A SYNTHESIS OF GROUP DYNAMIC PROCESSES AND GDSS DESIGNS
to Foster Innovative Organizational Decisions

Linda Volonino
Canisius College
Department of Management Information Systems
Buffalo, New York 14208

ABSTRACT
Environmental challenges are intensifying an organization's need to capitalize on its managers' collective knowledge, intuitions, and creativity to foster innovative decision making and vital strategic changes. This paper presents a synthesis of small group dynamics theory and practice which are of relevance to group decision support system (GDSS) designs, with special attention to the dynamics of productive discussion and pro-innovative decision making. It suggests that developing a climate conducive to innovative thinking in group decision situations requires the maintenance of equilibriums between (1) the use of human judgment and analytic models, (2) conflict and conformity behaviors, and (3) the encouragement of open discussion tempered by the need to make progress.

INTRODUCTION
Decision making and planning grow continually more elaborate, though less certain, as the number, velocity, and complex interconnections of factors influencing organizations accelerate [35]. Due to a lack of economic, political, and marketplace certainty, managing has been characterized as an ever increasing 'gamble' which requires that information be systematically organized, ranked, and analyzed to help executives hedge their bets [3]. The recent development of group decision support systems (GDSS) exemplifies the trend toward increased decision-making elaborateness by providing computer-based systems as tools for group decisions and the broader concept of cooperative work [17].

GDSSs support organizational meetings by incorporating information, communication, and audiovisual technologies such as electronic boardrooms, teleconferencing or electronic meetings, local area group networks, and group decision support software [9] [14] [17] [24]. In addition, a GDSS can provide various decision-structuring techniques for systematic information analysis and an agenda system to coordinate group discussion and activities. The quality of support provided by a GDSS depends upon an understanding of information systems building and group decision making processes. A structural-functional model for studying and analyzing dynamic group processes can provide a useful basis for activity-driven GDSS design strategies.

In his discourse of the coming of the new organization, Peter Drucker [11] predicts that changes in demographics, economics, and information technology will demand a shift toward information-based organizations, which must be innovative and entrepreneurial to remain competitive—possibly even to survive. Our growing, competitive environment requires unprecedented foresight to create the future by translating strategic vision into actionable practices [22]. Environmental challenges are intensifying the organization's need to capitalize on the collective knowledge, intuition, and creativity of its managers to cope with and manage new and complex interconnections of vital strategic changes. Organizations of the future have to become innovative to be responsive to market challenges and opportunities, particularly those created using information technology. Computer-based systems capable of providing intelligent support for strategic planning sessions and managerial meetings require designs based upon knowledge of successful small group interaction processes. A futuristic idea is that of a GDSS developing and evolving into an organization's innovation center, a facility dedicated to providing group methods training and process models, tools for facilitating creative thinking and discovery, and technical assistance, comparable to the support provided to end-user's by an information center.

The major segments of this article include:
1. Discussions of group decision making and group decision support systems.
2. Discussions of group decision productivity and effectiveness.
3. Descriptive accounts of successful and unsuccessful group decision processes.
4. Recommendations for facilitating the productiveness of group decision making, obtaining member acceptance of the decision, and increasing satisfaction. These objectives require dynamic equilibriums between (1) human judgment and analytical analysis, (2) discussion permissiveness and control of decision making progress, and (3) conflict and conforming behaviors.

GROUP DECISION SUPPORT SYSTEMS
Numerous types of group decision support systems (GDSS) have been discussed in the literature. The taxonomies of GDSS types as defined by DeSanctis and Gallepe [9] and Kraemer and King [17] provide the classification necessary to examine the factors that are relevant to the designs of specific types of GDSSs. Two major factors affecting GDSS design are group size and member proximity [9]. GDSSs which support smaller-sized, face-to-face interacting groups of managers of comparable status are referred to as the decision conference [17].
decision room [9], or face-to-face conference [30]. The focus of this paper is on the decision conference facility which incorporates computerized structured decision processes and, increasingly, group process models [17].

Based on observations of GDSSs, Huber [14] notes "that the extent of rich verbal interaction among different participants is not significantly different from that in meetings not supported with GDSS" although the nature of that communication is different. Likewise, the interaction processes of group members, which include not only their interpersonal communication patterns, but also discussion format and style and degree of cooperation or conflict, may be different in nature when supported with a GDSS. The totality of these interaction processes either contribute to or impede successful accomplishment of the group's task [1].

**GROUP DECISION MAKING PHASES**

Numerous researchers have identified various stages in group decision making. Four discernible phases of group decision activity have been described by Tuckman [32] as:

1. **Forming**, in which the group establishes its identity and begins to build cohesion.
2. **Storming**, in which conflicts arise between personalities and positions.
3. **Norming**, in which standards and compromise areas of agreement emerge.
4. **Performing**, in which the group accomplishes its task and evaluates its success.

Decision outcomes are dependent on the manner with which interaction processes are managed during these stages of group decision making. Therefore, the design of effective GDSS features and tools, as well as training for meeting participants, need to be based upon a synthesis of communication and group dynamics theories. Previous research in these areas provide insights into the relationship between small group processes and decision consequences.

As will be described later in the paper, differences between successful and unsuccessful problem-solving groups become manifest during the norming stage. Also to be discussed is how the management of conflict and compromising behaviors during the storming and norming stages has a profound impact on the meeting's outcomes and members' attitudes.

**GDSS DESIGN PHASES**

Three proposed phases for GDSS design research are illustrated hierarchically in Figure 1. These phases reflect a movement from relatively rudimentary group decision support toward more sophisticated support. GDSS design strategies can focus on increasing the **productivity** of meetings by reducing the time and energy required to arrive at a decision, on improving decision **effectiveness** by providing decision analysis and modeling software, or on supporting data scanning and discovery to foster **innovativeness** decision making. Data scanning refers to gleaning environmental information for insight and inspiration. Scanning encompasses looking at a wide variety of data systematically and continuously to learn information beyond what meets immediate practical needs [22]. Innovative problem-solving "involves 'discovery' and 'creation,' since no general algorithm can be derived from the information about the problem that generates its solution automatically" [10]. Thus, an important GDSS capability is the support of ill-structured group decision making.

**FIGURE 1 HIERARCHY OF GDSS DESIGN RESEARCH PHASES**

GDSSs can be designed not merely to **conform** to and facilitate the way meetings are typically conducted, but also to **transform** the group meeting process into more innovative ones. To achieve this objective, it is important to determine features that will enhance group interaction dynamics to improve the productiveness, i.e. the productivity, effectiveness, and innovativeness, of organizational meetings. A conceptual framework illustrating the interrelated nature of the variables relevant to the study of group discussion and deliberation processes is presented in Figure 2. This paper addresses several of the productiveness issues relevant to face-to-face interacting groups by focusing on the endogenous variables which influence group outcomes and consequences.

**GROUPS: A DECISION MAKING TOOL**

The prevalence of organizational meetings indicates that managers have realized, at least intuitively, that groups are a potentially powerful planning and decision making tool. Like any tool, the group format can be used productively by its members or be subject to misuse or overuse. Evidence exists to suggest that the latter situation continues to more accurately reflect managers' perceptions of group meetings. Based on his survey of 25 organizations, Goldhaber [13] reported in 1974 that most managers considered meetings a waste of time because they took too much time and accomplished too little. A decade later, Huber [14] presented a strikingly similar critique of organizational meetings.

One of the most frequent criticisms of group meetings is that they are a waste of time because they often require a lot of effort without achieving the tangible results commensurate with that expended effort [14] [31]. This lack of productiveness is attributable primarily to the labor intensiveness of meetings. Yet the demand for meetings continues to increase despite the considerable derision directed at groups. This paradox justifies continuing the
bases in GDSSs facilitates planning and decision making during functional discussions. Of integrated data, knowledge, and model effort of learning more effective ways to support group barriers and conformity pressures enabling decision makers and obtain and exchange information more quickly and enabling decision makers to consider many more variables and adversity by improving the productiveness of organizational meetings. Use of integrated data, knowledge, and model bases in GDSSs facilitates planning and decision making by enabling decision makers to consider many more variables and obtain and exchange information more quickly and accurately. By providing anonymity, a GDSS nullifies status barriers and conformity pressures enabling decision makers to freely generate, discuss, and criticize novel and controversial ideas without offending group members. Equality translates into uninhibited interaction and interstimulation of ideas which are necessary to foster innovative organizational changes.

GROUP DECISION MAKING

Individual decision making is primarily an intellectual process while group decision making involves both cognitive and social processes [34]. Group decision making often involves a great degree of conflict and tension and is substantially more complex and difficult (Bui & Jarke, 1984) with its success dependent heavily upon interpersonal skills, verbal interactions, and its members interrelationships [1].

A group operates as a collective entity and has some characteristics analogous to an individual, though distinct from any one group member. Researchers of group dynamics have observed that a principle characteristic of groups is that they possess a personality. Cattell [5] had coined the term syntality to refer to the group's personality and the effects of that intricate personality as a whole (cf. [1]). Syntality is determined by the group members' individual factors specified previously in Figure 2 and leadership styles. The group's syntality (e.g., cooperative, committed, enthusiastic, or the opposites) plays an important role in the decision processes and determines a group's chances for success.

Although two groups may have different syntalities as well as different decision-making methods, they may still arrive at the same solution to a given problem. The term equifinality refers to this principle whereby the incredibly large number of combinations of variables which characterize a group may interact to produce the same decision, but from dramatically different processes [31]. Conversely, groups may use the same procedures, but have radically different outcomes. Due to the equifinality principle, the quality of a group's outcomes remains somewhat unpredictable even when standard procedures are followed. The importance of equifinality is its explanation of the group's flexibility in adapting to changing and challenging tasks, activities, members, and tools/technologies to ensure that its work gets accomplished.

DILEMMAS OF DISCUSSION

All meetings, with or without computer support, involve the transmission and reception of words and ideas which elicit meanings in the minds of the participants. This interpersonal communication gives rise to two dilemmas of group discussion, namely, dilemmas of efficiency and creativity [1]. Efficiency is a measure of the energy required to arrive at a group decision. The group situation simultaneously encourages and inhibits the efficiency with which individuals work [1]. Individuals tend to be stimulated to greater performance outputs in the presence of others. However, some expenditure of energy is directed toward meeting goals extraneous or contrary to the ultimate goal of the group.

Similarly, some aspects of creativity are enhanced by the group while others are hampered. The diversity and stimulation the group offers can increase the likelihood of an innovative decision being formulated. Counter-creative effects such as motivational problems of apathy and hostility may occur when individuals are inalterably opposed to one another. Thus, groups' performance levels may be unequal or inconsistent due to these dilemmas.

GDSS DESIGN DIFFERENCES

Just as the design for decision support systems (DSS) differs from that of management information systems, there are significant DSS and GDSS design differences, corresponding to individual and group decision process differences. The progression from DSS to GDSS reflects both a broadening of scope, to incorporate computer-mediated and verbal interpersonal
GROUP DECISION MAKING PRODUCTIVITY

Kraemer & King [17] propose that a key GDSS concept is to increase the productivity of meetings by reducing the decision time without a reduction, and preferably an improvement, in decision quality. This concept can be broken down into two components as suggested by Steiner. According to Steiner [29], groups have the potential to make higher quality decisions than the same individuals working alone unless the group process has been counterproductive. He has represented these two components with the following formula:

\[
\text{Actual group productivity} = \frac{\text{Potential productivity} - \text{Losses due to faulty group processes}}{}.
\]

This formula highlights the distinction between intellectual and resource productivity and counterproductive group processes. It indicates that two of the purposes of a GDSS are to maximize the group's potential productivity while minimizing faulty processes which restrain or deter collaboration.

A group's potential productivity is dependent primarily upon the accumulated knowledge, expertise, creativity, cognitive abilities, and cohesiveness [28] of its members and the organizational resources at its disposal. A GDSS improves productivity by allowing anonymous, simultaneous generation and processing of ideas or alternatives, automatic recording and storage of information, and public display screens for easy open discussion [17]/[24].

Counterproductive processes can result from polarization [31], group pressure, individual domination, conflicting secondary goals, and unbalanced emphases on human judgment and analytic models [26], discussion permissiveness and decision making progress [20], and conflict and conforming behaviors [7]. The importance of using a balanced approach to maintain dynamic equilibriums between human judgment/analysis, discussion/progress, and conflict/conformity are discussed in the section on innovativeness.

GROUP DECISION MAKING EFFECTIVENESS

A description of intelligent group decision making behavior would be helpful to the design of GDSS features capable of supporting group activities. To provide operational guidance, the behavior needs to be described in terms of concrete and specifically exhibited processes that have been observed in successful and unsuccessful situations, rather than solely in terms of generalized dispositions or tendencies.

Research in speech communication by Larson [18] and Dance and Larson [8] has focused on determining differences between the behavior of successful and unsuccessful problem-solvers to determine a technique that could be used by problem-solving groups. Their descriptive summary indicates that the processes of the high success and low success groups differ primarily along the four dimensions listed in Table 1. Despite its descriptive nature, this summary has important prescriptive implications for the design of systems to support group decision making.

<table>
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<tr>
<th>TABLE 1 DISTINGUISHING DIMENSIONS BETWEEN SUCCESSFUL AND UNSUCCESSFUL PROBLEM-SOLVING GROUPS (DANCE &amp; LARSON, 1972)</th>
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<tr>
<td>1. STARTING THE ATTACK ON THE PROBLEM.</td>
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<td>2. THE APPROACH TO BASIC IDEAS WITHIN THE PROBLEM.</td>
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<td>4. ATTITUDES TOWARD PROBLEM SOLVING.</td>
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STARTING THE ATTACK ON THE PROBLEM

At the outset of the meeting, the high success problem solvers formulated a specific objective toward which to work. They were correspondingly more productive since their time and energy was channeled to the accomplishment of their objective. This channelling was achieved by selecting a phrase or concept as a point of departure for the subsequent discussion. Their higher decision quality resulted from an effort focused on identifying the problem and the principle requirements of the solution.

Often low success solvers disagreed with the nature of the problem or considered it stupid. Also, attempts to alter the problem to a more readily-solvable one were common. These attitudes would naturally have a negative effect on the members' motivations and impair their decision processes and outcomes.

THE APPROACH TO BASIC IDEAS WITHIN THE PROBLEM

The high success group used simple techniques to facilitate their understanding of the basic component issues of the problem. The techniques involved the use of analogies and examples for clarification. They also considered more causes of the problem as well as the implications of their ideas using forms of sensitivity analysis.
The low success group did not attempt to reach an understanding of the component issues of the problem. Their thoughts were disjointed rather than adequately focused to provide a connected flow of ideas since a specific problem-solving objective had not been determined.

**THE GENERAL APPROACH TO PROBLEMS**

There was an interest in making progress and proceeding toward solutions by the high success group. This was accomplished by avoiding discussing trivial details which would have detracted from the main issues. Attention to details by the low success group supplanted considering the nature of the problem. The high success group considered and analyzed the potential effects of their solutions more "scientifically" by using hypotheses. Conversely, the low success group relied heavily upon affective feelings and impressions.

**ATTITUDES TOWARD PROBLEM SOLVING**

The high success group displayed determination and confidence in their ability to solve the problem unlike the low success group. The latter were easily discouraged and/or avoided complex problems. There was a marked difference between the eagerness to make progress by the high success group and attempts to alibi out of it by the low success group.

**IMPLICATIONS FOR GROUP DECISION SUPPORT**

The introduction of GDSS technology into group meetings would have a greater and more immediate impact on the endogenous and outcome variables shown in Figure 2. However, the impact of attitudes on performance seems to be most crucial to the problem-solving processes and outcomes, possibly through the mediating effect of motivation. Syntality differences were evident between these two groups as reflective in their attitudes. Necessary changes in individual's attitudes and motivations need to be enacted by proper training and preparation prior to decision making. Subsequently, they can be reinforced by successful GDSS experiences.

Through the use of GDSSs, meeting productivity improvements can be derived relatively easily. Performance improvements are attainable by keeping the discussions focused and avoiding disorder caused too much attention to trivial details. Securing innovative decision making requires maintaining dynamic equilibriums between competing forces as discussed in the next section.

**INNOVATIVE GROUP DECISION MAKING**

As previously stated, distinctions between productivity, effectiveness, and innovativeness are somewhat illusionary. Although this section focuses on innovative decision making, it overlaps onto the other two aspects of decision making. Developing a climate to foster creative thought and innovative decision making requires the maintenance of dynamic equilibriums between three pairs of interacting variables. Balanced emphases are required with respect to the use of human judgment and analytic models, the tolerance of conflict and conformity behaviors, and the encouragement of open discussion tempered by a need to make progress. As will be discussed, the equilibriums between these variables affect the quality of the group's process and creativity of their decisions. They also impact the amount of time required for the meeting as illustrated in Figure 3.

**HUMAN JUDGMENT AND ANALYTIC MODELS**

The data analysis and modeling capabilities of information and decision support systems facilitate coping with complexity and uncertainty, but only to a limited extent [36]. Limitations on uncertainty reduction persist because "models and techniques are, after all, simplified analogs of reality; they are inevitably incomplete." [19]. In addition, static models have only short-run relevance since they reflect how things are at the present time. Human judgment remains an essential decision making component because it "can sometimes capitalize on idiosyncratic features that are difficult or impossible to model." [11]. Strategic planning and innovative decision making require the experience, expertise, intuitive feelings, and knowledge of a group of managers. Together these capabilities constitute human judgment [23].

However, human judgment is subject to numerous biases and inconsistencies which often impact decision quality negatively [33]. Computer-based information systems such as DSSs, expert systems (ES), and GDSSs are needed to debias the judgmental aspects of the decision, to impose consistency, and to improve performance. Therefore, a balanced approach between human judgment and models to support data and information analysis is integral to effective and innovative decision making.

**CONFLICT AND CONFORMITY**

Problem-solving groups have been characterized as open systems of simultaneously interacting forces [31]. These forces become manifest during the group’s communication processes, particularly its conflict communication. Since conflict communication is inevitable and pervasive in group discussions, it must be understood and managed carefully to ensure the groups' success [7].

"Conflict can be a healthy source of unification and an impetus for generating innovative ideas and new solutions to problems." [37]. Lack of conflict due to an emphasis on conformity tends to preclude innovative thinking. This concept is dramatically exemplified by groupthink which refers to a group's singular mode of thinking based upon norms which transcend those of the individual members [15].

Decision makers who refuse to acknowledge the existence of conflict find it difficult to make clear, coherent, functional contributions [25]. Conflict promotes open discussion, critical evaluation and confrontation of ideas, and helps identify and clarify perceptions. When conflict is used inappropriately or too frequently to impede or impose on others, the group becomes unable to function.

Conformity also serves a positive purpose. Conformity to group norms provides a basis for organized effort which can lead to constructive attitudes and the pursuit of creative and innovative solutions [2]. Therefore, a dynamic equilibrium between conflict and conformity to group norms would provide the greatest thrust toward sound innovativeness.
The GDSS goals of increasing decision making productivity and performance, both effective and innovative, represents a multi-objective maximization problem which requires a tradeoff between discussion permissiveness and control of progress.

A delicate balance exists between group discussion and decision making progress. Any discussion/progress imbalance has the potential to impact the group solution detrimentally as illustrated in Table 2. Discussion, either electronically or verbally, during idea-generation, idea-evaluation, and disagreement resolution is necessary to foster solutions that are integrative rather than compromises [20]. The unrestricted ability to communicate informatively facilitates the elicitation of critical, supportive, descriptive, and explorative comments. However, failure to make progress during the meeting due to an over-emphasis on continuing discussion may cause boredom, frustration, exhaustion, or apathy. Such reactions can result in fatigue-type solutions with members agreeing to any solution just to get out of the meeting [20].

Only the balanced discussion/progress meeting approach would provide assurance that all three phases of decision making, intelligence, design, and choice, receive adequate time and attention. Meetings characterized by excessive emphasis on discussion would have the worst impact on the choice stage since the selection of an alternative would be based on expediency. In essence, the members would be treating their previously expended efforts as sunk costs. Overemphasis on progress caused by too much concern with reaching a solution would diminish the intelligence and design phases. From the perspective of innovative decision making, these are the most important phases. Information scanning, clear specification of the problem(s), formation of a problem-solving objective, and generation of alternatives would receive insufficient development. At best, a local optima solution would result.

Given that the first two stages of decision making are most crucial, the initial impression might be that if one is to err, it should be in favor of a discussion emphasis. However, managers seem keenly aware of the amount of time they spend in group meetings. Quite plausibly, they would measure progress primarily in terms of returns on their time rather than in terms of performance. Productive discussion would help minimize time and aversion to organizational meetings. Consequently, effective utilization of discussion time would simultaneously accomplish multiple aims: (1) to capitalize on the group's creative potential, (2) to facilitate their decision progress, or at least the perception of progress, (3) to increase acceptance of the decision outcome, and (4) to reduce dissatisfaction with the group process.

A group's past experience with decision-making can be represented along a continuum from zero-history to a well established mature-history. Business decision meeting groups that fall into the middle-to-upper range on this historical-continuum tend to be distinguished by their own unique discussion format and agenda system [7]. If the chronology of their agenda system is too rigidly enforced or interfered with during the meeting, the members' negative reactions would cause a deterioration in decision quality.

Unfortunately, there are no clear-cut, à priori guidelines or algorithms to determine when the group members' thresholds of tolerance for furthering discussion will be reached. Thresholds are a function of numerous variables, particularly the importance and complexity of the task, the number of participants, and their degree of motivation. The group facilitator must be attentive to overt and covert cues which indicate futility-reactions to
Table 2  Potential Impacts on Group Decision Outcomes Due To Imbalances Between Discussion and Progress

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<td>EMPHASIS:</td>
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<td>DISCUSSION</td>
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minimize negative decisional consequences. Futility-reactions such as detrimental changes in conversation tone, acute participation withdrawal, and/or rapid convergence toward a consensus signify that threshold tolerances have been exceeded.

SUMMARY

This paper has shown how the study of communication and interaction behaviors of small groups can lead to pragmatic advice for the design of GDSS capabilities to improve small group discussions and the outcomes of executive meetings. A GDSS designed to support particular tasks, rather than activities, is too limited to capture the essence of group processes. Group decision support systems can be used to increase the productivity of organizational meetings, to improve decision quality, and to support more innovative decision making. A three-tiered hierarchy of GDSS research aspects was introduced to provide a framework for the discussion of various group interaction dynamics which impact group performance. In order to facilitate the productiveness of group decision making and reduce meeting-adversity, balanced equilibriums between the use of human judgment and analytic models, conflict and conformity, and discussion permissiveness and decision progress were proposed.

REFERENCES


