AUTOMATING DECISION GUIDANCE IN A GROUP DECISION ENVIRONMENT

Moez Limayem
Universite Laval

Gerardine DeSanctis
University of Minnesota

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AUTOMATING DECISION GUIDANCE IN A GROUP DECISION ENVIRONMENT

Moez Limayem  
Departement des Systemes d'Information Organisationnels  
Université Laval

Gerardine DeSanctis  
Curtis L. Carlson School of Management  
University of Minnesota

ABSTRACT

Many managerial decisions involve consideration of more than a single criterion. Despite the development of multicriteria decision models (MCDM), decision support systems (DSS), and group decision support systems (GDSS), there is inadequate success in supporting multicriteria decision making. This study explores the possibility of embedding decision guidance within MCDM GDSS. We outline guidelines for the design of decision guidance and demonstrate the benefits of guidance within the context of a resource-allocation task. The findings suggest that the addition of guidance may improve the effectiveness of decision support systems.

1. INTRODUCTION

Complex multicriteria problems are a key component of organizational life. Ethical choices, trade-offs between cost and quality, and conflicts of preferences are all examples of multicriteria decisions. Often these decisions are undertaken by groups. Many multicriteria decision making models have been suggested, but most are geared toward individual decision makers. These models allow the decision maker to express subjective preferences by weighing the relative importance of different criteria and then systematically evaluating how well alternative solutions meet these criteria. Multicriteria decision making models (MCDM) have been extensively researched (e.g., Keeney and Raiffa 1976; Bui and Jarke 1984; Saaty 1986), and surveys of these models are found in Bui (1984), Zeleny (1982), Minch and Sanders (1986), and Vargas (1990). However, despite their large number and potential for improving decision making, multicriteria decision models and decision support systems embodying them (MCDM DSS) are not adequately applied and used:

Why are the developed MCDM theories well-known, used and generally accepted almost without criticism only in the academic field? Why — if multicriteria decision situations are so common — does the number of managers/decision makers effectively using MCDSS [that is, MCDM DSS] remain particularly insignificant? (Angehrn 1990, p. 522)

This paper argues that a key problem hindering the success of existing MCDMs and MCDM DSS lies in their failure to address the need for user learning. Many researchers state that learning is an important goal of decision support, but relatively little consideration has been given to how systems might be designed to foster learning. In the multicriteria decision context, fostering learning means more than providing multicriteria models. It means providing mechanisms that enable decision makers to better understand the task at hand, to gain a deeper understanding of how MCDMs work, to interpret the model recommendations, and to achieve mutual understanding of others' viewpoints.

To date, there has been no formal attempt to provide learning support to MCDM DSS. This is true in the case of MCDM DSS designed for individual use, as well as multiuser systems designed for group settings (MCDM GDSS). When using MCDM GDSS, the group members must decide which decision models to apply to their task, and they are left to their own devices to distill and interpret the data provided by the models. Adaptive structuration theory (AST) (DeSanctis and Poole 1993) stresses the need
to support learning in the context of GDSS. AST emphasizes the importance of group interaction in appropriating technology structures. Structures are the rules and resources embedded in an intervention technology such as a MCDM GDSS. Two dimensions are used to describe structures: the spirit and the structural features. The spirit represents the general goals an intervention technology aims to promote. For example, a MCDM decision aid encourages a thorough examination of all alternative solutions. Structural features are the tools built into the system, such as criteria weighting procedures.

Poole, Holmes and DeSanctis (1991) and Sambamurthy and Poole (1992) found that a faithful appropriation of the rules and resources provided by a GDSS does indeed facilitate a productive decision process, in turn leading to higher group consensus. DeSanctis and Poole (1993) predict that the greater the awareness decision makers have of a technology's spirit, the more faithful their appropriation. Consequently, they assert that learning of the spirit is very important because it enables decision makers to enforce and improvise in line with it.

To facilitate effective MCDM use in the GDSS context, researchers have experimented with providing human agents (known as facilitators) to guide the group members through their use of the modeling techniques (Anson 1990; Dickson, Robinson and Lee Partridge 1993; Stee and Johnston 1981). Though human facilitators bring expertise and the flexibility to customize the group's use of the MCDM GDSS, human facilitators are costly and can be inconsistent in the kinds of guidance they deliver to the group. Training is an alternative to human facilitation. Group members can be given lectures, manuals, or other forms of training designed to enhance their understanding and ability to apply MCDMs. Although perhaps fruitful, this option, like human facilitation, is expensive and time consuming. Embedding decision guidance into the MCDM GDSS may be a less costly and more consistent mechanism for enabling successful use of the technology.

2. THE CONCEPT OF DECISION GUIDANCE

Decision guidance is the enrichment of decision models with cues that direct decision makers toward successful structuring and execution of model components (Silver 1991). A distinction should be made between decision guidance and mechanical guidance, which instructs decision makers on how and when to push buttons. For example, mechanical guidance might simply provide a list of features and illustrate how to invoke each one. Decision guidance, on the other hand, assists people with decision making concepts such as dealing with decisional conflict and tradeoffs when evaluating several alternatives on multiple criteria (Silver 1991). In order to enhance learning and improve decision making performance, decision makers should be provided with cues and information enabling them to construct a mental model of the decision making process. Simple mechanical guidance, although helpful to decision makers in their navigation through the system features, does not qualify as decision guidance because it does not affect understanding of the decision model or process.

Decision guidance differs from expertise in that it provides an array of possible ways decision makers might proceed when building or interpreting a model, rather than a single "best" approach. Whereas an expert system plays the role of an expert decision maker or a facilitator, guidance helps users organize and structure their own knowledge and expertise. Decision guidance is an add-on to an existing decision model(s). Guidance aids decision makers in the selection and execution of models, explaining the output of model runs and recognizing patterns in data.

3. PURPOSE OF THE STUDY

This study investigates the design and impacts of decision guidance on multicriteria decision making in a group setting. There are three main objectives:

Objective 1. Several theoretical views are integrated in order to generate a set of high level design guidelines for the design of decision guidance for MCDM GDSS.

Objective 2. The feasibility of the design guidelines is demonstrated by implementing them as an add-on to an existing MCDM GDSS.

Objective 3. A laboratory experiment is conducted to evaluate the impact of guidance on decision outcomes as groups undertake a multicriteria decision task.

This study makes several contributions. First, to the MCDM discipline this study contributes to the emerging effort of to overcome the difficulties experienced by decision makers when using sophisticated multicriteria decision models. Second, this research enhances understanding of the impact of these GDSS technologies on decision making. Finally, to the system analysis and design area, the study provides a set of guidelines toward the development of more supportive decision support systems.

We begin by reviewing prior research in MCDM and GDSS. Next, our theoretical perspective is presented in order to generate a set of design guidelines. Finally, we
present the results of an empirical study investigating the impacts of decision guidance on learning and decision outcomes.

4. PRIOR MCDM AND GDSS RESEARCH

Evans (1984) reviewed 78 research articles on MCDM and found that no more than two MCDMs were being regularly used in organizational settings. Several studies have found that decision makers avoid the use of MCDM decision aids; when given a choice, they are most likely to select relatively unsophisticated decision models (e.g., Buchanan and Daellenbach 1987; Narasimhan and Vickery 1988). Lab experiments show that decision makers avoid sophisticated MCDMs because they reveal decisional conflict, despite the fact that the decision aids can improve the decision making process (Kottemann and Davis 1991). The implication is that MCDM decision aids might be improved by adding mechanisms that facilitate resolution of decisional conflict. Further, as indicated by Buchanan and Daellenbach’s research, understanding the logic behind the MCDM methods is an important determinant of users’ adoption or abandonment of these models.

In the group context, the typical multicriteria process consists of problem definition, prioritization of evaluation criteria by group members, determination of individual preferences about alternative solutions, aggregation of individual preferences, and refinement of individual and group preferences through consensus seeking. Group multicriteria decision making is complicated by the fact that information about alternatives and criteria is often subjective. Thus, every group member must not only identify his or her own preferences and values but also consider other members’ inclinations (Jacquet-Lagreze and Shaftek 1984).

To date, very few studies of GDSS impact have considered MCDM GDSS. Steeb and Johnston (1981) and Bui and Jarke (1984) found MCDM GDSS to improve decision performance over unaided decision making. However, Dickson et al. (1991) were unable to show an advantage of MCDM GDSS over GDSS without a MCDM component. This raises an important question: Will embedding decision guidance mechanisms into an MCDM GDSS result in enhanced learning and decision outcomes relative to an MCDM GDSS without guidance?

5. THE DESIGN OF DECISION GUIDANCE MECHANISMS

Following Silver (1991), we believe that one way to reduce problems with using MCDM is to enrich decision models with guidance mechanisms targeted at fostering learning. Important to the design of decision guidance for MCDM GDSS are the concepts of cognitive feedback, feedforward, and breakpoints in group interactions.

5.1 Cognitive Feedback and Feedforward

Feedback is the process by which cues about the decision making process and outcomes are provided to a decision maker (Sterman 1989). A distinction is made between outcome feedback and cognitive feedback (Sengupta and Abdel-Hamid in press). Outcome feedback refers to information about knowledge of results. This type of feedback is provided to the decision maker after a preliminary decision has been made; the objective is to direct the decision maker toward making appropriate changes during the next trial. Cognitive feedback, on the other hand, refers to information about the decision making process rather than outcomes (Te’eni 1991). Specifically, cognitive feedback includes task information, cognitive information, and functional validity information (Balzer, Doherty, and O’Connor 1989). Task information refers to relationships in the task environment; it allows the decision maker to learn more about the different cues comprising the task. Cognitive information deals with relations as perceived by the decision maker; it provides cues about the decision maker’s cognitive activities by feeding back a description of the weights assigned to various cues. Finally, functional validity feedback refers to details about relations between the task environment and the decision maker’s perceptions (Balzer, Doherty, and O’Connor 1989).

In their reviews of the empirical research on the effectiveness of feedback, Sengupta and Abdel-hamid (in press) and Balzer, Doherty, and O’Connor (1989) conclude that cognitive feedback is more effective than outcome feedback in improving learning and decision making performance. In fact, Balzer, Doherty, and O’Connor suggest that “knowledge of outcomes may deter learning” (p. 410) since outcome feedback does not necessarily enable decision makers to construct an adequate model of the decision making process. The absence of such a model can inhibit the decision makers in their ability to discern the inconsistencies in their judgments (Te’eni 1991). Unlike outcome feedback, cognitive feedback has been found to enhance learning and to improve decision making performance (e.g., Sterman 1989; Te’eni 1991). The following factors contribute to the effectiveness of cognitive feedback: first, this type of feedback draws attention to inconsistencies and illustrates their causes (Te’eni 1991); second, it enables decision makers to understand their judgments and reduce commitment to incorrect analysis (Balzer, Doherty, and O’Connor 1989); third, by providing information about
important relationships and tradeoffs in the task environment, cognitive feedback helps decision makers shape an adequate model of the decision making process (Sengupta and Abdel-Hamid in press).

An alternative mechanism for enhancing learning and alleviating cognitive strain that has received growing attention is feedforward, which is the process of providing instruction prior to performing each step in the decision making process (Bjorkman 1972). Whereas feedback can place additional cognitive load because it can convey more information that the decision makers need to process, store, and develop a plan on how to proceed next, feedforward attenuates this cognitive strain by providing decision makers with information which otherwise should have been learned through feedback (Bjorkman 1972). Malloy, Mitchell and Gordon (1987), Cats-Baril and Huber (1987), and Sengupta and Abdel-Hamid (in press) have found that, when presented in conjunction with feedback, feedforward can enhance learning and improve decision making performance.

An implication of the cognitive perspective is the conceptualization of decision guidance as a vehicle for delivering cognitive feedback and feedforward. The significant body of knowledge concerned with the design and impacts of feedback and feedforward can serve as the basis for design of decision guidance.

5.2 Breakpoints in Group Interactions

Two theories of decision making sequences have been proposed by group decision researchers. The unitary theory postulates that groups go through a uniform set of phases, or developmental stages, during decision making (Bales and Strondtbeck 1951). The multiple sequence theory, on the other hand, postulates that groups adopt different sequences of decision making (Van den Daele 1969). The number and the order of occurrence of development stages varies across groups. Poole (1981) compared the two theories and found that the multiple sequence model explained twice as much variance in decision development in groups as the unitary sequence. He suggested that the multiple sequence model takes into consideration the effects of groups’ immediate internal and external environment, whereas the unitary model assumes that the same set of developmental sequences will occur regardless of the conditions surrounding the group. Poole (1983a 1983b) suggested that, even though most groups do not go through a uniform set of development stages, they all encounter three types of “breakpoints” during decision-making:

1. **Normal breakpoints:** shifts from one decisional step to another. These shifts are more or less expected and are dealt with as a matter of normal procedure.

2. **Delay breakpoints:** a holding pattern wherein the group recycles through the same analysis or decision step. Delay breakpoints are often caused by an unfinished previous decision making procedure.

3. **Disruption breakpoints:** difficulties regarding how the members use and interpret the information available to them to reach a decision. These breakpoints are characterized by major disagreement among the group members.

Poole (1983b) suggested that some assistance is needed to help groups deal with these breakpoints. Friedman (1989) used Poole’s concept of breakpoints to suggest different types of interventions that a group facilitator can adopt to steer the group toward successful problem solving. Similarly, the breakpoints classification can be used to derive a set of design principles for system-based decision guidance. Specifically, we propose three types of decision guidance.

**Forward guidance** targets normal breakpoints. When the group is making normal progress, system-based guidance can summarize the current step, describe how the current step relates to the previous and next steps, and display a status window identifying the current step and the next step. Forward decision guidance parallels the concept of feedforward discussed earlier. Forward guidance is presented in the form of instructions that clarify the objective of the step to be performed and explain how the step in question fits into the overall multicriteria decision process.

**Backward guidance** targets delay breakpoints. The group can be led backward to complete an unfinished or partially finished previous step. For instance, guidance can recommend that the group go back and further clarify the definition of some criteria. This might be necessary if group members varied widely in their evaluations of each alternative on different criteria. Backward guidance supports cognitive feedback, revealing the inconsistencies that take place when decision makers are dealing with decisional conflict and tradeoffs during the MCDM process.

**Preventive guidance** aims to prevent disruption breakpoints, which are misunderstandings of the information and recommendations provided by the decision model. Preventive guidance helps the group to interpret decision model output. This is possible through the provision of tables and graphs summarizing and simplifying the model output.
5.3 Design Guidelines for Automating Decision Guidance

The theoretical perspective just reviewed suggests the following design principles for automating decision guidance in the context of group multicriteria decision making:

1. When embedding decision guidance into MCDM GDSS, designers should consider three forms of decision guidance: forward guidance, backward guidance, and preventive guidance. Each type of decision guidance aims to help decision makers manage the breakpoints that groups face during the decision making process. Specifically, forward guidance should be presented prior to each major step in the MCDM process. It explains the purpose of the step to be performed and clarifies how the step in question relates to the overall MCDM process. Backward guidance provides cognitive feedback that exposes the inconsistencies that ensue when decision makers are evaluating the alternatives on the specified criteria. Hence, in order to be effective, cognitive feedback should be followed by specific instruction guiding the decision makers on how to proceed to resolve the identified inconsistencies. Uncovering inconsistencies without advising decision makers on ways to deal with them can result in increased frustration (Balzer, Doherty and O'Connor 1989). Finally, preventive guidance should be designed to provide cognitive feedback. Preventive guidance differs from backward guidance in that it helps decision makers interpret the model output.

2. Decision guidance can be designed in two different ways. It can recommend a specific course of action (suggestive guidance) or it can provide relevant information without making suggestions on what to do (informative guidance) (Silver 1991). Forward guidance is suggestive because it provides instructions (i.e., feedforward) on how to execute the next step to be performed. Backward guidance can also be suggestive because it presents cognitive feedback that illustrates inconsistencies and makes suggestions on how to resolve them. Finally, preventive guidance helps decision makers interpret MCDM output and is mainly informative. However, it can be enriched, as suggested by the cognitive perspective, with suggestions on how the decision makers can use the model recommendations effectively.

3. Designers should display decision guidance using meaningful presentation formats. According to the theory of cognitive fit (Vessey 1991), graphs and tables represent viable alternative display formats for multicriteria judgment tasks. MCDMs provide information on every alternative on all specified criteria. With this volume of information, it is difficult for decision makers to make a cognitive judgment based solely on free text. Graphs and tables emphasize associations and relationships among alternatives. Further, these display formats integrate the effects of all the criteria, reducing the cognitive strain necessary for evaluating the merit of each alternative. Graphs may be particularly helpful in the case of preventive guidance, where the purpose is to aid in pattern recognition and interpretation of the MCDM output.

4. Backward guidance aims to identify inconsistencies and so is expected to be more effective when it is automatically invoked every time a delay breakpoint occurs. In the case of forward and preventive guidance, designers have to decide on the invocation form. Two options are available: the decision maker can explicitly request decision guidance, or the system can provide it automatically (Silver 1991). Although the superiority of either form is subject to empirical investigation, the cognitive difficulties involved in multicriteria decision making suggest that, at least for first time users, guidance might be more effective when invoked automatically. In fact, decision makers might get too engrossed in the complicated decision making process to the point of forgetting to request decision guidance even though it is available by pushing a keyboard key. However, automatic decision guidance might become an unnecessary burden as decision makers gain proficiency in their use of the decision model. Therefore, designers are advised to design software switches that can change the method of invocation of forward and preventive guidance.

5. Even when designers elect to implement decision guidance so that it is invoked automatically by the system, they should give the option to the decision makers to request forward and preventive guidance at any point during the decision making process. This is necessary because groups do not follow a uniform set of development activities. Thus, at any point during the decision making process, decision makers might realize that they need to go back to an earlier step and might request a feedforward screen to get some cues on the purpose of the step in question. Therefore, forward and preventive guidance should be context-sensitive, meaning that any guidance mechanism requested by a decision maker should assist the user with the step that he/she is performing at the time of the request.

Following these guidelines, we demonstrated the feasibility of embedding decision guidance into an MCDM within the
Software Aided Meeting Management (SAMM) GDSS. The MCDM, called the allocate/multicriteria model, had been previously developed and evaluated (Dickson et al. 1991). This MCDM is a compensatory additive model; it requires that decision makers exhaustively examine all attribute tradeoffs among alternatives before choosing the best solution. Figure 1 displays the main menu of the allocate/multicriteria model. Although this MCDM GDSS has been shown to bring decisional benefits when delivered with human facilitation (Lee Partridge 1992), groups have been found to struggle with model use when left to their own devices (Dickson et al. 1991). Our hope was that the addition of decisional guidance to the MCDM GDSS would enable more effective use of the model by groups, thus eliminating the need for costly facilitation.

Table 1 summarizes the decision guidance mechanisms embedded into the allocate/multicriteria model.

### Allocate/Multicriteria Model

1. Define criteria.
2. Weight criteria.
3. Define alternatives.
4. Evaluate alternatives.
5. Set/view weights and ratings.
6. Calculate scoring.
7. Allocate resources.

### Figure 1. The Main Menu of the Allocate/Multicriteria Model

6. **HYPOTHESES**

We tested the following proposition: For groups working on a multicriteria decision, embedding decision guidance into a MCDM GDSS will enhance learning and will improve decision making outcomes. Several hypotheses, derived from this proposition, are stated in terms of anticipated differences between groups using the MCDM GDSS with embedded decision guidance and groups using the same system without decision guidance.

#### 6.1 Decision Guidance Effects on Learning

Forward guidance is expected to help decision makers construct a clear mental model of the decision process, which in turn is argued to be necessary for user learning. Backward guidance identifies the inconsistencies in members' inputs to the MCDM and provides suggestions on how the group can resolve these inconsistencies, thus preventing misuse of the model; it should facilitate the group's understanding of the spirit or overall philosophy behind the system. Finally, preventive guidance clarifies the model output, enabling interpretation of results. Groups using the MCDM GDSS without decision guidance on the other hand, do not benefit from either cognitive feedback or feedforward and so can encounter difficulty in figuring out the purpose of each step undertaken, in forming mental models, or in interpreting of model outputs. Therefore, in the absence of decision guidance, the MCDM GDSS might be a poor teacher, and learning can fail.

**H1.** Groups using a MCDM GDSS with embedded decision guidance will achieve better learning of the decision model than groups using the system without decision guidance.

### Table 1. Summary of Decision Guidance Mechanisms

<table>
<thead>
<tr>
<th>Type of Guidance</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward</td>
<td>Feedforward screens explaining each step in the MCDM model. A status window displaying the current step and the next step.</td>
</tr>
<tr>
<td>Backward</td>
<td>Feedback pointing to the criteria and alternatives showing the number of discrepancies. Flag discrepancies. Feedback identifying low scoring alternatives.</td>
</tr>
<tr>
<td>Preventative</td>
<td>Graph alternative scores. A table summarizing average ratings of alternatives on all criteria.</td>
</tr>
</tbody>
</table>
6.2 Decision Guidance Effects on Post-Meeting Consensus

Forward guidance provides the group members with feed-forward specifically advising them to resolve their differences before moving on to the next step. Backward guidance identifies group member inconsistencies in applying the criteria to different alternatives. Backward guidance also provides members with cues on how to resolve their disagreement. Preventive guidance will provide the group members with graphs and tables that facilitate the recognition of the sources of their disagreements. Therefore, the provision of explicit mechanisms for facilitating conflict management is expected to encourage group members to achieve higher post-meeting consensus. On the other hand, MCDM GDSS without decision guidance does not offer specific tools that encourage group members to identify disagreements and work out their differences.

H2. Groups using a MCDM GDSS with embedded decision guidance will achieve a higher level of post-meeting consensus on their decision than groups using a MCDM GDSS without decision guidance.

6.3 Decision Guidance Effects on Time Taken to Reach a Decision

When undertaking multicriteria decisions, decision makers tend to circumvent decisional conflicts associated with a given alternative, scoring well on some criteria and poorly on others. Group members tend to quickly reach a decision that does not reflect a thorough evaluation of all the alternatives (Shaw 1981). Guidance is expected to help group members deal with these tradeoffs by offering suggestions and graphs that illustrate the differences among the alternatives, encouraging careful assessment of all the alternatives based on the specified criteria. Moreover, decision guidance identifies the discrepancies arising from the use of certain components of the model that might have been otherwise neglected. Dealing with these inconsistencies, even though advantageous, is time consuming. Thus, groups benefitting from decision guidance are anticipated to take more time to achieve a decision than groups using the MCDM without explicit guidance.

H3. Groups using a MCDM GDSS with embedded decision guidance will take more time to reach a decision than groups using a MCDM GDSS with no explicit decision guidance.

7. METHOD

A laboratory study was conducted to test the impact of decision guidance on learning and decision outcomes. The experimental design consisted of two treatment conditions: (1) control groups using the MCDM GDSS with no decision guidance and (2) experimental groups using the same decision model enhanced with the decision guidance mechanisms described earlier. MBA students and upper level undergraduate student groups participated in the study, with a balanced number of MBA and undergraduate groups assigned to each treatment condition. Except for balancing educational level across treatments, assignment of groups to condition was random. A total of thirty-five groups (139 subjects) were distributed across the two treatment conditions (eighteen control groups and seventeen experimental groups). Participation in the research was included as part of an assignment, although students were offered an alternate exercise if they preferred not to participate in the experiment. Subjects were given training in the allocate/multicriteria model with guidance or without guidance depending on their treatment condition. Efforts were made to provide equivalent training for groups in both treatment conditions. During the training, the administrator walked the group through a printed training guide that illustrated the different features of the MCDM.

7.1 Task

"The Foundation Task" (Watson 1987) was used in this study because it presents a complex multicriteria decision problem suitable for solution by individuals and groups.1 Individual group members performed the task prior to group discussion, yielding a measure of pre-meeting consensus, and after group discussion, yielding a measure of post-meeting consensus. The task requires decision makers to allocate a sum of $500,000 among six competing projects requesting funds from a philanthropic foundation. The foundation task is a multicriteria problem because it requires that decision makers choose among alternatives: the greater the contribution made to a particular project the smaller amount of money left to allocate to the remaining projects. The task is considered to be difficult because of its low analyzability and the ambiguity in the cause-effect relationships. The background information provided to the subjects does not allow them to choose an evident best solution. The task has also been found to be highly motivating to groups while at the same time not requiring special knowledge or skills. For more detail on the task and experimental procedures see Limayem (1992).

7.2 Dependent Variables

Learning was defined as degree of understanding the allocate/multicriteria model input, process, and output. MCDM models consist of three main elements:

1. Input component: includes the alternatives, the criteria, and the decision makers' preferences.
2. Process: includes mechanisms and mathematical rules for aggregating the decision makers’ preferences in order to compute a score for each alternative.

3. Output component: is composed of a table, graph, or a matrix illustrating the scores of the different alternatives.

An instrument was developed for measuring group members’ understanding of the model input, process, and output. First, several multiple choice questions were generated to specifically test learning of each one of the three components. Second, the questions were validated by several MCDM experts who were familiar with the multicriteria model and the MCDM GDSS. Finally, the instrument was administered to twelve groups that participated in a pilot test. The purpose of the last step was to ensure that the wording of the questions was understood by the participants. The final version of the instrument consisted of fifteen multiple choice questions.

Post-meeting consensus was measured using the Spillman, Bezdek, and Spillman (1980) approach. A scale ranging from zero to one reflects the degree of concordance among individuals when they perform the decision task alone, following the group decision.

Decision time was measured as the number of minutes between the time when the group began work on the task and the time when members announced they had reached a group decision.

Group size was a control variable. Although an attempt was made to keep group size within the range of four to five, events beyond the researchers’ control resulted in several groups of size three and six. This variable was treated as a covariate in analyzing the effects of the treatment on the dependent variables. Group history was also controlled. The experiment took place approximately half way through the participants’ academic term, after each group had met several times to work on other class assignments. Pre-meeting consensus is the degree to which individual members make similar choices in the decision task, prior to engaging in group discussion; it was calculated using the same method as post-meeting consensus. This variable was treated as moderator to investigate whether existing agreement affected the impact of decision guidance on the outcome variables.

8. RESULTS

A multivariate analysis of covariance (MANCOVA) was performed to assess the differences between control and treatment groups and to test the moderating impact of group size and pre-meeting consensus on the dependent variables. The MANCOVA multivariate test indicated that decision guidance had significant effects on the dependent variables. Neither covariate (pre-meeting consensus and group size) was significant in the model. As indicated in Table 2, treatment groups outperformed control groups in learning, achieved higher post-consensus, and took more time to reach a decision.

Observations made by the researchers during the experimental sessions revealed differences in how the control and guidance conditions executed the MCDM. Statements of frustration were not uncommon in control groups. Typical comments included:

“I don’t understand the purpose of this step”
“What should we do next?”
“I have no idea why we are doing this”
“Can we skip this step?”

Control groups referred extensively to a printed training guide that accompanied the MCDM to answer some of their questions about use of the model. In many instances, control groups overlooked some mistakes they made when executing model components, leading to less effective or
faithful (DeSanctis and Poole 1993) adoption of the MCDM. The most frequent mistake made by control groups was the input of vague or equivocal criteria into the model which, in turn, led to more problems during the evaluations of how well each alternative met the specified criteria. Delay and disruption breakpoints were glossed over as groups struggled with acting on model outputs and felt pressure to move on prematurely. A stronger emergence of leadership was observed among control groups than guidance groups; in many control groups, one member of the group played the role of a teacher or a facilitator by answering some other members’ questions about the MCDM.

Observation of groups in the guidance condition indicated that feedforward facilitated normal breakpoints. There were fewer comments or questions about “what we are trying to do” during execution of the step. When such questions arose, group members either went back to the feedforward screens (to read them again) or received answers from other members which were consistent with the feedforward screens. Backward guidance appeared to have a strong effect on group conflict management. Guidance groups spent considerable time discussing items flagged by the system as points of inter-member disagreement about criteria and alternatives. Groups tried very hard to resolve their differences in order to eliminate the flags and in this way managed disruption breakpoints rather than avoiding them. For example, in one group a member attempted to convince another to lower his rating on one item so that the flag would disappear but he refused to do so. She then left her chair, put his hands behind his back, and forcefully used his keyboard to change his ratings under the cheers of the other group members who also wanted to get rid of the flags. This incident was extreme but illustrates the time devoted to conflict detection and resolution by guidance groups. More typically, members perceived the flags as a sign of failure and tried very hard to work out their differences through discussion in order to reduce their disagreement and eventually remove the flags. Thus, the cognitive feedback within the backward guidance encouraged the groups to address decisional conflicts and tradeoffs. Graphical displays within the preventative guidance component of the MCDM were another mechanism for groups to interpret model outputs. When discussing graphical outputs of alternative evaluations, guidance groups seemed more able to develop common understanding of their positions, rather than to develop conflicting understanding of the information. In sum, the processes of eliminating flags and interpreting model outputs allowed the group members to understand each others’ viewpoints, which in turn led to a high post-meeting consensus. In fact, two groups in the guidance condition achieved a perfect post-meeting consensus of 1.0.

The guidance groups took more time to reach decisions for two reasons. First, reading the feedforward screens constituted an overhead cost to the groups requiring extra time. Second, guidance highlighted the discrepancies arising from group members’ disagreement over the evaluation of the alternatives and offered suggestions on how the group might go about resolving them. Dealing with these inconsistencies, even though advantageous, was time consuming. In fact, three treatment groups took more than two and a half hours to resolve all their disagreement before reaching their final decision. The control groups, on the other hand, tended to circumvent the decisional conflicts that occurred during the evaluation of alternatives. Thus, many control groups quickly reached a decision that did not reflect a thorough evaluation of all the alternatives. Empirical literature in multi-criteria decision making indicates that premature convergence is common when decision makers are using complex MCDMs (Kottemann and Davis 1991).

9. DISCUSSION

This study explored the possibility of embedding decision guidance within MCDM GDSS, outlined specific guidelines for the development of such guidance, showed how the guidelines can be implemented, and demonstrated the potential benefits of enhancing MCDM GDSS with guidance for a resource-allocation task. Overall, the findings suggest that the addition of guidance to MCDM GDSS can improve group learning and consensus. The limitations of the empirical part of this research are the ones normally associated with laboratory experiments. The main limitation is low external validity. It is difficult to achieve high generalizability of findings and, at the same time, perform a tight control over the independent variables that may affect the outcomes. The current study opted for high internal validity by controlling the setting, task, and subjects. Moreover, although the development of the learning instrument was based on the theory of MCDM and was performed with the input of several MCDM experts who were familiar with the allocate/multi-criteria model, there is a need for repeated measures and further validation of this instrument before concluding that learning was accurately measured.

Given the rather dismal state of affairs in the current literature with regard to usefulness of MCDM in general and MCDM GDSS in particular, the findings are, indeed, encouraging. In his recent influential book, Silver (1990) states that: “For many systems today, providing meaningful decisional guidance may not be feasible because our knowledge of the means for constructing and delivering such guidance is limited” (p. 276).
The authors hope that this study represents a significant step toward overcoming these barriers. Several directions for future research can be identified to build upon the conceptual and empirical work presented in this paper. First, this research has suggested three types of decision guidance: forward guidance, backward guidance, and preventive guidance. The value of embedding these types of decision guidance into MCDM GDSS has been empirically demonstrated. A natural follow up question is: Are these three types of decision guidance equally effective in enhancing learning and improving decision outcomes? If not, which type of decision guidance has the strongest impact? Future research can adopt experimental designs that allow for the investigation of the relative merit of each type of decision guidance. Further, alternative approaches to guidance design and implication would appear to be a fruitful avenue for DSS research.

The concept of decision guidance is tightly related to the concept of restrictiveness (Silver 1991). The former refers to the enrichment of a decision support system with cues that guide decision makers through the decision making process. The latter is a reflection of the degree to which a system restricts and controls decision makers’ activities. Future research can investigate the rather complex relationship between these two concepts. Specifically, the following questions are worth pursuing: How can we best enhance learning and improve decision performance? Is it by restricting decision makers, by guiding them, or by doing both?

The current study focused on evaluating the effects of decision guidance during “one-shot” use of MCDM GDSS. For groups that use the system more than once, the effects of guidance may vary over time as groups gain proficiency in the use of the system. Future research might investigate the longitudinal impacts of decision guidance. The focus of this study was on multicriteria decision making. However, the concept of decision guidance goes beyond a particular problem domain and is not based on a particular technology (Silver 1990). Future research can extend the conceptual development reported in the current study by investigating the design and impacts of decision guidance in domains other than multicriteria decision making.

Finally, the current study used a laboratory experiment to evaluate the impacts of decision guidance. The next logical step would be to assess the merit of decision guidance in a field setting. On a related note, future research might consider adding process measures to investigate the effects of decision guidance on the decision making process. Such measures would further explain the significant improvement in outcomes resulting from decision guidance.

Embedding decision guidance into a DSS is only one way of enhancing learning and improving decision performance. Guidance can also be provided via a human agent, such as a trainer or facilitator. There is a need for more systematic evaluation of the tradeoffs associated with these approaches of delivering guidance. For instance, Limayem et al. (1993) found that system-based decision guidance was as effective as human-delivered decision guidance.

We believe that the current paper can open up provocative discussion about the nature of guidance systems for decision makers, their design, implementation and evaluation.

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11. REFERENCES


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11. ENDNOTES

1. We also selected this task so that the findings could be compared to earlier studies using the SAMM GDSS. The SAMM GDSS originally included only brainstorming, voting, and commenting tools. Watson (1987) found these to surface group conflict but not to facilitate consensus above unsupported groups. Later, Dickson et al. (1991) added a MCDM to SAMM (the allocate/multicriteria model) but found that group consensus was not improved over use of the original SAMM tools. Recently, Lee Partridge (1992) showed that the MCDM yielded significantly higher group consensus when a facilitator worked with groups as they used the model. All of these studies used the Foundation Task.