GDSS Laboratory Experiments and Field Studies: Closing the Gap

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INTRODUCTION

Over the past few years, there has been a rapidly growing interest in the use of information systems to support group work. From this increased interest in Group Decision Support Systems (GDSS), we are learning more. Unfortunately, the results from different streams of research tell us different things. For example, experiments with small groups of students in laboratory settings have shown that while the use of GDSS software can improve the quality of meeting outcomes, it can also require slightly longer meeting times and lead to decreased participant satisfaction [14, 16, 44]. Studies of the use of GDSS environments by medium and large sized groups of managers and professionals have shown that the use of GDSS produces higher quality outcomes in less time, with highly satisfied participants [9, 20, 32, 35, 43].

Why are the results different? There are many ways to approach this question. It is our contention that many of the differences in the findings of previous GDSS research can be attributed to research design. Previous laboratory experiments have produced distinctly different findings than previous field studies due in part to research design decisions made by researchers. However, this is not to say that future laboratory experiments will necessarily produce different research results than future field studies.

The purpose of this paper is to highlight key differences between previous experimental use of GDSS and the previous use of GDSS by business groups, and to discuss the implications that these differences have for researchers in designing future GDSS research. We begin by very briefly examining previous GDSS laboratory studies and field studies. We then highlight key differences for researchers between these experimental sessions and business group sessions. These differences include organizational context, group characteristics, group size, task, GDSS support, information management needs, and group work process.

The final section discusses two sets of implications for researchers that follow from these key differences. First, we need to embark on a synergistic program of research that combines experimental research with field studies. Such a suggestion is not new (eg [15]). However, few such research programs exist. It bears repeating. Secondly, we present a series of suggestions for enhancing experimental and field study GDSS research.

PREVIOUS RESEARCH

In this paper, we will focus exclusively on GDSS research conducted in decision rooms. Obviously, there is a much broader scope to GDSS research [10]; however, our objective is to contrast GDSS experiments with GDSS field studies. As GDSS field studies have focused on decision rooms, there is little benefit in examining laboratory experiments conducted in GDSS environments other than decision rooms. Some experimental research that has been traditionally included under the GDSS headings will therefore not be reviewed [eg. 41].

Our focus on decision rooms is not to suggest that all GDSS supported meetings that occur in decision rooms are similar; indeed, as we shall see in a later section, the group meeting process has varied considerably between studies, as the GDSS technology used to support meetings has varied.

Experimental Research

Experimental research conducted in decision room environments has produced a variety of research findings. Many experimental studies have examined the effects of GDSS support versus no GDSS support on the quality of decisions. Results have been mixed; several studies have shown the use of GDSS to improve decision quality compared to traditional face-to-face meetings [14, 16, 29, 30, 40, 45, 46], while other studies have shown the use of GDSS to have no effect [3, 11, 12, 38] or to be detrimental [44].

Other measures of the impact of GDSS have been less encouraging. The use of GDSS has been shown to increase...
time required to make a decision [12, 14, 16, 40] or to have no effect on time required [3, 11]. In one study, subjects were more satisfied with the GDSS-supported group work process [40], while in others, GDSS support has produced lower satisfaction with the process [14, 16, 44], or indifference [11, 12, 29]. Group satisfaction with outcomes of the meeting has been higher with GDSS support [11, 40], lower with GDSS support [14, 16] and no different with GDSS support [3]. In another experimental study, where specific GDSS features were tested, subjects reported that they perceived the use of the GDSS to be more effective than traditional meetings [6].

Field Study Research

We define GDSS field study research to include the use of GDSS technology by specific business groups (public or private sector) addressing problems of their own choosing, whether in a GDSS facility at their organization or another institution. After reviewing published research and talking with colleagues, we are able to cite only six papers that present field study research [2, 9, 20, 32, 35, 43]. Not all field study research is formally documented and submitted for publication; therefore, these papers are merely representative of GDSS field study research, not a complete review.

In all cases, participants found the use of GDSS technology to improve the outcomes of the meetings. The use of the GDSS was perceived to shorten the time required for the meeting. In most cases, these were post-meeting perceptions, but in one case [32], they were based on the difference between pre-meeting time estimates and actual meeting times. In all cases, participants were highly satisfied with both the meeting process and meeting outcome.

KEY DIFFERENCES

Laboratory experiments and field studies are complementary and synergistic research methodologies. Each provides a piece of the puzzle. Experimental laboratory research provides a controlled investigation of a limited set of factors, but suffers from a lack of generalizability. Field studies provide high generalizability, but suffer from a lack of control. As such, there is a need for GDSS research programs encompassing both experimental and field study techniques. Research programs that do not have a balanced portfolio of experiments and field studies run the risk of providing ungeneralizable or unverifiable results.

In a balanced, multi-methodological research program, it is important to understand the differences between the phenomena being investigated with each research methodology, so that differing results can be better integrated. With the present status of GDSS research - experimental studies and field studies presenting different conclusions - it becomes even more important to understand the differences between these two methodologies. While some of the differences are fundamental, and endemic to the methodologies, many are not. By examining the differences among previous studies, we are able to draw implications for the design of future studies.

GDSS research can be examined along many dimensions; seven seem particularly salient: the organizational context of the group meeting, group characteristics, group size, task characteristics, information management needs, GDSS environment, and the group work process that emerges from the impact of these factors. Table 1 presents a summary of the key differences between previous laboratory experiments and field studies on these dimensions, which are discussed below.

Organizational Context

By nature, experimental studies lack an organizational context. Instead, according to Benbasat, they have a “contrived and created setting” [4, p. 51], in which the experimentor attempts to manipulate a small set of factors, while holding other variables relevant to the study constant at some level appropriate for the context of the study. Ideally, the experimental context will match the target environment which the researchers intend to generalize their findings to and across [7]. The better the experimental design, the more the controlled factors provide a context that resembles the organizational environment, and the more generally applicable the research findings.

There are many contextual factors to be considered. For example, organizational culture and behavior norms serve as a guide to the meeting process for business groups. These norms may be lacking in groups formed for the purpose of an experiment; an assembled group of individuals may be a group in body, but not in spirit. In pre-existing experimental groups, contextual norms may simply be different from the norms of business groups. For example, in a recent experiment using pre-existing groups [45, 46], the norms of one group was such that it choose not to use the GDSS during the experiment.

In business groups, group members have incentives to perform. Accomplishing the task successfully means recognition and reward for the group. In some experiments, where the tasks are such that performance can be measured objectively, this has been provided by pay and incentives based on experimental performance [eg. 14]. However, business group participants may not always have consistent goals and objectives on which incentives are based.

In the organizational context, issues and problems are interrelated. Basically, every real world problem is related to every other real world problem. This is an important finding. It means that every time a policymaker [or group of policymakers] attempts to solve a particular policy problem he or she must consider its potential relationship with all other problems. [33, p.4]. By removing the implicit relationship to other problems, the experimental setting provides a context less like that of actual organizations.

Group Characteristics

Several differences between the groups used in experimental research and in field study research are obvious. Most experimental groups have been composed of students, while business groups are composed of managers and professionals. Individual characteristics of the two populations may be different. For example, one individual characteristic of interest is prior experience with group meetings; most managers and professionals will have had more experience with group meetings than undergraduates. While the use of senior and junior undergraduate students in experimental research is a common practice, studying one population (eg. undergraduates) may produce different results than studying another (eg. managers and professionals) [7].
Experimental groups have typically been formed for the sole purpose of the experiment, and have no past history or foreseeable future. Field studies have typically used pre-existing groups of managers and professionals, for whom the group meeting under study is just one meeting in a long series of meetings. Participants in field studies will have to associate with each other and live with the meeting outcome long after the meeting is over, in contrast with many experimental groups.

Groups in experimental studies are generally peers. While some experiments have studied the effects of an emerging leader or have temporarily assigned a leader for the duration of experimental session [eg. 17], this style of leadership can be different than that in field studies. Groups in field studies normally have a distinct hierarchy. The group's leader(s) is the leader before and after the meeting. The leader(s) promotes and rewards participants. His/her presence was poorly communicated. Johansen (1976) [reference not listed in original article] has observed in the case of teleconferencing systems that initial uses of the system serve as poor basis for generalizing about future uses. Similarly, Hiltz and Turoff report "an evolution or pattern of change toward greater complexity and specialization and diversification of user behavior over time" in computer-mediated conferencing settings (Hiltz and Turoff, 1981, [21] p.746). Similar learning effects are likely . . . [in GDSS settings] given the relative novelty of GDSS technology in most organizations. [10, p.603]

The observations drawn from the study of inexperienced users of GDSS technology are useful, but may apply only to inexperienced users. Generalizing the results of these studies to the on-going organizational use of GDSS may be misleading.

Group Size

Experimental research has primarily focused on small groups (often 3 or 4 participants). Obtaining a sufficient number of subjects for large group experiments is clearly a difficult problem. In contrast, most field study groups have been larger (10-30 participants). Group size could have been a major factor influencing the research findings.

A more fundamental question is why groups are formed in the first place. The group as a whole must have special skills or domain knowledge pertaining to the issue beyond that of the most knowledgeable or skilled participant, otherwise, why bother to form a group? Thus we must consider the logical size of the group in addition to the physical size of the group. Groups can be considered logically small if there is a high overlap in the participants' domain knowledge and skill; while there may be many participants, their combined domain knowledge and skills do not extend very far beyond the knowledge and skill of the most knowledgeable and skilled person in the group. Logically large groups have less overlap in knowledge and skills, and thus the group has a much wider range of knowledge and skills than any one person in the group.

In business group meetings, participants have typically come from different areas. They bring different skills and domain knowledge that can be used by the group in resolving the issue at hand. Business groups have therefore been logically large. In contrast, experimental groups have often been logically small, having been drawn from one population, typically members of an MIS course.

Participants in logically large groups, such as business groups, may not have a common understanding of the problem or knowledge of the facts. Experimental groups, who generally work from a common description of the experimental task have a common understanding. In a recent field study at Arizona, for example, several "new" programs were proposed by group members to meet identified organizational needs; however, these programs already existed - their presence was poorly communicated. In this case, the problem was communication, not the lack of a program. GDSS assists the group in communication, and helps integrate the different perceptions of the issue and the domain knowledge and skills of the participants. This integration and sharing of knowledge is a major benefit to business groups [1]. Experimental sessions are less likely to recognize this contribution, as experimental groups are less likely to be logically large.

The Task

"The general variable 'group task type' is emerging as an especially important variable, often accounting for as much as 50% of the variation in group performance" [36, p. 88]. Therefore, differences in tasks between experimental groups and business groups will have a major impact on the conclusions drawn from research studies.

Experimental tasks must be appropriate for the experimental group and the time for which they have agreed to participate. Most tasks last one session - at most a few hours. While some experimental work has attempted to provide complex tasks [eg. 14], the complexity of experimental tasks is usually far below the complexity of tasks faced by business groups. Tasks addressed by business groups in previous field studies have typically had several layers requiring several sessions to fully address.

In contrast to the tasks used in experimental sessions, tasks faced by business groups are often 'wicked problems', as described by Mason and Mitroff [33] and Rittel [37].

Today, few of the pressing problems policymakers face are truly problems of simplicity or of disorganized complexity. These problems simply cannot be tamed in the same way that other problems can. For this reason Rittel [sic] refers to these problems of organized complexity as 'wicked' problems.

Wicked problems are not necessarily wicked
in the perverse sense of being evil. Rather they are wicked like the head of a hydra. They are an ensnared web of tentacles. The more you attempt to tame them, the more complicated they become. [33, p.100]

These problems have several characteristics [33, 37]. They cannot be exhaustively formulated and written down on paper. They cannot be stated separately from their solution, as understanding the task is synonymous with solving it. They have no end; the task is never complete. They cannot be reproduced and are essentially unique. While these tasks are common in field studies, they have typically not been studied in experiments - for obvious reasons! However, these tasks are particularly appropriate for GDSS support.

Huber [22] identifies four models of organizational decision making (the rational model, the political model, the garbage can model, the program model). Tasks in experiments have traditionally presumed the rational model - "where organizational decisions are consequences of organizational units using information in an intendedly rational manner to make choices on behalf of the organization" [22, p.3].

Tasks in field studies have not always followed the rational model. They have often had a political component, "where organizational decisions are consequences of the application of strategies and tactics by units seeking to influence decision processes in directions that will result in choices favorable to them" [22, p.3]. This political component was clear in a recent Arizona study [9]. Three divisions lobbied for changes that would have increased their resource base by merging the other divisions into their division. Similar events have been observed elsewhere [eg. 18].

According to Mason and Mitroff, and Ackoff, decisions are determined by assumptions as well as facts. . . complex problems depend in countless ways upon a host of critical assumptions. In short, complex problems depend on assumptions because it is not humanly possible to know everything of importance about a problem of organized complexity prior to the taking of action. . . Most policymakers are unaware of the fact that much of their action rests on assumptions and, moreover, they are unaware of the particular set of assumptions they hold. [33, p.18]

It is very important to be aware of the fact that a decision maker's conception of a choice situation may differ significantly from the real situation. It is the discovery of such differences that opens up the possibility of formulating new means. These differences are normally obscured by assumptions that either appear to the decision maker to be so obviously true that they need not be questioned, or they are unconscious. [1, p.175]

In the tasks faced by business groups, these assumptions play a crucial role. The GDSS addresses these assumptions either explicitly, by using an appropriate software tool (eg. an assumption surfacing tool), or implicitly, by enhancing the communication between group members and enabling them to identify, understand and challenge the assumptions held by each other. Unfortunately, this process of identifying preconceived, unknown assumptions that inhibit the effectiveness of the group has not been addressed in the experimental use of GDSS. Few tasks that experimenters have used contain the richness of assumptions found in the substantial problems faced by organizations.

Information Management Needs

The information management needs of experimental groups and business groups typically are different. As we have seen above, of necessity, experimental tasks tend to be "clean" well-defined tasks. They are generally neatly packaged and small in scope. All needed information is provided to participants in case packages. In contrast, the tasks used by business groups are usually ill-defined and "messy" [1, 33]. "Messiness" in this sense refers to the degree that the needed information comes from a wide variety of fragmented sources of varying degrees of objectivity and accuracy. Data may be internal documents, external reports, or subjective assessments held by the participants. Accessing and integrating data from different sources is a task in its own right. The necessary reporting of information to experimental participants removes their need to access this messy data from multiple sources - a need often keenly felt by business groups.

Virtually all business groups take minutes of meetings for future reference. As a rule, experimental groups don't. The GDSS helps ensure key information that will form part of the minutes is recorded error-free, without requiring one of the participants to devote time to the recording process - and potentially lose opportunities to participate. As the GDSS records this information, it also promotes their accuracy; a person recording information from which the minutes will be prepared has a greater chance to mis-hear or misinterpret spoken comments.

The information needs of business groups extend across group sessions. As more than one session is commonly needed to address the task, it becomes important to manage the information arising in one session in a manner that allows it to be accessible in subsequent sessions. It must be available for members to refer to, and it must also be available to members who have missed prior meetings to ensure they are briefed on the missed session(s). These information management needs are not addressed by experimental tasks requiring one session.

Finally, with business groups there is a need to share information beyond the group to other individuals and groups in the organization. Ackoff [1] argues that it is essential for those who are charged with implementing plans and policies to have participated in meetings in which those plans and policies were formulated to ensure they understand why the plans and policies were developed. Without a solid understanding of the "why", the "what" of plans and policies may be misinterpreted. GDSS provide the ability to share the "why" with those who were not present in the actual meeting through a meeting transcript.

GDSS Environment

The GDSS environment has varied greatly between research studies at different institutions, but has usually been the same between experimental research and field study research conducted at the same institution. Many of the differences in research results could be attributed to the specific GDSS environment used in each study. Different GDSS technology can affect meeting outcomes and therefore research findings. Likewise, it is important to match the GDSS support to the needs of the group, task and context. It is unlikely that one tool can provide effective support to all groups, tasks and contexts.
While the GDSS environment has five dimensions (facility, hardware, software, people and procedures) [8], the most important dimension is arguably the GDSS software. The software implements additional communications channels and/or formal structures for the problem or the process to address the problem (eg. Nominal Group Technique). The availability and effectiveness of the specific capabilities provided by GDSS software supporting meetings (whether additional communication channels or structure) will directly influence the group work process of the meeting, and will therefore affect outcomes and research findings.

There are not necessarily any differences between the GDSS environments used by experimental groups and business groups. However, the minimum requirements of the groups are different. Experimental groups will accept whatever GDSS environment is provided. If the GDSS environment is not effective, efficient or satisfying to use, it is irrelevant. Their objective is to complete the experimental task. If we examine the group work process of previous studies, we see some striking differences - but not clearly cut along experimental versus field study lines. Rather, the differences have been produced by differences in the specific GDSS software used in these studies. A GDSS assists the group work process by providing an additional communication channel via the computer system, and by adding structure [8, 10]. If we compare recent experiments at the University of Minnesota to experiments and field studies conducted at the University of Arizona, we see distinctly different use of the verbal versus GDSS-supported electronic communication channels.

For example, in the Zigurs, et al experiment [45, 46] conducted at Minnesota, on average, across all GDSS-supported groups, each participant typed one comment (with an average length of 254 words) into the GDSS every 5.5 minutes, as compared with one comment every 28 minutes for the another Arizona field study [43]. In an Arizona experiment [6], on average each participant typed one comment (with an average length of 227 words) every 1.75 minutes. No data on total GDSS usage is available from the previously mentioned Minnesota experiment [45, 46]. However, it is reported that across all groups, a maximum of 3 (average of .57) influence behavior comments were entered in total in any 50-minute session. This suggests that the GDSS channel was far less used than the verbal channel.

In the same Arizona field study [9], on average across all sessions, each participant typed one comment (with an average length of 254 words) into the GDSS every 5.5 minutes, as compared with one comment every 28 minutes for the another Arizona field study [43]. In an Arizona experiment [6], on average each participant typed one comment (with an average length of 227 words) every 1.75 minutes. No data on total GDSS usage is available from the previously mentioned Minnesota experiment [45, 46]. However, it is reported that across all groups, a maximum of 3 (average of .57) influence behavior comments were entered in total in any 50-minute session. This suggests that the GDSS channel was far less used than the verbal channel.

These major differences in communication channel use suggest that Minnesota and Arizona are studying fundamentally different groups, which could help explain differences in research findings. They also have major implications for the study of such process variables as anonymity, which can be provided in the GDSS-supported channel, but not in the verbal channel.

**Group Work Process**

Some of the effects of the differences discussed above are evident in the group work process. Business group meetings typically run longer and have more sessions than experiments. Sessions are relaxed, or filled with tension, or both. Participants may joke with each other or avoid confrontations. There is an air of common purpose. As sessions progress, participants consult notes, think, point out comments to colleagues, get up, walk around, use the washrooms, and get coffee.

Experimental sessions feel different. While this feeling is difficult to measure and report, this does not make it any less real. It is apparent to observers. Participants are seated and focused on the experimental task. There is little joking or tension in the air. No one leaves for coffee. Participants proceed through the agenda as the experimenter says, rather than acting as they choose.

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In the preceding sections, we have reviewed previous GDSS research, and have examined the key differences between previous laboratory experiments and field studies. Some of these differences are fundamental to the nature of the research methodologies; we cannot change them. Other differences have been research design decisions, and can therefore be addressed in future research. In this section, we present some basic implications that can be drawn from these differences. We first present some general considerations,

**IMPLICATIONS FOR RESEARCHERS**

In the preceding sections, we have reviewed previous GDSS research, and have examined the key differences between previous laboratory experiments and field studies. Some of these differences are fundamental to the nature of the research methodologies; we cannot change them. Other differences have been research design decisions, and can therefore be addressed in future research. In this section, we present some basic implications that can be drawn from these differences. We first present some general considerations,
followed by more specific recommendations for the design of GDSS research studies. We do not address the important issue of measurement, as this has discussed elsewhere [eg. 6, 15] and is fundamental to all research studies.

General Implications

The first and most basic implication from these differences is that it is important to acknowledge explicitly the limitations of conclusions drawn from GDSS research. Experiments test theories under narrowly controlled conditions, while field studies often include a variety of groups, tasks, etc. Regardless, results from both experiments and field studies cannot be unabashedly generalized beyond their scope to all organizational contexts, all groups, all tasks, and all GDSS environments. Research must report sufficient context, group, group size, task, information management, GDSS environment and group work process information to enable readers to judge the limitations of the conclusions. For example, simply using the label "GDSS" to describe the software used in the research is not sufficient; capabilities must be explained in sufficient detail to enable readers to compare and contrast research findings using different software, and to determine to what extent findings were affected by the capabilities of the software.

Secondly, and equally important, no one methodology should be regarded as the preeminent research paradigm. No one methodology can provide a complete understanding of this complex research area. Each methodology has advantages and opportunities; each has limitations. Good research requires rigor and relevance. What the experimental methodology provides in rigor it lacks in relevance. We agree with Galliers and Land: "Although the experimental design of such IS research may well be academically acceptable and internally consistent, [by itself] all too often it leads to inconclusive or inapplicable results" [13, p. 900]. Good research therefore requires both research methodologies. Experimental research provides rigor; field studies provide relevance. The integration of experimental and field study techniques becomes paramount. Indeed, given the relative strengths and weaknesses inherent in these research approaches, a strategy combining different research methodologies is no more than common sense [47].

This is made even more poignant by several of our earlier observations: some of the most important potential impacts of GDSS technology on organizations (eg. in addressing wicked problems) cannot be effectively studied via laboratory experimentation.

How should experiments and field studies be combined in a research program? Experimental research is primarily confirmatory, while field study research is primarily exploratory. Experimental research has the ability to focus on a narrow, well-defined set of factors and rigorously investigate the effects of manipulating them. In contrast, field research has the ability to take a broader - and less focused - perspective. Therefore, as suggested by Benbasat [5], field studies should be used at the initial stages of research to gain insight into the phenomenon under study. Variables for further study, experimental hypotheses, and grounded theories should be developed from these field studies to ensure their relevance. Experiments can then test the inferences drawn from these field studies. Of course, field studies can also be used to corroborate the conclusions of prior experimental research, but this is less common. This is not to suggest, however, that the GDSS should not undergo alpha and beta testing (which could be termed "experimental" research) prior to use by business groups.

For example, in studying the design aspects of GDSS environments, field research has to date proven more valuable, as its broad focus has enabled designers to test a variety of design characteristics in each study. However, as GDSS environments begin to stabilize, the role of experiments in design research becomes more important; with a GDSS infrastructure in place, selecting a small set of narrowly defined factors to examine is made simpler. Several studies are now under way at Arizona to investigate the effects of different GDSS environment designs and group processes - for example, the effects of anonymity [6].

The goal then, is to close the present gap between experimental GDSS research and GDSS field study research. The following sections explore this area by presenting approaches to improve the design of laboratory experiments and field studies. The inherent problem in laboratory research is the lack of context (ie. external validity). According to McGrath:

The need to study group behavior as it occurs within the group's time/place/thing context has methodological and conceptual implications as well as substantive ones. On the methodological side, we must reckon with the potential distortion, as well as the massive reduction in potential information gain that can result from cutting our phenomena out of context . . . The context question is also a matter of conceptual strategy. If we are to take a view of groups that stresses their status as intact social systems, we need to think of group behavior as action within a complex context with which the focal system (the group) is intricately interdependent. This is true for the study of groups in general, I would argue. It is even more the case for the study of work groups within organizations. The embedding organization is a crucial part of any work group's context, and the pattern of mutual interdependence between the group and the surrounding organization is a crucial part of the substantive phenomena to be explored. [34, p. 385]

The key for GDSS researchers conducting experimental research is to think of the lab experiment as a challenge, as an opportunity to model the 'real' world as closely as possible to maximize relevance and increase the ability to generalize findings to the organizational use of GDSS. This entails moving the context, groups, task, GDSS technology, and group process of experiments closer to that of business group use of GDSS.

In contrast, the inherent problem in field study research is the lack of control (ie. internal validity). The challenge for GDSS researchers conducting field study research is to improve the level of control. For example, the increased use of "hard" performance measured rather than "perceived" measures. Several recent papers concerning MIS field research have presented insightful observations about the design of MIS field studies [28, 31, 47]. Rather than take the general perspective as in these papers, we will focus on issues particularly relevant to GDSS field studies.

Building Groups

Identifying a pool of subjects that can be used to form experimental groups is often an early step in the research
design of a laboratory experiment. Ideally, subjects will be the same managers and professionals that could use GDSS in the organizational environment. Unfortunately, this is not usually a practical alternative; born of necessity, the use of student subjects is a well accepted practice. In all likelihood, undergraduate students will differ from managers and professionals in a myriad of ways; hopefully none of these differences are relevant to the variables under study.

Care should be taken in forming experimental groups from a common pool of subjects. Studying groups of undergraduate MIS students, for example, may not lead to the same conclusions as studying groups of managers and professionals whose training, experience, and interests are not exclusively in the MIS field. Drawing subjects from a narrowly defined population may also lead to the formation of groups whose members have the same basic skills and knowledge domain; that is, it may lead to the formation of logically small groups, not the logically large groups found in business. One solution may be the use of stratified random sampling from several populations of students, rather than simple random sampling from one population. For example, groups could be built by randomly selecting one subject from an MIS course, one subject from an organizational behavior course, one from an engineering course, and so on.

Another step to provide an experimental context more similar to that of organizations, is to use role playing. Each subject is assigned a specific role as one of the characters in the case. A similar approach would be to give each subject different information about the case, to better reflect the differing views held by the characters or groups of characters in the case.

The selection of groups to study in field studies is equally important. The desirability of simultaneously studying randomly selected treatment and control groups is obvious. However, such a luxury is not common in field studies. Instead, opportunistic analysis of naturally occurring organizational events is more likely. With GDSS technology, these opportunities may arise more commonly than anticipated. For example, resource constraints can make it impossible for all possible groups in an organization to use GDSS technology or, alternately, only part of an organization may be targeted for the initial installation of GDSS technology. In these cases, it may be possible to study otherwise similar treatment and nontreatment groups addressing similar tasks in similar organizational contexts.

Other opportunities also exist. Markus [31] argues that in order to disconfirm a theory, it is necessary to define a set of conditions in which the theory(ies) is most likely to hold. By selecting a case that satisfies these conditions, and then proceeding to disconfirm a theory, the theory will be have been "quite decisively disconfirmed" [31, p.10]. Therefore, in the study of single groups using GDSS, it is necessary to define the characteristics of a desired group, and then identify a group that meets those characteristics.

Field studies can also benefit from data gathered on the background of group members. Such information is useful in determining the appropriate technology and tools to make best use of the group's time, as well as assisting in explaining why seemingly similar groups have dissimilar GDSS experiences. Hypotheses from such observations can then be tested experimentally. The combined knowledge base of experimental and field experience can encourage the development of empirically based guidelines for appropriately matching technology to task and group characteristics.

**Group Size**

A host of prior, non-GDSS supported research has shown that the process and outcome of group meetings is different between groups of different sizes (see [39] for an overview). As business groups tend to be larger than experimental groups used in previous studies, one obvious suggestion is to increase the size of groups used in experimental studies. Although this clearly increases the difficulty of experimentation, it is needed.

Field studies, as well, can benefit from careful tracking of group size as a function of impact on the process and outcome of sessions. Much can be learned by taking advantage of situations that suggest various group sizes, as well as situations in which there appears to be a mismatch of the group size with the task. One goal is to compare equivalent group sizes in experimental and field settings.

**On-going Groups**

In order to better model on-going groups typically found in business (who have a past and future together), Zigurs et al. [45, 46] used pre-existing groups of students. These groups were taken from an MIS course that required groups of students to work together for the duration of the course. The experimental session (unrelated to the course material) occurred mid-way through the term. The groups had no prior experience with GDSS, which Zigurs et al. conclude was a major factor in one group's refusal to use the GDSS; they did not want to change their existing group work patterns. This points out the benefits and hazards of using on-going groups. The groups had established norms and work patterns, making them more similar to business groups. However, these norms, coupled with their inexperience with GDSS, can cause problems during experimental sessions.

This suggests an alternate design for the use of on-going groups. Randomly built groups from courses taken by students of different backgrounds (e.g. the capstone business policy course) could be studied over one four-month term, in which participation was linked to the course(s). These groups could use GDSS-support for many group meetings over the term. These group meetings would be experimental sessions, in which the group would address different tasks. Such a design would provide a more longitudinal view of the group over time, as it would be possible to measure changes as the group gained experience with GDSS. Experimental tasks could also span several sessions, to better resemble the tasks and information management needs of business groups.

Field studies should focus not only on the session as a unit of analysis but also the project as a unit of analysis, where a project may consist of a number of sessions. Group membership and linked use of information across sessions should be monitored. Particular attention should be given to tracking changes in group member perceptions and performance over a series of sessions. Comparisons can be made on a longitudinal basis within a project or series of sessions as well as between projects.

**The Task**

Selecting the task is arguably the most important part of the experimental research design. The task must be both appropriate for the subjects, and similar to the tasks addressed by business groups [15]. As well as providing an
issue to be addressed by the group, it must provide the backdrop for the group discussion. The task may be readily familiar to the subjects, such as a parking problem common to most universities [6] or the issue of requiring students to purchase a computer [11]. Such tasks are readily understood, and provide a rich meeting environment. Participants bring assumptions to the meeting. Different perceptions are likely. It may even be possible to measure the improved understanding of the issues gained by each individual.

If such pre-existing tasks are not used, sufficient background information must be provided in the case packages provided to subjects to enable them to understand the variety of issues involved. Organizational culture and norms should be provided. Subjects should be actively encouraged to consider all relevant components of the issues at hand, as would be the case in the tasks facing business groups.

Field studies should likewise be concerned with task issues from a number of perspectives. In many cases there is a lack of consensus on what the task is in field settings. Group members may not share a common understanding of the group's goals and objectives of the group. Further, members may be more or less interested in participating in the stated task. Although this is true of field groups with or without provision of automated support, it becomes particularly important to track group member perceptions of task in GDSS to facilitate comparisons across groups and tasks.

**Information Management**

Information for the experimental sessions could be provided in a variety of forms. Rather than being neatly condensed in one case package, it could be spread across a variety of "organizational" reports and data bases, as it would be with business groups. The information can then be made available in either paper or electronically accessible copy during the group's deliberations. The end result is a setting more typical of the way business groups use GDSS. Further, the availability, or lack thereof, of information can be used to reinforce the group's charter, as well as evaluate aspects of the impact of introduction of information external to the group during the decision making process. Again, such information dynamics is typical of business group use of GDSS. Decisions are rarely made in a information vacuum.

From a field research perspective, it is important to provide channels for information commonly used to be readily available to the group. Links to corporate databases and integration into organization information systems are paramount. It is particularly important, however, to systematically monitor and track the use of external information to evaluate implications on the group process and outcome, which can be done as a background function without affecting the group. Provision should also be made for integrating information across group sessions and between groups to further provide a measure of effective group support and provide a foundation for evaluation.

**Incentives**

Performance incentives should be provided to experimental subjects. For example, subjects in the group(s) achieving the "best" meeting outcome can be rewarded for their good performance. If subjects are informed of this reward, they will be motivated to perform. While some tasks do not provide outcomes that can be measured subjectively, incentives can still be used. In business groups, incentives are not necessarily tied to the "best" outcome for the organization as whole; meetings have political components. In the same manner that the same information may not provided to each subject, incentives need not be provided equally to each subject. To better model the vested interests and political nature of business group meetings, each subject's reward could be determined on a different basis. For example, increasing the resource base of the constituency that the subject represents would provide a higher reward.

An important function of rigorous field research is to understand the nature and administration of performance incentives in the organization being studied. Pre- and post-questionnaires as well as systematic tracking of group member interaction during GDSS sessions is helpful to evaluate incentive issues. Additional information can be obtained in interviews with group leaders, facilitators, managers, and executives knowledgeable in the incentive structure and politics of the organization to determine the degree to which it would impact group process and outcome.

**GDSS Environment**

Research data should be collected unobtrusively from a variety of sources. GDSS environments can be designed to provide more detailed process information to gain insight into the GDSS-supported meeting process. Software can provide detailed activity logs. Audio-video recordings of sessions can be used for detailed analysis. Groups can be more carefully observed before and after the GDSS-supported meeting(s) to provide a better understanding of exactly how the GDSS altered the group work process.

GDSS is a state-of-the-art technology. Unlike other technologies in MIS research, such as end-user computing or system development techniques, it cannot yet be widely studied in the hands of practitioners. Few organizations use GDSS technology as researchers know it today [27]. This has several implications. First, researchers must develop their own GDSS technology (or use GDSS technology developed by other researchers). While it is tempting to develop only the minimum GDSS environment necessary for laboratory research, this lessens the ability of findings from these environments to be generalized to GDSS environments in organizations.

Secondly, a major concern of field studies lies in comparison of results across sites. Rarely are sites identical. Rather, each site, for historical or practical reasons, or a conscious desire to evaluate different physical configurations, tends to have a certain distinctiveness. This can seriously confound the ability to compare results across sites, ignoring cultural and other organizational differences that may also vary significantly, even within the same organization. The site characteristics should be carefully recorded to enhance the explanatory capability of field research results.

Finally, a major research contribution that GDSS researchers can make is to develop guidelines for the successful implementation of new GDSS technology in organizations. Practitioners in the early 1980's were unsuccessful in their attempts to implement GDSS [27]. However, research to date has shown GDSS technology to make effective contributions to group work [8]. One of our tasks is to guide practitioners in its successful development and adoption, which requires the use of GDSS environments similar to those required by organizations.
CONCLUSION

Findings from GDSS laboratory experiments have been different from those of GDSS field studies, due in part to the fact that the use of GDSS by organizations has been distinctly different than the use of GDSS in previous laboratory experiments. We have identified 26 specific differences in seven areas. The organizational context has been different; group characteristics have been different; group size has been different; the task has been different; information management needs have been different; GDSS environments have been different; and, the group work process has been different. To paraphrase Huber [23, p. 57], while we believe that each of these differences has merit, it is important to note that if only one or two has merit, the conclusion has merit - that experimental GDSS use and business group GDSS use have been different. Each argument does not have to be valid in order for the conclusion to be valid.

These issues do not lessen the value of previous experimental or field study research. Both have been key components in advancing the state of knowledge of GDSS-supported group work. However, each has been, and will continue to be, only one component. Many of these past differences reflect research design issues that can be addressed in future studies. Other differences are more fundamental to these research methodologies, and will not be completely ameliorated. Therefore, the integration of field study and experimental research is key.

The first step in this integration is to embark on multi-methodological research programs that provide individual researchers with first hand understanding of the key GDSS issues from both the experimental and field research perspectives. The absence of either experiments or field studies in a research program reduces the strength with which conclusions can be drawn, and the applicability of those conclusions to actual organizations.

The second step is to understand the effects that these differences have on the process and outcome of group meetings, and to use this understanding in interpreting and applying the conclusions of experiments to the use of GDSS by business organizations. From this understanding, we can develop new research designs for studies with greater rigor (internal validity) and experiments with greater relevance to the organizational use of GDSS (external validity).

We have presented several approaches to enhance the design of GDSS experiments and field studies. Clearly, these are not without cost. However, as suggested by Javenpaa, Dickson and DeSanctis [26] with regard to another research area (graphics), the publication of articles with a lesser attention to these issues will not advance our understanding of GDSS; it will only serve to cloud the issues.

Acknowledgement

This research was partially supported by the Social Sciences and Humanities Research Council of Canada.

REFERENCES

24. Jablin, F.M. "Cultivating Imagination: Factors that Enhance and Inhibit Creativity in Brainstorming Groups"
TABLE 1: SUMMARY OF KEY DIFFERENCES

Organizational Context
- Organizational culture and group norms
- Incentives for participants
- Interrelatedness of problems faced by organizations

Group Characteristics
- Participants’ individual differences
- History and future of the group
- Hierarchical structure of group
- Experience of users with GDSS technology

Group Size
- Physical group size
- Logical group size (i.e. combined skill and knowledge)
- Sharing and integration of skills and domain knowledge

Task
- Task complexity
- Type of task ("Wicked Problems")
- Political component
- Assumptions about the task held by group members

Information Management Needs
- "Messy" versus "Clean" information
- Record and minutes of the meeting
- Storage and access to information from previous meetings
- Provision of meeting information to others

GDSS Environment
- Facility: professional environment, presentation support
- Hardware: reliable, fast
- Software: group activities, individual support
- Procedures: objectives, agenda management
- Facilitation: agenda and session guidance, transcripts

Group Work Process
- Number and length of sessions
- Meeting atmosphere
- Communication channel use: verbal and GDSS-supported