possible. No idea is wrong; no idea is too crazy or impractical. No criticism is allowed, however, you are allowed to build, or "piggyback" on each other's ideas if you wish.

Again, our problem is - "How to improve students' personal safety at ODU." Some of your ideas will be obvious, and there may be repetition. Some will be so creative that they have not been considered before. ALL ideas are acceptable.

IV. DIRECTED BRAINSTORMING: ***(1ST PHASE - 3 MINUTES:)*** You will be given 3 minutes to brainstorm your ideas. At the end of the three minutes, I will call time. How do we improve student safety and security on the ODU campus? Ready? Go!

(At the end of the three minutes) STOP. You may finish your last ideas and then stop recording. Please take a look at the ideas you have generated.

2ND PHASE - 2 MINUTES. Research tells us that the most useful and creative ideas arise in a second round of brainstorming. I challenge you to come up with as many ideas in two minutes as you just did in three. Same subject. Ready? Go?

TRANSITION: *(Give two more minutes.)* STOP. Finish your last idea and stop.

V. INTRODUCTION TO RATING: We now have a wide variety of ideas to evaluate. At this point, we would normally ask you to consider what criteria are important in considering your ideas. To save time today, however, we are going to ask you to rate your ideas against three specific previously-developed criteria - effectiveness, practicality, and acceptability to students. Since rating is a very quick and efficient tool, we are going to consider each idea three separate times.

VI. INSTRUCTIONS ON HOW TO USE RATING:

EFFECTIVENESS: You are going to use a scale of 1 to 10 to rate each idea according to its effectiveness - that is, how much it is going to improve Student Safety. If you think that this idea is going to be the most effective possible, give it a 10. On the other hand, if you think it will have no effect at all, give it a 1. Highly effective ideas may rate 8's or 9's, less effective ideas will have lower scores. After entering a number after each idea, move down to the next item. Please use a RED marker to enter your score for each item. Do this as a group, as quickly as possible, and when you are done, please look up. Are there any questions? Start now.

PRACTICALITY. You are now going to rate the same ideas again, this time, only considering how easy each item is to actually accomplish. This time, please use a BLUE marker to record your score next to each item. Any questions? Start now. When you are done, look up and let me know. ACCEPTABILITY. You are now going to evaluate all your ideas just one more time. This time, please consider each according to how well students on the ODU Campus will accept and implement them. Again, the most acceptable ideas will receive the highest scores. Be sure to use a GREEN marker to enter your score for acceptability. Begin now.

TRANSITION: ***We have now completed our rating evaluation of all your generated ideas. The next thing we are going to do is pick the top seven in each category. These may be self evident. If not, please add the three colored scores for each item together, and divide by 3 to get the weighted score. Please circle the top seven items, and print them again, neatly, on the sheet I have provided to you. You should have a maximum of 21 items, fewer if there are duplicates. We are next going to decide which of these top ideas you, the experts, consider to be the highest priority***

VII. DIRECTIONS TO SUB-GROUP. Each of you is being given seven colored stickers. I want you to take just a minute, and make an individual decision.

As an individual expert, you are going to choose the five to seven items from the list that you personally most strongly recommend and support. You will do this by placing one dot next to each of your choices. You must pick 5, and may pick no more than 7. Please begin.

(DECISION POINT: IF THERE IS ENOUGH TIME, MOVE ON TO CATEGORIZING. IF NOT, ALLOW THE GROUP TO SEE ITS WORK, AND MOVE TO THE QUESTIONNAIRE, BY SAYING: You should be proud of the work your group has accomplished today. You have generated ideas, rated them according to independent criteria, and indicated which are the most important to accomplish, all in less than one half an hour. Are there any comments?)

VIII. TRANSITION: The last tool we are going to use today is designed to categorize your top ideas. This will let the Knowledge Engineer know who is most responsible for the work. You now see in front of you the compilation of the top ideas that you as experts also felt were of the highest priority, as shown by the highest number of dots. Please underline the ten that were most highly rated. We are now going to decide who has the greatest responsibility for implementing each item. Again, we would rather ask the group of experts to decide on the categories, but in the interest of time have also predetermined these for your use today.

IX. DIRECTIONS TO CATEGORIZING: On the BLACKBOARD you see several groups who might have the primary responsibility for implementing each of your ideas. They are: Students, Administration, Community, University

Security, the University Budget Office, and the Faculty. Each group has its own identifying number. You are to put the number of the group with the greatest responsibility for each item next to each of the top 10 items. Please circle your number, to make the category clear. Remember that although several groups may share the responsibility for an item, you must decide on the ONE MOST RESPONSIBLE GROUP for each. Do this as quickly as possible. Any questions?

X. ***TRANSITION:*** ***Thank you for your hard work. You have now generated your ideas, rated them against specific criteria, prioritized them according to importance, and identified the most responsible parties, all in less than one half hour. There is only one more task before we begin final directions. We need to have your responses and opinions about the experience and tools you just used.***

XI. ***DIRECTIONS TO QUESTIONNAIRE:*** ***I am now going to pass out your personalized questionnaire and a pencil. Please take your time in responding to these items. The questionnaire is designed to take no more than 10 minutes, and you have ample time. When you have completed your responses, please look up. In 10 minutes, we will begin our final instructions.(Allow 10 minutes) (Then choose either FINAL DIRECTIONS OR FINAL FINAL DIRECTIONS)***

FINAL DIRECTIONS ***(Monday): This completes your first experimental experience. You will have an opportunity to compare your productivity and satisfaction with your***

experience at your next class. On Friday, you will meet in Chandler 106, working with a trained facilitator on another problem. You will use many of the same techniques, but you will also be using the GDSS network. Please be sure to be there as promptly as possible. I hope you enjoy that experience, and I hope that you have enjoyed this one. Please turn in your surveys as you leave. Thank you, and have a great day.

FINAL FINAL DIRECTIONS (Friday): There is only one more activity for today. At the back of your questionnaire, printed in ivory, is a very brief response form, directed to your impressions of your experiences with the entire study. Your responses and comments will be immensely useful to us. Please take your time in completing this page. Thank you for all of your interest and energy over these two days. If, at any time, you would like to see the results of this study, would like to participate in another GDSS activity, or have questions about GDSS or Expert Systems, please feel free to contact Bob Lewis, in Engineering Management. Please turn in your surveys as you leave. Thank you, and have a great day.

April 22, 1994

KNOWLEDGE ACQUISITION USING GDSS
RESEARCH INTO METHODS OF ELICITATION AND STRUCTURING
OBTAINING A JOB IN YOUR FIELD

I. OVERVIEW

Welcome. The first thing I'd like to do is give you a brief review and overview of what we're going to do today. As you recall, we are going to gather from you, the assembled experts, your best thoughts as to how to solve a problem that has real meaning in your life at ODU. To do that, we are going to use a series of activities that will allow us to gather your ideas, rate them against several independent criteria, prioritize the importance of these ideas, and finally, put them in meaningful categories. The final product will be handed over to a knowledge engineer who will try to incorporate them as the beginnings of an expert system. Please understand that time is a factor here. We are going to get as much done as possible in the time allowed. Part of our evaluation will measure how much was accomplished in each problem setting. We will work as quickly as possible, but if we have to skip a planned activity, please do not worry.

II. INTRODUCE PROBLEM

Today, we are going to be working with a problem that has real-life applications to you as experts - how to land a position in your major area of study after graduation. This is a real-life problem, brought to our attention by the large numbers of recent college graduates who are unable to find professional positions in their fields, and who are either taking minimum wage positions or not working at all. This is a problem that has received a lot of attention, and we are sure that you have already given it some thought. Remember, you are the real experts, who can provide the best answers to how to build a computerized system to follow human reasoning. Your ideas, organized and evaluated, will form the basis of a future expert system.

III. REVIEW OF THE RULES OF BRAINSTORMING: We are going to brainstorm every idea we can think of. Remember that in brainstorming or brainwriting, the goal is to come up with as many ideas as possible in as short a time as possible. No idea is wrong; no idea is too crazy or impractical. No criticism is allowed, however, you are allowed to build, or "piggyback" on each other's ideas if you wish.

Again, our problem is - "How to land a job in your major field of study after graduation." Some of your ideas will be obvious, and there may be repetition. Some will be so creative that they have not been considered before. ALL ideas are acceptable.

IV. DIRECTED BRAINSTORMING: (1ST PHASE - 3 MINUTES:) You will be given 3 minutes to brainstorm your ideas. At the end of the three minutes, I will call time. How do we improve student safety and security on the ODU campus? Ready? Go!

(At the end of the three minutes) STOP. You may finish your last ideas and then stop recording. Please take a look at the ideas you have generated.

2ND PHASE - 2 MINUTES. Research tells us that the most useful and creative ideas arise in a second round of brainstorming. I challenge you to come up with as many ideas in two minutes as you just did in three. Same subject. Ready? Go?

TRANSITION: (Give two more minutes.) STOP. Finish your last idea and stop.

V. INTRODUCTION TO RATING: We now have a wide variety of ideas to evaluate. At this point, we would normally ask you to consider what criteria are important in considering your ideas. To save time today, however, we are going to ask you to rate your ideas against three specific previously-developed criteria - effectiveness, practicality, and acceptability to prospective employers. Since rating is a very quick and efficient tool, we are going to consider each idea three separate times.

VI. INSTRUCTIONS ON HOW TO USE RATING:

EFFECTIVENESS: You are going to use a scale of 1 to 10 to rate each idea according to its effectiveness - that is, how much it is going to help you to obtain a job in your field. If you think that this idea is going to be the most effective possible, give it a 10. On the other hand, if you think it will have no effect at all, give it a 1. Highly effective ideas may rate 8's or 9's, less effective ideas will have lower scores. After entering a number after each idea, move down to the next item. Please use a RED marker to enter your score for each item. Do this as a group, as quickly as possible, and when you are done, please look up. Are there any questions? Start now.

PRACTICALITY. You are now going to rate the same ideas again, this time, only considering how easy each item is to actually accomplish. This time, please use a BLUE marker to record your score next to each item. Any questions? Start now. When you are done, look up and let me know. ACCEPTABILITY. You are now going to evaluate all your ideas just one more time. This time, please consider each according to how well prospective employers will react to and accept. Again, the most acceptable ideas will receive the highest scores. Be sure to use a GREEN marker to enter your score for acceptability. Begin now.

TRANSITION: We have now completed our rating evaluation of all your generated ideas. The next thing we are going to do is pick the top fifteen ideas that you have chosen. These may be self evident. If not, please add the three colored scores for each item together, and divide by 3 to get the weighted score. Please circle the top seven items, and print them again, neatly, on the sheet I have provided to you. We are next going to decide which of these top ideas you, the experts, consider to be the highest priority

VII. DIRECTIONS TO SUB-GROUP. Each of you is being given seven colored stickers. I want you to take just a minute, and make an individual decision. As an individual expert, you are going to choose the five to seven items from the list that you personally most strongly recommend and support. You will do this by placing one dot next to each of your choices. You must pick 5, and may pick no more than 7. Please begin.

(DECISION POINT: IF THERE IS ENOUGH TIME, MOVE ON TO CATEGORIZING. IF NOT, ALLOW THE GROUP TO SEE ITS WORK, AND MOVE TO THE QUESTIONNAIRE, BY SAYING: You should be proud of the work your group has accomplished today. You have generated ideas, rated them according to independent criteria, and indicated which are the most important to accomplish, all in less than one half an hour. Are there any comments?)

VIII. TRANSITION: The last tool we are going to use today is designed to categorize your top ideas. This will let the Knowledge Engineer know who is most responsible for the work. You now see in front of you the compilation of the top ideas that you as experts also felt were of the highest priority, as shown by the highest number of dots. Please underline the ten that were most highly rated. We are now going to decide which factor is most necessary to the accomplishment of each of these ideas. Again, we would rather ask the group of experts to decide on the categories, but in the interest of time have also predetermined these for your use today.

IX. DIRECTIONS TO CATEGORIZING: On the BLACKBOARD you see several factors which might be most necessary in order to have each idea succeed. They are: Money, Contacts, Initiative, Ability, and Established Programs. Each factor has its own identifying number. You are to put the number of the factor that is most necessary for its success next to each of the top 10 items. Please circle your number, to make the category clear. Remember that although several factors may contribute to the success of an idea, you must decide on the ONE MOST NECESSARY FACTOR for each. Do this as quickly as possible. Any questions?

X. TRANSITION: Thank you for your hard work. You have now generated your ideas, rated them against specific criteria, prioritized them according to importance, and identified the most responsible parties, all in less than one half hour. There is only one more task before we begin final directions. We need to have your responses and opinions about the experience and tools you just used.

XI. DIRECTIONS TO QUESTIONNAIRE: I am now going to pass out your personalized questionnaire and a pencil. Please take your time in responding to these items. The questionnaire is designed to take no more than 10 minutes, and you have ample time. When you have completed your responses, please look up. In 10 minutes, we will begin our final instructions.(Allow 10 minutes) (Then choose either FINAL DIRECTIONS OR FINAL FINAL DIRECTIONS)

FINAL DIRECTIONS (Monday): This completes your first experimental experience. You will have an opportunity to compare your productivity and satisfaction with your experience at your next class. On Friday, you will meet in Chandler 106, working with a trained facilitator on another problem. You will use many of the same techniques, but you will also be using the GDSS network. Please be sure to be there as promptly as possible. I hope you enjoy that experience, and I hope that you have enjoyed this one. Please turn in your surveys as you leave. Thank you, and have a great day.

FINAL FINAL DIRECTIONS (Friday): There is only one more activity for today. At the back of your questionnaire, printed in ivory, is a very brief response form, directed to your impressions of your experiences with the entire study. Your responses and comments will be immensely useful to us. Please take your time in completing this page. Thank you for all of you interest and energy over these two days. If, at any time, you would like to see the results of this study, would like to participate in another GDSS activity, or have questions about GDSS or Expert Systems, please feel free to contact Bob Lewis, in Engineering Management. Please turn in your surveys as you leave. Thank you, and have a great day.

FACILITATOR QUESTIONNAIRE

1. What tools did you use and in what order?

2. Which tools appeared most difficult for your groups?

3. Were there dominant figures among your groups? Was participation evenly distributed?

4. Were there idiosyncrasies or particularities about the way each group interacted?

5. Did the degree of control you exerted change between the groups? How tight was the structure you provided?

6. To what extent did debate/conflict occur in your groups?

7. How was rating of ideas achieved?

8. How did sub-grouping occur?

9. Which tools appeared to take the most time, or to be the most difficult, for your groups.

10. Which tools appeared to be easiest for your groups to use?

EVALUATION DIRECTIONS FOR KNOWLEDGE ENGINEERS

Thank you for agreeing to help in this study of Group Decision Support Systems (GDSS) in the self-development of multiple expert-designed pre-prototypical knowledge-based systems. The purpose of this study is to examine the use of GDSS in the development and structuring of ideas for expert systems using multiple experts. As a practicing knowledge engineer, you are being asked:

How useful is the groups' product in helping you build a prototypical expert system.

STRUCTURE OF THE STUDY

This exploratory study followed a model in which participants were divided into randomly assigned groups: half addressed a real-life problem using GDSS, and half worked with the same problem in a facilitated face-to-face group meeting. Each group then switched to the other research model and addressed a new problem. Each session lasted approximately the same amount of time, and the goals for each session were identical. Records were kept of all responses as the groups worked through similar steps toward the goals. You are looking at the results of: brainstorming, sub-grouping, rating, and categorizing the groups' best solutions to the problem. The two problems given were A: How to improve the personal safety and security of students at Old Dominion University, and B: How to get a job in your field for after graduation. You are being given the recorded results from each group's work sessions to evaluate. Again, your goal is to help decide which group results are the most useful for helping the Knowledge Engineer build a prototypical expert system.

DIRECTIONS

Please follow these steps in evaluating the groups' products.

1) Each group of responses has an evaluation form clipped to it. Please take a few minutes to review each set of responses.

2) Use the evaluation questions to describe how useful the package is in helping to build a pre-prototypical expert system.

3) Using a scale of 1 to 5, with 5 Most Useful, check the box that is closest to your feeling about each question.

4) Place any comments or clarification you have in the space provided after each section. Additional comments may be placed on the back of the sheet.

5) When you have completed the list of questions, re-attach the evaluation form back to the response package, and move on the next set.

6) When all are done, place the completed packages in the folder they came in, and call me for pickup.

Thank you for all of your help. I appreciate your interest and support.

Knowledge Engineer's Evaluation Sheet

Knowledge Acquisition and Structuring by Multiple Experts in a Group Support Systems Environment

CRITERIA Please indicate the usefulness of this package in each of the following areas:	SCALE Essentially Useless 1	Slightly Useful 2	Useful 3	Very Useful 4	Extremely Useful 5
Structuring					
Helps prioritize by making the relative importance of ideas clear					
Provides a clear picture of the relationship of ideas					
Structures ideas into a basic organization					
Provides necessary categorizing information					
Comments on Structuring:					
Breadth and Depth					
Provides breadth of data, i.e., the range of ideas seems encompassing					
Provides sufficient complexity and perspective to create required depth					
Comments on Breadth and Depth:					
Pre-prototyping					
Provides sufficient information to construct a pre-prototype expert system					
Allows determination of realistic confidence factors from this data					
Helps to formulate follow-up questions for pre-prototyping					
Comments on Pre-prototyping:					

EVALUATION DIRECTIONS FOR DOMAIN EXPERTS

Thank you for agreeing to help in this study of Group Decision Support Systems (GDSS) in the self-development of multiple expert-designed pre-prototypical knowledge-based systems. The purpose of this study is to examine the use of GDSS in the development and structuring of ideas for expert systems using multiple experts. As a recent graduate and successful job applicant, you are being asked to act as an expert in:

How to land a job in your major area of study for after graduation.

STRUCTURE OF THE STUDY

This exploratory study followed a model in which participants were divided into randomly assigned groups: half addressed a real-life problem using GDSS, and half worked with the same problem in a facilitated face-to-face group meeting. Each group then switched to the other research model and addressed a new problem. Each session lasted approximately the same amount of time, and the goals for each session were identical. Records were kept of all responses as the groups worked through similar steps toward the goals. Your are looking at the results of: brainstorming, sub-grouping, rating, and categorizing the groups' best solutions to the problem. One of the problems given was: How to land a job in one's major area of study for after graduation. You are being given the recorded results from each group's work sessions to evaluate. Again, your goal is to help decide which group results are the most useful in achieving the goal of landing a job in your major area of study for after graduation.

DIRECTIONS

Please follow these steps in evaluating the groups' products.

1) Each group of responses has an evaluation form clipped to it. Please take a few minutes to review each set of responses.

2) Use the evaluation questions to describe how useful the package is in achieving the goal of landing a job in one's major area of study for after graduation

3) Using a scale of 1 to 5, with 5 Strongly Agree, check the box that is closest to your feeling about each question.

4) Place any comments or clarification you have in the space provided after each section. Additional comments may be placed on the back of the sheet.

5) When you have completed the list of questions, re-attach the evaluation form back to the response package, and move on the next set.

6) When all are done, place the completed packages in the folder they came in, and call me for pickup.

Thank you for all of your help. I appreciate your interest and support.

Domain Expert's Evaluation Sheet

How to Land a Job in Your Major Area of Study for After Graduation

CRITERIA Please indicate the usefulness of this package in each of the following areas:	SCALE Strongly Disagree 1	2	3	4	Strongly Agree 5
To Answer these Questions, Please Refer to the Results of the Sub-Grouping Activity Only					
These ideas are effective in reaching the desired goal					
These ideas are well prioritized					
These ideas together provide a good example to follow					
The range of these ideas is exhaustive and complete, i.e, provide breadth					
These ideas provide sufficient detail and perspective, i.e., depth					
To Answer these Questions, Please Consider the Results of All the Activities in the Total Package					
These ideas show originality and diversity					
These ideas are very thorough, i.e., exhaustive and complete					
These are the "right" ideas, i.e., correct and appropriate					
The ideas in this group help me, as an authority in the field, by presenting new information, understanding or perspectives.					

Comments:

April 15, 1994

NAME: SECTION:
PASSWORD: GROUP: CLUSTER:

DEMOGRAPHICS

1. What is your gender? (Circle the letter)
   a. MALE
   b. FEMALE

2. What is your age? (Circle the letter)
   a. LESS THAN 18 YEARS
   b. 18 - 21 YEARS
   c. 22 - 25 YEARS
   d. 26 - 29 YEARS
   e. 30 - 33 YEARS
   f. 34 - 37 YEARS
   g. 38 - 41 YEARS
   h. 42 - 45 YEARS
   i. 45 OR OLDER

3. What is your current professional status? (Circle the letter of the choice closest to your status. Make one choice for each column)

a. FULL-TIME STUDENT	a. NOT WORKING
b. PART-TIME STUDENT	b. PART-TIME JOB NOT RELATED TO STUDIES
	c. PART-TIME JOB RELATED TO STUDIES
	d. FULL-TIME JOB NOT RELATED TO STUDIES
	e. FULL-TIME JOB RELATED TO STUDIES

BACKGROUND EXPERIENCE

4. What is your experience using personal computers? (Circle the letter)
   a. NEVER USED ONE BEFORE
   b. USE SELDOM
   c. USE OCCASIONALLY
   c. USE FREQUENTLY
   d. USE ALL THE TIME

5. How well do you type? (Circle the letter)
   a. HUNT AND PECK
   b. POORLY
   c. FAIRLY WELL
   d. COMPETENTLY
   e. VERY WELL

6. What is your degree of familiarity with conferencing groupware? (Circle the number. Conferencing groupware system is a group of computer terminals linked together by software with all participants working on the same task at the same time.)
   a. NEVER HEARD OF IT BEFORE TODAY
   b. VAGUELY FAMILIAR WITH IT BEFORE THIS SESSION
   c. FAMILIAR WITH IT BUT NEVER USED
   d. LIMITED HANDS-ON EXPERIENCE
   e. PROFICIENT IN ITS USE

7. Based on what you know at this moment, how would you rate your attitude toward using conferencing groupware technology? (Circle the number)
   a. EXTREMELY NEGATIVE
   b. SOMEWHAT NEGATIVE
   c. NEUTRAL
   d. SOMEWHAT POSITIVE
   e. EXTREMELY POSITIVE

8. What is your degree of familiarity with expert systems? (Circle the number. An expert system is a computerized program designed to solve problems by emulating the thought processes of a human expert(s).
   a. NEVER HEARD OF THEM BEFORE TODAY
   b. VAGUELY FAMILIAR WITH THEM BEFORE THIS SESSION
   c. FAMILIAR WITH THEM BUT NEVER USED
   d. LIMITED HANDS-ON EXPERIENCE
   e. PROFICIENT IN THEIR USE

9. Based on what you know at this moment, how would you rate your attitude toward using expert systems? (Circle the number)
   a. EXTREMELY NEGATIVE
   b. SOMEWHAT NEGATIVE
   c. NEUTRAL
   d. SOMEWHAT POSITIVE
   e. EXTREMELY POSITIVE

10. Approximately how many hours per week do you currently spend in meetings,

excluding your educational classes? (A meeting refers to two or more people meeting together for a business or organizational purpose.)
Approximately ________________ hours.

11. Please indicate your responses by circling the appropriate number, using this code:
<u>1 = Strongly Disagree 5 = Strongly Agree</u>

		Strongly Disagree		Neutral		Strongly Agree
a.	I am normally influential in groups	1	2	3	4	5
b.	I like to work in groups	1	2	3	4	5
c.	I contribute a lot to group discussion	1	2	3	4	5
d.	I am normally satisfied with my role in groups	1	2	3	4	5

October 18, 1994

NAME:	**MIS 360**	**SECTION:**
PASSWORD:	**GROUP:**	**CLUSTER:**

Complete this Questionnaire based on your impressions from THIS SESSION ONLY.

GDSS PERCEPTIONS CHECK

1. Please indicate your responses by circling the appropriate number, using this code: 1 = Strongly Disagree through 3 = Neutral through 5 = Strongly Agree

		Strongly Disagree		Neutral		Strongly Agree
a.	Working with the GDSS is often frustrating	1	2	3	4	5
b.	The GDSS is rigid and inflexible to use	1	2	3	4	5
c.	It is easy for me to express myself using GDSS	1	2	3	4	5
d.	It is easy to understand what others think using GDSS	1	2	3	4	5

SATISFACTION WITH PRODUCT

Please indicate your degree of agreement with the following statements by circling the correct number. 1 = Strongly Disagree through 5 = Strongly Agree.

		Strongly Disagree		Neutral		Strongly Agree
2.	I have confidence in our group's recommendations	1	2	3	4	5
3.	I am sure our model will be useful for others to follow	1	2	3	4	5
4.	Our rating, subgrouping and categorizing were thorough enough for good recommendations	1	2	3	4	5

PERSONAL SATISFACTION

Please indicate your degree of agreement with the following statements by circling the correct number. 1 = Strongly Disagree through 5 = Strongly Agree.

		Strongly Disagree		Neutral		Strongly Agree
8.	I felt comfortable to disagree with other members' ideas	1	2	3	4	5
9.	I freely offered my own ideas	1	2	3	4	5
10.	I remained interested and attentive to the group's activities	1	2	3	4	5

PERCEPTION OF GROUP INTERACTION

Please indicate your degree of agreement with the following statements by circling the correct number. 1 = Strongly Disagree through 5 = Strongly Agree.

		Strongly Disagree		Neutral		Strongly Agree
11.	People worked together better than in most groups	1	2	3	4	5
12.	Participation in the activities was evenly distributed	1	2	3	4	5
15.	Ideas expressed in the group were critically examined	1	2	3	4	5
17.	The facilitator effectively guided the group toward its goal	1	2	3	4	5

PROFESSIONAL SATISFACTION

Please indicate your degree of agreement with the following statements by circling the correct number. 1 = Strongly Disagree through 5 = Strongly Agree.

		Strongly Disagree		Neutral		Strongly Agree
18.	I now have a much better understanding of how other members of my group view this issue	1	2	3	4	5

		1	2	3	4	5
19.	This meeting made me critically reevaluate my own thoughts on the topic	1	2	3	4	5
20.	The meeting uncovered ideas that I had not thought of individually	1	2	3	4	5
21.	Members were able to provide enough information about their ideas	1	2	3	4	5

FUTURE COMMITMENT

Please indicate your degree of agreement with the following statements by circling the correct number. 1 = Strongly Disagree through 5 = Strongly Agree.

YOU WILL NOT BE ASKED for any future commitment of time, but respond as if this were a real-life situation.

		Strongly Disagree		Neutral		Strongly Agree
22.	I am committed to my group's model	1	2	3	4	5
23.	I would be willing to participate in the group's next task in developing this model	1	2	3	4	5
24.	I would be willing to work with this group again on another task	1	2	3	4	5
25.	I would be willing to work with another group of people to refine this expert system	1	2	3	4	5

April 18, 1994

NAME:	**MIS 360**	**SECTION:**
PASSWORD:	**GROUP:**	**CLUSTER:**

Complete this Questionnaire based on your impressions from THIS SESSION ONLY.

GROUP FAMILIARITY

1. Please write the number of people in your group whom you: (Fill in the blanks. Be sure to fill in a number for each letter).
   a. DO NOT KNOW AT ALL________
   b. RECOGNIZE BUT THAT'S ABOUT ALL_______
   c. HAVE TALKED WITH 2 OR 3 TIMES BEFORE_______
   d. HAVE BEEN IN CLASSES WITH BEFORE_______
   e. KNOW VERY WELL OR HAVE WORKED WITH ON PROJECTS BEFORE_______

SATISFACTION WITH PRODUCT

Please indicate your degree of agreement with the following statements by circling the correct number. 1 = Strongly Disagree through 5 = Strongly Agree.

	Strongly Disagree		Neutral		Strongly Agree
2. I have confidence in our group's recommendations	1	2	3	4	5
3. I am sure our model will be useful for others to follow	1	2	3	4	5
4. Our rating, subgrouping and categorizing were thorough enough for good recommendations	1	2	3	4	5

PERSONAL SATISFACTION

Please indicate your degree of agreement with the following statements by circling the correct number. 1 = Strongly Disagree through 5 = Strongly Agree.

		Strongly Disagree		Neutral		Strongly Agree
5.	I feel that the final model reflects my inputs	1	2	3	4	5
6.	I feel that my time in the group was productive	1	2	3	4	5
7.	I enjoyed working with this group	1	2	3	4	5
8.	I felt comfortable to disagree with other members' ideas	1	2	3	4	5
9.	I freely offered my own ideas	1	2	3	4	5
10.	I remained interested and attentive to the group's activities	1	2	3	4	5

PERCEPTION OF GROUP INTERACTION

Please indicate your degree of agreement with the following statements by circling the correct number. 1 = Strongly Disagree through 5 = Strongly Agree.

		Strongly Disagree		Neutral		Strongly Agree
11.	People worked together better than in most groups	1	2	3	4	5
12.	Participation in the activities was evenly distributed	1	2	3	4	5
13.	Members were able to express opposing ideas	1	2	3	4	5
14.	The group used its time wisely	1	2	3	4	5
15.	Ideas expressed in the group were critically examined	1	2	3	4	5

16.	One or two members strongly influenced the group's decisions	1	2	3	4	5
17.	The facilitator effectively guided the group toward its goal	1	2	3	4	5

PROFESSIONAL SATISFACTION

Please indicate your degree of agreement with the following statements by circling the correct number. 1 = Strongly Disagree through 5 = Strongly Agree.

		Strongly Disagree		Neutral		Strongly Agree
18.	I now have a much better understanding of how other members of my group view this issue	1	2	3	4	5
19.	This meeting made me critically reevaluate my own thoughts on the topic	1	2	3	4	5
20.	The meeting uncovered ideas that I had not thought of individually	1	2	3	4	5
21.	Members were able to provide enough information about their ideas	1	2	3	4	5

FUTURE COMMITMENT

Please indicate your degree of agreement with the following statements by circling the correct number. 1 = Strongly Disagree through 5 = Strongly Agree.

YOU WILL NOT BE ASKED for any future commitment of time, but respond as if this were a real-life situation.

		Strongly Disagree		Neutral		Strongly Agree
22.	I am committed to my group's model	1	2	3	4	5
23.	I would be willing to participate in the group's next task in developing this model	1	2	3	4	5
24.	I would be willing to work with this group again on another task	1	2	3	4	5

25. **I would be willing to work with <u>another group</u> of people to refine <u>this</u> expert system** 1 2 3 4 5

NAME:__________________________

FOLLOW-UP SURVEY

1. Which of the two experiences did you personally enjoy more?

   a. GDSS
   b. Face-to-Face

2. Which of the two organized lists of ideas would you more strongly recommend to others?

   a. Safety and Security at ODU
   b. Landing a Job in My Field

3. My best ideas came from the experience in:

   a. Safety and Security at ODU
   b. Landing a Job in My Field

4. I was most satisfied with the way we organized ideas in:

   a. GDSS
   b. Face-to-Face