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Supporting Virtual Teams with Distributed Group Support Systems: A Study of the Effect of a Group Leader

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ABSTRACT

Though leadership is essentially the function of structuring group interaction, the effect of leadership on group outcome still remains as one of the least answered GSS research questions. In this study, the role of leadership is studied with virtual teams, or distributed groups with Distributed Group Support Systems, which is another least investigated GSS topic. This study observes that group leaders made significant differences in objective decision quality and satisfaction with decision process, while perceived decision quality and consensus were not significantly different between groups with and without a leader. The content analysis group leaders' comments shows that a group leader is effective when a group leader provides comments on making clear group objectives and providing interaction structure in early stage, and comments on encouraging interaction and on maintaining group cohesion.

INTRODUCTION

Group Support Systems (GSS) are information technology-based environments to increase the performance of group interaction by facilitating the interactive sharing and use of information among group members. This objective is accomplished by augmenting the information-processing capability, increasing participation and improving interaction process structuring, which has evolved from the techniques of structuring group communication such as brainstorming, nominal group techniques, or Delphi technique (Turoff et al. 1993). Among key variables studied in these techniques to influence group performance are leadership and structuring communication process. In fact, the GSS research tradition has been very strong in studying the effect of structuring communication process (Fjermestad and Hiltz 1999). Research on the effect of leadership on group performance, on the other hand, is one of the least answered GSS research questions (Briggs et al. 1998, Fjermestad and Hiltz 1999).

Another less explored area is the effect of Distributed Group Support Systems (DGSS) on virtual teams, or distributed groups (Turoff et al. 1993), in which communication is mediated asynchronously through Computer-Mediated Communication Systems (CMCS). Because mediated communication makes it difficult for groups to exchange information (Hightower and Sayeed 1996), an effective communication support for virtual teams must be arranged to overcome the potential problems of mediated communication, such as the lack of social presence (Short et al. 1976) and limited bandwidth of an interaction medium (Hiltz and Johnson 1990). Besides, a support for anytime-anywhere communication should include ways to support larger groups, to improve participation of uncooperative members, and to deal with critical mass phenomena (Turoff et al. 1993).

LEADERSHIP AND GROUP SUPPORT SYSTEMS

Though leadership is one of the key variables that influence the effectiveness of group performance, only less than 10% of GSS studies investigated leadership effects (Fjemestad and Hiltz 1999). Among these GSS and leadership studies, findings are inconclusive and sometimes conflicting. What seems clear, however, is that leadership alone does not result in significant differences in group process outcome. Rather, in conjunction with other GSS tools, leadership generates some interaction effects. George et al. (1990) find that anonymous groups with leaders significantly more satisfied with a decision process because the leaders provided them with some direction. Participation is more likely to be equal with a leader presence because it is more difficult for an individual to control the flow of the group process.

Ho and Raman (1991) and Lim et al. (1994), however, argue that a leader in GSS-supported group settings has less influence on participation and consensus. A leader in a non-GSS group had more influence where a group needs to establish a structure, which is also confirmed in Hiltz et al. study (1991). Ho and Raman (1991) even assert that a leader may be only important where a group needs to establish an interaction structure. Therefore, when GSS provides this structure, a leader seems to be less influential in improving group performance.

In summary, these studies all conclude that a leadership alone does not result in significant difference, rather indicates diminished emphasis on a leadership variable (Dickinson et al. 1993). It is because a leadership variable is a moderating variable, which affects group outcome in interaction with other variables such as anonymity, communication medium, most importantly, the type of GSS support used. It seems that structuring group process with a leader in GSS-supported groups where GSS itself is another layer of structuring creates too restrictive interaction process, which actually has a negative impact on group performance (Kim et al. 2002). This may explain why no significant effect was found in GSS leadership studies

What do these findings mean to virtual teams asynchronously interacting through CMCS? Are these findings can be generalized to help a virtual team improve its performance? The answer may be no because there are not enough studies to generalize findings. All findings are context specific of each study, and not replicated in other studies. In addition, the findings of previous studies are limited to face-to-face groups. Therefore, these findings cannot be readily used by virtual teams. In this regard, this study is designed to explore the least studied variable in GSS research, leadership as a way to structure a group interaction process, particularly being conducted with asynchronously interacting virtual teams in DGSS. The findings of this study may answer whether leadership in DGSS environments shows significant differences, and in what specific context. Also included in the study is the other key variable in GSS research, the mode of communication structuring, to investigate how leadership interacts with different mode of communication structuring.

RESEARCH METHODOLOGY

A controlled 2 x 2 experiment was designed with two conditions of two independent variables: leadership and communication structuring. The Investment Club Task (Kim et al. 1998) was used, which is to

Table 1: Summary of Experimental Conditions

Presence of Group Leader	Communication Structuring Mode: Sequential	Communication Structuring Mode: Parallel
With Leader	• Discussion Items Presentation: Sequential • Transition: Sequentially by leader's decision, one item at a time • Leader: Allowed to modify procedures • Revisit: Not allowed for previously discussed items	• Discussion Items Presentation: Parallel • Transition: No transition required; all items open throughout the experiment • Leader: Allowed to modify procedures • Revisit: Allowed for all items at any time
Without Leader	• Discussion Items Presentation: Sequential • Transition: Sequentially by time table, one item at a time • Leader: No group leader • Revisit: Not allowed for previously discussed items	• Discussion Items Presentation: Parallel • Transition: No transition required; all items are open throughout the experiment • Leader: No group leader • Revisit: Allowed for all items at any time

maximize portfolio value by agreeing to invest in at least one, but no more than three stocks from fifteen candidate stocks, to be held for at least six months. The Investment Club Task shows the characteristics of both Intellective and Decision-Making task types (McGrath 1984). It shows the characteristics of a decision-making task because when a decision is made at the end of the experiment, there is no way to know objective decision quality. On the other hand, after the decision horizon is reached - at least six months after the experiment - objective decision quality can be evaluated by measuring actual changes in stock prices.

212 subjects were recruited from universities in New York area and assigned to 47 groups in this experiment. Electronic Information Exchange System 2 (EIES 2) was used as a DGSS tool, which is one of the major GSS research tools (Fjermestad and Hiltz 1999), and frequently used in conducting asynchronous experiments with distributed groups. Though EIES 2 has been used previously to study leadership and GSS, it was used as a synchronous conferencing tool, not asynchronous one (Hiltz et al. 1991). The experiment continued for two weeks. The experimental procedures were constructed by arranging discussion items, and the details are summarized in Table 1.

DEPENDENT VARIABLES AND HYPOTHESES DEVELOPMENT

Dependent variables measured are decision quality, consensus, and satisfaction with decision process. GSS research has clearly shown that communication structuring has a positive impact on group's decision quality, while the impact of leadership seems insignificant (Geroge et al. 1990, Hiltz et al. 1991). In GSS research, decision quality is generally subjectively measured either by a panel of experts or by conducting a questionnaire, which rather measures group's satisfaction level with various aspects of group's decision making process, not objective quality of a decision. In fact, a study finds that perceived decision quality is highly correlated with satisfaction with decision and satisfaction with decision process (Kim et al. 2002).

Consensus measures what happens during group interaction, which refers to the degree of support involving group members in synthesizing divergent and mutually conflicting ideas during interaction, as well as the degree of acceptance of a decision and commitment to it (Dess and Orieger 1987; McGrath 1984). This variable is measured because, when implementing a decision is more important, consensus as the measure of acceptance of a group's decision should be the prime concern rather than decision quality (Dickson et al., 1993). Leadership in GSS settings generally shows no significant impact of leadership on consensus (Geroge et al. 1990, Hiltz et al. 1991, Ho and Raman 1991). Hiltz et al. (1991) assert that asynchronous interaction through CMCS tends to produce relatively more task-oriented communication leading to group agreement, which generates a lower level of consensus than that of face-to-face group. Therefore, a group leader is expected to play a more significant role to raise the level of consensus in asynchronously interacting groups through DGSS.

Satisfaction refers to morale, loyalty, or any other manifestation of individual content with group outcomes and processes, and is clearly related to group consensus, productivity, general performance and effectiveness. Research on the level of satisfaction with decision process in GSS-supported groups has found either no difference or lower satisfaction in GSS-supported groups (Watson 1987; Easton et al. 1990; Chidambaram and Jones 1993; Valacich and Schwenk 1995). However, no studies have exclusively tested the effect of leadership on satisfaction with decision process. In this regard, the hypotheses tested in this study are as follows:

H1a: Groups with a leader will make better decisions than groups without a leader.

H1b. Parallel communication groups will make better decisions than sequential communication groups.

H2a: Groups with a leader will perceive their decisions better than groups without a leader.

H2b. Parallel communication groups will perceive their decisions better than sequential communication groups.

H2a: Groups with a leader will show a higher level of consensus than groups without a group leader.

H2b: Sequential communication groups will show a higher level of consensus than parallel communication groups.

H3a: Satisfaction with a decision process will be higher in groups with a leader than in groups without a leader.

H3b. Satisfaction with a decision process will be higher in parallel processing groups than in sequential processing groups.

FINDINGS AND DISCUSSION

Statistical Measures

While decision quality was measured objectively, other dependent variables were measured subjectively by composite variables of multiple questionnaire items. A composite variable was used to test a hypothesis only when Cronbach's Coefficient Alpha was higher than 0.8. Because of the unequal number of subjects and groups for each experimental condition, the General Linear Model procedure was chosen for hypothesis testing instead of ANOVA. Whenever an interaction effect was significant, Fisher's Least Significant Difference Test (LSD) was used for pairwise comparison of means among all experimental conditions.

DISCUSSION

The results of statistical analysis are summarized in Table 2. Decision quality was investigated both objectively and subjectively. Subjective decision quality was measured with questionnaire items, which was insignificant. Objective decision quality was measured by comparing the dollar values of portfolios. It was measured twice, six months and one year after the experiment. Though communication structuring did not make any significant difference, the presence of a group leader made both objective decision quality after six months and one year significantly better than groups without a leader.

Though it did not make any significant differences on objective decision quality, communication structuring made a significant impact on perceived decision quality. Parallel communication groups felt their decisions significantly better than those of sequential communication groups. Though objective and perceived decision qualities are expected not to be different (Gopal et al., 1993), there was a difference between objective and perceived decision quality. Perceived decision quality was significantly higher in parallel communication groups than in sequential communication groups while objective decision quality showed no

Table 2: Results of Statistical Analysis

	Group Leader	Communication Structuring	Interaction
Objective Decision Quality	W > O (6 months) W> O (1 year)	-	-
Perceived Decision Quality	-	P > S	PO > SO ^{M}
Consensus		P > S ^{M}	-
Satisfaction	W> O	P>S	SW>SO

Communication Structuring: P - Parallel S - Sequential
Group Leader: W- With a Leader O - withOut a Leader
^{M} - Marginally Significant

difference. On the other hand, though it was marginally significant for the decision one year after the experiment, objective decision quality was significantly better in groups with a leader than in groups without a leader for both decisions. Pearson's Correlation Coefficient Rho between perceived and objective decision qualities was -0.0604, which indicates no correlation between them. Actually, perceived decision quality was highly correlated with satisfaction with decision process (r=0.7718). It seems that perceived decision quality cannot be used as a surrogate measure for objective decision quality in all situations. Any studies that measure only perceived decision quality must make clear why objective decision quality can not be measured and how perceived decision quality can be used as a surrogate measure for objective decision quality. Otherwise, the findings of studies will be misleading. Failure to clearly distinguish between perceived and objective decision quality may have contributed to inconsistent findings on decision quality in previous GSS research.

In regard to consensus, communication mode had marginally significant impact on consensus. Parallel communication groups indicated a higher consensus level than sequential communication groups. DeSanctis et al. (1989) and Dickson et al. (1993) report that the presence of a group leader did not make any significant difference in consensus. The finding of this study also indicates no influence of group leadership on consensus in asynchronously interacting groups. Further investigations are called for to understand what may affect the level of consensus in GSS environments.

Unlike consensus, satisfaction with decision process shows significant differences with both independent variables. For communication mode, parallel communication groups reported a higher satisfaction with decision process than sequential communication groups. Groups with a leader perceived a higher satisfaction with a decision process than groups without a leader. Further analysis with Fisher's LSD indicated that sequential communication groups with a leader reported a higher level of satisfaction with decision process than sequential communication groups without a leader. One important finding in satisfaction measure is that parallel communication groups generally indicated a higher level of satisfaction than sequential communication groups. Though it is generally acknowledged that new GSS technologies generate unintended consequences, or a novelty effect (Watson et al., 1988), groups with parallel communication reported a higher satisfaction with the decision process than groups with sequential communication which groups used to work with before the experiment.

The simple presence of a leader would not make much difference. What is more important is whether leaders' performance indeed contributed to better group interaction and outcome. To investigate group leaders' performance, the contents of group leaders' leadership-related comments are analyzed. Each comment by a group leader was classified either a task-related or leadership-related comment, and leadership-related comments were assigned to one of the content categories of defining objectives, providing interaction structures, facilitating interaction, and maintaining group cohesion. These categories were based on the previous studies of leadership functions.

As for leaders' comments by content, 51.1% of the comments by a group leader in a parallel communication group were made to guide the group while a group leader in a sequential communication mode group made 41.7% of similar comments. Among other content categories, the number of comments on providing structure was significantly different. On average, a group leader in a parallel communication group made more comments to provide group interaction structures than a group leader in a sequential communication group. A group leader in a parallel communication group generated more comments to remind the group of group objectives than a group leader in a sequential communication group. It appears that, for an asynchronously interacting virtual teams, there is a need to provide a certain level of interaction requirements. In a parallel communication group, a group leader managed well what could have been chaotic interaction by providing more structuring of interaction. In general, a group leader in parallel communication groups provided more comments on defining objectives and structuring interaction than in sequential communication groups.

Timing of each content category is also worthy of mentioning. The content analysis of group leaders' comments further revealed that, in both sequential and parallel communication groups, a group leader tended to generate more comments on defining group objectives and providing interaction structure in the early stage of the experiment. The frequency of these comments diminished toward the middle of the experiment. On the other hand, a group leader started making comments on facilitating interaction and maintaining a group shortly before the middle of the experiment through the later stages of the experiment. It appears that in asynchronous group interaction through CMCS, the role of a group leader in the early stage is to make clear a decision strategy by which group interaction is coordinated. As group members came to understand requirements for process structuring of asynchronous interaction, however, the role of a group leader tends to change to that of a facilitator of encouraging uncooperative members to improve their participation in order to increase group cohesiveness and to deal with "critical mass activity" phenomena associated with negative feedback if the participation rate is too low (Turoff, et al., 1993).

LIMITATION AND FUTURE RESEARCH

Caution should be exercised in interpreting the findings on the group leader variable, too. Literature on leadership points out many different leadership styles (House 1971). Unfortunately in this study, leadership styles were not controlled. Groups in the same experimental condition could have different degrees of system restrictiveness of their coordination structures because of different leadership styles used by group leaders. In a future study with the group leader variable, it may be necessary to control different leadership styles rather than simply adopting 'with and without a group leader' conditions. Leadership is a very complex construct for which a stronger theoretical basis is needed to develop software support for leadership and facilitation roles in DGSS, and GSS in general. This is particularly the case for asynchronously interacting groups where a group leader has to perform unique coordination activities.

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