8-16-1996

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1. Introduction

Research in the GDSS field exhibits some common characteristics. Typically, the tasks used are what McGrath [1984] terms idea generation and choice tasks (Connolly et al., 1990). Members of the group have the same stake in the outcome. Group members have had little or no prior interaction as a group and will have little or no interaction after the exercise (Rhee et. al., 1995). With few exceptions, such as (Lim et al., 1994), groups without a formal leader are used. This research has provided a rich body of knowledge about GDSS to support idea generation and choice tasks. It is a foundation on which to build additional knowledge of the theory and practice of GDSS.

Given this foundation, it is important to broaden the context within which GDSS are studied. Groups also work in environments different from those depicted above. In an organization, groups often confront tasks that involve uncertainty, equivocality, and complexity. Increasingly, groups working on a task may be distributed. The objectives of each group member may be different. A task embedded in such an environment of conflicting motives has been characterized by McGrath [1984] as a negotiation task of the mixed-motive type. Other realistic assumptions include information asymmetry (not all members have the same information), the existence of a group history, and the presence of a group leader. From a theoretical perspective, study of GDSS in the environment just described will build on and add to the knowledge already acquired. From a practical viewpoint, the knowledge gained will directly inform decisions that deal with the implementation and use of GDSS.

In this paper, we summarize an experiment that studied the effects of proximity (face-to-face versus distributed) and leadership mode (groups with a designated leader and without leader) on group performance, group behavior, and individual behavior for groups using a GDSS. The experimental setting is characterized by:

(a) a mixed-motive task,

(b) information asymmetry as defined above,

(c) different objectives across group members,

(d) groups with a history.

2. Hypotheses

Of the many important questions that can be posed, four are the focus of this article:

(a) How does proximity affect member performance?

(b) How does leadership mode affect member

performance?

(c) How does proximity affect frustration with the

process?

(d) How does group leadership mode affect frustration

with the process?

The empirical work cited in the introduction along with the work of McGrath and Hollingshead (1993) on the fit of task and communication media, the work of Daft and Lengel on media richness (1986),the literature on the phenomenon of deindividuation (Festinger et al., 1952; Zimbardo 1969), and Communication Theory (Shannon and Weaver, 1949) provide the basis for our hypotheses.

As pointed out in (Rao, Jarvenpaa, 1991), Shannon and Weaver's (1949) Communication Theory suggests that adding redundancy to the message, improves error detection and correction. Media richness theory asserts that face-to-face communication allows one to convey more information than leaner forms of communication media. This suggests the following hypothesis:

H1: The performance of members of face-to-face groups will be better than the performance of members of distributed groups.

We expect that a leader, having the authority to override member solutions, will foster a competitive environment as each member wants to convince the leader that his or her solution has merit over that of others. This competitive behavior may result in misleading and inaccurate information exchanges that could result in solutions that are worse for members in groups that have a leader in charge. When groups do not have a leader in charge, they have to negotiate with one another to arrive at a solution that is satisfactory to everyone. Hence, we pose the following hypothesis:

H2: The performance of members of groups without leaders will be better than the performance of members of groups with leaders.

McGrath and Hollingshead (1993) conjecture that a face-to-face channel is more compatible with mixed-motive tasks than is a leaner channel. An incompatibility between task and medium may give rise to member frustration. This suggests that:

H3: Member frustration with the process will be lower in face-to-face groups than in distributed groups.

For the same reasons that motivated H2, we would expect the following:

H4: Member frustration with the process will be higher in groups with a leader than in groups without a leader.

3. Research Methodology and Task

The experimental study consisted of a 2 by 2 factorial design. The two factors were proximity and group leadership mode where proximity had two values, face-to-face or distributed, and leadership mode had two values, leader or no leader. No leader groups consisted of three members and leader groups consisted of three members plus the leader. A total of 14 three member groups and 12 four member groups were used.

The members of face-to-face groups were seated facing each other and could engage in both verbal and electronic communication. The members of distributed groups were seated separately and communicated exclusively through the computer.

Leaders were chosen by self-nomination and majority vote. The individual designated as the leader had the authority to override the solution of group members in that the leader could impose a solution that he or she

perceived as more beneficial to the organization than that proposed by the group. The leader however, did not have all the information that was necessary to make the best decision unilaterally and had to rely on the information that he or she obtained from the members.

The experimental task was a production planning problem. A company manufactures four products. Although each product has a set of basic characteristics, they differ in some features depending on customer requirements and specific orders. A customer order consists of some combination of all four products, each tailored to the customer's specification. Associated with each order is a total revenue value which depends on the number of products and the complexity of modifying the products to satisfy the specific requirements. For example, an order might consist of 200 units of product 1, 450 units of product 2, 200 units of product 3, and 400 units of product 4. Total revenue generated when this order is filled might be $865. The subjects were given detailed information on each order and the revenue generated by the order.

Each member of the group acts as a department manager (marketing, production, purchasing). Associated with each order is a projected departmental cost, which is the best estimate the organization has regarding the departmental cost incurred if an order is filled. This information is available to all group members. Each department has information about its internal costs, the Actual Departmental Cost (ADC). This information is not available to the other departments unless the department wishes to reveal these costs. ADC is not necessarily equal to the projected departmental cost. Furthermore, the departments can incur hidden costs in an attempt to reduce their ADC.

The payoff to each member is a percentage of organizational profit. Each member of the group receives the same percentage of profit. Organizational profit is the revenue minus the sum of the ADCs. The group must decide which orders to fill in order to maximize payoff. The actual compensation received by each participant was in the form of a grade for this project. Each person's performance (percentage of organizational profit) was directly linked to the grade he or she received for the project which in turn was one component of the overall course grade.

4.0 The Subjects

Ninety junior and senior undergraduate business students in a business decision-making course were the subjects for the experiment. Participation in the experiment was not mandatory. All students, however, volunteered to participate. Students were told that their grade for the experiment (fifteen percent of the course grade) was directly proportional to the payoff they achieved.

To acquaint the subjects with the GDSS, a training session was held, and a sample problem was solved. The formal experiment began after it was determined that the subjects fully understood the problem and the features of the GDSS.

5.0 The GDSS

A GDSS was designed to support the problem solving and communication needs of the cross-functional group. The GDSS ran in a PC windows environment with a LAN supporting Novell Netware. The GDSS was used by all groups under all experimental conditions. Members of each FTF group were seated facing one another; whereas, members of a distributed group were seated separately, so that they could not see or talk to one another. The FTF groups could engage in verbal communication but the distributed groups had to communicate through the electronic communication channel to exchange messages (i.e. a real-time e-mail system).

The GDSS features included: modeling and optimization capability, information exchange facilities, what-if capability, and a group memory capability. Given the modeling capabilities of the GDSS, it can be classified as a level 2 GDSS (DeSanctis and Gallupe, 1987). The GDSS provided process support (i.e.

information exchange via pre-defined templates), task structure (i.e. modeling and what-if capability), and task support (i.e. optimization capability) as defined in a framework proposed by Nunamaker et al. (1991). The system consisted of three main screens: GDSS Menu, Outgoing Messages, and Public Message Board. Task-specific, predefined templates provided the means of information exchange among members, for example, a template to exchange departmental costs. The appropriate mathematical models were available via the GDSS's modeling component. What-if capability allowed each person to examine the incremental effect of changes to a solution. Finally, Group Memory capability kept a history of all the solutions proposed by group members.

The task-specific templates provided a means to exchange information pertaining to the task. Examples of such templates include those that allow members to transmit their departmental cost information to others, or to propose solutions to others. These templates facilitate task specific information exchange and automatically updates the local database of message recipients.

6.0 Preliminary Results

Formal statistical tests of the hypotheses, including tests for interaction, were not complete, at the time of this writing. Some preliminary impressions based on a visual examination of the data, however, can be reported.

Indications are that for both face-to-face groups and distributed groups, there is no difference in group member payoffs between groups with leaders and groups without leaders.

For groups with a leader, member payoffs are higher in face-to-face groups than distributed groups but the difference does not appear to be statistically significant. In groups without a leader payoffs in the face-to-face groups is higher than in distributed groups and this difference appears to be statistically significant.

With respect to frustration, for groups with leaders, members of face-to-face groups reported higher frustration than members of distributed groups. The same is true for groups with no leaders.

For the face-to-face groups, frustration was greater in the groups with leaders than in the groups without leaders. Similar results were obtained for distributed groups where frustration was higher in groups with leader than groups without leaders, although the effect is less marked than in the face-to-face groups.

It appears that some interaction between the two independent variables exists. This remains to be tested along with the formal statistical testing of the hypotheses.

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