CONFLICT MANAGEMENT AND GROUP DECISION SUPPORT SYSTEMS

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Computers promise to change collaborative work in profound ways. They are likely to have special impact on processes which require fine judgments, foresight, and handling of large amounts of information, such as decision-making and strategic planning. Several authors (Huber, 1984; Kraemer and King, 1986) have discussed the potential benefits of decision support systems for organizational decision-making.

Group decision support systems (GDSSs) combine communication, computer, and decision support technologies to support problem formulation and solution in group meetings. Communication technologies include electronic messaging, local and wide-area networks, teleconferencing, and store-and-forward facilities. Computer technologies include multi-user operating systems, fourth generation languages, databases, data analysis facilities, and data storage and modification capabilities. Decision support technologies include agenda-setting decision modelling methods (such as decision trees, risk analysis forecasting methods, and multiattribute utility functions), structured group methods (e.g., Nominal Group and Delphi Techniques), and rules for directing group discussion. DeSanctis and Gallupe (1987) have distinguished two levels of GDSS. A level 1 GDSS provides features to eliminate communication barriers, such as large screens for display of ideas, voting solicitation, and anonymous input of ideas and preferences. A level 2 GDSS provides problem-structuring techniques, such as automated planning tools, modelling packages, and information libraries. Level 2 thus represents an enhanced GDSS, as opposed to Level 1, which is a communication medium only.

GDSSs can be tailored to tackle critical situations decision-makers face. One of the most ubiquitous and potentially troublesome situations is interpersonal conflict. Several features of GDSSs can play a key role in conflict management, including methods for the identification of conflict, structured agendas that guide the group through discussion of the conflict, utilities for clarifying the nature of the problem and for generating alternative solutions, and structures that promote members' participation. A few GDSSs have been specifically designed to manage conflicts (e.g., Sainfort, Gustafson, and Bosworth, 1987). However, these tend to be concerned with specific problem types, such as family conflict, and are not well-adapted for dealing with general conflicts.

In this article we will focus on how a nonspecialized multipurpose GDSS influences conflict management in groups. It is this type of GDSS that groups will most often use to deal with conflicts. Groups will not always have the time or inclination to switch into specialized conflict management routines, and what routines there are will rarely

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This research was supported by National Science Foundation grant SES-8715565 to Poole and DeSanctis, by the Conflict Project: Theory and Practice at the University of Minnesota, and by NCR Corporation. The views expressed here are solely those of the authors and not the research sponsors. Correspondence should be addressed to Poole, Department of Speech Communication, 317 Folwell Hall, 9 Pleasant St. S.E., U of M, Minneapolis, MN 55455.

fit the specific problems groups face. Moreover, to assume a special routine is needed to deal with conflicts is to assume conflict is somehow distinct from group decision-making. On the contrary, we believe conflict is part and parcel of all collaborative work. So we will study how varying levels of conflict emerge and are handled within a GDSS.

The GDSS used for this research is a "generic", level I system, version 1.0 of the University of Minnesota SAMM GDSS system (DeSanctis and Gallupe, 1987; DeSanctis, Watson, and Sambamurthy, in press). The level 1 version of SAMM is designed to facilitate group communication and organize group interaction. It was purposely designed to embody a widely-used decision procedure, Dewey's Reflective Thinking Model, along with a few popular methods of deciding--rating, ranking, and voting. It purposely omits some of the more advanced features that could and would be incorporated in Level 2 systems (and are available in later versions of SAMM). This was done so we could compare work by groups using the GDSS with that of groups using manual versions of the same procedures.

In the next section we will first consider the effects GDSSs are likely to have on conflict management and advance several research questions and predictions. Following this we will describe a study designed to ascertain these effects.

GDSSs AND CONFLICT MANAGEMENT

Productive Conflict Management

Before discussing possible effects of GDSSs on group conflict, it is useful to consider what effective conflict management is. If we have this firmly in mind, it is easier to gauge GDSS impacts. The extensive literature on conflict suggests a number of conditions that promote effective conflict management (Putnam and Poole, 1987; Folger and Poole, 1983; Fisher and Ury, 1981; Walton, 1969). These include, a focus on the problem rather than personal or emotional slights, consideration of a wide range of alternative solutions, a cooperative climate, an organized and orderly process, and avoidance of artificial conflict-reducing devices such as voting or having the leader make the decision. Considerable evidence suggests that groups which follow this pattern are more likely to reach a solution that preserves and builds relationships among group members.

By what criteria do we assess productive conflict management? Like most social outcomes, productive conflict is complex and multidimensional. At the most fundamental level, we can tell a conflict has been productive if parties achieve consensus on the final solution and are satisfied with and committed to it. But productive conflict management is gauged not just by outcomes, but by the process used by the group to arrive at its outcomes. If certain parties stick firmly to their positions, shunning compromise and refusing to consider alternative, creative solutions, the conflict is unlikely to be productive for the other parties. So amount of change in positions during discussion is a second indicator of productive conflict.

Two additional indices of productive conflict management are based on observation of behavioral processes and group interaction. Studies of conflict have distinguished three general modes of conflict handling behavior: distributive behavior, avoidance behavior, and integrative behavior (Sillars, 1980; Sillars, Perry, Colletti, and Rogers, 1982; Killman and Thomas, 1975). In distributive behavior parties pursue their own interests, regardless of others' need or interests. Distributive behavior is also nondisclosive--parties conceal information and indicate a closed attitude to the

problem and to many alternatives. Parties exhibiting avoidance behavior seek to flee or to smooth over the conflict. Integrative behavior attempts to find a resolution that realizes the interests of all concerned. It is disclosive, in that it makes the party's interests clear and evinces openness to other points of view and solutions. It is widely accepted that integrative behavior promotes constructive resolutions. However, recent research suggests that productive conflict management also is promoted by "hard bargaining", in which there is a mixture of distributive and integrative behavior (Putnam, 1988). Distributive behaviors advance positions, while integrative behaviors suggest compromises and temper competition. The mix may also include some avoidance behavior, to further temper competition and prevent the spiral from getting out of hand. In a productive conflict there would be a high level of integrative or mixed integrative-distributive behavior relative to purely distributive and avoidance behavior. This does not mean there would be no distributive or avoidance behavior. Distributive and avoidance behavior, as noted above, are often useful in early stages of conflict. But as the discussion proceeds, integrative or mixed integrative behavior should increasingly predominate. So a shift from pure competition and avoidance at the beginning of the discussion to integrative or mixed behavior at the end is another indicator of productive conflict management.

GDSS Effects on Conflict Management

The limited number of studies of GDSSs and the wider literature on teleconferencing and computer-mediated communication suggest several impacts GDSSs may have on group conflict management. Some of these may facilitate the group by fulfilling conditions for productive conflict management. However, other effects may militate against productive uses of conflict.

Existing evidence concerning GDSS impacts on conflict outcomes is mixed. Several studies have found that computer-mediated decision-making leads to lower levels of group consensus (Rice, 1984: pp.137-8; Hiltz, Johnson, and Agle, 1978; Hiltz, Johnson, and Turoff, 1981; Hiltz, Turoff, and Johnson, 1982; Siegal et al., 1986; Watson, DeSanctis, and Poole, 1988). On the other hand, several case studies suggest that GDSSs may promote consensus (Stefik et al., 1987; Sainfort, Gustafson, and Bosworth, 1987). Whether a GDSS promotes or undermines conflict management depends on at least two factors: (1) The particular configuration of features in the GDSS and the balance of helpful and harmful effects it elicits; and (2) How the group uses these features, which it emphasizes and which it ignores, which it uses faithfully and which it misuses.

A review of current literature reveals seven distinct effects, positive and negative, that GDSSs may have on conflict management. Several of these work in opposite directions, and the balance among them that the system creates determines whether it promotes or discourages productive conflict management.

The influence of GDSSs on conflict processes and outcomes stems from at least three sources (Poole and DeSanctis, 1987). First, GDSSs serve as a medium for group interaction. In a face-to-face group, the GDSS is a complement to and sometimes substitute for direct interaction, while in a decision network it is the sole channel. As several studies suggest, machine-mediated interaction is likely to differ from free communication in important ways (Rice, 1984). Second, the GDSS is a means to impose processual structures on groups. GDSSs have built-in process guidelines and thus have the capacity to "program" group activities and shape how members work. Third, the GDSS hardware and software provide members with a means of influencing the group. Seven distinct effects can be discerned:

1. There is greater expression of affect, both positive and negative, in computer-mediated communication than in face-to-face modes (Siegal et al, 1986; Turoff and Hiltz, 1982; Johnson, Vallee, and Spangler, 1979; Rice, 1984). Evidence suggests that negative affect will come out more strongly than positive feelings. In general, this should make productive work more difficult, since it may shift the group's focus to personal antagonisms rather than the issues. So this will tend to produce lower consensus, less change in positions, and less integrative behavior. This effect may be ameliorated by systems such as the one used in this study, in which people can talk face-to-face, as well as through the computer system.

2. GDSSs emphasize written media over spoken communication. Public and private screen displays force people to express their positions in writing. In general, people are more likely to maintain written positions rigidly than more fluid spoken stances (Johnson et al., 1979). This should make it harder to change positions, leading to lower consensus overall; it may also result in less integrative and more distributive behavior.

3. Computer-mediated communication may deemphasize personal relations. Mediated communication is less intimate and immediate than face-to-face communication. Because they are less personal, GDSSs may "desensitize" conflict, enabling members to focus more on issues and arguments and less on personal antagonisms (Rice, 1984; Williams, 1977). This suggests consensus will be higher, amount of change in positions may be greater, and integrative behavior will be encouraged over distributive behavior. A less intimate medium may also enable the group to face up to conflict more easily, reducing avoidance. In addition, a GDSS is a highly salient communication channel which may focus members' attention on the system and turn it away from people and their interchanges. This can provide a useful distraction, which "depersonalizes" the conflict.

4. GDSSs equalize member participation. A wide variety of studies have demonstrated this effect (Watson et al., 1988; Siegel et al, 1986; Johnson et al., 1979; Gallupe, 1985; Rice, 1984). This may promote conflictive exchanges, since members who ordinarily would not express themselves are able to put forth positions pro and con. This may make dealing with the conflict more time-consuming. But if the group can work out an agreement, there is likely to be higher consensus; if members all work on the decision, they will feel "ownership".

5. GDSS procedures make processes and roles in conflict management clearer. When roles and procedures are clearly-defined, as they are in a GDSS, it will be easier to organize the group. This preempts a key source of conflict, tension created by social uncertainty and disorganization. This should make conflict less extreme, and therefore lead to higher levels of consensus, more change, and more integrative behavior.

6. When GDSSs incorporate decision rules, these can influence the course of the conflict. GDSSs often incorporate voting or other decision procedures and make them salient to group members. As conflict researchers have long known, voting procedures can serve as disincentives to conflict management. Members know the issue will come to a vote, so they have little motivation to compromise or problem-solve. Those in the majority know they can force their will, while minorities often take "noble, and principled", but losing stands. Such procedures will tend to lower consensus, and reduce change. They may also generate lower levels of integrative behavior, combined with higher levels of distributive behavior. They may also lead to avoidance by the group.

On the other hand, voting procedures can be used to surface conflict as a preliminary to problem-solving. Straw polls are often a useful technique to make members aware of differences and to suggest possible compromises. Votes can be used to move a group toward agreement if members do not polarize on key issues. Provided voting is used in this way, it can produce integrative behavior, change in members' positions, and high levels of consensus.

7. When GDSSs have procedures for brainstorming or defining solutions, they will stimulate the group to explore a wide range of alternatives. The wider the range of alternatives considered by the group, the more likely it is members will find a creative solution that meets their needs and satisfies their interests. So in this case there should be a higher level of consensus, greater change in positions and more integrative behavior relative to distributive and avoidance behavior.

The predictions generated from these effects are displayed in Table 1. The strength of effects relative to each other is indicated in the last column of the table. It is important to note that these effects do not always occur, but depend on the nature of the GDSS and the nature of the conflict. Many theories of GDSS and other technologies posit simple, general, direct effects on group processes and outcomes. For example, Weeks and Chapanis (1976) hypothesized that group interaction patterns would differ in face-to-face, audiovisual, visual only, and teletypewritten modes. However, things are not that simple. How a GDSS influences conflict management depends on at least three contingencies:

First, the configuration of features available on a given GDSS determines which effects can result. For example, a GDSS with no facilities for generating or evaluating solutions could not have effect number 7.

Second, the nature of the group's task and associated conflict may also determine GDSS effects. The task must invoke the features of the GDSS for associated effects to be observed. If the task is such that alternatives are predefined for the group and no expansion or redefinition is permitted (as with a jury), then effect number 7 also cannot emerge--it is rendered impossible by task limitations.

Third, how the group uses the GDSS is the ultimate determinant of which effects occur and whether these are beneficial or harmful. If the group chooses not to use voting procedures, for example, they cannot influence the conflict. Members may use GDSS features in ways that mitigate their effects. Members who type personal attacks into the system may override the impersonal feel of the GDSS, eliminating any benefits which might derive therefrom. Moreover, we noted above that several effects of GDSSs could have either positive or negative impacts, depending on how the group used the GDSS. The group's use (or misuse) of the GDSS is a key link in any theory of GDSS impacts (see Poole and DeSanctis, 1987). The next to last column in Table 1 displays the likelihoods of the effects, given the GDSS and task used in this study.

Research Questions

In view of this discussion, this study will address three research questions:

1. How will conflict behavior differ in computer-supported groups compared to nonsupported groups? Overall, conflict processes might be expected to be different in GDSS-supported groups than in nonsupported cases. Exactly what differences emerge depend on which effects the GDSSs produces. This leads to a second question:

2. Which of the seven potential GDSS effects emerge, and is their impact productive or destructive? Once we know which effects occur, we can make predictions concerning how conflict management in groups using the GDSS will compare to that of nonsupported groups. If most observed effects are antithetical to effective conflict management, the GDSS groups should be less productive on the four measures. However, if the balance of effects is positive, then GDSS groups should have more productive conflict management that nonsupported groups. This implies a third question,

3. Will computer-supported groups manage conflict more productively than nonsupported groups?

PROCEDURES

General Research Strategy

In a laboratory study, three types of groups were contrasted: (1) "Computer-supported" groups used a level 1 GDSS, the SAMM system; (2) "Manual" support system groups were supported through a paper-and-pencil version of the GDSS; (3)"Baseline" groups were freely interacting and were given no support system whatever. Comparison of GDSS with the Manual and Baseline conditions enabled us to determine the impact of the technology over and above group work without technology. Comparison of the GDSS and Manual conditions with the Baseline condition enabled us to determine the impact of structure, independent of technology. Comparison across the three conditions is essential to sort out the effects of the technology from those due simply to structuring the discussion.

All groups worked on a budget allocation task designed to elicit conflict. We assessed GDSS effects and group conflict management behavior through interaction analysis of video and audiotapes of the group discussions. Interaction analysis was the most accurate means of gauging processes of system usage and conflict management. This method also enabled us to identify differences in how groups approached the GDSS. To measure conflict outcomes we assessed pre- and post-decision consensus among group members, as well as member satisfaction.

Experimental Procedures

Subjects. Forty three- and four-person groups participated in the study. They were drawn randomly from a larger sample of some eighty groups analyzed by Watson, DeSanctis, and Poole (1988). A subset of their groups was used due to the extraordinary effort involved in conducting close interaction analysis. The groups were composed of graduate and undergraduate students enrolled in introductory MIS classes at a large urban university. Many of the students were employed full-time in business settings, and most were working at least part time. The average age of participants was 24, with slightly more than 2.5 years of work experience. Approximately 60% of the subjects were male. All groups had some experience working together prior to participating in the study.

Task. The research task, "The Foundation Task" (Watson, 1987), required subjects to allocate a sum of money among six competing projects that have requested funds from a philanthropic foundation. Conflict arises because team members have varying preference structures that result in different allocation patterns. The task was pretested and refined over the course of six months with over 100 subjects. Watson (1987) reports details on the development and validation of this task.

The Group Decision Support System. The computer support system, called "Software Aided Meeting Management" (SAMM), was developed by a research team at the University of Minnesota for a series of studies concerning the impacts of computer-supported meetings. SAMM is written in the C programming language and runs under the Unix operating system on an NCR Tower Computer System. The system is described in DeSanctis and Dickson (1987) and DeSanctis et al., (1988) and is being used in a long-term program of research at Minnesota. Five universities other than the University of Minnesota are currently using the SAMM system for GDSS research. The system is also used on a regular basis for live group meetings in the University of Minnesota Decision Laboratory.

Basically, the SAMM system incorporates a rational problem-solving agenda. It performs the functions of recording, storing, and displaying problem definitions, criteria for evaluating solutions, alternative solutions, and a final group decision. Group members can enter relative weights for solution criteria, and the system will aggregate and display average group weightings. In addition, the system will cumulate and display ratings, rankings, and votes associated with one or more alternative solutions to a problem. A group scratch pad and messaging function are other features of the system. These features have been identified as appropriate for supporting the communication needs of groups (Gray, 1987; Huber, 1984; DeSanctis and Gallupe, 1987). Group members can enter individual ideas, messages, weights, ranks, or votes at their private terminal, and a public screen is used to display group ideas, messages, and aggregated (average and ranges) values of weights, ranks, votes, etc. The system is easy to use and menu-driven and does not require a facilitator or technician for operation.

Conditions. Each group was assigned to one condition, giving 13 Computer-Supported groups, 13 Manual groups, and 14 Baseline groups. Both the Computer-Supported and Manual groups were trained in the use of their support system. Baseline groups received no training at all and were left to their own resources. Training materials for the SAMM system were pretested and refined prior to data collection. Pre-tests indicated that people were comfortable with the system following a 20-minute training session.

In the case of the manual groups, subjects were provided with an 11-page handout outlining the same agenda that was on SAMM. Each page of the handout corresponded to a screen in the GDSS. The page explained the agenda item, giving details on how to accomplish the item parallel to those in the sub-menus of the GDSS. Manual groups were given a flip chart to display ideas publicly. Every effort was made to ensure that manual groups had the same structural aids as the GDSS groups. Manual groups were also trained in how to use the meeting structure. Baseline groups were given no structure, flip chart, or training. They were told to operate on their own resources.

Procedures. At each session the following procedure was followed: (1) Subjects filled out a preliminary questionnaire and signed an informed consent document. (2) Subjects worked on six budget problems as individuals to familiarize themselves with the task; this included the budget they were later to do in their group; (3) Groups received whatever training their condition required; (4) The groups made their budgetary allocation; (5) Members filled out a post-session questionnaire which assessed their attitudes toward the system and their individual opinions about how the money should have been allocated among the six projects; and, (6) Subjects were debriefed.

All group decisions were recorded for purposes of analyzing group interaction. The sessions took from one hour (for the fastest baseline groups) to two and a half hours (for the slowest GDSS groups). (See Watson, DeSanctis,& Poole, in press, for procedural details.)

Measurement

Post decision consensus and amount of change in positions. As Table 1 indicates, amount of consensus after the decision and amount of change in positions were two indicators of productive conflict management. Pre- and post-decision consensus were measured by having subjects indicate their own preferences for the budget allocations before and after the group decisions. Pre-decision preferences were gathered during the individual budget work prior to the group session. Post-decision preferences were gathered on the post-session questionnaire. Consensus was measured with Spillman et al's (1980) method. This method assesses the degree of concordance between individual preferences and produces a scale with a range of 0 to 1, where 1 implies complete agreement. Amount of change in positions was indexed by the difference between pre- and post- measures.

Conflict behavior. Conflict behavior was measured by interaction coding of the recordings of the forty sessions with two category systems: Sillars' (1987) Interpersonal Conflict Interaction Coding System (ICICS) and Poole's Group Working Relations Coding System (Poole and Roth, 1988). In our analysis we considered both the group's interaction profile--the total distribution of conflict behavior summed across the entire session--and the developmental path of the conflict--the sequence of conflict phases the group engaged in as the discussion progressed.

The ICICS codes 29 conflict behaviors that group into eight categories, shown in Table 2. These eight categories represent subtypes of distributive, integrative, and avoidance behaviors. The various combinations of integrative, distributive, and avoidance types yield seven possible conflict phases for the longitudinal analysis; the three pure phases and four mixed phases are shown in Table 2.

The Group Working Relationship Coding System (Poole, 1983a) identifies eight types of interaction patterns that reflect different working relationships in groups: Focused Work represents periods where members are task-focused and do not disagree with one another, as in brainstorming. During Critical Work members disagree with each other, but the disagreements are centered on ideas and no opposing sides have been differentiated. In Opposition disagreements are expressed through the formation of opposing sides; conflict is personalized during these periods. There are three modes of resolution for oppositions, Accommodation (where one side gives in), Tabling (where no resolution occurs, but the subject is dropped), and Open Discussion (which involves problem-solving discussions, negotiation, or compromise). Integration periods are times when the group is not task-focused; these exhibit tangents, joking, and positive socioemotional behavior. Each of the eight relational types represents a phase, as Table 2 shows.

Intercoder reliabilities were .85 or better for all categories, as measured by Scott's coefficient. Discussions were first coded with the Working Relations System, and then periods of Critical Work, Opposition, and the three resolution types were coded with the Conflict Coding System.

As noted, two types of interaction data were computed from these codings--interaction profiles and developmental maps. Interaction profiles were simply the number of acts in the session that fell into each Relationship or Conflict category.

Conditions were compared in terms of absolute numbers of acts and proportion of time used in each activity type. This enabled us to assess if there was more productive conflict behavior in one condition than in the others.

Developmental maps showed the phases of conflict behavior groups went through as they made the decision. They were identified with procedures described in Poole and Roth (1988). The procedure used the two types of codings to produce a map of a group's decision that indicated the order of phases of conflict behavior and the proportion of time spent in each. The mapping procedure is very flexible. It is designed to find any ordering of phases, no matter how simple or complex and does not attempt to fit the developmental sequence into any ideal model with a set order of phases. Table 3 shows two sample developmental maps. Each phase is indicated by both conflict and relational codes. Note that one is very simple, with each phase occurring only once, while the other is very complex, with repeating phases. The first has a single prolonged conflict with a logical progression. The second has two "bursts" of conflict and recycles between opposition and other phases. In the sample some groups were simple, like chart 1, while others were complex, on the order of chart 2 or even more complicated. Our analysis compared groups in terms of their order of phases, whether phases shifted from distributive and avoidant to integrative and mixed integrative behavior, and in terms of complexity of developmental path.

Presence of GDSS effects. Seven separate effects that the GDSS might have on conflict were posited. For each of these we developed a set of indicators to show whether the effect was present or not for the three conditions. The codings of conflict behavior with the ICICS and the Working Relationships systems were used, as well as other indicators. Indicators will be discussed below.

RESULTS

Question 1: Does conflict behavior differ in computer-supported groups versus nonsupported groups?

We compared the three conditions in terms of their interaction profiles and the properties of their developmental paths. Here we will cover only the major differences; more detailed results are available from the authors.

The interaction profiles of each group's Interpersonal Conflict and Working Relationship behaviors were computed for both absolute numbers and proportions of each major category. Differences were tested with two-way ANOVAs with condition and group size as independent variables. There were few significant size effects and few interactions. Because these tests often had nonhomogeneous variance, the Kruskal-Wallis one-way rank order analysis of variance was also used to compare the three conditions. Only differences significant at the p=.05 level for both tests are reported.

Computer-supported (CS) and Manual groups had more Focused Work than Baseline groups; this is because, in general, CS and Manual discussions were longer than Baseline decisions. There was no difference in the amount or proportion of Opposition behavior for the three conditions, but Manual groups had more Critical Work, in absolute and proportional terms, than did CS or Baseline groups. And CS groups had a significantly greater amount of Relational Integration (joking, tangents, etc.), both in absolute and proportional terms, than did Manual or Baseline groups. (Henceforth, Relational Integration will refer to integration coded with the GWRCS and Integration to the integrative conflict behavior coded with the ICICS.)

There were only two differences among the conditions in Interpersonal Conflict Behavior. CS groups had a greater proportion of Analytic Remarks than Manual groups, which in turn had a greater proportion than Baseline groups. In part, this is due to the fact that CS groups talked more about their group process and how to use the system than did the other groups. In addition, CS groups had a greater proportion of Noncommittal Remarks (Avoidance) than did Manual groups, which had more than Baseline groups.

From the developmental path diagrams we identified the amount of occurrence of the seven conflict phases. There were no significant differences among the three conditions in terms of the conflict phases. There were, however, some interactions between the conditions and effectiveness of conflict management; these will be discussed below. There were also some significant correlations between condition and phase occurrence, which highlight suggestive trends in the data.

There was a correlation of -.32 (p=.02) between occurrence of Integration phases and condition, and mean values suggest there were fewer periods of Integration in the CS groups than in the Manual or Baseline groups. In addition, there was a correlation of .36 between the proportion of mixed avoidance-integration phases and condition, suggesting there were more of these phases in the CS than in Manual and more in Manual than in Baseline groups. Finally, the correlation between complexity of developmental path and condition was .31 (p=.03). Means suggest the CS and Manual paths were more complex than Baseline paths.

Overall, differences between the three conditions came not so much in openly recognized oppositions, but in more subtle debate, signified by Critical Work. The Manual condition elicited more of this sort of conflict than did the other two conditions. CS groups relied on more neutral (Analytic) conflict responses than the other two conditions and tended toward using more avoidance. There was also much more Relational Integration--joking, tangents, and positive socioemotional behavior in CS groups than in noncomputer groups. Qualitative observation suggests this is due to the fact that CS groups were somewhat frustrated and occasionally had trouble with the system and that they vented through positive integrative interactions.

Question 2: Which of the seven potential GDSS effects emerge, and is their impact productive or destructive?

The possible effects of the GDSS were listed in Table 1. The indicators for each effect and results of the analysis will be briefly discussed; more detail is available from the authors.

Effect 1. Level of positive affect was indicated by the amount of Relational Integrative behavior and by the amount of Conciliatory-Supportive behavior (one of the 29 categories of the ICICS). Negative affect was indicated by the amount of Confrontative behavior as coded with the Interpersonal Conflict Coding System. Results showed no difference in negative affect for CS and Nonsupported groups and some evidence of greater positive affect in CS groups. However, some of this positive affect was due to hostile joking about the system.

Effect 2. Emphasis on written material was assessed by counting the number of statements referring directly to written displays in the three conditions. In addition, the valence of the reference--accepting, rejecting, or neutral--was coded. The CS condition had significantly more references to written material than the Manual condition, which had more than the Baseline conditions according to a Kruskal-Wallis test. There were also more negative references to written materials in the CS groups.

Did this emphasis have the effect of rigidifying the discussion? In general it seems it did not. There were fewer Tabling resolutions to oppositions in CS than in the other conditions, and more Open Discussion Resolutions (though these were not statistically significant trends).

Effect 3. To assess whether the computer system led to more impersonal discussion, we looked at the relative amounts of Analytic Remarks, which tended to be impersonal, and Conciliatory and Confrontative Remarks, which were more personal. Results were mixed, but CS groups did have a greater proportion of Analytic Remarks and fewer Conciliatory and Confrontative Remarks (though the latter results were only a nonsignificant tendency).

Effect 4. To determine whether the GDSS equalized participation, we used the coded behavioral data. We calculated the proportion of the total acts each member created. The measure of participation was the standard deviation of this proportion for each group. The lower the standard deviation, the more equal is group participation. For a oneway Anova and Kruskal-Wallis test, there were no differences between conditions in level of participation. The mean values indicated that there was more participation in the Manual condition than in the Baseline or CS conditions. This result parallels that found by Watson, DeSanctis, and Poole (1988) for actual influence over the decision in the larger sample from which this sample was drawn.

Effect 5. Indicators of role and process clarity (or, rather, lack thereof) were procedural remarks followed by Disagreement or Confrontation. We assumed that disagreement with procedural remarks indicated lack of agreement or uncertainty about procedures or roles. Procedural remarks were coded with a Task Function Coding System described by Poole and Roth (1988). The evidence suggests that CS groups did not have greater clarity than groups in the other two conditions. Indeed, CS groups had more procedural remarks followed by confrontation than the other two conditions.

Effect 6. Does voting suppress discussion and, hence, conflict management? To decide we identified points where groups took votes, either manually or using the GDSS. For each vote we also identified whether the vote was followed by further discussion of the issues, whether there was no further discussion of the issue, or whether the vote was actively used to cut off discussion. Voting was used significantly more often by Manual and CS groups than by Baseline groups. CS groups had significantly more neutral or negative uses of voting than Baseline groups, which had more than Manual groups. Conversely, Manual groups had significantly more positive uses of voting than CS or Baseline groups. Voting facilities in the CS condition did tend to cut off or end discussions.

Effect 7. To assess whether using the GDSS would encourage groups to explore more alternatives, we identified the number of solution statements made by the groups with the Task Function Coding System (Poole and Roth, 1988). This system identifies the number of new solutions or modifications advanced by groups, the number of statements elaborating a given solution, and the number of remarks evaluating solutions. On none of these indicators did CS groups exceed nonsupported groups. Indeed, proportionally the Baseline groups had more alternative-related behavior than did Manual, which had more than Baseline. Apparently, being able to enter solutions into the SAMM system at the beginning of the discussion reduced later discussion.

To summarize, the following effects emerged for the GDSS vis-a-vis the other conditions: there was more positive affect, more emphasis on written material, some evidence of a depersonalization of conflict interaction, and suppression of discussion

through voting. There was no evidence of equalization of participation, clarification of roles, increased negative affect, or increased exploration of alternatives. Indeed, there was less alternative exploration for the CS conditions than in the other two. Based on the observed effects and the predictions regarding these in Table 1, we would expect the CS groups to handle conflict less productively than the Manual groups.

Question 3: Do CS groups manage conflict more productively than nonsupported groups?

There were two measures of conflict outcomes: amount of change in positions and degree of member satisfaction with the decision. Watson et al. (1988) found a nearly significant difference among conditions in post-decision consensus. For this subsample, the mean values of predecision consensus were equal in the three conditions (.27 for the CS groups, .23 for the Manual groups, and .26 for the Baseline groups). However, the amount of pre-post change was quite different (.14 for the CS groups, .32 for the Manual groups, and .28 for the Baseline groups). This difference was significant for a oneway ANOVA and for the Kruskal-Wallis test. These tests indicated there was more change in the Manual groups than in Baseline or CS groups. In terms of member satisfaction, there were no significant differences between the three conditions.

ANOVA and Kruskal-Wallis tests showed no differences between the three conditions in the amounts of integrative, distributive, or avoidance behavior, although there were some significant correlations, noted above. The negative correlation between integrative behavior and condition suggests there is less integrative behavior in CS groups than in the nonsupported groups. We also assessed whether there was a shift from pure distributive and avoidance behavior to integrative and mixed integrative behavior; each developmental map was coded "yes" or "no" on this shift based on qualitative analysis of the maps. There was a slight negative correlation between the existence of this shift and condition, suggesting it occurred less often in the CS groups than in nonsupported groups ($r=-.26$, $p=.05$). The shift was observed in 3 of 13 CS groups, 6 of 13 Manual groups, and 8 of 14 Baseline groups. There was a significant association between amount of change and shift ($r=.31$, $p=.02$).

Further analysis of the developmental maps provides some indications of the relationship between conflict behavior and effectiveness in the groups. Within each condition we split the groups at the median of change in positions; all groups at or above the median were classified as "High change" groups, and all below the median were classed as "Low change" groups. We conducted two-way ANOVAs with condition and amount of change as independent variables and the seven types of conflict phase as dependent variables. Significant results are shown in Table 4. As Table 4 indicates, the interaction patterns related to high change differed for the three conditions. For the CS groups, the proportions of AID behavior and ID behavior were higher in high-change groups than for low-change groups. For Manual groups the absolute amounts of ID and the proportion of ID were higher in high-change groups than in low-change groups; in addition, there was more AID behavior and proportionately more Avoidance and AID behavior in low-change groups than in high- change groups. Finally, in Baseline groups, there were more phases with avoidance behavior (AID, proportionate AID and avoidance) in high-change groups than in low and less ID and proportional ID in high-change groups than in low.

As noted earlier, mixed Integrative and Distributive phases are most likely to be associated with hard bargaining, while mixtures of Avoidance, Integrative, and Distributive behaviors are hard bargaining, with competition tempered by the Avoidance behaviors. The patterns of results suggest that conflict surfaces in effective CS groups, as indicated by the ID phases, but that groups also utilize avoidance behavior.

This may be to tone down conflicts that threaten to get out of hand, or it may be a sign that the group cannot manage the conflicts that the GDSS surfaces and so "bail out", settling for what consensus there is (which is lower, on the average than that in Manual groups). A formula for ineffectiveness in CS groups is to confront the conflict without tempering it with avoidance. In effective Manual groups, on the other hand, there is little avoidance behavior, but rather direct hard bargaining, as indicated by high levels of the ID phases. Avoidance leads to ineffective results in the Manual groups. Apparently, these groups were able to surface and deal with conflict until a fairly high level of change was achieved. Effective baseline groups engaged in more phases with avoidance behaviors than did ineffective groups. Hard bargaining (ID and proportional ID) was not conducive to high levels of change in these groups.

We will attempt to put these results into perspective in the next section.

DISCUSSION

We posited that GDSSs would influence conflict outcomes in different ways, depending on the particular effects the GDSS had on conflict interaction and how group members chose to use the GDSS. So it was necessary to assess conflict management processes and outcomes, along with the GDSS effects that might account for them.

The study showed differences in how Computer Supported and Nonsupported groups handled conflict. In part, this can be traced to the effects of the GDSS. Our analysis showed that in CS groups there was more focus on written materials, somewhat more depersonalization, and greater expression of positive affect. Members also seemed to use voting to cut off or end discussions more in CS groups than in other conditions. This is in contrast with the Manual conditions, where voting stimulated further discussion of positions. In addition, rather than leading to greater consideration of alternatives, CS resulted in a reduction. Perhaps this is because entering alternatives "froze" them. (However, we only coded direct verbal referents to alternatives, and it is possible there were other modes of reference in the CS groups.) Taken together, these effects suggested that the CS groups should not manage conflict as well as Manual groups.

This prediction was borne out by the results. CS groups exhibited less change in positions than Manual groups, and fewer cases of shift toward integrative behavior than Manual or Baseline groups. Based on the analysis at the end of the last section, the following conjectures can be advanced:

Effective CS and Manual groups both surfaced conflict. But the differences in positional change suggest that Manual groups were more effective than CS groups in dealing with this conflict. Is this due to the processual structure? Probably not, since both Manual and CS groups had the same structure. Did the technology get in the way of conflict management? There is some evidence that it did, since change in CS groups was lower than in the other conditions. But the effects analysis showed the potential for positive impacts of the GDSS in these groups, as well as negative ones. Further, there was also more change in the Manual condition than in the Baseline condition, which did not have technology. So the difference must lie in how the Manual groups handled conflict and used their processual structure. To be effective, Baseline groups had to engage in some avoidant behaviors. In contrast, effective Manual groups surfaced and dealt directly with conflict through hard bargaining. Manual groups also tended to have somewhat longer discussions than the other conditions, perhaps providing time to air differences and check for consensus. There was more avoidance behavior in effective CS groups; when CS groups attempted to use hard bargaining, untempered by

avoidance, they were less effective. In the CS groups, adapting the technology to the task may have gotten in the way of conflict management. Using the GDSS may have distracted members from substantive discussion. This is suggested by the fact that a good part of the avoidance behavior in CS groups was due to hostile joking about the GDSS. Structure did seem to help with conflict management, but this depended on how the groups implemented it. In general, Manual groups seemed to do this better than CS groups.

The results of this first study support our basic framework, which posits that GDSSs do not directly determine conflict behavior or outcomes. Instead group use of the GDSS mediates its impact. This, in turn, depends on the type of task the group is confronted with, the particular configuration of effects the GDSS features make possible, and which of these effects the social interaction of the group realizes. This framework would seem to be useful for organizing future inquiry on this question.

An important implication of this framework is that GDSSs will not always result in less effective conflict management. For one thing, a GDSS with somewhat different features may elicit a different combination of effects which would lead to more (or even less) effective conflict management. Second, how the GDSS is explained to users may make a difference. Pretesting showed our training was adequate, but it was rudimentary; we appear to have had better success in later studies where we trained users in heuristics and a philosophy that stressed productive conflict behavior. Third, it is how individual groups use the system that ultimately determines effectiveness. As we noted, CS groups differ in their conflict management patterns; part of this difference may stem from how they appropriate and use the system (Poole and DeSanctis, 1987). It would be useful to do a followup analysis in which we identify those groups that use the system to produce positive GDSS effects and those that produce negative effects; we could then test for differences in productive conflict between the two groups.

The study also has implications for the design of GDSSs. In particular it suggests care in design of voting and alternative listing and how the system encourages people to use them. In addition, it implies that specialized conflict management programs may need to be included in GDSS training or software.

BIBLIOGRAPHY

DeSanctis, G. and Gallupe, B. (1987) A foundation for the study of group decision support systems. Management Science, 33, 589-609.

DeSanctis, G. and Dickson, G. (1987) GDSS: A shell system in support of a program of research. Proceedings of the 19th Annual Hawaii International Conference on Systems Sciences.

DeSanctis, G., Sambamurthy, V. and Watson, R. (in press) Computer-supported meetings: Building a research environment. Large Scale Systems.

Fisher, R. and Ury, W. (1981) Getting to yes. Hammondsworth: Penguin.

Folger, J.P. and Poole, M.S. (1983) Working through conflict. Glenwood, IL: Scott, Foresman.

Gray, P. (1987) Group decision support systems. Decision Support Systems: The International Journal, 3, 233-242.

Hiltz, S.R., Johnson, K., and Agle, G. (1978) Replicating Bales's problem solving experiments on a computerized conference: A pilot study. (Research report no. 5) Newark, N.J.: New Jersey Institute of Technology Computerized Conferencing and Communications Center.

Hiltz, S.R., Johnson, K., and Turoff, M. (1986) Experiments in group decision-making: Communication process and outcome in face-to-face versus computerized conferences. Human Communication Research, 13, 225-253.

Hiltz, S.R., Turoff, M., and Johnson, K. (1985) Mode of communication and the "risky shift": A controlled experiment with computerized conferencing and anonymity in a large corporation (Research report no. 21) Newark, N.J.: New Jersey Institute of Technology Computerized Conferencing and Communications Center.

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

Johanson, R., Vallee, J. and Spangler, K. (1979) Electronic meetings: Technical alternatives and social choices. Menlo Park, CA: Addison-Wesley.

Killman, R. and Thomas, K. (1975) Interpersonal conflict-handling behavior as reflections of Jungian personality dimensions. Psychological Reports, 37, 971-980.

Kraemer, K.L. and King, J.L. (1986) Computer-based systems for cooperative work and group decisionmaking: Status of use and problems in development. Proceedings, Conference on Computer-Supported Cooperative Work, Austin, Texas.

Poole, M.S. and Roth, J. (1988) Decision development in small groups IV: A typology of group decision paths. Manuscript, University of Minnesota, Department of Speech-Communication.

Poole, M.S. and DeSanctis, G. (1987) Group decision-making and group decision support systems. MIS Research Center Working Paper 88-02.

Putnam, L.L. and Poole, M.S. (1987) Conflict and negotiations. In F. Jablin, L. Putnam, K. Roberts, and L. Porter, Handbook of Organizational Communication. Beverly Hills: Sage.

Rice, R. (1984) The new media: Communication, research, and technology. Beverly Hills: Sage.

Sainfort, F., Gustafson, D.H. and Bosworth, L.K. (1987) Experimental evaluation of a computer-based conflict resolution program. Paper presented at TIMS/ORSA Joint Meeting, New Orleans, LA, May 6-8.

Siegal, J., Dubrovsky, V., Keisler, S., and McGuire, T.W. (1986) Group processes in computer-mediated communication. Organizational Behavior and Human Decision Processes, 37, 157-167.

Sillars, A. (1980) Sequential and distributional structure of conflict interactions as a function of attributions concerning the locus of responsibility and stability in conflicts. In D. Nimmo (Ed.) Communication Yearbook, Vol. IV, New Brunswick, NJ: Transaction Books.

Sillars, A., Colletti, S.F., Parry, D., and Rogers, M.A. (1982) Coding verbal conflict tactics: Nonverbal and perceptual correlates of the "avoidance-distributive-integrative" distinction. Human Communication Research, 9, 83-95.

Stefik, M. Bobrow, D.G., Lanning, S., and Tatar, D. (1986) WYSIWIS revised: Early experiences with multi-user interfaces. Proceedings of the Conference on Computer-Supported Collaborative Work, Austin, TX, Dec. 3-5.

Walton, R.E. (1969) Interpersonal peacemaking: Confrontations and third party consultation. Reading, MA: Addison-Wesley.

Watson, R. (1987) A study of group decision support system use in three and four-person groups for a preference allocation decision. Dissertation, University of Minnesota, Management Sciences Department.

Watson, R., DeSanctis, G. and Poole, M.S. (1988) Using a GDSS to facilitate consensus: Some intended and unintended consequences. MIS Quarterly, forthcoming.

Weeks, G.D. and Chapanis, A. (1976) Cooperative versus conflictive problem-solving in three telecommunication modes. Perceptual and Motor Skills, 42, 879-917.

Williams, E. (1977) Experimental comparisons of face-to-face and mediated communication: A review. Psychological Bulletin, 80, 963-976.

TABLE 1. PREDICTIONS ABOUT GDSS EFFECTS ON CONFLICT BEHAVIOR

POSSIBLE OUTCOMES GDSS FEATURES-EFFECTS	AMOUNT OF CONSENSUS AT END	PRODUCTIVITY OF CONFLICT BEHAVIOR		AMOUNT OF CHANGE IN POSITIONS
		INTEGRATIVE-DISTRIBUTIVE RATIO	SHIFT TOWARD COOPERATION	
1. Greater expression of affect (negative outweighs positive)	Lower	Less integrative; more distributive; more avoidance; less mixed integrative	Little shift	Low
2. Emphasis of written over spoken word	Lower	More distributive; less integrative; more avoidance; less mixed integrative	Little shift	Low
3. GDSS deemphasizes personal relations.	Higher	More integrative; less distributive; less avoidance; less personal focus; more mixed integrative	Pronounced shift	High
4. GDSS equalizes participation	Higher or lower	Can go either way depending on conflict	Either way	Higher or lower
5. GDSS makes procedures and roles clear	Higher	More integrative; less distributive; more mixed integrative	Pronounced shift	High
6. GDSS decision rules influence conflict	Higher or lower	Can go either way depending on conflict	Either way	Higher or lower
7. GDSS stimulates group to explore alternatives	Higher	More integrative	Pronounced shift	High

Table 2. Categories of Coding Systems and Phases of Group Interaction Derived from Categories.

Coding Categories	Phases
<u>Interpersonal Conflict Interaction Coding System</u>	
1. Denial and Equivocation 2. Topic Management 3. Noncommittal Remarks 4. Irreverent Joking 5. Analytic Remarks 6. Confrontative Remarks 7. Conciliation 8. Disagreement	A - Avoidance (Categories 1,2,3, and 4) I - Integration (Categories 5 and 7) D - Distributive (Categories 6 and 8) ID - Mixed Integrative and Distributive IA - Mixed Avoidance and Integrative AD - Mixed Avoidance and Distributive AID - Mixed Integrative, Distributive, and Avoidance
<u>Working Relationships Coding System</u>	
1. Focused Work 2. Critical Work 3a. Opposition 3b. Accommodation 3c. Tabling 3d. Open Discussion and Negotiation 4. Integrative Behavior	FW - Focussed Work (Category 1) CW - Critical Work (Category 2) OPP - Opposition (Category 3a, followed by 3b or 3c) OD - Open Discussion (Category 3d) INT - Integrative Behavior (Category 4)

TABLE 3. Two Developmental Path Charts

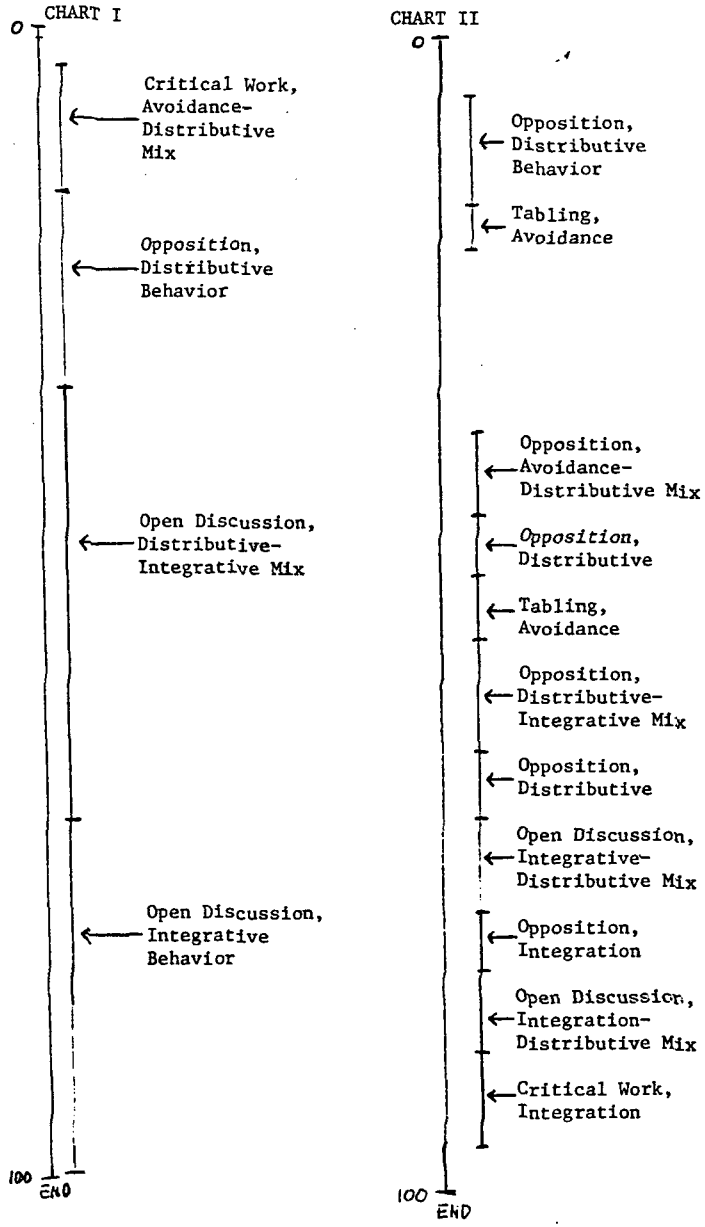

TABLE 4. Differences in Conflict Phase Occurrence Across Conditions and Amount of Positional Change; F-Tests.

VARIABLE		TABLE			SIGNIFICANCE
AID		CONDITION			
		BASE	MANUAL	CS	
	AMOUNT LO OF CHANGE	.71	3.7	3.7	p=.007
	HI	8.6	1.4	3.2	
ID		CONDITION			
		BASE	MANUAL	CS	
	AMOUNT LO OF CHANGE	13.3	3.7	2.4	p=.07
	HI	5.6	8.1	5.2	
PROPORTION OF AVOIDANCE		CONDITION			
		BASE	MANUAL	CS	
	AMOUNT LO OF CHANGE	8.0	30.6	27.1	p=.039
	HI	28.0	15.4	32.0	
PROPORTION OF AID		CONDITION			
		BASE	MANUAL	CS	
	AMOUNT LO OF CHANGE	0.7	15.8	6.1	p=.045
	HI	21.0	2.1	14.0	
PROPORTION OF IDENTIFICATION		CONDITION			
		BASE	MANUAL	CS	
	AMOUNT LO OF CHANGE	23.1	6.8	9.1	p=.007
	HI	6.4	16.7	10.4	