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Team Building: An Experimental Investigation of the Effects of Computer-Based and Facilitator-Based Interventions on Work Groups

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This study examined the effects of using a group decision support system (GDSS) and outside facilitation support in a three-hour team-building process on the attainment of "team." Twenty-four preexisting work groups (N = 186) were randomly assigned to three treatments: (1) a facilitated team-building process without computer support, (2) a facilitated team-building process with computer support, and (3) normally scheduled meetings without a facilitation or computer support. Twelve dependent "team" measures were assessed using a self-report questionnaire following the team-building session (immediate effect) and following the next normally scheduled group meeting (delayed effect).

On immediate-effect measures, both facilitated team-building processes resulted in higher member ratings of group process than ratings for meetings with no outside facilitation. On most measures, the positive immediate effects did not last over time, indicating that the three-hour team-building session was not effective. The implications for practice are severe in that both team building and GDSS technology are often implemented as one-time interventions. It is common practice to use these techniques and/or methods as a three- to four-hour component of a development session or as part of a specific task-related meeting.

HRD professionals, along with behavioral scientists, leaders, and technologists, have been focusing on methods and processes for increasing overall team effectiveness and overcoming problems associated with team performance. HRD professionals prepare team members to use effective team skills, develop lists of characteristics to differentiate high- and low-performance teams, and design team-building interventions to develop more successful teams. These all share a focus on accomplishing interdependent objectives through a group process.

However, accomplishing work through teams has not always been more effective or more efficient than accomplishing work through individuals. While teams may outperform individuals at certain times, researchers have found that at other times the collaborative effort of the team does not exceed or equal the performance of the best individual on the team (Shaw, 1978). Teams can make notoriously bad decisions in myriad ways (Janis, 1982; Harvey, 1988). Process losses result from the additional problems created when people work together (Steiner, 1966). Norms, the hidden rules that build high performance levels, can also work to reinforce patterns of low productivity (Whyte, 1955).

Many structured techniques and procedures have been developed to improve group performance, but more are needed (Hackman, 1987). Traditional procedures for overcoming process losses include parliamentary procedure and Robert's Rules of Order. Newer procedures include the Delphi method (Dalkey, 1969; Dalkey and Halmer, 1963) and the nominal group technique (Van De Ven and Delbecq, 1974). The newest procedures include the application of computer technologies in the form of group decision support systems (GDSSs) (DeSanctis and Gallupe, 1987; Gray, 1983; Huber, 1982, 1984). Kraemer and King (1988) identified six types of GDSS: electric boardroom, information center, teleconferencing facility, decision conference, local area group network, and collaboration laboratory.

Solutions to team performance problems have centered around the use of procedures and facilitation to increase group performance. Group procedures of almost any type have been shown to increase group outcomes (Poole, 1991). For example, the use of procedures such as the nominal group technique and the Delphi process have been shown to generate a greater quantity and quality of ideas (Delbecq, Van De Ven, and Gustafson, 1975). In addition, the use of a facilitator has been shown to increase process and content performance (Anson, 1990). An additional answer to this group performance problem may be the application of GDSS technologies as a mode to incorporate procedural management into groups.

Poole (1991) suggests four benefits of GDSS: (1) it presents procedures consistently and competently, (2) it makes procedures more convenient, (3) it makes the beneficial effects of procedures obvious, and (4) it provides new methods of meeting. Using GDSS features such as modeling tools, data bases, and group authoring support, groups may be able to perform tasks they normally would not attempt as a group.

Advances in information technology systems have created GDSSs that may be adapted by HRD professionals for use in team-building applications. If these computer-based systems can increase the benefits or decrease the costs associated with team performance, they could be an important tool for improving team effectiveness. Researchers have identified a number of structural features in GDSSs that affect team outcomes: anonymity, parallel processing or simultaneous input, public display, meeting structure, electronic display and

recording, and an information-processing capability (Bostrom and Anson, 1988; DeSanctis and Gallupe, 1987; Nunamaker, Applegate, and Konsynski, 1987; Poole and DeSanctis, 1987; Zigurs, 1987). Three classes of benefits based on these features have been identified by Kraemer and Pinsonneault (1989): affective benefits from the introduction of new ways of running meetings and enlisting cooperation, protocol facilitation benefits from structuring and streamlining processes, and information-quality benefits from using mathematical models and data sources. These features—particularly anonymity, full member participation, and democratic decision making—are seen as important elements of team building.

Research Question and Hypotheses

The purpose of the study was to determine the work effects a GDSS has on ongoing managerial and nonmanagerial groups during a three-hour team-building process. The general research question was: What are the effects of computer-based and facilitator-based team-building interventions on a team task among intact work groups?

The framework for this research consisted of three treatments. Two used team building, one each without computer support (T_1) and with computer support (T_2). The third group was a control (T_3). The measures administered at the end of each meeting assessed team performance and process outcomes. The basic hypothesis was that none of the groups would differ in any way on any of the dependent variables. The specific null hypotheses were as follows:

HYPOTHESIS 1: *Cohesion will not significantly differ between T_1, T_2, and T_3.*

HYPOTHESIS 2: *Quality of group process will not significantly differ between T_1, T_2, and T_3.*

HYPOTHESIS 3: *Participants' behaviors will not significantly differ between T_1, T_2, and T_3.*

HYPOTHESIS 4: *Solution satisfaction (performance) will not significantly differ between T_1, T_2, and T_3.*

HYPOTHESIS 5: *Socioemotional behavior will not significantly differ between T_1, T_2, and T_3.*

HYPOTHESIS 6: *Decision-scheme satisfaction will not significantly differ between T_1, T_2, and T_3.*

HYPOTHESIS 7: *Personal task participation will not significantly differ between T_1, T_2, and T_3.*

HYPOTHESIS 8: *Informal leadership will not significantly differ between T_1, T_2, and T_3.*

HYPOTHESIS 9: *Confidence in conclusions will not significantly differ between T_1, T_2, and T_3.*

HYPOTHESIS 10: *Depth of evaluation will not significantly differ between T_1, T_2, and T_3.*

HYPOTHESIS 11: *Perceived change in understanding will not significantly differ between T_1, T_2, and T_3.*

HYPOTHESIS 12: *Commitment to implement results will not significantly differ between T_1, T_2, and T_3.*

Summary of the Literature

This summary is divided into three areas: small-group research, team building, and computer-based support for groups (GDSS). Each of these areas was extensively reviewed.

Small-Group Research. McGrath's conceptual framework for the study of groups (1984) has been proposed as a theoretical model for research on a group process involving the GDSS (DeSanctis and Gallupe, 1987; Zigurs, Poole, and DeSanctis, 1988). McGrath's taxonomy distinguishes the relatively stable characteristics of the standing group (existing relationships between group members) as distinct from the dynamic processes of the acting group (the behavior created between members in relation to a specific task or situation and environment) (Miranda, 1991). This model provides a taxonomy of four classes of variables and relationships that must be accounted for in systematic group research. The influence of the four classes of variables—standing (preexisting) group characteristics, task characteristics, individual differences, and environmental variables—can be monitored or manipulated to determine their effects on the acting group processes and outcomes.

To measure the effects of differences in treatment, this study adapted an available instrument from a leading training-and-development-resources firm that addressed the areas of goals and objectives, utilization of resources, trust and conflict, leadership, control and procedures, interpersonal communication, problem solving and decision making, experimentation and creativity, evaluation, roles and responsibilities, and organizational context (Alexander, 1985; Phillips and Elledge, 1989).

Team Building. A number of criteria have been identified as important to an effective team (Likert, 1961; McGregor 1960, 1967). Measures of team effectiveness can be considered in terms of both performance and process outcomes.

The research on team-building interventions shows mixed results. A review of thirteen published studies conducted between 1980 and 1990 yielded nine that considered ultimate team performance. Of these nine, only four showed performance improvement. Ten of the studies used some form of in-

terpersonal intervention in conjunction with another type of intervention. The conclusion of the review was that "in some circumstances team development interventions may have enhanced work group effectiveness" (Sundstrom, De-Meuse, and Futrell, 1990, p. 128).

Traditional team-building interventions generally focus on a performance improvement cycle consisting of problem recognition, data gathering, data analysis (diagnosis), feedback and action-planning sessions, implementation, and follow up and evaluation (Dyer, 1987). The team work performance improvement process for the present study followed a simplified version of this model, consisting of data collection, data analysis, feedback, and action planning (Nadler, 1977).

Computer-Based Support for Groups. Experimental research has shown inconsistent results concerning differences in decision quality between GDSS and non-GDSS groups, while field studies have shown increased decision quality. Readers are directed to a number of well-written reviews of GDSS research (Anson, 1990; Dennis and others, 1988; George, Easton, Nunamaker, and Northcraft, 1990; Kraemer and King, 1988).

Anson (1990) suggests that a primary reason for the differences between GDSS laboratory and field study findings may be the key differences in facilitation, a position supported by Dennis, Nunamaker, and Vogel (1989). They showed that groups with facilitator support and computer support outperformed groups without support or groups with only computer support. Process perceptions were significantly improved in groups that received facilitator support over computer support (Anson, 1990).

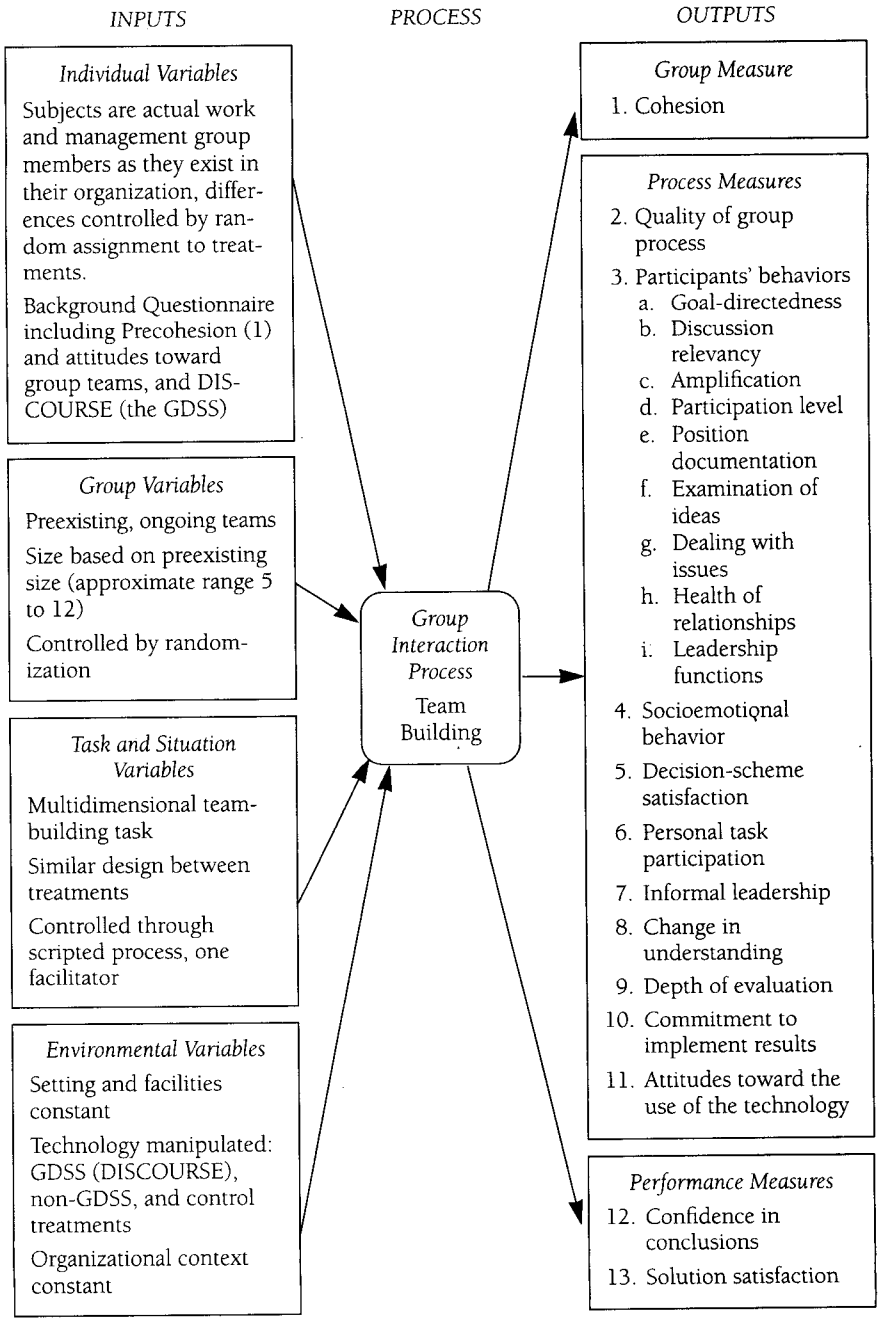
Significant differences in decision making exist based on the degree of human support provided to the group. Facilitated use of the GDSS showed benefits over user-driven use of the GDSS (Anson, 1990; Dickson, Lee, Robinson, and Heath, 1989). Increased experience on the system showed a higher degree of comfort (Miranda, 1991). Many of the studies may show different results as groups develop greater expertise and understanding of how to use or manipulate the GDSS. Many of the initial research results may not remain valid when group learning occurs and participants' ability to use and understand the GDSS increases (Gallupe, DeSanctis, and Dickson, 1988).

This study used a GDSS called DISCOURSE. Each participant has a keypad, networked to the facilitator's computer. The facilitator uses the DISCOURSE software to control how participant responses are collected, displayed, reported, scored, and used as a basis for discussion. DISCOURSE has more tools than keypad-based GDSSs, but it does not have the higher-level tools used in systems based on networked computers.

Research Methodology

A number of group performance and process outcome measures were used to assess and compare the three treatment groups; they are displayed in Figure 1.

Figure 1. Overview of Research Design Showing Research Variables in the Context of an Input, Process, and Output Model of Group Process



Experimental Design. A three-hour team-building session was facilitated for the experimental treatments. Treatment 1 (T_1) teams consisted of a team-building session without the assistance of computer support. Treatment 2 (T_2) teams consisted of a similar team-building session that used GDSS technology for computer support. The teams in T_1 and T_2 then held their next regularly scheduled meeting, which became part of the experiment. A control treatment (T_3) team assessed their own two regularly scheduled meeting without a team-building intervention (see Figure 2).

At the beginning of the first meeting, participants completed a background questionnaire and measure of group cohesion. At the end of the first meeting, they completed a postmeeting questionnaire that addressed dependent measures of group cohesion, performance, and processes. An identical questionnaire was completed at the end of their next regularly scheduled meeting as a team, assessing that meeting's group-process and group-performance outcomes.

Properties of the Team Task. A unique aspect of this study is the team-building focus of the task. A team-building task—or more technically, a team-building process—was developed specifically for this study. The task requirements of this team-building process benefited primarily from the information-processing, display, simultaneous-data-entry, and anonymity features of the GDSS. The nontechnology treatment benefited from the use of a facilitator and a data-based process (data collection, analysis, feedback, and action planning) to carry out the team-building task.

The team-building process started with a set of questions based on a group-effectiveness critique published in a leading team-building sourcebook

Figure 2. Experimental Research Design Displaying Treatments and Measures over Time

Groups	*Time 1 Pretreatment*	*Time 2 Immediate*	*Time 3 Delayed*
1. Team Building	M_1 T Team Building	M_{1-13} T Team Meeting	M_{1-13}
2. Team Building plus Computer Support	M_1 T Team Building	M_{1-13} T Team Meeting	M_{1-13}
3. Control, Meetings Only	M_1 T Team Meeting	M_{1-13} T Team Meeting	M_{1-13}

Key: T = Treatment M= Measurement
M_1 = Team cohesion
M_{2-11} = Team-process measures
M_{12-13} = Team-performance measures

(Alexander, 1985). These items address key dimensions of a group's effectiveness: goals and objectives, utilization of resources, trust and conflict, leadership, control and procedures, interpersonal communication, problem solving and decision making, experimentation and creativity, evaluation, and roles and responsibilities.

The team-building task consisted of several parts: (1) introduction to team building, which included rating the group on a seven-point degree-of-collaborative-work scale as they were working together at the time of the experiment and as they would ideally work together in the future; (2) data collection, analysis, and feedback, using a survey of twelve group dimensions; (3) discussion of the survey data; (4) brainstorming a list of group strengths; (5) brainstorming a list of areas to focus on to improve the group's functioning; and (6) creating an action plan of specific ways the group could improve their performance in the future, including prioritizing items and assigning specific members the responsibility to complete each item.

Subjects and Groups. This study focused on naturally occurring groups within the nonprofit organization. The groups were either intact work groups or long-term task forces. Differences were controlled by randomly assigning treatments to groups as well as by using a sufficient number of individuals to allow for a statistically insignificant chance that differences in individual group members would affect research outcomes. The pretreatment survey asked several questions concerning individual members' experiences and backgrounds, which were used to statistically verify randomization of individual differences and possible individual differences affecting outcomes. Questions concerning such issues as how long members had belonged to their group, attitudes toward team building, attitudes toward using the GDSS, work experience, familiarity with computers, and other demographic data were included.

Because the study was based on existing, ongoing groups, group size, by necessity, varied naturally according to the size of the groups in the organization. In this organization, the group size varied from five to twelve members. Randomization of treatments to groups controlled for confounding effects based on group size. There were a total of 186 subjects and 24 groups—8 groups for each treatment.

Another control variable was the perceived attitudes toward the use of the technology by the subjects who participated in the computer-supported team-building sessions. Sambamurthy's questionnaire (1989) to assess participants' attitudes toward the technology in GDSS sessions provided some indication of how the participants using GDSS support responded to the technology. Three factors were assessed with this questionnaire: level of challenge introduced into the task by the technology, level of respect for the technology, and users' comfort with the technology.

Properties of the Team-Building Environment. Two aspects of the environment were considered: setting and facilitation. In this study, variables as-

sociated with the setting and the procedures were controlled. Each group met in the same room at an off-site conference center operated by the larger organization. The room consisted of a U-shaped arrangement with small tables in front of the participants. At the front of the room were two flipcharts, a large-screen projection device and screen, and the computer used by the facilitator. Keyboards were situated in front of each participant. For the groups not using the technology, the same arrangement and room were used, but the GDSS equipment was removed.

Facilitation is a major factor in a GDSS group process. To control for facilitation in this study, key parts of the team-building process were scripted to increase the similarity of the facilitations among sessions. In addition, the same person facilitated all groups in the experiment, helping to control for possible differences in facilitation across groups.

Dependent Variables and Analysis. The dependent variables involved performance and process measures. The variables and the analysis of the resulting data follow.

Performance Measures. Two performance measures were assessed: solution satisfaction and confidence in conclusions. A set of five self-report questions was used concerning the participants' level of satisfaction with the solutions. Participants answered five questions on the Green and Taber questionnaire (1980) to arrive at a satisfaction-with-solution rating. A reliability coefficient of .88 was reported for this scale. Sambamurthy (1989) devised and validated an eight-item measure to assess the degree of certainty group members felt toward the group's conclusions.

Process Measures. The nature of this team-building task did not lend itself to common organizational performance measures. Thus, a focus on the processes occurring in the group became an alternate means of assessing group performance. In certain situations, such as decision making, where the link between process and outcomes is difficult to establish, researchers argue that the process by which an issue is considered may be more important than assessing the actual outcome (Rohrbaugh, 1988).

Process measures used in this study included the perceived quality of the group process, group behavioral measures, decision-scheme satisfaction, personal task participation, socioemotional behavior, confidence in conclusions, commitment to implement results, perceived change in understanding, perceived depth of evaluation, and attitudes toward the technology.

Analysis of the Data

The analysis of the data corresponds to the general research question and the twelve hypotheses. Testing of the hypotheses required a nested analysis of covariance. The model statement for the analysis considered the effects of treatments, groups within treatment, and individuals within groups. Assuming that groups were random, the appropriate F ratio for testing treatment differences

was F equals means squared of treatments over means squared of groups within treatments.

A special t-test for multiple comparisons, Duncan's multiple-range test, was used when significant results appeared with any of the nested analysis of variance (ANOVA) procedures. Duncan's multiple-range test accounts for the variances of all the groups rather than only the variance of the two specific groups being compared. This minimizes the probability that significant differences between mean scores will occur simply because multiple comparisons are made on the same data (Borg and Gall, 1989). In the tables of statistical analysis results, the Duncan's test result is assumed to show that the means of T_1 = the means of T_2 = the means of T_3, unless shown otherwise. In the footnotes to the tables showing the results of the covariate analysis, the Duncan's test results did not change from the results reported in the table unless it is stated as such in the footnote.

The analysis was conducted in exactly the same way as the experiment. A straightforward ANOVA on the individual scores would have ignored the effect of the group on the individual scores. The individual scores are not necessarily independent measures. For example, if one person in a group rated cohesion high, it is probable that other members of the group would also rate the measure high. Because the ANOVA assumes independence of measures, using a straightforward ANOVA without accounting for group effect would not be appropriate for this study. Performing an ANOVA on the group-level data without nesting would fail to produce the appropriate F statistic based on the reduced-error term for groups within treatments.

Individual and Group Characteristics. Because groups were randomly assigned to treatments, it may be assumed that significant differences between the groups making up the samples for the three treatments have been statistically accounted for. In addition, an analysis of the treatment groups showed no significant difference ($p < .05$) on the variables of sex, age, employment status, amount of time spent in meetings, typing ability, previous team-building experience, attitudes toward teamwork and groups, and attitudes toward using the GDSS.

Another key variable that could have interacted with other variables was difference in group size. An ANOVA at the group level on differences in group size showed no significant difference (means squared = 3.88, $F = 1.16$, $df = (2, 21)$, $p = .3314$).

Task. At the end of each session, participants answered a series of eight questions based on McGrath's taxonomy (1984) to rate the tasks completed during the meeting. A multivariate analysis of variance of the scores for the eight questions that compared the team-building task meetings with the regular meetings did reveal the existence of significant differences (Wilks's Lambda = .79, $F = 2.24$, $df = (16, 290)$, $p = .0045$). The team-building task meetings differed from regular meetings by being rated as requiring multiple solutions (versus a specific solution), having more intrinsic interest, requiring

slightly more cooperation, being possibly less familiar, and being more important. The scores indicated that T_1 participants rated the computer-supported team-building process more like a regular meeting than did the T_2 participants who did not receive computer support. Comparisons of the differences between ratings of the task on the delayed measures were not significant (Wilks's Lambda = .86, $F = 1.37$, $df = (16, 282)$, $p = .1573$).

Results

The results in relation to the research hypotheses, considering each of the dependent or output measures, are summarized in Table 1.

The cohesiveness of the groups did not significantly differ over time (H_1). While both team-building treatments showed an increase from when they started, the increase was not enough to be significant.

For the measures concerning group performance (H_{12}), solution satisfaction did not differ between the team-building treatments. The team-building groups in general were significantly better than the control groups in producing a higher level of solution satisfaction.

Process measures (H_2–H_{11}) showed considerable differences between team-building treatments and between the combined team-building treatments and the control. During team building with computer support, participants were significantly less likely to have one or two members dominate the meeting than in the other two treatments. Socioemotional behaviors in the team-building-with-computer-support treatment were significantly better than in the control treatment, but not significantly different from the team-building-without-computer-support treatment. In summary, computer support reduced member domination and, to a lesser degree, created more positive socioemotional behaviors.

The team-building-without-computer-support treatment was perceived as providing a significantly higher quality group process and equalizing the amount of influence for each member in the group (informal leadership) better than the other treatments. Also, leadership functions and change in understanding were perceived as significantly better than in the control groups, but not significantly different from the other team-building treatment.

The facilitated team-building sessions, with and without computer support, differed significantly from the regular meetings on eight measures: quality of group process, goal-directed behavior, relevancy of discussion, amplification of participants' contributions, even distribution of participation, documentation of positions, systematically dealing with issues, and solution satisfaction.

In summarizing the results over time, differences were detected on five process measures. The team-building-without-computer-support treatment was significantly higher than the team-building-with-computer-support treatment on these measures: goal-directed behavior, documentation of positions,

Table 1. Summary of Results for the Null Hypotheses

Dependent Variable ($T_1 = T_2 = T_3$)		*Unit of Analysis*	*Immediate Effect*	*Duncan's Test*[a]	*Delayed Effect*	*Duncan's Test*[a]
H_1	Cohesion	Indiv. Group	Reject* Accept	2>3	Accept Accept	
H_2	Quality of group process	Indiv. Group	Reject** Reject*	1>2>3 1>3	Reject* Accept	3>2
H_3	Behavior scales (overall)	Indiv. Group	Reject** Reject*	1, 2>3 1, 2>3	Accept Accept	
H_4	Solution satisfaction	Indiv. Group	Reject** Accept	1, 2>3	Accept Accept	
H_5	Socioemotional behaviors	Indiv. Group	Reject* Accept	2>3	Reject* Accept	1, 3>2
H_6	Decision-scheme satisfaction	Indiv. Group	Reject* Accept	1, 2>3	Accept Accept	
H_7	Personal Task Participation	Indiv. Group	Accept Accept		Accept Accept	
H_8	Informal leadership	Indiv. Group	Reject** Reject**	2>1>3 2, 1>3	Reject* Accept	2>3
H_9	Confidence in conclusions[b]	Indiv. Group	Reject* Accept	2>1, 3	Accept Accept	
H_{11}	Change in understanding	Indiv. Group	Reject Accept	1>3	Accept Accept	
H_{12}	Commitment to implement results	Indiv. Group	Accept Accept		Accept Accept	

[a] Duncan's multiple-range-test results are reported if significant differences in means are detected; 1 = team-bulding treatment, 2 = team-building-with-computer-support treatment, 3 = control treatment.

[b] H_{10}, "depth of evaluation," was eliminated due to an unacceptable reliability score.

*$p < .05$ **$p < .01$.

healthier interpersonal relationships, leadership functions fulfilled, and more positive socioemotional behaviors. In addition, the team-building-without-computer-support treatment was significantly better than the control on the measure concerning documentation of positions.

The significant results for the immediate and delayed measurements are summarized in Tables 2 and 3. Table 4 provides a review of findings based on a comparison of the difference scores between groups and by treatment.

Both team-building treatments were consistently higher than the control on measures of immediate effects. Measures of team building with computer support did not greatly differ from measures of team building without computer support. The use of the technology apparently reduced the unequal

Table 2. Differences Between Treatment Groups on Measures Immediately Following Treatment

Both Team-Building Treatments over Control	*Team-Building-with-Computer-Support Treatment*	*Team-Building-Without-Computer-Support Treatment*	*Control*
1. Quality of group process	1. Cohesion (over the control)	1. Quality of group process (over team building with computer support and over the control[a])	None
2. Behavior scales[a] (overall)	2. Quality of group process (over the control and less than the other team-building treatment)	2. Informal leadership (over the control)	
3. Goal-directed behavior	3. Socioemotional behaviors (over the control)	3. Change in understanding (over the control)	
4. Relevancy of discussion	4. Informal leadership (over team building without computer support and the control)		
5. Amplification of contributions[a]	5. Confidence in conclusions (over both other treatments)		
6. Distribution of participation			
7. Documentation of positions[a]			
8. Dealing with issues			
9. Leadership functions			
10. Solution satisfaction			
11. Decision-scheme satisfaction			
12. Informal leadership[a]			

[a] The significant difference was also found using the group as the unit of analysis.

influence of one or two people (informal leadership). Measures of team-building-without-computer-support groups were significantly higher in terms of perceived quality of group process. Measures of the delayed effects suggest that there may be some difference; the groups receiving the team-building-without-computer-support treatment outperformed the groups receiving the computer-supported treatment on five measures.

Considerable differences were found between the facilitated team-building sessions and the nonfacilitated control group meetings for the immediate measures. When the facilitation was removed, the delayed results showed that group processes and performance for groups going through team building did not differ from those of the control groups. One reason for this lack of difference over time is noted in previous reports of a pattern in which groups respond to the GDSS with an initial lag followed by a jump above non-GDSS-supported groups (Chidambaram, 1989). It is possible that in this study, a similar pattern would have occurred if the treatment had been continued. The

Table 3. Differences Between Treatment Groups on Delayed Measures

Both Team-Building Treatments over Control	*Team-Building-with-Computer-Support Treatment*	*Team-Building-Without-Computer-Support Treatment*	*Control*
None	None	1. Goal-directed behavior (over team building with computer support) 2. Documentation of positions (over team building with computer support and the control[a]) 3. Leadership functions (over team building with computer support) 4. Socioemotional behaviors (over team building with computer support) 5. Informal leadership (over the control)	1. Quality of group process (over team building with computer support) 2. Goal-directed behavior (over team building with computer support) 3. Interpersonal relationships (over team building with computer support) 4. Leadership functions (over team building with computer support) 5. Socioemotional behaviors (over team building with computer support)

[a] The significant difference was also found using the group as the unit of analysis.

overall mean scores for the GDSS groups were slightly below those of the non-GDSS scores, which is consistent with the theory of an initial lag. Perhaps with additional sessions, the scores would have changed significantly.

Rather than indicating significant advantages or disadvantages to the use of technology in team building, this study implies that the use of GDSS technology did not interfere with the team-building process. Given the issues involved in using the technology, this may be a considerable accomplishment. Within the three-hour time constraint for the task, the computer-supported participants not only had to focus on the team-building process; they also had to learn how to use the GDSS. Most of the participants in the study had little or no experience with computers in general and with the GDSS in particular. When they entered the room, computer-supported participants saw the technology associated with the computers. In addition to having concerns about

Table 4. Significant Differences over Time for Each Team-Building Treatment (Based on *t*-Tests and Analysis of Variance on Differences)

Both Team-Building Treatments over Control	*Team-Building-with-Computer-Support Treatment*	*Team-Building-Without-Computer-Support Treatment*	*Control*
1. Quality of group process (decreased)	1. Goal-directed behavior (decreased[a])	1. Relevancy of discussion (decreased[a])	1. Behavior measures (overall) (increased)
2. Behavior measures (overall) (decreased)	2. Amplification of contributions (decreased)	2. Socioemotional behaviors (increased more than other two treatments)	2. Distribution of participation (increased)
3. Documentation of positions (decreased[a])	3. Documentation of issues (decreased)	3. Change in understanding (decreased)	3. Leadership functions (increased)
4. Leadership functions (decreased[a])	4. Interpersonal relationships (decreased[a])	4. Solution satisfaction (decreased)	4. Solution satisfaction (increased)
5. Commitment to implement results (decreased[a])	5. Socioemotional behaviors (decreased)		5. Confidence in solutions (increased)
	6. Personal task participation (increased)		
	7. Informal leadership (decreased[a])		
	8. Confidence in conclusions (decreased[a])		

[a] This measure showed a significant decrease compared with the control treatment.

team building, participants reported that seeing the equipment in the room created fears about how the computers would be used. Some portion of the GDSS session agenda was spent helping people feel more comfortable with using the technology, creating another focus from the team-building task. With additional sessions, differences between the two treatments may have been detected as familiarity with the technology increased, reducing its direct influence on the outcome measures.

Group Outcome (Cohesion). The measure of group development used in this study was cohesion, or attraction to group. For this study, the initial cohesion levels of the two team-building treatments were not identical, with cohesion being slightly higher for the team-building-with-computer-support groups. They showed a significant increase immediately after the team-building session, when precohesion was used as a covariate. Given the direction of

change for this variable, it may be that team building with or without computer support would have increased cohesion more significantly with more sessions.

The use of computer support had a slight effect on cohesiveness. The direction of change for the team-building sessions was positive and was sustained over time when compared with the direction or lack of change for control sessions.

Performance Outcomes. Two measures of performance were considered: solution satisfaction and confidence in group conclusions. Solution satisfaction was significantly higher for the team-building treatments over the control, indicating that the facilitated session with or without computer support resulted in a higher level of performance. Field study research has consistently supported the value of GDSS groups having increased solution satisfaction over non-GDSS groups. Experimental research has shown mixed results. This result does not support the field study research results, especially given the lack of significant difference for the measure of confidence in conclusions. The analysis infers no significant difference in solution quality between the GDSS and non-GDSS team building. It does infer that facilitation, with or without the GDSS, produces a higher level of perceived performance.

Process Outcomes. A number of process measures differed between treatments. As previous research has shown (Anson, 1990), facilitation with or without computer support created significant differences compared with groups not using a facilitator. In addition, two measures indicated significant differences between the two team-building treatments: quality of group process and informal leadership.

Why would participants in groups not receiving computer support rate quality of group process higher than participants in groups receiving computer support? Previous research has shown that the GDSS allows groups to focus more on issues where they differ. Where the normal group process focuses on areas of agreement to cover up areas of contention, a GDSS-supported group process may accentuate areas of contention. At least part of this result may be a consequence of using the GDSS's anonymity and forced simultaneous responses, which might serve to heighten differences and increase conflict.

This study showed that the non-GDSS participants rated their perceived changes in understanding higher than did control participants. Non-GDSS participants were more likely to feel that they better understood and could better predict the positions and opinions of other members. This may indicate that the technology interfered with the team-building session's ability to focus the group on issues in depth. Or perhaps the anonymity of the GDSS made it difficult to associate people with an opinion.

The other difference between the two team-building treatments concerned informal leadership. This difference showed that group decisions of GDSS-supported groups were significantly less likely to be strongly influenced by only one or two members. Possibly the use of the technology moderated the amount of influence any one individual such as the leader could exert on the

decision-making process. If the purpose of team building is to reduce the influence of one or two strong members, the technology could be a significant supporting factor for the goal.

Nonsignificant differences between the two team-building treatments were many. Compared to previous research, this study did not find significant differences in the areas of critical examination of ideas, healthiness of interpersonal relationships, decision-scheme satisfaction, depth of evaluation, or commitment to implement results (as referenced in Table 1). Part of the reason for this lack may be the additional time needed to explain, to practice, and to create comfort in using the technology at the beginning of the session. Measured results indicated factors that may only be reflective of the initial learning curve, and not use of the technology over time. However, the reported measures concerning comfort, challenge, and respect for the GDSS on the part of the participants indicated that they rated use of the GDSS at levels comparable to those of participants in other studies where the participants had more training and more experience using the GDSS.

Findings Concerning Team Building. Given the increased satisfaction with solution ratings for facilitated sessions over regular meetings, this study further substantiated the benefits of using an outside facilitator for group meetings if performance improvement is desired. Improvement was found on eleven of seventeen group-process measures for the facilitated sessions over the nonfacilitated sessions. Facilitation in this study, as in previous studies, was shown to increase group functioning.

These positive effects did not necessarily transfer to future performance. A one-time three-hour team-building session did not create measurable long-term changes in group outcomes. Delayed measures indicated a greater likelihood that groups will transfer the improved processes into their future meetings when they receive team building without computer support.

Conclusions and Suggestions for Future Research

Members of the groups receiving facilitated team building without computer support reported the highest rating for quality of group process on the *immediate-effect measures.* These members also reported a greater change in understanding compared with ratings by the members of the control group.

Members of the groups receiving facilitated team building with computer support reported that one or two members of the group were less likely to strongly affect the decision (informal leadership) and were more confident in the groups' conclusions on the *immediate-effect measures.* To a lesser degree, these members reported increased cohesion and more positive socioemotional behaviors in the group process when compared with the ratings by members of the control groups.

Members of the groups receiving facilitated team building—with or without computer support—reported significantly higher ratings than members of

the control groups on twelve out of twenty-one of the immediate-effect measures (including the nine participant-behavior subscores): quality of group process, overall behavior scales, goal-directed behavior, relevancy of discussion, systematically dealing with issues, fulfilled leadership functions, solution satisfaction, decision-scheme satisfaction, and informal leadership.

Measures of critical examination of ideas, healthiness of interpersonal relationships, personal task participation, and commitment to implement results did not significantly differ between treatments for the immediate-effect measures.

Delayed-effect measures showed that members of the team-building-without-computer-support group rated their meetings significantly better than members of the team-building-with-computer-support group did for their meetings on four measures: goal-directed behavior, documentation of positions, leadership functions, and socioemotional behaviors. The members of the control groups rated their meetings higher than members of the groups receiving team building with computer support on the five delayed measures: quality of group process, goal-directed behavior, healthiness of interpersonal relationships, fulfilled leadership functions, and more positive socioemotional behaviors. Overall, the differences between control groups and treatment groups on the delayed measures were minimal.

On immediate-effect measures, the facilitated team-building process resulted in higher member ratings of group process than the nonfacilitated process. For the most part, the positive immediate effects did not last over time, indicating that the three-hour team-building session was not effective over time.

In conclusion, the implications for practice are severe in that both team building and GDSS technology are typically implemented as one-time interventions. It is common to have these techniques and/or methods as a three- to four-hour component of a management development session or used as part of a specific task-related meeting. This study demonstrates that one-time HRD interventions in team building are not effective and that GDSS technology as an aid to improving one-time team-building interventions has no lasting positive impact.

Three strengths of this experimental study are the use of intact work groups, controlled treatments, and measures over time. Suggestions for future research include the following:

- The effects of using the GDSS over an extended time period
- The cost-effectiveness of the GDSS compared to other team-building options
- The process learning of team members using the GDSS versus non-GDSS interventions
- Group willingness to use the GDSS as a part of team decision making over the long term
- The effects of the GDSS on long-term team functioning

- The effects of the GDSS on the validity and quality of team action plans
- The effects of the GDSS on business performance outcomes

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