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6 Group Decision Support Systems (GDSS): Review, Taxonomy, and Research Agenda

Collaborative decision-making is an integral part of organizational life (Bradford 1976; Fisher and Ellis 1990; Zander 1989). Meetings often are used to facilitate decision-making processes because all parties can be involved and pertinent issues can be addressed collectively in a single setting (Maier 1980). *The Wall Street Journal* (Hymowitz 1988) reported that managers spend from 25 to 50 percent of their total work time in group meetings. While immediate, collective intelligence can improve decision-making (Shaw 1981), meetings often are inefficient—failing to resolve issues, to complete decisions, and to handle problems effectively (Huber 1990; Mintzberg 1973).

New technologies, including the personal computer, are being reconfigured to enhance the efficiency of such meetings. With their information-processing capabilities (information retrieval, retention, processing, graphic display, etc.), as well as new developments in computer networking and software sharing programs (Johansen 1988; Saffo 1991; Shrage 1990), the *group*-friendly computer is possible. Hardware and software have been designed for work groups not only to share the information generated by computers, but to edit it together in real time, with immediate results. Developing the potential of the *impersonal computer* is the rationale behind computer hardware and software for increasing the effectiveness and efficiency of the daily meeting (DeSanctis and Gallupe 1987; Kraemer and Pinsonneault 1990).

However, the technological advances and increased capabilities of personal computers do not completely explain why collaborative technologies are being introduced into organizational meetings. The larger trend toward collaborative work and collaborative technologies in U.S. organizations offers additional insight into the role and results of the computer's introduction into meeting support. For example, Schrage (1990) argues that organizations today increasingly hire and train members to become specialists in order to deal with the daily plethora of specific problems and opportunities. Ideally, this diversity in specialization should provide better meetings and meeting outcomes. Yet, Shrage (1990) argues, sharing unique information between the specialists is not sufficient to harvest that diversity. Organizations need to focus more on collaboration (mutual creation between at least two people) than simply on information sharing. Successful meetings should include the active integration of those insights and thinking processes in order to create superior collaborative efforts. The computer, with its continually improving abilities to process, track, organize, incorporate, and analyze information, becomes a powerful tool in shaping a more *collaborative* organizational culture.

Group Decision Support Systems (GDSSs) are a recent innovation in communication technology with direct implications for collaborative group work. GDSSs are interactive computer-based systems that combine communication, computer, and decision technologies to support groups' formulation and solution of unstructured problems (DeSanctis and Gallupe 1987; Jessup, Connolly, and Galegher 1990; Kraemer and Pinsonneault 1990). As coordination tools designed to improve group performance, GDSSs vary in their capability to support meetings (Huber 1984; Kraemer and King 1988; Kraemer and Pinsonneault 1990). However, the emphasis is on giving "access to the positive aspects of coordination—not just preventing collisions" among group members (Greif 1988, 9). Some GDSSs offer simple communication support—sometimes called Group Communication Support Systems (GCSS) (Kraemer and Pinsonneault 1990), Level 1 GDSS (DeSanctis and Gallupe 1987), or "display" level support (Seibold and Contractor 1991)—and are intended primarily to support interaction processes among members. This simplest type of GDSS is designed to reduce communication barriers in groups by providing tools such as a third communication channel (text based) which can, for example, support anonymous contributions. Some GDSSs "poll" users by asking them to rank order alternatives (cf. Hiltz, Johnson, and Turoff 1987). Others allow for brainstorming and idea organizing by having users type ideas for display in a common viewing area and then linking them together verbally (e.g., Stefik, Foster, Boborow, Kahn, Lanning, and Suchan 1987; Stefik and Brown 1989). Other GDSSs provide more complex support such as the capability to structure meetings; run complicated tasks like PERT and strategic planning; provide mathematical forecasting; and utilize Robert's Rules of Order among many possibilities (Dennis, George, Jessup, Nunamaker, and Vogel 1988; DeSanctis and Gallupe 1987; Poole and DeSanctis 1990; Seibold and Contractor 1991). Still other types of GDSSs augment group interaction by providing expert support systems (Malone, Grant, Lai, Rao, and Rosenblitt 1989).

The increase in the number of GDSSs and in their capabilities is well documented. Since the seminal work by Steeb and Johnson (1981), recent bibliographies by DeSanctis (1989) and the 3M Corporation (1991) indicate that between 200 and 300 papers directly related to GDSS were available by 1991. Although only a small portion of these are empirical studies of GDSS use and effects, research facilities increasingly are being established in a variety of academic institutions for the purpose of conducting systematic research on GDSS. Recent reviews (Kraemer and King 1988; Kraemer and Pinsonneault 1990; Seibold and Contractor 1991; Vogel and Nunamaker 1990) point to twelve different U.S. universities that have GDSS social research facilities. Additionally, at least seven major corporations including IBM, Marriot, and Dell Computer Corporation have invested from fifty to two hundred thousand dollars installing GDSS facilities at company locations (Bulkely 1992). Finally, a number of corporate research sites specifically designed to develop this collaborative technology's potential have emerged (Johansen 1988; Kraemer and King 1988).

In the remainder of this essay we undertake three tasks. First, we review recent research on GDSSs with primary attention to major reviews in the area. Inconsistent findings concerning GDSS effects, as well as recent theoretical development, lead us, second, to propose a taxonomy of contextual contingencies for interpreting and anticipating GDSS effects—a framework that represents a philosophical, theoretical, and empirical departure from previous classificatory schemes. Finally, new perspectives and promising directions for the future of GDSS research are discussed. Both the framework provided and the perspectives discussed are couched within the emergent perspective (Pfeffer 1982) on organizational action and, as we demonstrate in the conclusion, are consistent with how this metatheoretical approach has been applied to information technologies' use and effects in organizations (Markus and Robey 1988; Contractor and Eisenberg 1990).

Review

The majority of GDSS research has focused on exploring new options and designing prototypes (for reviews see Greif 1988; Dhar and Olson 1989). There have been fewer studies which have hypothesized specific individual or organizational *outcomes* of GDSS. Most of the hypotheses proposed are based on the assumption that computer-mediated communication has specific unchanging attributes. For instance, computer-mediated communication is said to have a lower degree of social presence (Short, Williams, and Christie 1976) and media richness (Daft and Lengel 1986) than face-to-face communication. Therefore, for example, computer-mediated communication is hypothesized to be well suited for those tasks which do not require the social presence and media richness offered by face-to-face communication.

Within the domain of GDSS effects research, several reviews of the literature have appeared. These summaries can be differentiated based on the taxonomic categories employed in each. Some reviews organize the GDSS effects literature in terms of technological sophistication, or capabilities of the GDSS, and the level of decision-making support that the system provides (DeSanctis and Gallupe 1987; Kraemer and Pinsonneault 1990; Seibold and Contractor 1991). Other reviews have assayed studies in terms of physical arrangements or attributes of GDSS systems such as whether GDSS users are dispersed or face-to-face; or whether communication support is synchronous or asynchronous (Dennis et al. 1988; Smith and Vanacheck 1989; Kraemer and King 1988; Kraemer and Pinsonneault 1990; Smith and Vanechek 1989). Third, some reviewers have argued that experimental design manipulations and operational definitions of process and outcome variables need to be mapped more precisely (George 1989; Kraemer and Pinsonneault 1990; Kudsi 1991; Seibold and Contractor 1991). Finally, others have attempted to illustrate task differences in terms of the complexity, characteristics, completion time, and type of task existing between studies (DeSanctis and Gallupe 1987; Gallupe, DeSanctis and Dickson 1988; McGrath and Hollingshead 1991a) as well as how different system support environments most appropriately "fit" with certain tasks (DeSanctis and Gallupe 1987; Gallupe and DeSanctis 1988; Huber 1984; Jarvenpaa, Rao, and Laase 1988). These approaches, and specific reviews typical of each, are described next. Any single review that we highlight as typical of one approach may also encompass some of the other taxonomic approaches mentioned above, but this is unusual. Importantly, even if a particular literature review evidences several of the approaches mentioned, we will emphasize whichever aspect

seems to offer the greatest insight into the GDSS literature. Even then, as will be evident, there are many other contingencies that affect GDSS interactions and outcomes which these schemes fail to incorporate. Those contingencies will be the focus of the subsequent section.

Three reviews are representative of those taxonomies that seek to categorize GDSSs in terms of their *technological sophistication, capabilities, and level of decision-making support.* DeSanctis and Gallupe (1987) differentiate GDSSs by the three levels of support they can be designed to provide. They argue that as these GDSSs increase in sophistication, they will have differential effects on interaction dynamics. Seibold and Contractor (1991) inventoried seventeen GDSS studies and grouped them according to five hierarchical levels of support. Pinsonneault and Kraemer (1990) divided thirty-three GDSS studies into two types of GDSS: Group Decision Support Systems and Group Communication Support Systems. Seibold and Contractor (1991) and Pinsonneault and Kraemer (1990) used their classification scheme to search for patterns of effects; both failed to find any uniform pattern with their classification schemes. Pinsonneault and Kraemer (1990) provided three possible explanations for their findings: developmental stage differences in groups between studies, failure of the GDSS to meet user expectations, and differences in task focus between studies—all contextual variables beyond the focus of their classification schemes.

A second class of reviews has been concerned with discriminating how the *physical arrangement or specific attributes of a GDSS system might effect outcomes.* Dennis et al (1988) inventoried studies of computer supported groups versus noncomputer supported groups. Because of the vast configuration differences in their review, they separated these comparisons by type of GDSS arrangement: those which utilized local area decision networks and those which used decision rooms. Decision rooms typically are designed to function with all group members present in the same room. Local area decision networks are not necessarily designed to host all participants in the same room (users may be in different rooms, floors, or even different buildings depending on the nature of work and decision-making task). Kraemer and King (1988) classified thirteen different collaborative decision-making technologies by six types of computer-support arrangements (electronic boardroom, group network, decision conference, collaboration laboratory, teleconference facility, and information center). Each of the six systems had very different physical arrangements and support characteristics. For instance, an electronic boardroom takes the form of computer "'storyboards' or computer controlled audiovisuals (e.g., slide projectors, video projectors, movie projectors) used for presentations" (Kraemer and King 1988, 119). On the other hand, a collaboration laboratory consists of workstations that are build into a conference table to permit face-to-face communication as well as sharing an electronic chalkboard and interactive document-editing software. A decision room had a similar physical arrangement to a collaboration laboratory—but it usually utilizes different types of software (e.g., decision-tree modeling, strategic planning, etc.). These differences serve to illustrate the point that different GDSS attributes and arrangements augment collaborative decision-making in different ways. Kraemer and King (1988) assert that these various systems have been indiscriminately thrust under the definition of GDSS.

Operational definitions of process and outcome variables as well as experimental design manipulations distinguish yet another class of GDSS reviews. For example, George (1989) scrutinized just four GDSS studies and noted several reasons why they may be inappropriate for comparison. He illuminated several elements of the research designs that could create inconsistencies in effects, such as channel selection (face-to-face only, computer only, or both), number of subjects, and treatments. Seibold and Contractor (1991) surveyed the most prevalent group outcomes associated with GDSS use and refined them in six categories. However, Kudsi (1991) re-reviewed each process and outcome variable in those studies and argued that those operational definitions varied considerably between studies.

At least two reviews have *classified GDSS studies in terms of task differences.* McGrath and Hollingshead (1991a) surveyed several GDSS studies and differentiated them according to the task type, complexity, and the time involved in the completion of each. DeSanctis and Gallupe (1987) applied McGrath's (1984) circumplex model of task differences to classify GDSS research by the way a particular system serves to support the needs associated with different types of tasks.

A final class of taxonomic reviews has attempted to classify how *different GDSS environments most appropriately "fit" with certain types of tasks.* DeSanctis and Gallupe (1987) integrated task, level of GDSS, and group size within their classificatory table. They argued that classifying GDSS studies in terms of these three factors helps to define the environmental contingency for an appropriate fit. Huber (1984) and Jarvenpaa and colleagues (1988) also discussed the importance of different environmental contingencies and how they might fit with the task at hand. This notion of "fit" is consistent with the central thesis of this paper. Current attempts to organize the GDSS effects literature have been limited in explanatory power because they force a

multitude of acknowledged differences into simple categorical differentiations—causing *any* decipherable patterns of effects to be interpreted as "isolated islands within a sea of ambiguity" (McGrath and Hollingshead 1991b).

As is evident from even this cursory review, generalizations about the effects of GDSS on group decision-making have been plagued by inconsistencies between study findings. For example, while a number of investigations have found that member satisfaction and group consensus were enhanced in GDSS groups, other studies revealed no differences beyond chance expectation. Further, although some studies have reported significant decreases in members' participation rates in GDSS groups, others have found that participation was significantly higher in GDSS supported groups. Indeed, one review of GDSS research concluded that "the most obvious generalization that can be made . . . is that the results from these studies are inconsistent" (Dennis et al. 1988, 600). For the most part these reviews all follow from a similar assumption: in order to illuminate the troubling inconsistencies in study by study comparisons, something must be done to organize the variety of studies, manipulations, systems, and environments that constitute GDSS research. Accordingly, each offers a singular, often narrow framework for classifying and accounting for GDSS effects. Most reviewers also acknowledge that theirs is by no means the only way to classify previous research. These reviews typically conclude that more research needs to be done illustrating the multitude of important contextual contingencies that are associated with the variety of studies. Two issues are apparent from these problems, and they serve as the bases for the two sections which follow.

First, as *descriptive* devices for categorizing potential factors upon which GDSS effects are contingent, these taxonomies may be too narrow and simplistic. None has addressed the *multiple* combination of factors that may affect GDSS use and, therefore, outcomes. The aforementioned approaches focus attention almost exclusively on their respective classifications for understanding GDSS effects. Rather than arguing that one taxonomy should be adopted over others, it is possible that all are correct to some degree. The assessment of multiple approaches *in combination*—the special attention to how the contextual contingencies might be functioning hierarchically in any one study—may provide researchers with increased explanatory power. The GDSS effect literature has yet to adopt a comprehensive framework for understanding all of the potential contingencies operating within any one study. Utilizing simple taxonomies or hierarchies of singular characteristic differences may inhibit researchers' abilities to be attuned to the full range of potential differences operating in association with reported outcomes. The following sections offer an alternative, more comprehensive and more synthetic framework classifying *contextual factors on which GDSS effects may be contingent*. Second, as *explanatory* devices for accounting for differences reported in GDSS effects studies, these taxonomies—like many of the individual studies they review—are rooted in the premise that the impact of GDSS technology ought to be consistent across groups using it. In the final section of this essay we question that assumption and identify nascent theories of GDSS effects which are grounded in assumptions antithetical to this one. Importantly, these are perspectives that also incorporate or permit incorporation of the multiple contextual contingencies identified next.

GDSS contextual contingencies

Given the inconsistencies and limitations noted in the previous review, this section proposes a synthesis of important characteristics differentiating GDSS research. Conclusions from previous reviews suggest *that effects should be viewed in terms of a combination of contextual contingencies* (Contractor and Seibold, 1993; Drazin and Van de Ven 1985; Gutek 1990; Poole and DeSanctis 1990). We propose that the most appropriate framework for conceptualizing these contingencies can be found in three global categories of GDSS: (1) *system characteristics*, (2) *use characteristics*, and (3) *user characteristics*. These categories have several subcategories that clarify the boundaries of the constructs. The subcategories are not meant to be exhaustive, but are illustrative of contextual variables mentioned in the literature and believed to have possible effects on outcomes. As demonstrated in ten short years since Steeb and Johnson's (1981) work, innovations in GDSS are occurring faster than research studies. This suggests that as this collaborative technology continues to develop, the contextual contingencies must also be modified to reflect current environmental developments. For example, with advances in laptop computers, real-time processing, graphics capabilities, and user friendliness, communication through computers as a medium is developing in terms of its ability to retain richness (Daft and Lengel 1986; Johansen 1988). Combinations such as these exist in every situation where a GDSS might be studied, and any classification system must be elastic enough to incorporate these changes. Three global categories and their subcategories are explicated next as aids to categorizing combinations of such contextual contingencies (see table 6.1).

GDSS systems, and by extension research on them, can be differentiated according to ***system characteristics***, those technological attributes associated with a particular GDSS and the character of support they provide (see table 6.1). First, the system's *physical configuration* will be apparent. Any GDSS can be characterized in terms of the number of computers associated with the system, the complexity of arrangement in a decision room, the system's speed of operation, whether it provides sophisticated decision-making support, its synchronous or asynchronous communication capabilities, and the number of support tasks it is designed to fulfill. The physical configuration subcategory also includes the spatial arrangement (Bradford 1976) of computers in a network (e.g., whether they are dispersed across the country, in the same building or in the same room, and how much the computers impede natural interaction). A very important consideration is that the physical configuration of a GDSS can be designed to completely support communication or merely augment it. This distinction can be manifested in terms of interaction impedance, spatial arrangement, modules of support, and the implicit rules about use that exist in the design of the particular support module. Finally, a system's capability to enable anonymity is included in the physical configuration construct (Connolly, Jessup, and Valacich 1990; Jessup, Connolly, and Galegher 1990; Vogel and Nunamaker 1990).

The second system characteristic along which any GDSS may be differentiated is the *system's adaptability of appropriateness of support*. Two predominant systems in the GDSS research literature reveal important differences in this respect. The PlexCenter at the University of Arizona is designed for a multitude of tasks and is located within a single site to which managers can be flown. There are two different large meeting rooms supporting 16 and 24 workstations respectively. Several smaller conference rooms surround the two larger decision rooms, each of which can host computers to run smaller meetings or have larger ones broken into subgroups. SAMM, at the University of Minnesota, is designed on the other hand to be easily programmed as needed for different groups that require unique tasks. SAMM is a scaled down or more portable package than the PlexCenter. SAMM can be reconfigured, whereas the PlexCenter meeting room is a massive moduled system that is not mobile and is designed to host a multitude of different meeting types and complex tasks. SAMM is currently limited to hosting 3 to 16 users, whereas the PlexCenter can host up to 65. The important point in the distinction between these

TABLE 6.1

Global Level — System Characteristics

#	Parameters	Sub Categories
1	Which Category of System does it fall under? (e.g., LAN, E-Mail, Decision Room, EMS, CSS, Linking, etc.) (Dennis, et al., 1988)	Physical Configuration
2	Number of Computers (Johansen, 1988)	
3	Degree of Interaction Impedence (Rice & Love, 1984; Kiesler, 1990)	
4	Spatial Arrangement (Bradford, 1976; Shaw, 1981; Fisher & Ellis, 1991)	
5	Dispersed/Face -To-Face (Dennis, et al., 1988)	
6	Degree of Complexity of System Setup (George, 1989; DeSanctis & Gallupe, 1987; Seibold & Contractor, 1990)	
7	The System's Speed of Operation (Johansen, 1989; Seigel et al., 1984)	
8	Capacity for Anonymous Support (Jessup, Connolly, &Tansik, 1990)	System Adaptability or Appropriateness of Support
9	Synchronous/Asynchronous (Poole & DeSanctis, 1990; Seibold & Contractor, 1990; Dennis et al., 1988)	
10	Degree of Mobility of the System (Vogel & Nunamaker, 1990)	
11	Degree of Specialization in Support (Johansen, 1989)	
12	Programmability (Adaptable to Changing needs of groups) (Huber, 1984)	Level of User Friendliness
13	Degree of Capability in support of Multitude of Tasks (Vogel & Nunamaker, 1990; Johansen, 1989)	
14	Rigid/Flexible in Design of Procedures for Use (Easton et al., 1989; Vogel & Nunamaker, 1990)	
15	Easy/Difficult to Learn (George, 1989; Poole & DeSanctis, 1990)	
16	Easy/Difficult to Use (George, 1989; Poole & DeSanctis, 1990)	
17	Degree to which System is Chauffeur/User/or Facilitator Driven (George, 1989; Poole & DeSanctis, 1990)	Who Drives the System?

TABLE 6.1 cont.

Global Level — Use Characteristics

#	Parameters	Sub Categories
1	Design/Research Question (s) (e.g., factorial, time series, independent/dependent variable(s) etc.) (Campbell & Stanley, 1978; Lipsey, 1990; Hare, 1976; Shaw, 1981)	Experimental Manipulations and Designs
2	Manipulation (e.g., Anonymity, Proximity, Task, Confederate, Climate, etc.) (Hare, 1976; Shaw, 1981)	
3	GDSS vs. FTF or LAN vs. GDSS or GDSS vs. Structured FTF (Dennis et al., 1988; George, 1989)	
4	Clear operational definitions of outcome variables (Seibold & Contractor, 1990; Kudsi, 1991)	
5	Operant rules about reaching final decision (e.g., Consensus: mode of decision makeing) (Davis, 1973)	
6	Task Type (McGrath, 1984; Desanctis & Gallupe, 1987; Poole & Doelger,1986)	Task Differences
7	Task Complexity (McGrath, 1984;Desanctis and Gallupe,1987; Poole & Doelger, 1986)	
8	Degree of Realism or Salience (McGrath, 1984)	
9	Degree of Uncertainty (McGrath, 1984)	
10	Degree to which deadline was imposed (Gersik, 1989; McGrath & Hollingshead, 1991a)	Time Constraints
11	Accomplished in one meeting or several (Zigurs et al.,1988; McGrath & Hollingshead, 1991a)	
12	Degree to which computer is encouraged to be the dominant channel (George, 1989)	Channel Selection
13	Degree to which face-to-face is encouraged to be the dominant channel (George, 1989)	
14	The degree to which freedom of user chioce is allowed(e.g., no explicit rules for interaction-George, 1989)	
15	Type of training (e.g., demonstration, walk through) (George, 1989; Poole & Desanctis, 1990)	Training
16	Extent of training (e.g., 20 minutes, twice a week etc.) (Poole & DeSanctis, 1990)	
17	Thoroghness of training (e.g., "Subjects were trained until everyone could use the system") (George, 1989; Poole & Desanctis,1990)	

TABLE 6.1 cont.

Global Level: **User Characteristics**

	Parameters	Sub Categories
1	Class, major, age, history during time of experiment – undergraduates (Campbell & Stanley, 1978; Dennis et al., 1988; Shaw, 1981; Bormann, 1970)	Sample Differences
2	Profession ,age, years of experience, tenure, type of job, etc. (Hare,1976)	
3	Total number of members per group (Shaw, 1981)	Group Size
4	Degree to which there is a hierarchy in the group (Fisher & Ellis, 1990; Bikson & Eveland, 1990; Shaw, 1981)	Group Structure
5	Extent of History (e.g., Time) (Bormann, 1970; Hall & Williams, 1972)	History of Interacting Together
6	Degree of familiarity among members (Shaw, 1981)	
7	Nature of history (e.g. workgroup, production team) (Hare, 1961)	
8	Level of comfort with training (Poole & Desanctis, 1990)	Training
9	Level of motivation toward training (Kiesler, 1990; Poole & Desanctis, 1990)	
10	Appropriateness of training (DeSanctis, Donofrio, Sambamurthy & Poole, 1989; Daft & Lengle, 1986; Poole & DeSanctis, 1990)	
11	Degree of comfort with using this technology (Poole & DeSanctis, 1990)	Attitude/Degree of Respect toward use of New Technologies
12	Expectations of the technology's performance/capabilities (Poole & DeSanctis, 1990)	
13	Degree of consensus about use of this technology(Poole & DeSanctis, 1990)	
14	Level of computer knowledge (Poole & DeSanctis, 1990;Barley, 1986)	Level of Computer Expertise
15	Peer evaluation of technology (Contractor & Eisenberg, 1990)	
16	Amount of exposure to new technologies(uncertainty/equivocality)(Daft & Lengle,1986)	
17	Time/ History with using computers (Poole & DeSanctis, 1990; McGrath, 1990)	Past Experience Adapting .o New Technologies
18	Number of new technologies actually using/incorporated/ adopted (Fulk et al. , 1990)	
19	Perceptions of personal adaptability to new technology (Poole & Desanctis, 1990; Fulk & Stienfield, 1990)	

systems is not merely in their environments, but in their respective abilities to handle specific tasks. Furthermore, the PlexCenter is permanent, expensive, and not easily programmed, having fixed and massive capabilities that usually require a facilitator to run, while SAMM is quite easily set up and programmed at any location for owners to run and specialize. Finally, level of adaptability or appropriateness of the system for a given type of collaborative work may affect interaction, and differently so (Jarvenpaa et al. 1987).

A third system parameter related to any GDSS is the matter of *who drives the system.* Some decision room systems reported in the GDSS literature are *chauffeur driven,* requiring a technical person who has expertise and the knowledge necessary to run complex GDSS systems, but users typically direct which modules to run and in which order they should appear. Other systems are *facilitator driven,* wherein the facilitator directs, structures, makes suggestions, and aids in technical problems. The facilitator is trained to run a specific type of meeting and assumes the role of both technical advisor and chauffeur. The facilitator's presence is always known and can have additional dynamic effects on the group. Finally, a GDSS may be *user driven,* wherein users drive the system themselves. For this form of support, a facilitator need only be present at first to train users on the system. Different norms may develop depending on how a GDSS is driven, and these norms may differentiate the groups depending on the degree of control groups have over how they will use the GDSS (e.g, Poole and DeSanctis 1990).

Level of user friendliness is a final system characteristic important for interpreting GDSS use and effects. While reviewers (Gallupe and DeSanctis 1987; Kraemer and King 1988; Seibold and Contractor 1991) have categorized GDSS systems variously, none has attempted to assess *how easy the systems are for subjects to use.* Although the concept of textual computer conferencing (simple message exchange between subjects) seems easy enough, it may not be for some users. Lack of user friendliness may heighten frustration and hinder successful decision-making (e.g., Hiltz, Johnson, and Turoff 1986; Kiesler et al. 1984; Siegel, Dubrovsky, Kiesler, and McGuire 1986). Some people may have difficulty typing (Suchan, Bui, and Dolk 1987), and others may have difficulty with interpreting procedures (Hiltz, Johnson, and Turoff 1987; Siegel et al. 1986).

The second category of parameters within which GDSS studies and findings may vary involves *use characteristics* of GDSS (see table 6.1). Use characteristics can be defined as conditions, manipulations, and constraints associated with the use of a particular GDSS in a particular setting for a particular task. To the extent that variations exist within and across these categories, all these factors have the potential to differentially affect the outcome of GDSS studies.

First, the multitude of *experimental manipulations* in GDSS research can confound attempts to organize effects. Some researchers have manipulated physical proximity (Hiltz et al. 1986; Siegel et al. 1986), while others have manipulated proximity in a factorial design combined with anonymity (Jessup et al. 1990). Although many studies have claimed to study similar decision-making outcomes, interstudy variation and few replications make drawing valid conclusions problematic.

Similarly, *clear and consistent operationalizations of outcome variables have proved troublesome.* Several variables such as "satisfaction" have received much attention in the GDSS literature. However, a review of fifteen GDSS experiments revealed inconsistent operational definitions in many of these constructs (Kudsi 1991). While multi-operational approaches are sometimes desirable, they do not always measure the same aspects of a construct, and therefore should not be inventoried as the same global variable when conducting meta-analytic classifications. For example, many studies have investigated "participation," variously defined as distribution of influence behavior (Zigurs, Poole, and DeSanctis 1987), total computer participation (Jessup et al. 1990), number of ideas generated (Nunamaker, Applegate, and Kosinsky 1987), time spent typing during a meeting (Kiesler 1990), time spent using GDSS during the meeting (Poole and DeSanctis, 1990), and total number of comments generated in a meeting (Siegel et al. 1986). All have been categorized under the rubric of "participation" despite clear differences in which aspect of group process they reveal. Lumping these definitions together can confound attempts to assess patterns of findings because they are measuring different aspects of participation (e.g., verbal participation, typed participation, time of meeting devoted to computer input, etc.).

Furthermore, *variations in the modalities afforded by the GDSS must be considered when interpreting findings.* For instance, decision rooms are different from dispersed Local Area Networks, but often are grouped under the rubric of GDSS (Dennis et al. 1988). Some experiments looked at the difference between face-to-face communication and GDSS "decision rooms" (Zigurs et al. 1987; Nunamaker et al. 1987) while others looked at the difference among two to three types of meeting support (Ellis, Rein, and Jarvenpaa 1989; Jarvenpaa et al. 1988). Others have looked at the difference between GDSS and paper and pencil versions of that support package (Watson, DeSanctis, and Poole 1988).

Task differences arguably have always been a concern for researchers when generalizing and organizing effects and when task differences are associated with different group outcomes (McGrath 1984). The first element that can separate studies is task *type*. Some researchers have studied idea generation (Nunamaker et al. 1987), others have included stakeholder identification (Easton, Vogel, and Nunamaker 1989). The *complexity* of a given task also can confound attempts to organize outcomes (Gallupe, DeSanctis, and Dickson 1988). Some tasks may involve many phases and material support before a decision is reached (Billingsley 1991; McGrath and Hollingshead 1991a), whereas others may only involve number of ideas generated (Nunamaker et al. 1987). If outcomes are measured in terms of satisfaction and participation distribution, the complexity of the task is at least as important as the technological support that the system provides. For example, Shaw (1981) argues that the complexity of a particular task may influence participation. Third, the *realism* or *salience* of a task is also important for interpreting dependent variables such as participation (McGrath 1984). Fourth, the *degree of uncertainty* associated with a task can have an effect on outcomes. Some GDSS studies have utilized risky shift tasks (McGuire, Kiesler, and Siegel 1986) in which the outcomes of given recommendations are uncertain for subjects. Other GDSS researchers have used more simplistic decision tasks for which an optimal answer can be determined (Steeb et al. 1981). Gallupe and DeSanctis (1988) directly tested the difference between a brainstorming task and a resource allocation task. The two tasks proved to differentially effect outcomes (Gallupe and DeSanctis 1988).

Time is an important variable in the study of groups in general (McGrath and Hollingshead 1991b; Gersick 1989), and certainly should be in GDSS studies as well. *Time constraint* is included as a use characteristic category in table 6.1 because the limits imposed on users for the completion of their tasks often varies between studies. Some of the GDSS research involves tasks that are completed within a maximum twenty minute period (Siegel et al. 1986), while others are allowed to run to completion (Watson et al. 1988). Some tasks in the literature were stretched over several meetings (Zigurs, DeSanctis, and Billingsley 1989), others were completed in one (Hiltz, Johnson, and Turoff 1986).

Another use characteristic parameter is *channel selection*. Interpreting GDSS effects is contingent upon the rules functioning during the meeting with regard to channel selection (George 1989). Some experiments have instructed subjects to communicate through the computer only (Hiltz, Johnson, and Turoff 1986; Siegel et al. 1986). Other investigations (especially those conducted in decision rooms where subjects are face-to-face) have not been explicit about the rules operating with regards to channel selection. Some GDSS may only be used to aggregate numeric data (Johansen 1988). In the users' training, or even across study conditions, did implicit rules operate that required subjects only to use the computers for certain tasks?

The final use characteristic in table 6.1 follows from the last point. Does the *training that the experiments provide* about use of the GDSS have a subsequent effect on outcomes? Were subjects given a demonstration? Were they allowed to walk through a practice meeting? What rules about use are inherent in the type of training? Answers to these questions are fuzzy in the literature.

The final global category of contextual contingencies, within which aspects of GDSS studies can be arrayed and compared, we term *user characteristics* (see table 6.1). User characteristics can be defined as the various attributes that individual members or groups bring to GDSS meetings that have implications for how the GDSS might be used. Eight categories combine to define and differentiate user characteristics: (1) sample differences, (2) group size, (3) group structure, (4) members' history of interacting together, (5) user training, (6) attitudes about use of technology, (7) computer expertise, and (8) experience adapting to new technologies. These categories represent attributes of GDSS users which may contribute to different GDSS outcomes.

First, *sample differences* refers to the variety of participants used in each study in the literature. GDSS studies have included business teams (Ellis et al. 1989), technical researchers (Steeb and Johnson 1981), undergraduate business majors (Jessup et al. 1990), and military personnel, among others. Second, *group size* is an important variable related to outcomes in the group literature such as distribution of participation (Fisher and Ellis 1990; Shaw 1981) and should be no less important in GDSS research. GDSS studies vary from three in a group to as many as twenty-two (cf. Pinsonneault and Kraemer 1990). Third, *group structure* can mediate and affect outcomes (Fisher and Ellis 1990; Shaw 1981; Poole, Seibold, and McPhee 1985). An active hierarchy operating in a group may influence participation or satisfaction differently than that of a leaderless group. There is some evidence that a leader can influence how the group uses the GDSS (Poole and DeSanctis 1990). Fourth, *a history of interacting together* can potentially affect the process and outcomes of meetings (Hall and Williams 1966; Torrance 1957). A group with a shared history together may orient to new technologies differently because of their collective experience with

uncertain situations. Fifth, *subject attitude* toward the type, extent, and thoroughness of training provided prior to using a GDSS has differed throughout the literature (George 1989), resulting in potentially important differences in users' skills with the particular GDSS studied. Sixth, *attitude about using new technologies* for problem-solving can affect outcomes (Barley 1986; Poole and DeSanćtis 1990). Seventh, users' general *level of computer expertise* may influence how they act during meetings where they are encouraged to use one (Kiesler 1990). Too, peer evaluation of a task and technology can mediate perception outcomes (Contractor and Eisenberg 1990; O'Reilly and Caldwell 1985). Eighth, *past experience* (adapting to new technologies) can influence how people use and are effected by it (Barley 1986; Fulk, Schmitz, and Steinfield 1990; Monge 1990).

The three global categories above provide a general framework within which other investigators can add theoretically relevant subcategories for examining *combinations* of factors on which GDSS outcomes are contingent. It is not meant to be an exhaustive taxonomy, merely a descriptive framework to illustrate the world of *contextual* differences between and within many GDSS studies. Attention to the combination of factors present in individual studies as well as across studies can add qualitative insight into the assessment of empirical findings. In addition, this descriptive framework provides researchers with a sensitizing device that documents key environmental considerations present in GDSS research. Finally, this approach provides an agenda for theory building in that contextual variables have been noted as crucial domain specifications for assessing outcomes (e.g., Contractor and Seibold, in press; Poole and DeSanctis 1990).

To summarize, we have surveyed the previous review literature on GDSS effects. A common observation in this literature is that there needs to be some way to organize the conclusions across the many variables that differentiate studies. A review of major reviews in the area revealed the need for a comprehensive descriptive framework for identifying contingencies. These contingencies can be arrayed and organized hierarchically by researchers to better interpret detected effects, as well as as a means to better "fit" their research into the literature. Incorporating environmental contingencies which differentially affect GDSS outcomes has been an important basis for taxonomic classification, but the GDSS literature is limited to singular contingencies which ignore influences occurring *in combination*. A conceptual framework was introduced in an attempt to incorporate the most important contextual contingencies explicitly addressed or alluded to in the GDSS literature. These distinctions were summarized within three global categories: system, use, and user characteristics.

Conclusion

Many of the GDSS studies, and GDSS reviews discussed throughout this essay, demonstrate that group process and outcome effects have not been systematically associated with the system, use, and user characteristics potentially present in GDSS use. In several cases, studies conducted at the same level of computer intervention have reported positive, negative, *and* no effects on key processes and outcomes. Perhaps the most significant implication of the essay is to reconsider the *assumption* surrounding previous work: that uniform effects should obtain within and across studies. As Malone (1985) points out, the majority of research on the social organization of work is based on the premise that the impact of a technology is consistent across adopting groups. However, this tradition of organizational research has repeatedly been confronted with the "dual effects hypothesis": communication technologies can have *opposite* impacts simultaneously and in spite of one another (Mesthene 1981). The introduction of telephones fostered both decentralization (the growth of the suburbs) and centralization (the growth of the skyscraper) at the same time (Pool, Decker, Dizard, Isreal, Rubin, and Weinstein 1981). After providing a comprehensive review of 251 articles, Johansen (1977) failed to arrive at unequivocal conclusions linking various configurations of organizational teleconferencing to specific communication tasks. Short, Williams, and Christie's (1976) series of carefully controlled experiments failed to demonstrate that telecommunication media characteristics (such as social presence) systematically influenced organizational communication tasks.

It seems increasingly evident that the tradition of research based on the technological imperative—including much of GDSS research—has failed repeatedly to provide an adequate understanding of mediated communication processes in the workplace. We propose that the study of technologies in organizations is better served by what Pfeffer (1982) called the "emergent perspective" on action in organizations. On this view, "the uses and consequences of information technology emerge unpredictably from complex social interactions" (Markus and Robey 1988, 588). In terms of the present review, adopting an emergent perspective would require a closer examination of the pragmatics and norms surrounding the use of GDSS in groups and the organizations in which they are embedded, considering at once the reciprocal relationships among goals, technology, and interactions that constitute emergent patterns and effects (Contractor and Eisenberg 1990).

Research of the sort we encourage has already proved fruitful in the study of other technologies. Johnson and Rice (1987) documented norms that evolved about the use of word-processing. Rice and Contractor (Fulk, Schmitz, and Steinfield 1990) showed that the introduction of integrated office information systems significantly alter the users' conceptualization of what constitutes effective communication. Steinfield and Fulk (1990) reported that users of a recently implemented electronic mail system used the medium to censure certain forms of communication (such as "flaming"). Steinfield and Fulk also described how the medium was used to structure users' perceptions of "message discipline" including the frequency of checking electronic mail, and the acceptable turnaround time for responses. Blomberg (1988) described how a computer-based design environment altered the social organization of the design process; equally significant was her finding that the evolution and meaning of the technology was influenced by the reallocation of tasks among designers and software engineers.

Similarly, we propose that the recursive interplay between goals, technologies and actors is an adaptive process by each group of GDSS users, thus allowing for widely divergent outcomes using the same level of GDSS in similar settings. Outside GDSS research an excellent example of research based on this premise is Barley's (1986) description of the introduction of the same technology in two radiology units. Barley's (1986) analysis revealed that the introduction of computerized tomography (CT scanners) occasioned similar dynamics but led to very different structural outcomes in the two units studied. Within the GDSS domain, Poole and DeSanctis (1990) have conceptualized GDSS use and effects as a process of adaptive structuration, and considerable empirical research has emerged within this perspective (e.g., DeSanctis, D'Onofrio, Sambamurthy, and Poole 1989; DeSanctis and Poole, 1990, 1991; DeSanctis, Poole, Dickson, and Jackson, in press; Holmes and Poole 1991; Poole and DeSanctis 1989, 1992; Poole, DeSanctis, Kirsch, and Jackson 1991; Poole, Holmes, and DeSanctis 1991; Poole, Holmes, Watson, and DeSanctis 1990). Contractor (this volume) explicates a self-organizing system perspective which we have formally contrasted with Poole and DeSanctis' adaptive structuration theory (Contractor and Seibold, 1993). Both theoretical approaches acknowledge that there are various contextual contingencies that mediate how GDSSs are used (e.g, Poole and DeSanctis propose a "double contingency" model). The comprehensive assessment of the various combinations of contextual contingencies we have provided (see table 6.1) not only expands and illuminates the first contingency in the Poole and DeSanctis model but hopefully provides an important starting point for enhancing our understanding of the *recursive* interplay between the various systems, uses, and users of GDSSs.

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