On the Design of Group Decision Processes for Electronic Meeting Rooms

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Abstract

This paper reports a set of experiments motivated by the observation that the design of group decision processes is crucial to the success of electronic meeting room usage. Decision processes can be designed with more emphasis either on exchanging meanings (discussing issues) or exchanging artefacts (generating and structuring topics). Our problem is that, given a particular case to be discussed in an electronic meeting room, we do not know how to design the meeting for best performance. The paper builds a framework for studying this problem based on the notion of communication mode. The experiments already made confirm that quality of results varies when different communication modes are used and show that meetings that do not exchange meanings result in solutions with inferior quality.

Keywords: Electronic Meeting Rooms, Group Support Systems, Communication Modes.

1. Introduction

The origin of this work was a project which main goal was to set up an electronic meeting room at INDEG, a public institute dedicated to provide Masters degrees in Management Sciences. The project's mission was quite straightforward, considering two fundamental purposes: (1) provide an infrastructure to teach topics related to management sciences; and (2) demonstrate the environment to companies with links to the institute. In what concerns research work, the project's goals were to explore the effects of software usage on decision-making processes.

The room is now operational with the following infrastructure (Figure 1): seats to a maximum of eight people, eight notebook client computers, one server, one Smart Board front projection unit from Smart Technologies Inc., one video projector serving the Smart Board, and two video cameras dedicated to record meetings. Concerning software, we have installed two Group Support Systems (GSS): Meeting Works for Windows from Enterprise Solutions Inc. and GroupSystems from Ventana Corp. [20].

By the end of the project, the team had already accumulated a significant amount of effort spent in understanding how meetings should be designed and, actually, designing meetings.

This project allowed us to perceive one major problem with the GSS. We found that it was extremely hard to design some particular types of meetings: the ones that require people to converge towards some common point of view. This is the central problem addressed by this paper.

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Figure 1 - Meeting room at INDEG

Let us give more detail to this matter. It is a well-known assumption that a group of people may get to better decisions than a single person, basically because the group is (potentially) able to share different expertises and points of view (e.g. [6][14]). In order to make a group decision, people must interact, which can be achieved in two very different ways: exchanging meanings or exchanging artefacts. The former case considers sending messages and getting immediate feedback while the later considers information building, organization and refinement.

Regarding the characteristics of the electronic meeting room described previously, several design alternatives may be adopted:

- Users discuss Face-to-Face (FtF);
- Combine FtF interaction with software tools that share artefacts;
- Eliminate FtF discussion and use software tools to share artefacts;
- Use software tools to exchange meaning (one alternative is using a chat tool), an interesting situation where users are FtF but not allowed to discuss verbally;
- Or use software tools to exchange meaning and artefacts.

Our informal experiments showed us that these design decisions affect the quality of group decision-making and deserve further investigation.

We use in this paper the concept of communication mode to classify the possible design alternatives. This variable is subsequently used to study its influence on decision-making.

The paper is organised in the following way. We start by summarising the experiments and results reported in the literature concerning these matters. Then, we define a framework to study the problem addressed by this paper. Finally, we describe the controlled experiments, their results and our conclusions.

2. Related Work

There are several reviews of experimental studies with GSS, the most relevant ones by Fjermestad and Hiltz [11], Nunamaker et al. [16], Benbasat and Lim [1] and Hollingshead and McGrath [13]. All of them identify a set of input variables for studying GSS based on the McGrath's [15] framework: (a) task characteristics, (b) group characteristics, (c) contextual factors, and (d) technological factors. These reviews also describe the most commonly studied dependent variables addressed by GSS research, which can be related to: (a) performance, (b) satisfaction, and (c) group structure. This set of variables is presented in Figure 2.

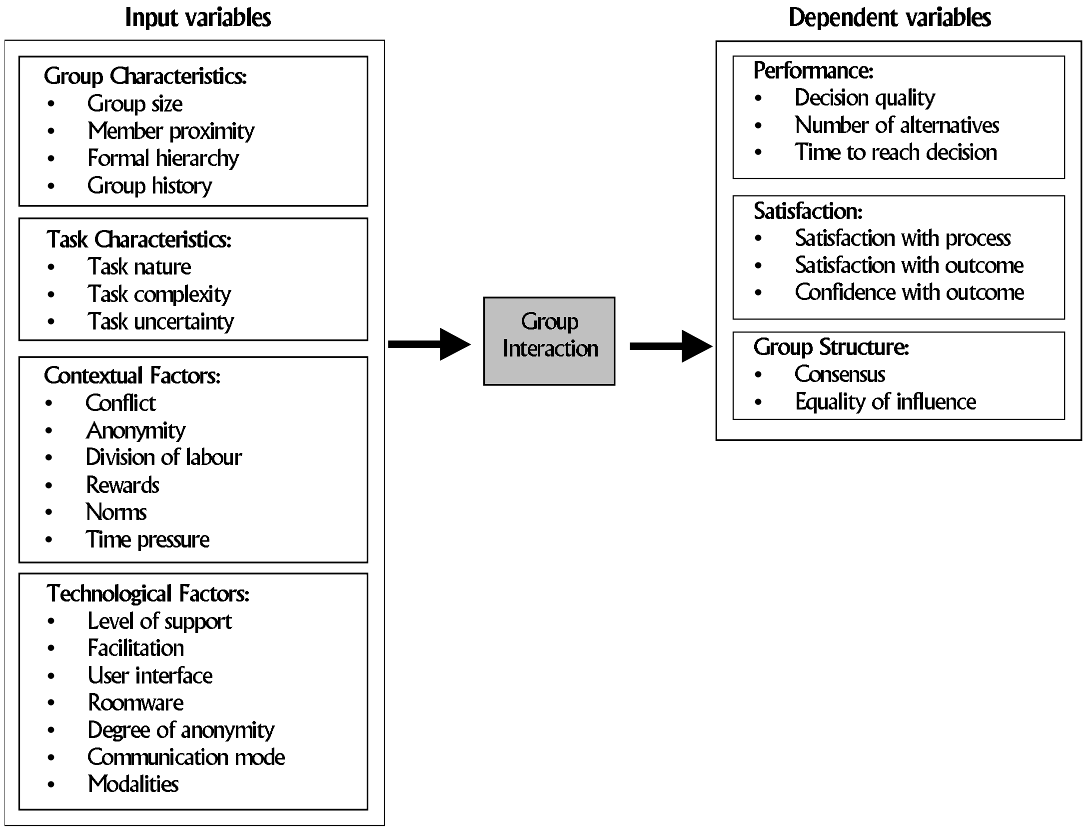

Figure 2 – Input and dependent variables for studying GSS

There is one variable in this framework that is particularly linked to the problem addressed by this paper: the communication mode. Besides that one, three other variables may also be related to the problem. They are task nature, task complexity and modalities. All these variables are described bellow.

Communication mode

Communication mode is defined as the medium or media of communication used by the group [10]. Fjermestad and Hiltz [10][11] classify these media according to the following modes[1]:

- **FtF** – The participants interact Face-to-Face;
- **DSS** – A Decision Support System, comprising single-user software and a single computer, is shared in a FtF setting;
- **GSS –** This situation uses software tools that structure communication and assist group decision (such as voting tools);
- **CMC** – Computer Mediated Communication tools [8] are used to support group discussions.

By far, most experiments with communication modes contrast FtF/GSS, seconded by FtF/CMC [11]. Fjermestad and Hiltz [11] report that GSS and CMC modes yield about the same proportion of positive effects in meetings, although the ratio positive/negative effects is more favourable to GSS. The six experiments contrasting FtF/DSS are reported as more favourable to DSS than FtF.

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[1] Considering that this paper only concerns same place synchronous systems, we do not present further classifications according to synchronous/asynchronous characteristics as well as same place/remote settings.

Interestingly, the experiments contrasting different types of GSS were focussed on evaluating the influence of time (synchronous/asynchronous) and place (same place or remote). In this paper we will report an experiment assessing other characteristics of GSS.

Task nature

This variable focuses on stated goals, i.e. what the group was mandated to do [18]. Task nature is commonly characterized using the McGrath's circumplex [15]:

- Generating ideas (creativity) or plans (planning);
- Choosing solutions, either with correct answers (intellective) or no correct answers (decision making);
- Negotiating conflicts, either of viewpoint (cognitive conflict) or interest (mixed-motive);
- Executing performance or competitive tasks.

Hollingshead and McGrath [13] report that task nature affects differently group performance, which makes it difficult to compare FtF and GSS sessions when different tasks are performed. For instance, GSS groups perform better than FtF for creativity, perform worse for intellective or negotiation tasks, and no differences between GSS and FtF were found for decision-making tasks.

The experiments reported in this paper will consider intellective tasks.

Task complexity

The definition of task complexity is related to a number of criteria, such as timing, information overload or uncertainty. Based on these criteria, Zigurs and Buckland [18] present a typology with five increasingly complex categories, ranging from simple to fuzzy tasks.

Most GSS experiments only cover simple tasks, in particular generation and choice. Benbasat and Lim [1] concluded that usage of GSS in simpler tasks was more efficient. However, Fjermestad and Hiltz [11] report two other studies where GSS groups working on complex tasks outperformed GSS groups working on simple tasks.

The experiments reported in this paper deal with problem tasks, classified immediately above simple tasks in terms of complexity.

Modalities

This variable concerns the combined use of different communication channels. To psychologists this term refers to human modalities, with people using their various senses of vision, hearing, touch smell and taste [2]. To the human-computer interaction field the term encompasses computer modalities, i.e. interaction styles that increase the bandwidth of the human-computer interaction [9].

To Blattnet and Glinert [2], multi-modal systems attract users who want to communicate with computers in more diverse and natural ways. Taking a slightly different perspective, Hollingshead and McGrath [13] argue that modalities place limits and structure the communication process of users.

The overview from Fjermestad and Hiltz [11] indicates that most experiments with different modalities were done to evaluate the Media Richness theory [5][3][7], which proposes that group performance is improved when matched to the medium's ability to convey information.

According to Dennis et al. [7], most experiments have assessed media fit rather than effects of media richness on group tasks. In this paper we will handle the later case.

3. Framework for Studying the Problem

In the previous section we associated our problem with the communication mode, classified as a technological factor. Unfortunately, the classification of communication modes presented by Fjermestad and Hiltz [10][11] is not well suited to our situation. Fundamentally, because our setting falls in the GSS category and thus the communication mode is not a discriminating factor in our meeting designs.

In order to explain differences in meeting designs we must categorize the GSS communication mode in more fine-grained detail.

To accomplish this objective we adopt a perspective from Hiltz and Turoff [12], which makes a distinction between the communication and information domains of users. To their view, "these domains are the expectations users have for their potential use of the system." In the former case, users expect to use the GSS to exchange meaning, sending messages and receiving immediate feedback. In the later case, users expect to use the GSS in order to build, organize and elaborate a common artefact. Naturally, the GSS may emphasise or weaken one particular domain.

Zigurs and Buckland [18] also make a distinction between communicational and informational domains. According to these authors, communication support is any aspect of the technology that supports, enhances or defines the capability of the group to communicate. The informational domain, designated by the authors information processing, is the capability to gather, share, aggregate, structure and evaluate information[2].

Thus, we classify the GSS mode in the following categories:

- **GSS-FtF** - The GSS supports shared artefacts, but the complete bouquet of human senses is also available since the meeting participants interact Face-to-Face.
- **GSS-Nominal** - Nominal means silent and independent [17]. The GSS does not allow participants to engage in argumentation or conflict. Interaction is accomplished through the display and manipulation of shared artefacts.
- **GSS-CMC** - The GSS substitutes Face-to-Face discussions with textual, audio and video channels, while enforcing its structuring abilities.
- **GSS-Combined** - The GSS combines text, audio and video communication with shared artefacts.

In Figure 3 we arranged the different GSS modes according to the communication and information domains of user' interactions.

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[2] The authors also define a process structuring domain, which is out of the scope of this paper.

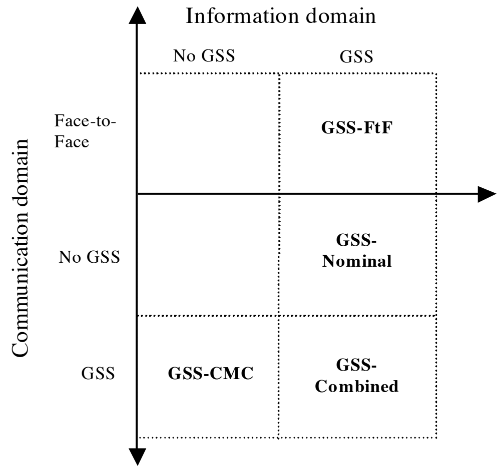

Figure 3 – GSS modes

In Figure 4, we describe some common meeting designs according to the defined GSS modes.

Meeting A is a Face-to-Face meeting around a whiteboard. Meeting B uses the system to moderate people discussing issues. Meeting C refers to a common situation where people first diverge, to gather ideas, next converge to discuss and evaluate the ideas and, finally, vote on a decision.

Meeting D is a variation of meeting type C where discussion is supported by the GSS. Meeting E corresponds to what is known as a Delphi discussion [8][12]. Finally, meeting F classifies decision processes based on the IBIS model (Issue Based Information System [4]). The perspective is that this model integrates both communication (positions, arguments) and information (issues) objects.

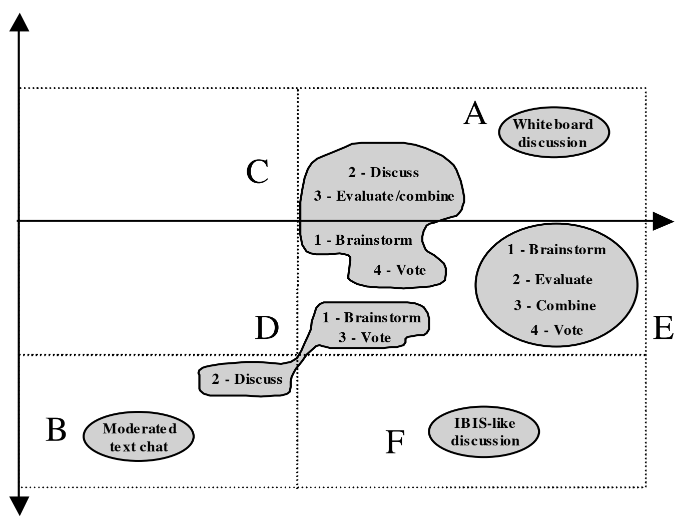

Figure 4 - Some common meeting designs

4. Controlled Experiments

We prepared controlled experiments to assess the influence of different GSS modes in meetings. This section describes the experimental setting and meetings setup. Currently, only two modes are confronted: GSS-Nominal and GSS-FtF. Furthermore, the FtF mode is also experimented, allowing us to define a baseline and compare our results with other FtF/GSS experiments.

Experimental Setting

Problem. Are there any significant differences in what concerns decision quality between processes using different GSS modes?

Variables. One single dependent variable was studied in the experiments: decision quality.

Hypotheses. The current experiments are limited to the following hypotheses:

- **H1:** We will observe differences between GSS-FtF and GSS-Nominal modes. The lack of support to the communication domain results in lower decision quality.
- **H2:** We will observe differences between FtF and GSS-FtF modes. The use of GSS for information sharing results in the improvement of decision quality.

Sample and procedure. University students from public and private institutes in Lisbon composed the chosen population. The variables used to select the sample were education, age and knowledge of Windows user-interfaces. The sample was made by a non-random method (family and friends) and had 72 participants (12 groups of 6 persons). The groups were randomly assembled.

Meetings Setup

There were three experimental conditions: GSS-FtF, GSS-Nominal and FtF. These conditions were applied, respectively, to four, five and three groups of different participants.

For all the experimental conditions the problem presented to subjects was the same - Moon Survival Problem [1]. This problem is an intellective problem, and "the task requires that the subjects imagine themselves crash-landed on the moon 200 miles from base. All but 15 pieces of equipment have been destroyed. The remaining items are to be ranked in order of declination in contribution to survival on the walk to safety" [19]. The task was presented to subjects as an exercise in individual and group problem solving.

Decision quality was measured as the absolute difference between the rank assigned by the group to the items and the rank assigned by the NASA Crew Research Unit. This variable can range between 0, as the best solution, and 210, as the worst.

FtF situation

The six participants went to the room and took their places (without any pre-established order). The facilitator introduced himself, told the instructions and requested the participants to fill a user profile.

Primarily, the participants had to solve the problem by themselves using paper and pencil. When finished their individual solutions, they were asked to discuss the problem among themselves. The main role of the facilitator was to involve all participants in the discussion and solve conflicts that could have been brought up during the discussion. After the group had discussed all essential points (aprox. 40 min.), they were asked to solve the problem again, in silence.

GSS-FtF situation

The modifications to the experimental setting were the following. The facilitator introduced GroupSystems and certified that there were no doubts about the software (aprox. 10 min.). The problem and instructions were then presented, and participants were requested to fill a user profile using GroupSystems.

Participants were asked to solve the problem by themselves, using the GroupSystems survey tool. When finished, the global solution was presented in the SmartBoard by the facilitator. Then, the subjects were asked to discuss the global solution. After the discussion, the subjects were asked to solve the problem in silence, using the survey tool.

GSS-Nominal situation

The modification to the previous setting was that the subjects were asked to examine the problem without any Face-to-Face interaction. GroupSystems' electronic brainstorming tool was used to collect information from the participants. The system was configured to automatically circulate pages through all participants. Each page was dedicated to gather comments about a piece of equipment.

5. Results and Observations

Our results are based on a comparison of the quality of individual rankings for each experimental condition. The results are summarised in Figures 5 and 7, where the horizontal and vertical axis display respectively the quality of initial and final rankings. The figures also display linear regressions of individual rankings.

We start by comparing results from GSS-FtF and GSS-Nominal situations (Figure 5). According to the set-up, the only difference between both meetings is that one is designed to allow participants to use all modalities associated to Face-to-Face interactions, while the other users can only share information via the computing system. These results show that quality diminished when participants were forced to use the system. Applying the T statistic to analyse if differences are significant (Figure 6), for a confidence level of 95%, we obtain that the null hypothesis is rejected. Therefore, hypothesis H1 is validated.

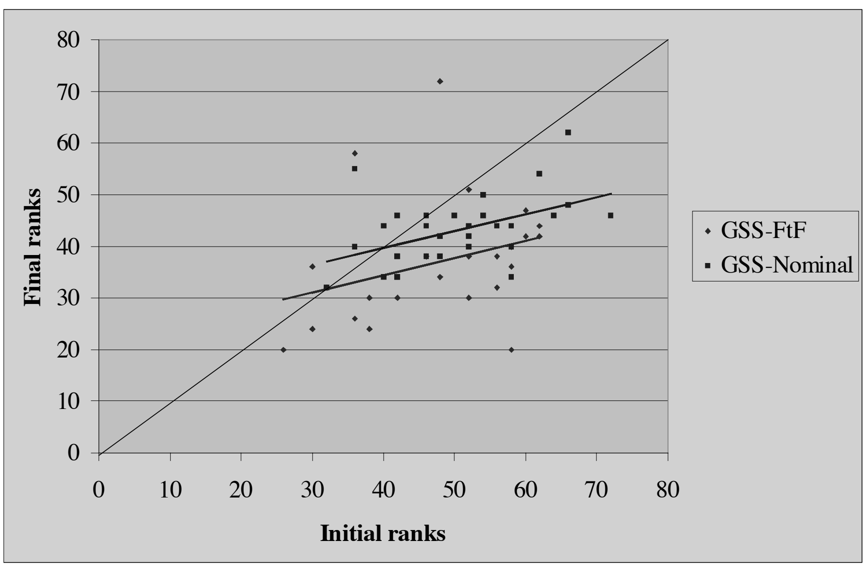

Figure 5 - Quality results

t-Test: Two-Sample Assuming Unequal Variances

	Co-located GDSS	*Nominal GDSS*
Mean	36.83	42.97
Variance	144.23	45.96
Observations	24	30
df	34	
t Stat	-2.23	
P(T<=t) one-tail	0.02	
t Critical one-tail	1.69	
P(T<=t) two-tail	0.03	
t Critical two-tail	2.03	

Figure 6 - t-Test applied to final quality results

We have also analysed in detail what happened to each one of the 15 pieces of equipment that were ranked by the group participants. Figure 7 presents the detailed analysis of the two most important items, oxygen and water. Using the average of the standard deviations as a measure of consensus, we can observe that the GSS-FtF situation allows participants to reach a higher degree of consensus.

The analysis of the two least important items shows a similar degree of consensus. That situation did not happen with the remaining items however.

	GSS-FtF								**GSS-Nominal**							
	Final ranking								**Final ranking**							
	1	**2**	**3**	**4**	**5**	**6**	**STD**	**Aver.**	**1**	**2**	**3**	**4**	**5**	**6**	**STD**	**Aver.**
Oxygen	1	1	1	1	1	1	0,00	1,00	1	1	1	1	1	1	0,00	1
Water	2	2	2	2	2	2	0,00	2,00	2	2	2	2	2	3	0,41	2,17
Oxygen	1	1	1	1	1	1	0,00	1,00	1	1	1	3	1	2	0,84	1,5
Water	2	2	2	2	2	2	0,00	2,00	4	3	4	4	2	3	0,82	3,33
Oxygen	1	1	1	1	1	1	0,00	1,00	1	1	1	1	2	1	0,41	1,17
Water	3	5	3	2	3	5	1,22	3,5	2	3	2	2	3	2	0,52	2,33
Oxygen									1	3	1	1	1	1	0,82	1,33
Water									2	4	2	3	2	2	0,84	2,5
							0,20								**0,50**	

Figure 7 – Final rankings of the two most important items

Figure 8 allows comparing the GSS-FtF and FtF situations. The results do not show any significant difference, which denies hypothesis H2.

These results are somewhat unexpected, given that one would expect at least two positive contributions from GSS support: (1) it allows users to easily check and modify their rankings during the initial and final phases; and (2) displaying group rankings allows users to more easily perceive agreements and disagreements.

On the other hand, we have previously mentioned that GSS perform worse for intellective tasks. Furthermore, these results are aligned with the meta-analysis of Fjermestad and Hiltz [11] which report that 66.1 percent of experiments with GSS/FtF communication modes result in “no effect.”

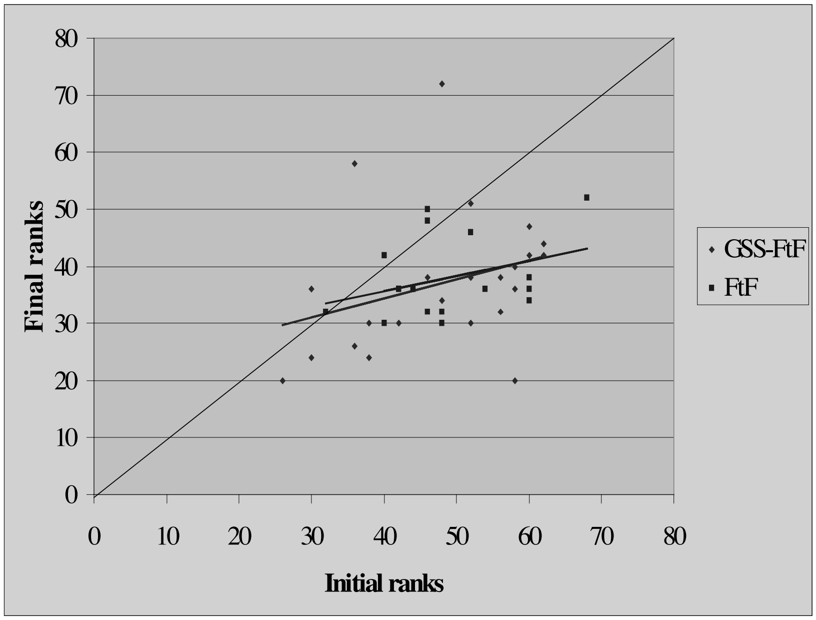

Figure 8 - Quality results

Again, we analysed what happened with the 15 individual items. What is interesting to note is that the degree of consensus for the two most important items is more favourable to the GSS-FtF than to the FtF situation (Figure 9). Thus, the "no effect" result must be credited to the middle items.

	GSS-FtF								FtF								
	Final ranking								Final ranking								
	1	2	3	4	5	6	STD	Aver.	1	2	3	4	5	6	7	STD	Aver.
Oxygen	1	1	1	1	1	1	0,00	1,00	1	1	1	1	1	1		0,00	1,00
Water	2	2	2	2	2	2	0,00	2,00	6	2	2	2	2	2		0,00	2,00
Oxygen	1	1	1	1	1	1	0,00	1,00	1	1	3	2	1	1	1	0,79	1,43
Water	2	2	2	2	2	2	0,00	2,00	6	2	2	1	3	4	3	1,63	3,00
Oxygen	1	1	1	1	1	1	0,00	1,00	1	1	1	1	1			0,00	1,00
Water	3	5	3	2	3	5	1,22	3,5	6	3	3	3	2			0,50	2,75
							0,20									**0,49**	

Figure 9 – Final rankings of the two most important items

Which observations can be made with these results? Apparently, considering the two most important items, the GSS-FtF outperforms the GSS-Nominal and FtF situations (symmetrically, the same occurs for the least important items).

The differences must then be attributed to the middle items, where GSS-Nominal is clearly inferior to GSS-FtF. Our comment is that the lack of the communication domain is responsible for such bad performance, which seems critical when there is not much consensus between the meeting participants.

These results have implications to software design and require further experiments to evaluate which software mechanisms are necessary to preserve the quality of results in nominal GSS. Such mechanisms include the support to users wishing to emphasise the importance, express acceptance or rejection of some piece of information, or attempt to build consensus.

6. Conclusions

This paper departed from our observation that the design of group decision processes for electronic meeting rooms is a difficult task due to, in the one hand, multiple design alternatives and, in the other hand, incomplete understanding of implications carried by different designs to group decisions.

In our perspective, the definition of GSS communication modes contributes to clarify and build a framework for the alternatives faced by meeting facilitators when designing decision processes. GSS communication modes are a combination of different communicational (face-to-face, no GSS, GSS) and informational (no GSS, GSS) interactions.

The experiments described in this paper assess two GSS communication modes: GSS-FtF and GSS-Nominal. Results show that GSS-FtF provides better quality group decisions than GSS-Nominal. The results also indicate that there are no significant differences in quality between the baseline mode (FtF) and GSS-FtF.

The experimental results were obtained in the context of a decision process characterised by an intellective task and moderate complexity. To understand if results apply to more complex tasks remains open.

Other GSS communication modes, namely GSS-CMC and GSS-Combined must be assessed in future experiments. Furthermore, each GSS mode can be fine-grain characterised, using multiple degrees of the communicational and informational domains. For instance, GSS-CMC can range from very simple scrolling (CMC level 0 [10]) to more rich support. A complete understanding of the design of group decision processes for electronic meeting rooms requires results from such fine-grained experiments.

The electronic meeting room at INDEG is currently running and being used to teach courses. Lessons have been learned and resulted in meeting designs that accommodate and try to take most profit from Face-to-Face discussions in GSS meetings. Still, strategies devised to increase software usage during sessions are needed.

Acknowledgements

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