AN EMPIRCAL STUDY OF THE FACTORS DETERMINING PERCEIVED USEFULNESS OF GROUP DECISION SUPPORT SYSTEMS

PARAG PENDHARKAR

PENN STATE UNIVERSITY

MEHDI KHOSROWPOUR

PENN STATE UNIVERSITY

GIRISH SUBRAMANIAN

PENN STATE UNIVERSITY

DAVID JUNKIN

PENN STATE UNIVERSITY

ABSTRACT

Group Decision Support Systems (GDSSs) have been developed to meet the increasing demand of computer mediated group work. Previous research shows that GDSS improves the quality of decision making in organizations. In the current research, we investigate the factors that improve the user evaluations (perceptions) of GDSSs by MIS practitioners in the North Eastern US. A set of hypotheses was derived from the literature and was tested using a survey MIS professionals from several professional organizations and companies in Northeastern US. Our research indicates that the need for anonymity, higher level of interaction, increase in information ambiguity, and increase in the size of decision making group increases the perceived usefulness of GDSSs of the practitioners.

INTRODUCTION

Today's information age environment is characterized by increased knowledge and greater complexity [27][15]. Decision making in today's complex environment is more complex, more frequent and more important [25]. The complexity of decision making environment calls for group decision-making and groups, rather than individuals, make most of the decisions [1]. A study by Alavi [6] shows that managers spend 40-70% of their time in meetings, which are often very inefficient. Dennis et al. [11] report that one Fortune 500 company lost about $71 million each year due to ineffectively managed meetings.

Among the reasons of ineffectively managed meetings are unstructured and unfocused approaches on the task at hand [38], domination by certain members in the group [46][38], and absence and shyness of certain individuals [46]. In addition, individual's political agenda and poor recollection of the events in the meeting can

cause many decisions to be made twice [39][46]. Sometimes even scheduling a meeting to have all of the right people together is a challenge.

In the early 1980's computer systems were developed to support groups in making decisions. These systems were called Group Decision Support Systems (GDSSs). A simple definition of a GDSS is software, hardware, language components and procedures that support a group of people engaged in a decision related meeting [26]. The objective of a GDSS was "to improve the process of group decision making by removing common communication barriers, providing techniques for structuring decision analysis and systematically directing the pattern, timing or content of decision" [15].

In this research, we investigate the factors that determine the perceived usefulness (user evaluations) of GDSSs by IS practitioners. The specific variables that are investigated in this research are the impact of group size, perceived need for anonymity, level of interaction and ambiguity of the decision problem on perceived usefulness of GDSS by IS practitioners. The contribution of our study is towards understanding the user evaluations of GDSS. Goodhue [22] argues that ".. task-technology fit will have performance impacts, and users can reliably evaluate task-technology fit." According to Goodhue [22], user evaluation is one way to measure IS success and user evaluation depends upon system, task and individual characteristics. Very few studies were focused on measuring the user evaluations of GDSS. The user evaluations of GDSS are important because they help us understand the GDSS features that assist or hinder the performance of the users of GDSS. Our current research approach is consistent with the task-technology fit model proposed by Goodhue [22] since our variables are concerned with task, technology and individual factors of the GDSS users.

The rest of the paper is organized as follows: in the next section, we review the literature related to anonymity, group size, ambiguity and level of interaction in GDSS and propose a set of hypotheses. In the section after literature review, we describe our research design and data collection procedure. A section, after the research design, describes the results of our data analysis in support of our proposed hypotheses. After the data analysis we provide a section describing the contribution of our study. In the end, we conclude with a brief discussion and directions for future work.

Review of Literature on Anonymity, Group Size, Ambiguity and Level of Interaction

Anonymity has been labeled as a key feature in GDSS by many field and experimental studies [24][11][46][3][18]. Webster's defines anonymous as something of unknown or unnamed origin. It can also be considered without personality [48]. Early non-computer-supported group decision processes, such as the Delphi Technique, attempted to improve the communication process by providing anonymity [24]. It was recognized that there are several process losses that occur because we as humans, due to shyness, fear or politeness are sometimes not honest or forthright in our comments or ideas.

The losses that may be addressed by anonymity include conformance pressure and evaluation apprehension. Conformance pressure and evaluation apprehensions are opposites. Conformance pressure is when one holds back criticizing or modifying an idea out of politeness or because they are afraid of reprisals [38]. The fear is usually present when a meeting involves people of differing levels in the organization hierarchy. The desire to spare others' feelings can outweigh a desire to honestly contribute an idea. This phenomenon is known a "Groupthink" [29].

Evaluation apprehension occurs when one withholds an idea because of fear of negative evaluation [38][43]. Members may contribute anonymously using a GDSS tool of electronic brainstorming or idea evaluation. The theory suggests that anonymity not only reduces conformance pressure but also provides a process gain such as more objective evaluation. Another benefit of anonymity is that members of a group will be less likely to hold on to an opinion out of pride if the conversation up to that point has been anonymous [18][39].

A study by Yellen, Winniford and Sanford [50] attempted to draw a correlation between an individual's personality type and the use of anonymity. The study used individuals who, according to the Extroversion Introversion measure from the Myers Briggs Type indicator (a personality test), were either an introvert or an extrovert. An extrovert is one who is impulsive and gregarious. An introvert is one who prefers to work alone, thinks before acting and dislikes distractions. There were an equal number of introverts and extroverts, and each had an idea-generating session with and without a GDSS. The GDSS communication was anonymous. It was discovered that introverts were less inhibited in a GDSS environment. Both introverts and extroverts produced more original solutions with GDSS. There was a reduction in the total number of comments. It is difficult to isolate these findings to anonymity. They could be attributed to parallel communication offered by GDSS. However, the fact that the introverts were less inhibited may indicate that the increase in original solutions can be attributed partly to the use of anonymity. The authors attributed the lack of shift to the anonymous communication. Those who communicate anonymously are more honest up front and will be less

likely to verbally support an idea with which they do not agree [32].

A study was performed to measure anonymity with people of different cultures [4]. The GDSS could interpret several languages. Even if an individual speaks another language, if it is not their native tongue, they may feel very self-conscious using it. Anonymity would allow them to contribute without having to worry about language and cultural norms. The test proved that the translation could be used, but unfortunately they did not compare the results to a non-GDSS group. This could prove to be an important tool for international organizations.

One experiment by Nunamaker, Dennis, Valacich and Vogel [39] studied the effect of anonymity and critical tone on outcomes. A critical tone is evidenced by comments such as "Bad Idea" and "That was a terrible alternative." Supporting tone includes "Good idea" and "I think that would work." The grouping of critical tone with anonymity produced more solutions at a higher quality. Overall, regardless of critical tone, the anonymous groups had more solutions and the solutions were of a higher quality. The anonymous groups were slightly less satisfied.

Jessup, Connolly and Galegher [29] compared GDSS-supported groups that used anonymity with those that did not in an idea-generation task. The groups that used anonymity produced more solution clarifications, had more critical comments, more questions about solutions and more total comments. This shows that anonymity can positively affect group outcomes independent of parallel communication. Jessup and Tansik [30] performed a similar study that examined the effects of anonymity and proximity on GDSS users. Anonymous groups produced more solutions. Dispersed groups generated more solutions. The combination of the two generated the most. They found no correlation between proximity and critical tone or anonymity and critical tone. They found no correlation between anonymity and satisfaction. This again supports the theories pertaining to how anonymity effects group processes.

Zigurs, Poole and DeSanctis [51] studied the effect that GDSS with anonymity has on influence behavior, which is communication that attempts to affect or determine the course of group behavior. They hypothesized that the amount of influence behavior would not change between GDSS and non-GDSS groups and that the distribution of the influence behavior would be more equal in the GDSS supported group. It is not certain whether these results could be attributed to parallel communication, which would prevent production blocking and dominance, or to anonymity.

Another study was performed by Sheppard, Briggs, Reinig, Yen, and Nunamaker [43] to see if results of anonymous groups could be improved by attempting to reduce free riding. This was done through social comparison, matching an individual's performance to the rate of those working around them. One group performed GDSS anonymously without social comparison. Another group performed GDSS anonymously but this time a graph appeared on the comer of the screen representing how they were doing relative to the "average" group. They found that the group with social comparison did better by producing more unique ideas. This shows that free riding does occur.

Massey and Clapper [36] determined through a comparison of GDSS groups (using anonymous communication) and non-GDSS groups participating in framing a task that participants felt more comfortable sharing and less worried about what other group members felt towards them when they used the GDSS. They also found that participants were more comfortable discussing sensitive issues, expressing strong feelings toward others and expressing negative feelings toward others when using a GDSS as compared to when they were not using a GDSS. Finally, a study by Aiken, Krosp, Shirani and Martin [3] determined that technology can impact evaluation and that evaluation apprehension increases with group size.

Some have claimed that anonymity leads to de-individualization which may be the reason some anonymous groups are less satisfied [30][18]. In addition, it may be difficult to rehash unworkable ideas from surfacing. In traditional meetings the senior members can stifle ideas that have been deemed unworkable [18]. Yet there is not much statistical evidence that anonymity is unsatisfying. The dissatisfaction could be due to the reduction in socialization. Anonymity certainly does not seem to lower satisfaction when used in field studies as was mentioned in the previous section. It is interesting to note that one of the sub-variables of the variable Context is the incentives or rewards that are available to those using the EMS. Anonymity may make it more difficult to reward those who are contributing. Participants may not be as open with their ideas if there is no way to obtain credit for their intellectual contribution [21]. No studies were found attempting to draw a correlation between anonymity and rewards. Given the pros and cons of anonymity, we propose the following hypothesis in null form:

Hypothesis 1: The perceived need for anonymity doesn't have an impact on the perceived usefulness of GDSS.

Group size has been cited as having an impact upon the outcomes of GDSS groups [15][11][38][3]. Exactly how group size influences the outcome of a non-GDSS supported group needs to be explored. Both positive and negative influences are created as the group size increases.

On the positive side, the number of potential information exchanges increases geometrically with group size. Also, there is a greater desire to share information [15]. This can be mapped to the process gains of synergy and more information [38]. On the negative side, the frequency, duration and intimacy of information decrease as the size of the group increases. There is also less of a tendency to give an opinion, ask for an opinion or arrive at a consensus [15]. There is also less of a chance to contribute as the size increases; members must wait their turn [47].

These negative influences can be mapped to the process losses of airtime fragmentation, production blocking and failure to remember [3]. There may also be increased conformance pressure and evaluation apprehension [39]. Overall, because the process losses grow faster than the process gains, as the size of the group grows, efficiency, effectiveness and satisfaction decrease [39]. This is why prior to GDSS the optimal size for a meeting was 3-5 individuals.

GDSS can address the process losses of airtime fragmentation and production blocking with the parallel communication it offers. Failure to remember can be reduced by providing a log of events that occurred during the meeting. Conformance pressure and evaluation apprehension may be reduced even if there is no anonymity. Some groups have experienced a degree of anonymity because as the size of the group grows it becomes more difficult to remember who said what. One type of GDSS, video conferencing, does not perform as well with larger groups. Even if there is a log to record what happened during the meeting, the airtime fragmentation and the production blocking are not as significantly reduced, because most video conferencing systems have no parallel communication. A study by Gowan and Downs [23] concluded that "the effectiveness of communication support may diminish as meeting groups are added to a video conference or remote group size increases." The study also inferred that there may be an effective maximum number of participants.

With the process losses minimized and process gains unaffected by the GDSS, the overall outcome should be an increase in efficiency, effectiveness and satisfaction as the group size grows. Claims have been made that GDSS may not be as effective with smaller groups because there is not as much synergy and there is less production blocking [20]. Experiments and field studies focusing on group size supporting the previous claims need to be examined.

A study was performed on how group size affects electronic brainstorming [20]. The outcomes of GDSS and non-GDSS groups of three different group sizes were compared. The performance of the non-GDSS group in terms of efficiency, idea quality and satisfaction did not increase with size. In contrast, the GDSS groups' performance in all three areas increased as group size increased. Nunamaker, Dennis, Valacich and Vogel [39] performed five experiments with three using group size as an independent variable. The first measured performance against anonymity and group size. The larger groups generated significantly more options of greater quality. Satisfaction differences were not significant. The second experiment looked solely at group size in three categories. The larger groups were more effective and had higher satisfaction. The third compared large groups to smaller pooled groups. They found that one larger group produced more options than the same number of participants working in nominal or pooled groups. The last experiment looked at group size and proximity. Once again the large groups were more effective. Efficiency differences were not significant and satisfaction was not measured.

An experiment by Aiken, Krosp, Shirani and Martin [3] determined that during the act of brainstorming, production blocking does stay relatively flat with GDSS groups as the size increases and production blocking grows with group size for non-GDSS groups. They did find that the smaller GDSS group had no perceived difference in production blocking and evaluation apprehension from a smaller non-GDSS group. They found any evidence to suggest that large group GDSS is superior to smaller group GDSS.

A different study by Hwang, and Guynes [28] examined group size and the entire decision process by comparing small and large GDSS and non-GDSS groups. They found that the large GDSS group did better than the small GDSS group. Quality of decision making of the large GDSS was improved. However, the efficiency difference between the large GDSS and large non-GDSS was not statistically significant. They concluded that there is no basis for claiming that GDSS is required to help make large groups more productive as was previously thought. The limitations of this discussed in the study by Dennis, Nunamaker, and Vogel [14] have already been addressed.

GDSS has been shown to allow a greater number of individuals to participate in process modeling (an activity in software engineering) with a significant increase in efficiency [10]. Case studies have found that for a distributive environment to work at least ten people should be involved [45]. The mean size of groups from IBM, previously mentioned in GDSS vs. Non-GDSS section, was 8.27. Showing that larger groups could be handled by GDSS than non-GDSS. A case study of an organization, Burr-Brown, which used GDSS with a large group for three days with a member size of 31 showed that it was an efficient, effective and satisfying experience [12]. We propose the following hypothesis in null form:

Hypothesis 2: The perceived size of the decision making group doesn't have an impact on the perceived usefulness of GDSS.

All of the foundational conceptual models include the task being performed as a major variable. Huber [24] states that tasks are complex, and sensitive in nature and therefore well suited for GDSS. DeSantis and Gallupe [15] included task in their three-dimensional research model. The model considers the task into three categories, Generating, Choosing, and Negotiating. A different level of support is then assigned for each task type. According to their study, the task type accounts for as much as 50% of the variance of a groups' performance [15].

Nunamaker, Dennis, Valacich, Vogel and George [38] included task as an impact on the process, carried over from Dennis et al. [11]. Within the task variable are task type and complexity. The influences of task support and task structure were added as two additional ways that a GDSS could impact the process. Gowan and Downs [23] suggest that for video conferencing system (VCS) success the system must support a specific task and that the effectiveness of a VCS varies from task to task.

With such a rich conceptual foundation one would expect there would be several studies comparing one task type to another. Almost every experiment will state the task at hand, either the desired goal, (example, solve problem X) or how it will be solved (brainstorming). Some studies group the task into one of the categories and document how this task is different. For example, a judgment task, one that has no "correct" answer, is better measured by consensus versus decision quality. Consensus among members is seen as a key factor in implementing the decision [16]. Another characteristic of judgmental tasks is that they can experience choice-shift. This means that individuals make a decision differently by themselves than in a group [32]. However, an overarching definition of how task types influence the GDSS process is much like Huber predicted, trial and error to see if GDSS works well with particular types.

Several studies report some level of success in having GDSS/EMS positively impact the task being performed [7][35][2][34][19][42][13][31]. Four of the aforementioned studies deal with some form of software engineering. Complexity is listed as one of the inherent aspects of software engineering that makes it so difficult. In fact, it has been stated that "software is more complex than any other construct made by human beings" [41]. Dennis, Nunamaker and Vogel [14] suggest that GDSS is very well suited to deal with what are called "wicked" problems. These are problems that are very complex, cannot be formulated or written down on paper, are on going with no end, and have no ultimate test as to the "goodness of the solution."

Among the different attributes of a given task, level of interaction to complete a task constitutes an important factor. A study by Migliarese and Paolucci [37] states that the increasingly competitive nature of business is causing the removal of slack resources, extra resources within an organization that make operation easier. This means fewer resources are available, which leads to more interdepartmental dependencies and need for higher level of interaction. This in turn leads to more complex problems. The study suggests that GroupWare is the right tool to meet this need of higher level of interaction. Most of these tasks have the potential of saving money (software development costs) or making money (strategic advantage) for the organization.

In summary, higher level of interaction arising from complex tasks and tasks that cross-organizational boundaries is obtained from using GDSS. This leads to the following hypothesis in null form:

Hypothesis 3: The perceived need for higher level of interaction in a task doesn't have an impact on the perceived usefulness of GDSS.

Various taxonomies and research models consider the proximity, or physical closeness, and the time aspect, using the system at the same time or at different times. These taxonomies categorize the impacts upon not only the design of a GDSS but also its application and use. There are two classes for each facet of proximity and time. Proximity is either face-to-face, in the same room, or it is dispersed. Time is either synchronous (members participate at the same time) or asynchronous, (members participate at different times). Often if a system supports dispersed meetings it will also support asynchronous meetings. This gives the GDSS an "anytime/anyplace" characteristic that is appealing to users and is considered a key feature in implementing a GDSS [49]. Hereafter, the term distributed will refer to dispersed, asynchronous GDSS. This feature allows for easier scheduling of meetings, saved expenses in travel-related costs and the ability to finish things more quickly [21].

Jessup and Tansik [30] conducted an experiment using proximity as an independent variable. They determined that dispersed groups generate more solutions and were more likely to adopt an idea and challenge a solution. They also concluded that the dispersed groups were less satisfied. In addition, Nunamaker, et al. [38] quote similar studies of proximity. In one case dispersed groups did not generate more ideas and satisfaction was down. In the second case the dispersed group created more ideas and the satisfaction was unchanged.

In another study, users of GDSS in a remote setting were not less satisfied with the process or the outcome than

those using GDSS in a same-place, same-time setting. There was a significant difference in satisfaction between GDSS and non-GDSS, with non GDSS being more satisfied [8]. Here it was the tool, not the distance that made the difference.

Lack of satisfaction could be due to a reduction in socialization [17]. If this were the case, then asynchronous groups would suffer the same feelings. Aiken, et al.[3] suggest that the lack of media richness is a disadvantage in electronic brainstorming. In a disbursed setting, participants do not have any other means of communication and this may lead to ambiguity. The lack of media richness leaves participants not quite sure how to interpret remarks that were meant to be sarcastic or funny. This lessens the sense of camaraderie.

Distribution characteristics also impact other previously examined characteristics of GDSS. There have also been claims that distributed groups are only effective when there is a minimal group size of 10 [45]. Distributed groups also can have the characteristic of pseudo anonymity. This is caused by the remoteness [38][21]. As was mentioned earlier, some claim that anonymity creates a deindividllalized environment.

John Chisholm [9] suggests that "electronic media alone cannot replace real face-to face contact, especially when group efforts are beginning or concluding." In the beginning of a meeting members are introduced to one another. They identify common values and build trust in one another. Without face-to-face contact up front, it is difficult for individuals to not only share risky ideas but also to rally behind an idea and implement it. Likewise, at the end of a meeting when negotiations may be required to reach a final decision, face-to-face meetings are of value. People may feel that the procedure is cold and may feel remote. The communication channels described by Zigurs, Poole and DeSanctis [51] may shed some light. In the periods where people are most vulnerable, at the beginning and end of a meeting, media richness may be the most important criteria. As discussed earlier, an electronic channel has the lowest media richness.

Er and Ng [18] state that researchers repeatedly ignore the fact that people talk before and after a meeting. Proximity and face-to-face meetings are likely to cause extra communication between the members of the group. This extra communication often reduces some ambiguities and sometimes alters the decision in a meeting. Er and Ng suggest that in addition to completing the desired task, reducing ambiguity and fostering extra communication, face-to-face meetings serve as the means of achieving and maintaining peer recognition in an organization. This interaction is used to fulfill one's personal need for social interaction. When this is missing, the meeting is less satisfying.

Hypothesis 4: The perceived need for reduction in ambiguity doesn't have a impact on the perceived usefulness of GDSS.

Research design and Data Collection

Previous research in adoption, user evaluations and diffusion of information technology (IT) suggests that a user's perceived usefulness and perceived ease of use of IT determines the actual usage of IT by the user. In the current research, we are studying the IS professionals perceptions of usefulness of GDSS. Based on our literature review, we conclude that anonymity, group size, ambiguity, and level of interaction needed for a decision making task will increase the perceived usefulness of GDSS.

Ideally, the perceptions of those who have used GDSS/EMS would be the most valuable. However, "attitudes towards the GDSS emerge through interpretations based on group members' past experiences with related technologies and procedures, training and related information provided to them about the GDSS, and their active exploration of the GDSS capabilities" [40]. Recent research suggests that electronic "chat" groups, Delphi groups and electronic discussion groups such as the "Usenet" can be categorized as EMS [33]. Considering the participation in electronic "chat" groups, video/telephone conferencing and other electronic discussion groups, all of our survey respondents had some experience in using GDSS. Only 73 of our 126 respondents had used a GDSS (other that internet "chat" groups, video/telephone conferencing and other electronic discussion groups on the internet). The subjects of our study were those who attended various IS professional organizations in the North Eastern US. The organizations were professional data processing organizations, computer professional organizations, and South Central Pennsylvania Chapter. In addition to the professional organizations several subjects in the following companies were mailed our research survey: ADT Data Systems, Harsco, Blue Shield, Rite Aid Corporation, Woolworths, York International and Pennsylvania Higher Education Agency. Our subjects represented the fields of government, technology, industry, retail and health care.

Our research methodology consisted of soliciting response from MIS professionals using a survey and then testing our proposed hypotheses using multiple regression. The dependent variable for our research was IS professionals perceptions of usefulness of GDSS and the independent variable was perceived need for anonymity, perceived need for reduction in ambiguity in decision making, perceived size of decision making group, and perceived level of interaction in the decision making task.

A survey was drafted consisting of four main sections. Section 1 included questions related to the information about the participant's organization. Section 2 included questions related to the information on the participant's experiences with GDSS, characteristics to group size, task complexity and interaction, anonymity and ambiguity. Section 3 included several questions on independent and dependent variables. The responses for questions in Section 3 were sought using a 5 point likert scale. Section 4 consisted of open-ended questions for the subjects to provide positive, negative and other general information regarding GDSS that was not previously covered in the survey.

There were a total of about 500 surveys, which were mailed and hand delivered. A total of 134 surveys were returned from the members of professional organizations and previously mentioned organizations. Due of the method of distribution and selection of sample for our survey, a formal response rate was not calculated. Seven surveys were removed from the study because they were incomplete. The next section details the results of our data analysis.

Results

The results of the survey were entered in spreadsheet, a database and into a SAS program. Tables 1 through 5 show the demographics of the respondents and provide information on the organizations the respondents worked in.

Table 1: Organization Types

Industry	Frequency	Percent
Health Care	25	19.7
Retail	22	17.3
Industrial	21	16.5
Financial	15	11.8
Government	14	11.0
Service	13	10.2
Technological	10	7.9
Non Profit	3	2.4
Other	3	2.4
Military	1	0.8

Table 2: Organization Size by Number of Employees in the Organizations

Number of Employees in Organization	Frequency	Percent
1-100	13	10.2
101-500	39	23.6
501+	83	65.4
Did not answer	1	0.8

Table 3: Organization Size by Annual Sales

Annual Sales	Frequency	Percent
Not Answered	24	18.9
Under 1 million	5	3.9
1 million to 500 million	42	33.1
501 Million - 1,000	13	10.2
Million	43	33.9
Over 1,000 million		

Table 4: Title of Respondents

Job Title	Frequency	Percent
Did not answer	3	2.4
Programmer/Technician	42	33.1
Analyst	35	27.6
Line Management	11	8.6
Mid Level Management	17	13.4
High Level Management	15	11.7
Other	3	3.2

Table 5: Age of Respondents

Age of Participant	Frequency	Percent
Under 25	2	1.6
25-44	90	70.8
45-64	34	26.8
65+	1	0.8

Majority of our respondents worked in health care and retail industry. We had a good distribution in terms of size of an organization both in terms of number of employees and sales revenue. The majority of our respondents were programmers and people working in technical division in an organizations. This was due to the manner the survey was distributed. Since most of our respondents were members of IS and other technical societies, there was a response bias in the titles of the respondents. Majority of our respondents were between 25 to 44 years old.

We used multiple regression to test our proposed hypothesis. In order for independent variables to be used in multiple regression, a test for collinearty needs to be done for independent variables. Table 6 shows the results of correlation between the independent variables. The pearson correlation coefficients show that all the independent variables had a correlation coefficient lower that 0.4 and independent variables didn't show multicollinierity.

Table 6: Pearson Correlation Coefficients for Independent Variables

	Group Size	Ambiguity	Level of Interaction	Anonymity
Group Size	1.00 (0.0)	0.38 (0.0001)	0.27 (0.002)	0.25 (0.004)
Ambiguity		1.00 (0.0)	0.24 (0.007)	-0.089 (0.32)
Level of Interaction			1.00 (0.0)	0.23 (0.01)
Anonymity				1.00 (0.0)

Note: The numbers in the brackets are significance levels.

Tables 7 and 8 show the overall results of the multiple regression and the individual Type I sum of square significance of the independent variables.

Table 7: The Overall Model Sum of Square Significance

Source	DF	Sum of Squares	Mean Square	F Value	P>F
Model	4	36.86	9.21	26.91	0.0001
Error	22	41.77	0.34		
Total	126	78.63			

$R^2 = 0.47$

Table 8: The Individual Type I Sum of Squares Significance

Source	DF	Type I SS	Mean Square	F Value	P>F
Group Size	1	9.41	9.41	27.47	0.0001**
Ambiguity	1	2.98	2.98	8.69	0.0038**
Level of	1	11.98	11.98	35.00	0.0001**
Interaction	1	12.49	12.49	36.48	0.0001**
Anonymity					

**α =0.01 (level of significance)

Table 7 shows the overall significance of our model. Based on the results from Table 7, we can say that overall variance in independent variables explains the variance in the dependent variable. The value of R-Squared for the overall model is 0.47. This indicates that our set of independent variables are not comprehensive. However, for the independent variables that we considered in this study for the four proposed hypotheses, all the independent variables significantly explained the variance in the dependent variable. At the level of significance of 0.01, all the four null hypothesis were rejected. This leads to the following conclusions:

1. Increase in the size of decision making group leads to better perceptions of usefulness of GDSS.
2. Increase in the ambiguity of information in decision making leads to better perceptions of usefulness of GDSS.
3. Higher level of interaction needed for a decision making task leads to better perceptions of usefulness of GDSS.
4. The need to maintain anonymity in a decision making task leads to better perceptions of GDSS.

GDSS has much to offer to an organization. It can aid in making meetings efficient by providing a unique form of communication via an electronic channel. Our results suggest that user will feel that a GDSS is useful to them if it can help them communicate anonymously, remotely and at different times to reduce ambiguity and support higher level of interaction and size of group. The need for anonymous communication varies from organization to organization. The following characteristics impact the need for anonymity in an organization: 1) The sensitivity of the topic, 2) the differences in job or power level of those who attend meetings, and 3) the corporate culture concerning authority and reward.

Organizations where individuals have hard time making it to meetings have more to gain from GDSS than those that don't. Scheduling a meeting is at times difficult when the size of the group is large. Furthermore, when the frequency of meeting reduces ambiguity increases and need for level of interaction increases. Given the interdependence of the three independent variables, we logically group these variables into a need for connectivity factor. We ran an exploratory factor analysis on the three independent variables. Table 9 illustrates the results of our factor analysis. All the three independent variables loaded on one factor (need for connectivity). The reliability of the factor, as measured by chronbach alpha was 0.56.

Table 9: Total Factor Loading for "Need for Connectivity" Factor

Variable	Factor Loading
Group Size	0.778
Ambiguity	0.754
Level of Interaction	0.653

Based on the results of our exploratory study, we suggest the following empirical model:

Perceived usefulness of GDSS = Need for Anonymity + Need for Connectivity.

CONTRIBUTION OF THE STUDY

The contribution of this study is in allowing the users of the GDSS evaluate the technology based on their individual, task and technology characteristics. While most studies use students as the subjects [33] for evaluating the performance of GDSS, the current study focused on using the practitioners to evaluate of the GDSS. We didn't use a specific GDSS and our definition of EMS/GDSSs included corporate intranets, chat and Usenet groups [33]. The proliferation of intranets makes it easy for companies to develop and implement GDSS. An intranet is a "mini-Web" hidden behind the corporate firewall. Several companies are using intranets to improve communication and decision making. The current study measures the perceptions of IS professionals towards GDSSs. We believe that the user evaluation of GDSS will provide an understanding of the user needs and expectations, and may improve and foster the development of GDSSs in organizations.

CONCLUSIONS AND FUTURE RESEARCH

As the business climate becomes more fast-paced and competitive, organizations search for the ways to gain an advantage over their competitors. One area that is a potential target is the traditional group meeting and decision-making process. The traditional decision making process is often inefficient and ineffective when groups are large and levels of interactions, needed for decision making, between the members are high. Among the reasons for inefficient decision making using the traditional approach are nature of group communication, social realities concerning how one addresses a peer or a superior and the unavailability of key people. In an attempt to reduce the inefficiencies due to the traditional group decision making process, research has focused on the ways that computer systems can impact the decision making process through the use of GDSS.

The purpose of this study was to determine how a GDSS is perceived and used by information systems professionals in the North Eastern US. A survey-based methodology was used to test four hypotheses derived from the literature. Based on the results of our survey all the four null hypotheses were rejected. The results of the survey suggest that GDSS is a useful tool where decision making group members need to maintain their anonymity of the decisions, and establish connectivity with the other members of the group. The need for connectivity arises from the larger group sizes, ambiguity of the decisions and higher levels of interactions needed for the decision-making tasks.

The results of our study can be used in various ways. First, organizations considering purchasing and implementing GDSS (due to growth and/or mergers or otherwise) need to evaluate their current decision making process and corporate culture. For example, if anonymity is not a part of corporate culture and decision-making groups are relatively small, GDSS may not increase the group decision-making performance significantly. Furthermore, even if analysis of organizational decision making process justifies the adoption of GDSS, it might be necessary to prioritize the goals that GDSS needs to achieve. Given the variety of GDSS tools and availability of corporate intranets, a company may need to evaluate the options that meet specific decision-making need better than others.

Acknowledgements

The authors thank the editor and an anonymous reviewer for providing valuable insights for this research.

REFERENCES

[1] Ackerman, Fan and Eden, Colin, (1994). Issues in computer and non-computer supported GDSSs. *Decision Support Systems*, 12(4,5), 381-390.

[2] Aiken, Milam W., Hassan, Bassam, and Vanjani, Mahesh, (1996). Total quality management: A GDSS approach. *Information Systems Management*, 26(3), 73-75.

[3] Aiken, Miliam, Krosp, Jay, Shirani, Ashraf and Martin, Jeanette, (1994). Electronic brainstorming in small and large groups. *Information and Management*. 27(3), 141-149.

[4] Aiken, Milam W, Martin, Jeanette S, Paolillo, Joseph G. P., and Shirani, Ashraf I, (1994). A group decision support system for multilingual groups. *Information and Management*, 26(3), 155-161.

[5] Aiken, Milam, Vanjani, Mahesh and Krosp, James, (1995). Group decision support systems. *Review of Business*, 16(3), 38-42.

[6] Alavi, Maryam, (1993). An assessment of electronic meeting systems in a corporate setting. *Information and Management*, 25, 175-182.

[7] Alavi, Maryam, (1994). Computer-mediated collaborative learning: an empirical evaluation. *MIS Quarterly*. 1 8(2),1 59-174.

[8] Cass, Kimberly, Heintz, Timothy J. and Kaiser, Kate, (1992). An investigation of satisfaction when using a voice-synchronous GDSS in dispersed meetings. *Information and Management*. 23(4),173-182.

[9] Chisholm, John, (1994). Electronic meeting systems, *Unix Review*, 12(5), 13-18.

[10] Dean, Douglas, L., Lee, James, D., Orwig, Richard E. and Vogel, Douglas R (1994-95). Technological support for group process modeling. *Journal of Management Information Systems*, 11(3), 43-63.

[11] Dennis, Alan R., George, Joey F., Jessup, Len M., Nunamaker, Jay F. Jr. and Vogel Douglas R., (1988). Information technology to support electronic meetings. *MIS Quarterly*, 12(4), 591-624.

[12] Dennis, Alan R., Heminger, Alan R., Nunamaker, J.F. and Vogel, Douglas R, (1990). Bringing automated support to large groups: The Burr-Brown experience. *Information and Management*, 18, 111-121.

[13] Dennis, Alan R., Nunamaker, Jay F. Jr. and Paranka David, (1991). Supporting the search for competitive advantage. *Journal of Management Information Systems*, 8(1), 5-36.

[14] Dennis, Alan R., Nunamaker, Jay F. Jr. and Vogel Douglas R., (1990-91). A comparison of laboratory and field research in the study of electronic meeting systems. *Journal of Management Information Systems*, 7(3),107-135.

[15] DeSanctis, Geraldine L. and Gallupe, Brent R, (1987). A foundation for the study of group decision support systems. *Management Science*, 33(5), 589-610.

[16] Dickson, Gary W, Partridge, Joo-Eng Lee and Robinson, Lora H, (1993). Exploring modes of facilitative support for GDSS technology. *MIS Quarterly*, 17(2),173-194.

[17] Ellis, C.A., Gibbs, S. J. and Rein, G. L., (1991). GroupWare some issues and experiences, *Communications of the ACM*, 34(1), 39-58.

[18] Er, M.C. and Ng, A.C., (1995). The anonymity and proximity factors in groups decision support systems. *Decision Support Systems*, 14(1), 75-83.

[19] Frolick, Mark, N. and Robichaux, Barry P., (1995). EIS information requirements determination: using a group support system to enhance the strategic business objectives method. *Decision Support Systems*. 4(2),157-170.

[20] Gallupe, Brent R., Dennis, Alan R., Cooper, William H., Valacich, Joseph S., Bastianutti, Lana M. and Nunamaker, Jay F. Jr., (1992). Electronic brainstorming and group size. *Academy of Management Journal*. 35(2), 350-369.

[21] Gavish, B.,Gerdes J. Jr. and Sridhar, S, (1995). CM3: a distributed group decision support system. *IIE Transactions*. 27, 722-733.

[22] Goodhue, D. L. (1995) Understanding User Evaluations of Information Systems. *Management Science*, Vol. 41, No. 12, 1827-1844.

[23] Gowan, Jack A., Jr. and Downs, James M.,(1994). Video conferencing human - machine interface: A field study. *Information and Management*. 27(3), 341-356.

[24] Huber, G. P., (1994). Group decision support systems as aids in the use of structured group management techniques. *Decision Support and Executive Information Systems*, Edgewood Cliff, New Jersey: Prentice Hall, 211-225.

[25] Huber, G. P. and Mc Daniel, R. R, (1984). the decision-making paradigm of organizational design. *Management Science*, 32(5), 572-589.

[26] Huber, G. P.,(1984). Issues in the design of group decision support systems. *MIS Quarterly*, 8(3), 195-204.

[27] Huber, G. P., (1984b). The nature and design of post-industrial organizations. *Management Science*, 30(8), 928-951.

[28] Hwang, Hsin-Ginn and Guynes, Jan,(1994). The effect of group size on group performance in computer-supported decision making. *Information and Management*, 26(4), 189-198.

[29] Jessup, Leonard, M., Connolly, Terry and Galegher, Jolene, (1990). The effects of anonymity on GDSS group process with an idea-generating task. *MIS Quarterly*, 14(3), 313-321 .

[30] Jessup, Leonard and Tansik, David A., (1991). Decision making in an automated environment: the effects of anonymity and proximity with a group decision support system, *Decision Sciences*, 22(1), 266-279.

[31] Jarvenpaa, Sirkaa, L., Rao, V. Srinivasan and Huber, George P. (1988). Computer support for meetings of groups working on unstructured problems: a field experiment. *MIS Quarterly*, 12(4), 645-666.

[32] Karan, Vijay, Kerr, David S., Murthy, Uday S. and Vinze Ajay, (1996). Information technology support for collaborative decision making in auditing: an experimental investigation. *Decision Support Systems*, 16,181-194.

[33] Kahai, S. S., Avolio, B. J., and Sosik, J. J. (1998) Effects of Source and Participant Anonymity and Difference in Initial Opinions in an EMS Context. *Decision Sciences*, 29(2), 427-460.

[34] Liou, Yihwa Irene and Chen, Minder, (1993-94). Using group support systems and joint application development for requirements specification. Journal of Management Information Systems, 10(3), 25-41.

[35] Liou, Yihwa Irene and Nunamaker, Jay F., (1993). An investigation into knowledge acquisition using a group decision support system. *Information and Management*, 24, 121-132.

[36] Massey, Anne P. and Clapper, Danial L., (1995). Element finding: The impact of group support system on a crucial phase of sense making. *Journal of Management Information Systems*, 11(4), 149-176.

[37] Migliarese, Peiro and Paolucci, Emilio,(1995). Improved communications and collaborations among tasks induced by groupware. *Decision Support Systems*, 14, 237- 250.

[38] Nunamaker, J. F., Dennis, Alan R., Valacich, Joseph S., Vogel, Douglas R. and George, Joey F. (1991). Electronic meeting systems to support group work. *Communications of the ACM*, 34(7), 41-61.

[39] Nunamaker, J. F., Dennis, Alan R, Valacich, Joseph S. and Vogel, Douglas R., (1991), Information technology for negotiating groups: generating options for mutual gain. *Management Science*, 37(10),1325-1346.

[40] Sambamurthy, V and Chin, Wynne W., (1994). the effects of group attitudes toward alternative gdss designs on the decision-making performance of computer-supported groups. *Decision Sciences*, 25(2), 215-241.

[41] Schach, Stephen, N. (1996). *Classical and Object Oriented Software Engineering*, Chicago: Richard D. Irwin.

[42] Schnitt, David L., (1993). Reengineering the organization using information technology. *Journal of Systems Management*, 44(1), 1442.

[43] Sheppard, Morgan M., Briggs, Robert O., Reinig, Bruce A., Yen, Jerome and Nunamaker, Jay F., (1995-96). Invoking social comparison to improve electronic brainstorming: beyond anonymity. *Journal of Management Information Systems*, 12(3), 155-170.

[44] Thornton, Caroline and Lockhart, Erik, (1994). Groupware or electronic brainstorming. *Journal of Systems Management*, 45(10), 10-12.

[45] Turoff, Murrary, Hiltz, Starr Roxanne, Bahgat, Ahmed N. F. and Rana, Ajaz R (1993). Distributed group support systems. *MIS Quarterly*, 17(4), 399-417.

[46] Vogel, Doug and Nunamaker, Jay, (1990). Group decision support systems impact: Multi-methodological exploration. *Information and Management*, 18(1), 15-28.

[47] Vogel, Doug, Nunamaker, Jay, Applegate Lynda and Konsynski, Benn, (1994). Group decision support systems: Determinants of success. *Decision Support and Executive Information Systems*, Edgewood Cliff, New Jersey: Prentice Hall, 243-254.

[48] *Webster's Ninth New Collegiate Dictionary*, (1985). Springfield Mass.: G.&C. Merriam Company, 88, 1209.

[49] Yellen, Richard E., (1993). Introducing group decision support software in an organization. *Journal of Systems Management*, 44(10), 6-8.

[50] Yellen, Richard E., Winniford, Mary Anne and Sanford, Clive C., (1995). Extroversion and introversion in electronically-supported meetings. *Information and Management*, 28(1),63-74.

[51] Zigurs, Ilze, Poole, Scott M. and DeSanctis, Geraldine L. (1988), A study of influence in computer-mediated group decision making. *MIS Quarterly*, 12(4), 625 - 644.

AUTHORS' BIOGRAPHIES

Professor Parag Pendharkar *is an assistant professor of Information Systems at Penn State University at Harrisburg. Parag received his DBA in Information Systems from Southern Illinois University in 1997. Parag's work has appeared or been accepted for publication in* Annals of Operations Research, Computers & Operations Research, Decision Sciences, Expert Systems with Applications, Interfaces, *and several other journals. Parag has consulted several airline, container shipping, governmental and health care companies for yield management and information systems related issues.*

Professor Mehdi Khosrowpour *received his Bachelor of Business Administration (BBA) and Master of Science (MS) in Computer Information Systems from the University of Miami, Master of Business Administration (MBA) from the Florida Institute of Technology, and Doctorate in Business Administration (DBA) from Nova Southeastern University. He is also a Certified Systems Professional (CSP). He is currently an Associate Professor of Information Systems at Pennsylvania State University at Harrisburg. He is also the Editor-in-Charge of the* Information Resources Management Journal, *the* Annals of Cases on IT Applications and Management in Organizations, Information Management, *and consulting editor of the* Information Technology Newsletter. *He also serves on the editorial review board of seven other international information systems journals.*

Professor Girish H. Subramanian *is currently Associate professor of Computer Information Systems in the School of Business at Penn State Harrisburg. He teaches both undergraduate and graduate information systems courses in the areas of Database Management Systems, Data Warehousing, Software Engineering, and Data Communications. He received his Ph.D. in Computer Information Systems from the School of Business at Temple University. His current research interests include data warehousing, application of data mining in software engineering, use of rapid application development in data warehousing, and global software development. In his recent sabbatical research, he was involved with industry in the areas of data warehousing and global software development. He has numerous research publications in journals such as the* Communications of the ACM, Journal of Management Information Systems, Decision Sciences, The Journal of Systems and Software, *and* Journal of Computer Information Systems.

Mr. David Junkin *received his MS in Information Systems from Penn State University at Harrisburg. He works as an IS professional in the Central PA region.*