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Jerry Fjermestad
School of Industrial Management, New Jersey Institute of Technology, jerry@eies.njit.edu

S. Roxanne Hiltz
Department of Computer and Information Sciences, New Jersey Institute of Technology, roxanne@eies.njit.edu

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Jerry Fjermestad
School of Industrial Management
New Jersey Institute of Technology
Newark, NJ 07102
(201) 596-3255
jerry@eies.njit
S. Roxanne Hiltz
Department of Computer and Information Sciences
New Jersey Institute of Technology
Newark, NJ 07102
(201) 596-3388
roxanne@eies.njit.edu

Introduction

The experimental group literature between 1971 and 1996 representing 122 empirical studies was reviewed and integrated into composite framework consisting of contextual, intervening, adaptational, and outcome variables. This paper presents an assessment of the methodology used in these studies. The results suggest that there is a need for future experiments to place more emphasis on the use of larger groups of non-student subjects, using more complex tasks than has been typical. It is also time for more experiments to use a design which explores how factors such as group size and task type and complexity interact with specific types of tools and processes that can be provided by GDSS, rather than simply comparing GDSS to baseline or "manually supported" Face to Face (FtF) groups (a larger version of this paper is available).

The study of Group Decision Support Systems (GDSS)

Experiments on Group Decision Support Systems (GDSS) made their first appearance in the literature in the early 1980's (Turoff and Hiltz , 1982; Kiesler, et al., 1985). However, there was relatively little published experimental work until after the mid-80's. This is when the research programs were started at the University of Minnesota and at the University of Arizona, as well as at NJIT, which would soon unleash a flow of theoretical papers, empirical results, and well-trained and productive young researchers.

DeSanctis and Gallupe's seminal paper, "A Foundation for the Study of Group Decision Support Systems" (1987) has been extremely influential in providing a common framework for research on GDSS. They defined GDSS as combining "communication, computer, and decision technologies to support problem formulation and solution in group meetings" (p. 589). They also presented a "contingency" theory to help explain why GDSS is not always beneficial; it would depend upon whether the nature of the technology and structuring provided was appropriate for the group size (smaller vs. larger), the type of task, and the communication mode, of which they identified two: same place (FtF, or "decision room") and different place, or dispersed. They also touched on what would later become Adaptive Structuration Theory (e.g., DeSanctis, Poole, Dickson, and Jackson, 1993), with the statement, "The effectiveness of the technology depends on its appropriate design and use by the group" (DeSanctis & Gallupe, 1987, p. 589) .

In our review of the literature, we located 122 different empirical studies that met our criterion for this meta-analysis. First, they were studies of groups, which we defined as comprising at least three members.. Secondly, they used a computer-based GDSS or group communication support systems (GCSS) with at least minimal features designed to support group communication and decision making processes. Third, the study was actually a controlled experiment: there were two or more conditions deliberately created and contrasted, and other variables were controlled in some manner; and there was at least one independent and one dependent variable, which was measured and statistically analyzed. Finally, the study had to be published in a refereed journal or conference proceedings; e.g., unpublished dissertations or conference presentations or book chapters are not included.

There are several prior summaries or meta-analyses of GDSS studies, of which Benbasat & Lim (1993) is the most comprehensive; others of note include Pinsonneault & Kraemer (1990), Gray, Vogel & Beauclair (1990); McLeod (1992), and McGrath (1994). However, none of these prior summaries include more than about 50 studies, since they were made before the great flood of GDSS publications in the mid-1990's.

The Theoretical Framework

Theoretical frameworks are designed to aid in the understanding and the design of empirical investigations. A number of representative frameworks were utilized as the core from which we originally extracted a comprehensive factors model (Fjermestad, et. al., 1993). This integrated framework was developed to provide complete coverage of factors present in the literature as a whole. The integrated theoretical framework is conceptualized as consisting of four major categories of variables: Contextual or independent variables; Intervening variables; group Adaptation processes; and Outcomes. A brief description is given here (see Fjermestad, 1996 for a complete description of this framework).

The Contextual factors are all external or driving variables that comprise the environment or conditions for the decision making task. For any one experiment, they are (relatively) fixed or controlled. These include characteristics of the group, task, environmental and organizational context, and of the particular technology (GDSS) being used.

Intervening factors, which also affect the group interaction, are derived from or added to the set of conditions created from the context of the group decision sessions. For example, the methods used by the group may vary as to session length, number of sessions, and presence and role of a facilitator.

Adaptation factors (adaptive structuration or interaction process of the group) includes such things as their level of effort, their attitude toward the GDSS, and participation patterns. They are the variables that are controlled by the group on an individual or collective basis.

Finally, the Outcomes are the result of the interplay of the intervening factors and adaptation of the group with the contextual factors. They include efficiency measures (e.g., calendar time to decision), effectiveness measures (e.g., decision quality), usability of the system and methods used, and subjective satisfaction measures.

SUMMARY: What has been studied

The tasks on which research has been conducted are clustered heavily in the "preference" and "brainstorming/creativity" sectors of the McGrath (1984) typology. This makes it difficult to obtain any objective measures of decision quality so that the relative effectiveness of different modes and tools can be assessed. Very few experiments have been conducted in the "difficult" task areas of planning, negotiation, and conflict; however, if a system is to support the full range of group tasks that must be accomplished in long term, complex projects, these are necessary group tasks to support.

More worrisome than task type is the apparent lack of complexity of the tasks used in most experiments. The majority (62%) of the tasks took less than an hour total for the GSS groups to learn the technology, adapt to the group, and agree on a decision or course of action.

The nature of the individual subjects and the distribution of group sizes used in most GDSS experiments are also of concern. Only 4% of the studies used established rather than ad hoc groups, and over 90% use students as the subjects. Using students has some advantages, since the relative homogeneity of the subjects removes a source of uncontrolled variance, and since most of them are familiar with computer keyboards and do not require extensive training to acquire the basic skills necessary to use a GDSS. However, their motivation to maximize effort and quality of decision is questionable, and they may also "put up" with

things that "real" subjects would never tolerate, because they are used to doing as they are told by their teachers. In terms of group size, most experiments used groups of five or fewer subjects.

Task Knowledge Group Size, and Complexity:

Dennis, Valacich, and Nunamaker (1990) compared small (size 3), medium (9), and large (18) groups showed that the larger the group using the GDSS, the better the performance and satisfaction of the group. Another pair of experiments using GroupSystems varied group size from 2 to 12 and concluded that the advantages of electronic brainstorming consistently become more pronounced as group size increases. Every other study varying group size (five studies) also showed larger groups out-performing smaller groups using GDSS. One study (Valacich et al., 1993) compared homogeneous to heterogeneous knowledge. The results suggested that greater performance gains were achieved for heterogeneous, large groups. Two studies investigated task complexity (Bui and Sivasankaran, 1990; and Gallupe et al., 1988) and found that as task complexity increases the decision quality and depth of analysis improve in groups using GSS. Thus, the limited evidence which exists suggests that complex tasks and larger groups will benefit more from GDSS, yet the experiments conducted to date have mostly used small groups with simple tasks.

In sum, there is a need for future experiments to place more emphasis on the use of larger groups of non-student subjects, using more complex tasks than has been typical. It is also time for more experiments to use a design which explores how factors such as group size and task type and complexity interact with specific types of tools and processes that can be provided by GDSS, rather than simply comparing GDSS to baseline or "manually supported" Face to Face groups. Different combinations of member proximity should also be studied. Some of these might even include combining face-to-face meetings with asynchronous interactions. This of course can only happen if the tasks become more complex and require more than one session to complete.

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Note: The research paper references can be found at: http://eies.njit.edu/jerry/gss/ais96.html.