An Information Systems Approach to Support Decision Makers Selecting Group Decision Processes

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Abstract

This paper describes a support system for group decision-making. The system is based on a database of typical decision cases and also an underlying model of the group decision process. The model serves to organize the way users interact with the database, exploring, analysing and selecting cases. Currently the database has 75 group decision cases.

Key words: *Decision-making processes, group decision support systems, group decision cases.*

1. Introduction

Group meetings are time-consuming, complex and subject to many barriers that decrease productivity and quality of outcomes. The complexity arises for two particular reasons: (1) there are many different intertwined processes in group meetings, which must be analysed differently but also regarded as a whole to understand group work; and (2) there are many process variables that must be analysed independently to understand variations in groups' behaviours and outcomes.

Group meetings involve decision processes (e.g., 8.[1]) as well as productivity processes [2], communication and relationship development [3][4][5], group conflict, strategy development and group training [3]. Regarding process variables, the set of variables identified in the literature encompass anonymity, proximity, time dispersion, facilitation support, usage of procedures, as well as technology support [6].

This paper is primarily focussed on the decision process. There is empirical evidence showing us that following a decision process that is well adapted to the problem at hand is decisive for the quality of group outcomes [7][8][9]. This evidence has raised an obvious interest in understanding the strategies adopted by groups when following a decision process.

The inquiries about this issue indicate that experts and novices in decision making adopt very different strategies. According to the responses obtained by Clawson et al. [10] and Niederman and Volkema [11], experts in decision making tend to focus on flexibility. They select some previous case from their personal collections, either well or badly succeeded, and adapt it as needed during the decision process.

On the contrary, novices seem to adopt a different strategy, based on grasping information about the task situation. Having smaller collections of cases, and more natural difficulties to adjust some generic process to the problems they face, it seems that novices prefer to spend time gaining a conceptual view about the process before responding to it.

In any circumstance, there is a significant effort in selecting and maintaining an adequate decision process. The hypothesis, which is in this work genesis, is that information systems can alleviate this effort, thus bringing performance gains to decision makers. To decision experts, providing organizational memory, easier identification and retrieval of decision cases; and also giving flexibility, by supporting the adjustment of old cases to new situations. To novices, information systems may support the complex process of gradually elaborating decision-making abilities, based for instance on decision aids and guides [12].

An approach suggested in the literature has recourse to intelligent agents [2][8]. These agents could include the automatic recognition and interpretation of decision structures, and provide expert advice on the better course of action.

Obviously, the agent approach is most adequate to novice users. Provided that knowledge about a wide range of problem situations and a sufficient number of generic guides are built into the system, novices may depend on the system to define the decision process. We should however highlight one major drawback with this approach. Analysing the system developed by Dickson et al. [8], we noticed that agents make opaque decisions, thus not allowing novices to develop their decision-making abilities. Decision experts may also see the agent approach as being obtrusive, given the lack of flexibility.

Another approach was adopted by the system described in this paper. The proposed system supplies a collection of decision cases, describing the problem situation and adopted decision process. Thus, novice

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decision makers obtain others' collections of cases and, at the same time, are able to analyse, understand and compare the adopted strategies. Expert decision makers also obtain a system that manages cases, allows fast information search and retrieval, and preserves flexibility.

Finally, this approach raises one interesting technical problem, which is the main subject discussed by the paper. There are many decision cases discussed in the literature, each one described in a different manner, having its own context and proposing a different approach to the decision process. In this scenario, how can we build an information system capable to provide a harmonised view of cases, allow users to explore decision processes and at the same time develop their comprehension about group decisions?

2. Criteria for Selecting Decision Cases

Most times the decision cases found in the literature describe some problem situation using generic terms and few details. Usually, there is a description of the goal that the group should accomplish. Other times there is a description about the task that should be performed by the group.

See, for instance, the example 1 given bellow. This case describes the goal that should be accomplished, i.e. select one of the two given options. No details about the task are given. The group may either discuss the issue to reach a consensus or simply vote the available options. On the contrary, the example 2 shows a case where several details about the task are given to the group. In fact, this case induces a multiple criteria decision process, where the group must go through a series of steps, defining criteria, weights and then voting to reach a consensual decision.

Still considering the variety of task details conveyed by decision cases, example 3 illustrates a situation where the task is very simple (a creativity task), while example 4 poses a much more complex task (planning), requiring several systematic steps.

Clearly, from the examples given below, the selection of cases should consider some diversity of tasks and goals, and also covering different levels of complexity.

When selecting cases, one important requirement to consider is that cases should contribute to make readers understand some fundamental factor explaining the decision task. Usually, these fundamental factors are only indirectly related to the case and must be inferred from the accompanying discussions about experimental conditions and obtained results.

Consider, for instance, the example 3. This is a familiar task intended to develop group creativity, based on the hypothesis that deferred judgement and lateral thinking abilities increase the quality of group outcomes [13].

Examples 2 and 4 focus on rationality when making decisions. According to this perspective, there exists a goal and a wish to maximize some utility function, and there is some systematic way to accomplish the task (bounded by considerations of time and cost, according to Simon [14]). Planning is a good example of such a systematic approach, where the group has to identify what actions should be taken, by whom, when, what resources are needed and how can success be measured.

Other times, the factor brought up by the case is much more subtle. Consider the example 1 again. This case was specifically designed to study the framing effect in risky decision-making. Framing considers the hypothesis that decision makers tend to avoid risk when they perceive a positive frame and seek risk when they perceive a negative frame [15]. Framing has been used to explain some well-known decision fiascos such as the Bay of Pigs, Watergate and Invasion of Cuba.

Once again, what is at stake when selecting decision cases is to ponder the diversity and different nature of factors explaining group decision.

Finally, we should also regard that, beyond the objective of making readers aware of some specific factor explaining group decisions, the cases should also supply a decision process adequate to the situation. However, it is clear from the given examples that an identification of the most adequate process is not easy and may be subject to debate.

In our example cases, we propose using decision trees in case 1, multiple criteria decision making in case 2 (select criteria, weight criteria, etc.), brainstorming in case 3, and planning in case 4 (what, whom, when, what resources, and how to measure).

Example 1 – Surgical Operation [15]

A 40 years old man with serious heart problem is faced with two alternatives: do nothing, with possible heart attack, or do a delicate surgical operation.

Example 2 – Financial Audit [16]

The situation deals with analysing clients accounting records in the context of auditor's work. The group must determine the level of acceptance risk, i.e. how many, and how serious, misstatements are accepted in the client's records before a negative report is generated. Accepting too many errors reduces the auditors' credibility, while accepting too few errors increases costs and the auditors' task. Client's background information and financial statements are provided to the group. There must be a consensus.

Example 3 – Thumbs Problem [17]

Identify practical benefits or difficulties that would arise if everyone had an extra thumb on each hand.

Example 4 – Inventory Department [18]

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Food products are manufactured and packed. Some are in quarantine, others are long-term stored in the bulk inventory. A buffer inventory also exists. The group must manage the materials flow.

3. Exploring Decision Processes

We have seen with some examples that, by nature, decision cases present an immense diversity of goals, tasks, factors affecting decisions and applicable processes. The goal then, is to identify a generic and systematic way to present decision cases to users and allow them to search and retrieve significant information.

In our view, the approach must be based on theory about decision making. We have analysed a large set of decision models available in the literature [19][20][21][14][22][23][13][24][25][27][1][28].

As we found out, our objective could not be successful by selecting just one model. Each one of these models provides a partial explanation of the decision process. For instance, the rational model [14] is concerned with the systematic ways to resolve problems, though considering that individuals have cognitive limitations, which may be overcome by groups.

The organizational model [28] posits that the complexity of the problems and differences among individuals require some division of labour and result in the establishment of an organization.

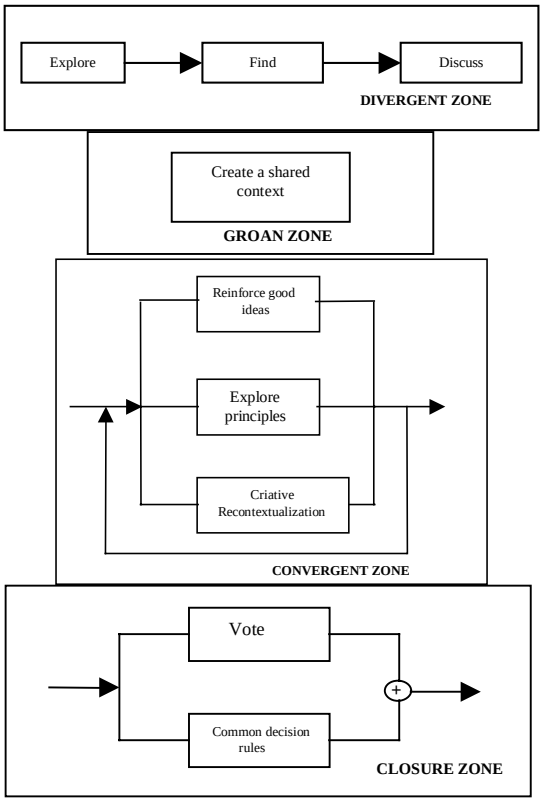

Figure 1 – Strategies in making decision

Thus, the organizational context is a factor that influences decision-making beyond the rational process. This organizational view accounts for imprecise or conflicting goals, conflicts among people, power differences, conformance pressures, time and money constraints, etc.

Since all these models seem to reinforce each other in constructing a coherent explanation of the decision process, our strategy was to find out different models that could explain each one of the several criteria defined in the previous section.

The first contemplated criteria were goals and tasks. A decision case must have some meaningful goal. To accomplish that goal, some unique task must be performed. Obviously, depending on the complexity of the problem, both the goal and the task may be decomposed. However, at an initial level of detail, it makes sense to classify a decision case using of one single goal and one corresponding task.

The model adopted by us was defined by McGrath [21] and is exactly intended to classify tasks in a mutually exclusive, collectively exhaustive and useful way. The model defines four main tasks: (1) generate (ideas or plans); (2) choose (logic or preference); (3) negotiate (criteria or interests); and (4) execute (competition or performance).

The next contemplated criterion was the decision process. The decision process is broadly defined as a bundle of tasks that include gathering, interpreting and exchanging information; creating and identifying alternative scenarios; choosing among alternatives; and implementing and monitoring a choice [24]. Note that we already obtained a typology of the tasks that make up a decision process, using the McGrath's model. What is missing then is to regard the decision process as a state machine: the group departs from an initial state, where several perspectives exist, and, by integrating perspectives in a new one, which represents some shared understanding, reaches a final state.

In the past [29][30][31], we have made successful experiments with one model defined by Kaner [19], that characterizes decision processes as a state machine. It was time again to rely on that model. The model considers one generic decision process, characterized by a sequence of four intermediate sub-processes, designated *zones*: divergent, groan, convergent and closure.

Furthermore, a *zone* is characterized by one or more partial goals that must be accomplished by the decision makers. Such partial goals are designated *strategies*. Figure 1 presents the set of *strategies* that are predefined for each *zone*.

The idea behind using different *strategies* in a particular *zone* is to support the notion of case complexity. More complex decision cases require

additional effort from the decision makers, which is reflected in the model by the necessity to accomplish additional *strategies* (goals).

Observe Figure 1. The divergent *zone* specifies a sequence of three *strategies*: explore the context of the problem; find alternative solutions for the problem; and discuss the alternatives. The groan *zone* is characterised by the single *strategy* of creating a shared context. Here, the different points of view are questioned in order to get a context shared by everybody.

The convergent *zone* is characterised by three *strategies* that can reinforce each other circularly. So, in most simple situations, it is possible to just reinforce good ideas or, in most hard to converge cases, complement the previous *strategy* with creative re-contextualization and principles exploration. The closure *zone* includes two *strategies* that may or may not be combined: voting and common decision rules. With this scheme it is possible to vote but do not decide (lack of authority) or vote and decide (the group has authority). In case of consensus, it is also possible to decide without voting.

Finally, the Kaner's model considers that a strategy may be implemented in many different ways. Thus, there is an additional model component, designated *activity*, which defines how can the group implement one selected *strategy*. At this level of detail, the group executes one *activity* for each adopted *strategy*. The set of *activities* is obviously an open one. See, for instance, the huge number of different activities collected by VanGundy [13] just to implement creative problem solving.

And no further models were selected to explore decision cases. We have covered goals, tasks and several details about the process, considering process complexity, partitioning and implementation. We were not able to identify one model capable to explain the different and relevant factors affecting decisions in an exhaustive and useful way. The alternative then, is to accept the association of any number and type of explaining factors to each decision case.

Finally, the structural components adopted to characterize decision cases were:

1. **Name** – Few words that summarize the case;
2. **Task** – The unique task that must be performed, according to the McGrath's model;
3. **Zones, Strategies and Activities** – Characterization of the decision process according to the Kaner's model;
4. **Instructions** – The case description;
5. **Observations** – Optional details, remarks and explaining factors that complement the instructions;
6. **References** – Source where the decision was found;
7. **Pre conditions** – Describes various resources, tasks or group conditions that should be fulfilled before running the case, e.g., preliminary documentation, a brainstorming task or some level of consensus;
8. **Post conditions** – Describes resources, tasks or group conditions that may be necessary to fulfil after running the case, e.g., collect additional data, develop some strategy, obtain consensus.

4. Implementation

This section is dedicated to describe the information system that was implemented to manage decision cases. The system was named "Decision Can"[1].

Having characterized in the above section the generic structure of decision cases that will be stored in Decision Can, the following issue to discuss concerns the users' interactions with the collection of cases, supporting the exploration and comparison of available cases, as well as understanding and learning how to make decision.

From the users point of view, the "Decision Can" prototype provides two different functionalities: (1) select and explore cases; and (2) manage cases.

The selection of cases departs from a bag where all cases in the database are listed. Then, users can successively reduce that bag, specifying the structural components that they are interested in. The first component that may be specified is the task. Several tasks can be selected, since users may not be sure about which one to select.

Then, users may characterize the zones, strategies and activities of their interest. Again, the cases displayed to users are those that cover the selected categories. Figure 2 illustrates this situation. Here, users may specify if they are interested in cases that cover any one of the selected zones, strategies and activities or, alternatively, indicate that they are interested in cases that cover all the selected zones, strategies and activities.

Note that users can always move back and forth between the selections they make. Also, at any point in time, it is also possible to analyse in detail one particular case and exclude it from the bag.

Finally, users can expand the cases that remain in the bag and obtain the additional information to decide if cases are according with their interests.

[1] The origin of this name is the Garbage Can model developed by March [32]. The idea behind the Garbage Can model is that problems, solutions, and choice opportunities are "floating" in an organization until they link at some point in time to make a decision. Something similar happens in our system, where decision cases are available in the system, and users with a problem may link it to a case, at some point in time, by interacting with the system.

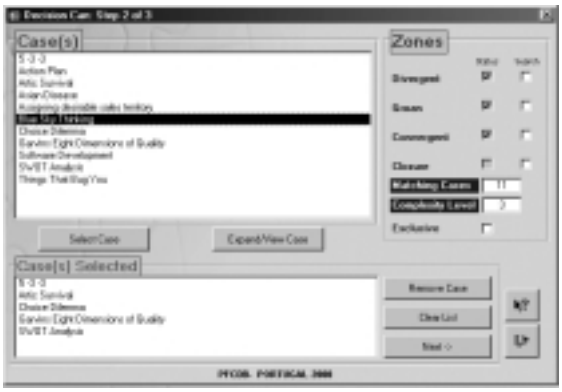

Figure 2 – Selection of zones

Users can modify any individual attributes of cases available in the database. As expected, it is also possible to append new cases to the system.

5. Profile

The Decision Can prototype currently has 75 cases, which were obtained from systematic research of a set of about 200 papers and a few books. These cases include every task of McGrath's task model, as well as every decision zone of Kaner's model.

In Figures 3 and 4 we show the distribution of cases amid tasks and zones.

6. Evaluation

We set up an experiment to evaluate the Decision Can prototype. The experiment involved about 30 university students from a Management Information Systems course. Students were requested to resolve two decision-making problems with the aid of Decision Can. Both problems were related to ethical problems in information systems development. Afterwards, the students were requested to individually respond to a questionnaire.

The participation in this experiment contributed to the students' final degree obtained in the MIS course. From the total population of 30 students engaged in this process, only 20 completed it with success, producing experimental results.

The questionnaire was organized in three major areas, concerning questions about the model, cases and tool. Each question could be rated in a scale of five points (1 - very low; 5 - very high). In Table 1 we present a summary of the obtained results.

The obtained results indicate that there is a global satisfaction with the approach, although the global opinion about cases is neutral. The most positive factors were the aids and capability to explore the decision process. The most negative factors identified by the subjects were the complexity of the model, adaptability to new conditions, the clarity of cases and the sufficiency of cases to support the decision process.

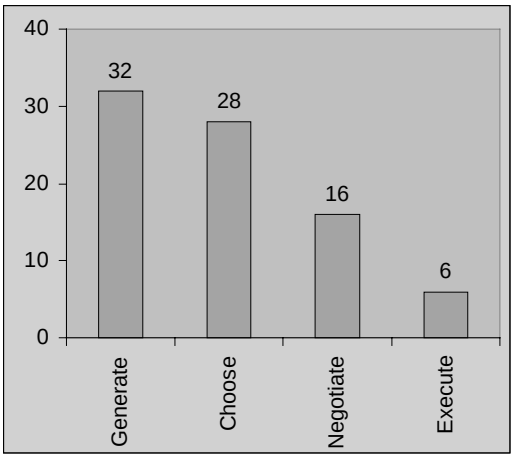

Figure 3 – Distribution of cases by tasks

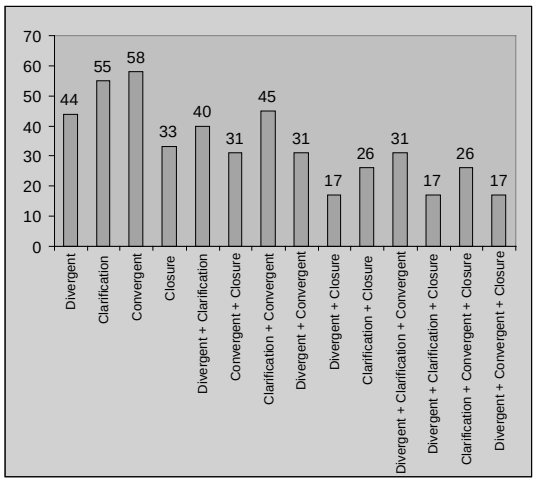

Figure 4 – Distribution of cases by zones

Evaluation criteria		AVG	STD
Model	Aid the decision process	3.65	0.67
	Completeness	2.95	0.89
	Complexity	3.6	0.99
	Explore-ability	3.2	1.1
	Adaptability to new conditions	2.45	1.47
	Global satisfaction	3.35	0.59
Cases	Clarity	2.5	1.15
	Practicality	3	1.52
	Sufficiency of information	2.7	1.26
	Global satisfaction	3	1.21
Tool	Clarity	3.05	1.28
	Complexity	3.15	1.27
	Explore-ability	2.9	1.21
	Global satisfaction	3.3	0.92

Table 1 – Results from the experiment

Using the same questionnaires, we also requested open comments about the model, cases and tool. Some of the responses provide explanations about the above criteria and scores. A summary of these comments is presented in Table 2. According to the subjects,

although well structured, the tool poses some initial difficulties to understand its underlying logic. The subjects also identified two erroneous details in the tool, which require further consideration: some mismatches between cases and their names; and a difficulty understanding the passage from strategies to activities.

Positive	Negative
"Simplifies the problem, dividing it in parts"	"The tool requires time, and knowledge about different possibilities"
"The structure is well organized"	"Some cases are not perfectly understandable"
"Increases productivity"	"Some cases are not related with their names"
"The cases are deep enough"	"It requires time to adapt"
"Some of the proposed activities help the decision process"	"The tool is complex at the first time"
"We can always follow the logic behind a case"	"At first, it is difficult to understand the logic of the model"
"Anyone can use the tool without much problems"	"It is simple, but the passage from strategies and activities is not so clear"
"The model is extensive and simple"	"If we want to search for other characteristics, do we have to go through all the database?"
"The tool only requires a bit of usage"	"The tool is complex because there are too many options"
	"Requires a lot of knowledge about the model and tool"

Table 2 – Summary of the collected comments

7. Conclusions

This paper describes a database of decision cases aiming at improving group decision-making. The selected approach is to support groups exploring, recognizing and selecting typical decision cases. A model was defined in order to support the users' interaction with the database. Currently, the database has 75 cases, covering a wide range of problems with different levels of complexity.

We have evaluated the tool with 30 users and obtained 20 responses ranking the tool in respect to several criteria, considering the model, cases and the tool itself. According to the responses, there is a general satisfaction with the model and tool. However, a more fine-grained evaluation of the obtained results highlights some few negative aspects of the tool, which should be redesigned in the future.

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