Using a Group Decision Support System to Make Investment Prioritisation Decisions

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Abstract

This paper is concerned with how decision making groups involved in making investment prioritisation decisions involving funding of technology and science projects may be supported by a group decision support system (GDSS). While interested in decision outcomes, the primary focus of this paper is the role of a group support system as an aid to developing shared understanding within a group. The paper develops the conceptual framework of decision-making, communication and group support, and demonstrates, through a field application involving a strategic investment decision making group, how a group decision support system can support the development of shared understanding in the group decision-making process. The paper concludes with an examination of how supported communication in groups, and enhanced understanding of individual views, may develop learning and impact on strategic decision outcomes. We suggest that the usefulness of these types of system, at this stage of their development, may be more in their role of developing shared understanding between members of a group, rather than in aiding 'better' decision outcomes.

Keywords: Group Decision Support Systems, OR in Research and Development, Investment Prioritisation

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1. Introduction

Many organisational decisions are made by groups rather than by individuals. This is particularly so when investment prioritisation decisions on the funding of technology and science projects need to be made which may require individuals with different expertise to contribute to the decision making process. This paper is concerned with the role of a group decision support system (GDSS), based on the use of wireless handsets and a large feedback screen, to support decision making groups, and it considers a field-based application of a decision making group concerned with making investment prioritisation decisions. The use of wireless handset based GDSS means that members of the decision making group focus their attention on a single feedback screen, and explore in conversation their reasons for displayed differences. Anonymity is maintained in the software and feedback displays, and inputs using the wireless handsets are normally simultaneous, and result in feedback displays of summarised information (e.g. barcharts) on a large screen which can be considered and discussed by all members of the group.

The paper is underpinned by data collected through a field-based application of a GDSS involving a decision making committee, supported by a group decision support system, given the task of determining strategic investment priorities between different technology and science projects competing for limited overall resources on behalf of a research funding body. This case study highlights how a GDSS might support a decision making group through helping to develop a shared understanding of the relevant issues and concerns by all members of the group and the importance of dialogue in developing this shared understanding,

2. The process of decision making

The study of decisions and decision making has been a major element in academic thought on the nature of management for a considerable time. Herbert Simon for example, focused attention on decision making in his seminal book ‘Administrative

Behavior' (Simon 1945). Lindblom (1959) introduced the idea of incrementalism, the view that decision making in groups/organisations is characterised by incremental steps rather than grand strategic design, in the context of limited (bounded) rationality in his paper, "The Science of 'Muddling Through", and Quinn (1980) developed this idea in his empirical studies of firms in 'Strategies for Change: Logical Incrementalism'. Invidious though it must seem to select a few names among the many contributions in this field, it is interesting to observe that Vaughan, in her monumental study of the Challenge space shuttle disaster, refers specifically to the significance of bounded rationality, and to incrementalism in organisations (Vaughan, 1996).

The theme of decision making in this paper is both conceptual and practical, and embraces four aspects:

(a) The idea that emphasis should be placed on decision making as much, if not more than, decision taking. This focuses on the processual nature of reaching decisions.

(b) A process takes place through time and hence in changing, and often unforeseen circumstances – especially in strategic decisions which govern the product-market scope of an enterprise. It may involve numbers of individuals within the organisation, working in designated groups, or drawing on inputs from various members or units within the organisation.

(c) The machinery of the process, that is to say the structure of organisation, the network of communications within it, and the mechanisms of responsibility and accountability, are important to the understanding of decision making. As noted elsewhere, in reference to Loasby's (1976) work, decision procedures are analogous to fixed capital: they are, so to speak, the fixed assets of decision making.

(d) Quinn (1980) commented that the kinds of incremental processes he encountered in his studies of strategic decision making in corporations *"... recognise and deal with psychological and informational problems of getting a constantly changing*

group of people with diverse talents and interests to move effectively together in adapting to a continually dynamic environment".

Insofar as the interest of this paper is with decision making in groups, of either established or changing membership, the concern is with precisely the problems which Quinn commented on above, and the conversation within groups through which the members become aware of the views held by one another. The present paper considers ways in which communication within groups can be facilitated and commitment to action secured, which underlies the interest in the use of technology-based group (decision or process) support systems.

It should be noted, as a significant codicil in respect of philosophy and management, that there are large considerations of responsibility and accountability in the complex modern corporation. For example, the relation between methodological individualism on the one hand, and corporate liability on the other, has exercised considerable interest among lawyers, criminologists, ethicists and management scholars, see e.g. Minkes & Minkes, 2000 and 2001; Mays R, 2000.

3. Group Decision Processes and Communication

Earlier studies (Gear and Read, 1993; Minkes and Gear, 1994; Gear, Minkes and Read, 1999) considered the relationship between decision processes and discourse in the context of conflict. In order to make clear that 'conflict' is not thought of as inherently destructive in this context, but rather as "imperfect compatibility", the definition expressed by Ross (1969) of "constructive conflict" is adopted. Schelling (1980) has drawn attention to the diverse meaning of the word, writing in the context of international strategy, that *".... the strategy of conflict is to take the view that most conflict situations are essentially bargaining situations. They are situations in which the ability of one participant to gain his ends is dependent to an important degree on the choices or decisions that the other participant will make".*

There is a clear analogy between Schelling's statement and problems of consensus within a group of individuals, who are, however, members of the organisation as a whole. The concern is with groups composed of individuals who, by personal

preferences and departmental and/or divisional perspectives, come together in the hope of reaching agreed courses of action. In such groups there will often be gradations in personality and power, and there is what might be regarded as the politics of the decision process.

In this paper, we define consensus as the willingness of members of a group to agree on a decision/course of action, even if they may have some reservations. The paper considers 'reservations' to mean that the decision may not be what a member would have chosen had he/she been considering only personal preferences – but what is acceptable to him/her when thinking as a member of the group. This is analogous to Schelling's points about the mixture of conflict and common interest(s), and his use of the phrase 'incomplete antagonism' (Schelling, 1980).

The significance of groups and mechanisms for interactive communication through which members can become aware of the assumptions and negotiating positions of one another are relevant. It is considered that the use of the phrase 'decision making in groups', rather than 'by groups', should be used. In any group there are likely to be questions of power, assertiveness, and debating skill. We argue that modes of discussion that encourage all members to participate in a non-threatening environment can lead to an improved pooling of ideas. It is at this point that the contribution which may be made by the use of technology-based group decision support systems is introduced.

4. Group Decision Support Systems

Group Decision Support Systems (GDSS) are information systems used to support the process by which a group of people meet and interact for learning and or deciding type tasks. They are sometimes also known as Group Process Support Systems, Electronic Meeting Systems, Electronic Meeting Aids, or simply as Group Support Systems. They have been developed to alleviate the well-documented problems of groups such as conformity of group members, domination of the group by certain individuals, and the effects of miscommunication within the group. DeSanctis and Gallupe (1987) define a Group Decision Support System as *"An interactive, computer based system which facilitates the solution of unstructured problems by a set of*

decision makers working together as a group." A later definition of Group Support Systems is given by Nunamaker et al (1997) who says that GSS are *"interactive computer-based environments that support concerted and coordinated team effort towards completion of joint tasks."*

There are a number of different types of GDSS, including networked computer based GDSS and handset based GDSS (Nunamaker et. al., 1991, 1997; Jones et. al., 2006). The objective of these systems are to improve the effectiveness of the group process and reduce negative effects of groups, including the pressure to conform, free riding of members, and domination of the group by one or more members (Nunamaker et. al., 1991). Many GDSS will share common characteristics (Finlay and Marples, 1992), including enhanced communication facilities between group participants, enhanced modelling and interface facilities to permit voting and ranking, and the availability of both qualitative and quantitative decision support tools, with which members are comfortable, which are transparent in operation, and which are flexible. Such systems may be designed to embrace features of group-based processes, including processes of information sharing, storage and retrieval, and also of learning (Wilson et. al. 2007). A theory to aid the analysis of technology type in relation to task type has been developed by Zigurs and Buckland (1998), and Dennis et al, (2001) reported that differences of GDSS design may have been responsible for some differences between the findings of past studies involving implementation and use of various types of GDSS.

Research into the effectiveness of GDSS in experimental settings (e.g. Barkhi and Kao, 2011) and field settings (e.g. Luo et al, 2011) has provided variable results. In a thorough search of the literature, Fjermasted and Hiltz (1999) reviewed over 200 different controlled experiments that had been published in the academic literature (both journals and conferences). They found that there was no significant difference between supported and unsupported face to face decision making groups. However, research using field experiments and real life applications appears to be much more positive. For example, Chun and Park (1998) compared experimental and field studies. Eighteen field studies were identified from the literature, each of which measured different variables. Analysing the results of each of these field studies, Chun and Park (1998) found that, when using a GDSS, the time to decision and

decision quality were improved, and that participants reported satisfaction with the process using a GDSS, had high confidence in the decision outcomes and reported improved participation.

The reasons for the inconsistent results between experimental and field settings may be due to the use of contrived tasks with small and adhoc groups of often four members or less in experimental settings (Stevans 1995). DeSanctis et al (2008) contains a review of experimental and field research by the Minnesota GDSS Research Project over a period of 20 years, and discusses the advances in both the theory and practice of Group Support Systems made through this research. This research has found that the use of GDSS is more successful when decision modelling models are included within the support available.

There are a number of different types of GDSS, including those based on networked computers, those based on the use of individual handsets to elicit views from group members, and those using a decision model with the group supported by a facilitator. The majority of research into GDSS has been based on computer networked systems and there has been limited research into GDSS based on handset systems, known as keypad-GSS or k-GSS by Watson et al (1994), when compared to GDSS based on computer networks despite the use of such systems by a number of organisations. Finlay (1991) identifies handset based systems as being ideal for average size meetings and which can be easily carried from room to room. Watson and Bostrom (1991) identify two strengths of handset based GDSS: their portability which enables them to be used in a wide number of settings, and the display of voting which is flexible and easy to use.

In an early application using handset based systems, Gear et al (1985) used a hard-wired k-GSS to study the effects on group behaviour when given feedback of participant feelings regarding the progress of meetings. Gear and Read (1993) identified a number of managerial applications of handset based GDSS. Other published articles include Banks (2001), who considered the use of handset based systems to obtain student feedback evaluation, Davies (1989) who looked at handset based technology for supporting groups in retail marketing, Irving and Hunt (1994) who looked at how handset based systems can support student groups, Flexner (1995)

and Flexner and Wheatley (1997) who consider how handset based technology can support management groups, and Read et al (2012) who looked at how handset based GDSS can support organisational learning. Watson et al (1994) investigated the perceptions of facilitators who have used handset based systems and identified the following facilitator perceptions:

1. Anonymity is beneficial
2. Meetings can have more participants without loss of effectives
3. Meeting participation is improved
4. Meetings are more focussed
5. Meeting planning is more important
6. GSS technology provides a structure and control mechanism for meetings

In an article by Nunamaker *et al* (1997) a number of lessons on electronic voting and polling have been compiled, which are directly relevant to any research into handset based GSS. Nunamaker *et al* (1997) identifies eight lessons which stem from using a GSS for electronic polling:

1. GSS polling can be used to clarify communication, focus discussion, reveal patterns of consensus or stimulate thinking.
2. Anonymous polling can bring out issues that remain buried during direct conversation.
3. GSS polling can demonstrate areas of agreement, allowing groups to close off discussion in those areas and focus only on areas of disagreement.
4. GSS polling can be used to formally register dissenting opinions.
5. GSS polling can fuse the aggregate judgement or opinions of all group members into a true group position.
6. GSS polling can facilitate closure of issues that are too painful to face using traditional methods.
7. Care must be taking to ensure that polling criteria are clearly established and defined.
8. Polling methods in decision groups need not be democratic.

5. The Teamworker Group Decision Support System

To illustrate how a handset based GDSS can enhance intercommunication in groups, an actual field application, using the 'Teamworker' GDSS, is briefly described. This handset based system has been described in detail elsewhere (e.g. Gear and Read, 1993: Read and Gear, 2006). The system comprises a number of wireless handsets, one for each group member. Each handset has a 0 to 9 digital keypad and this allows each member of the group to transmit one or more numbers to a receiver linked to a personal computer.

Typically, questions are asked on a large screen viewed by all members of the group. Responses from group members to the questions presented are presented back to the group in an aggregated and (normally) anonymous form (e.g. in the form of bar charts) using a large screen that all members of the group can view. This feedback is then used as a focus for debate and discussion of the reasons for the differences that are displayed. The responses may also be used as inputs into decision frameworks, for example multi-criteria decision making models.

6. An Application of Group Decision Support in Prioritising Research Projects

This case study concerns a UK Research Funding organisation which was required to determine funding for scientific and technical research projects, and, in particular, whether projects were funded or not. Funding decisions were made by the central staff of the organisation, using advice from Research Committees.

The overall research programme of the funding organisation was classified into 8 planning areas, which were overseen by four scientific and technical Research Committees The membership of the Research Committees consisted of senior people from academia and industry with relevant experience in the appropriate research and these appointments typically lasted for a three years. Each Research Committee was lead by an appointed Chair, an appointment that again was normally for a three year period. The membership of the Research Committees could vary from seven to nineteen members, each one an expert in scientific area. Permanent Central Office staff supported each of the four Research Committees. Each of these committees met

twice a year for one or two days, to consider and recommend funding of research proposals submitted by the universities and other institutions. The Research Committees would typically consider anywhere between twenty and over 200 individual research proposals, and these research proposals would be requesting funding of anywhere from £10,000 to over £200,000. Only a small proportion of research proposals would actually receive any funding.

Committee membership in each scientific area was relatively stable, with the majority of members serving for three years at a time. Each committee met twice yearly for 1 or 2 days in order to assess, and recommend selection or rejection, of up to 200 proposals. The overall budget was well defined, but the precise apportionment between the scientific areas covered by each of the committees was left somewhat flexible, depending on the quality of marginal submissions, when the committees met. To support this task, each Research Committee used the Teamworker GDSS to rank the research proposals in terms of the excellence of each proposal, to identify those proposals that should be funded, and to ensure that there was sufficient discussion of each proposal for the committee members to clearly understand the perspectives and views of the different committee members, and to be content with the decisions made by the committee.

Research Committee Process

The layout of the committee room used by each Research Committee is shown in Figure 1.

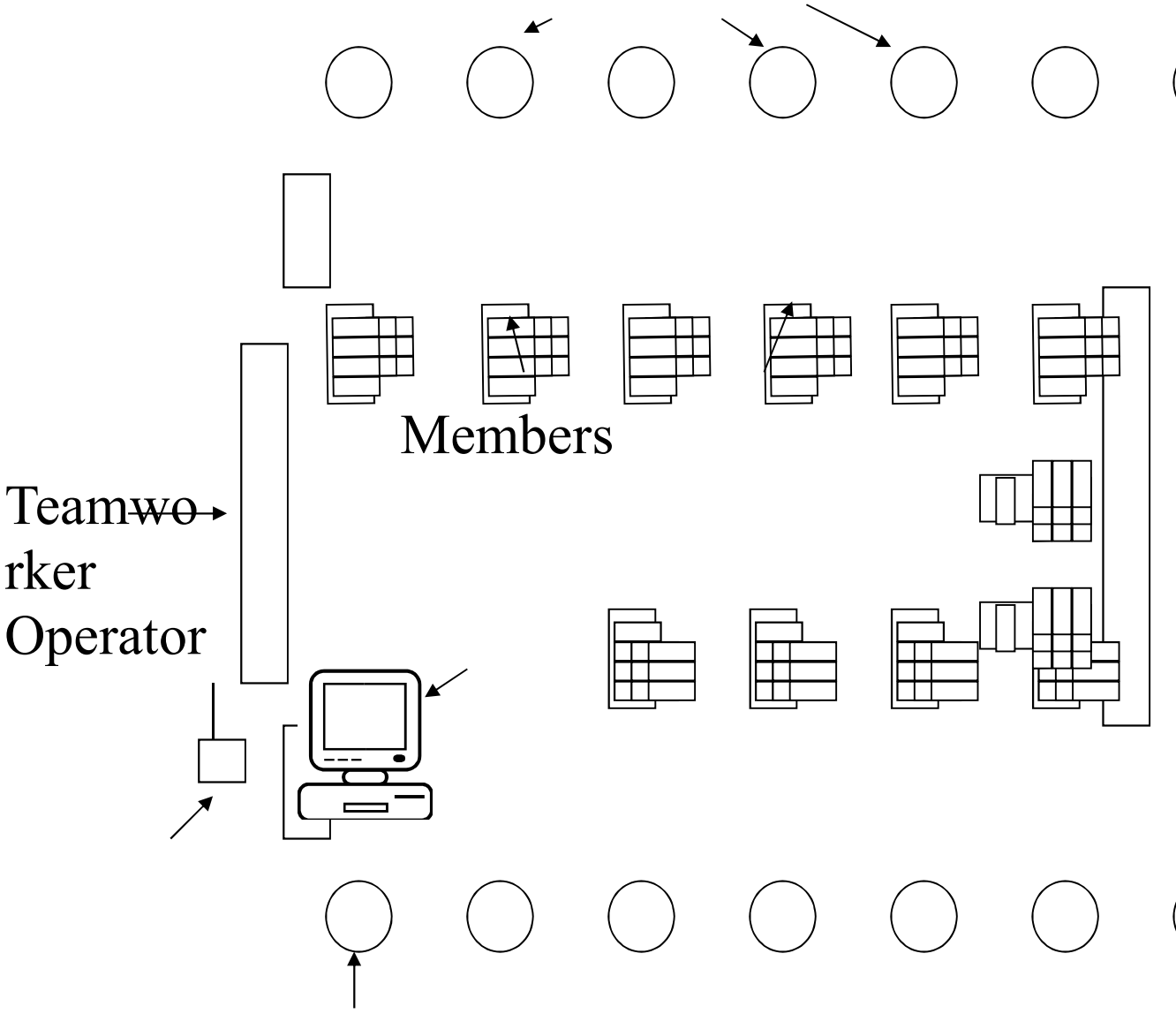

Figure 1. Layout of Committee Room

At each committee meeting, the complete list of proposals was held in the GSS software so that specific proposals could be called up for display in either agenda (usually alphabetical) or some other order. The display showed only the proposer's name, institution, and project cost, although committee members also had available a detailed hard copy of each proposal in advance of the meeting. The Funding Organisation Secretary had a 'controlling' handset that could be used to control the

Teamworker software remotely, ensuring that the Secretary was in control of the meeting agenda.

One or more nominated committee members (expert in the given topic of the research proposal) presented each proposal, referees' comments were noted, and a short discussion of views and points of clarification was held. At this point, the chairperson summarised the position and stated whether this project was of a fundable type (as opposed to a non-fundable type of project). When a fundable project was identified, each committee member anonymously scored the given proposal, using a Teamworker GSS handset, on the two criteria: 'scientific excellence' and 'relevance to policy'. A five-point scoring scale was used for each criterion, with 1 (low) and 5 (high). This scale was very familiar to a majority of the membership, having been in use over several years.

The mean scores and standard errors of the means for each of the two criteria were displayed after each set of inputs, and these were discussed further at this stage. Bar charts showing the distributions of scores were also displayed when it was clear that there was substantial disagreement (see Figure 2). These barcharts would lead to further discussion focused on the reasons behind differences of opinion, and then, when appropriate, re-scoring of the proposals.

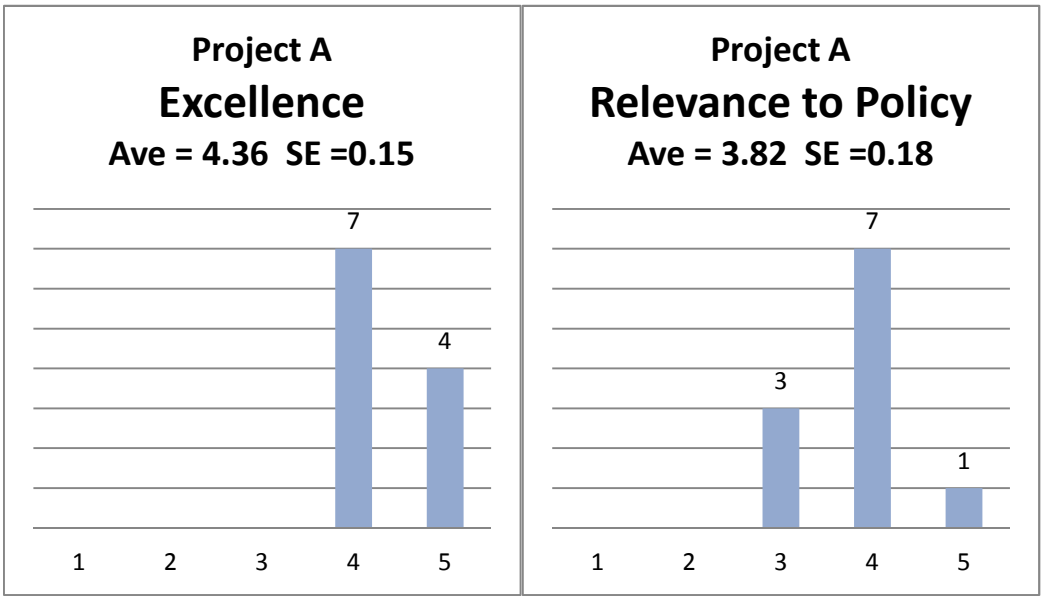

Figure 2. Bar Charts of Scores Showing Range of Opinion for a Project

After all proposals had been treated in this way, an overall rank ordered list of fundable projects was printed and given committee members, based on mean scores for 'scientific excellence' only, while also displaying the 'relevance to policy' mean and standard error alongside. The running total of aggregate first year costs was available to Officers only (not the committee members). The definition of an approximate range from minimum to maximum budget allocation for the given committee allowed identification of a number of 'grey' projects falling within this range. The grey projects were then reviewed by the committee to identify those projects that they might want to support if sufficient research funds were available. In general, it was assumed by the committee that projects above the grey area were selected and those below rejected although exceptionally, some proposals were discussed further and then re-scored.

Evaluation of the Process

After an initial trial of the system, the Teamworker GDSS system was used continuously with each Research Committee at their bi-annual Research Committee meetings for five years, after which the work of the Funding Organisation was subsumed into a new organisation. In total, the committee task of ranking research proposals was supported by the Teamworker GDSS in over 40 separate Research Committee meetings. Each of these meetings comprised between 7 and 19 members, and each meeting was required to rank between 5 and 200 research proposals.

The funding organisation identified the following benefits to using the GDSS:

- It helped committee members become more consistent in their scoring.
- It enabled the agenda to be completed in the time available. For some Research Committees the agenda was extremely large, with over 200 proposals to be properly considered.
- It reduced the possible domination of a committee by a small number of committee members.
- It enabled discussions to be focussed on important areas of disagreement.

- It made the administration of the committees easier, as all scoring inputs were automatically captured.

The head of the group responsible for implementing the GDSS was also very positive on the usefulness of the system, and made the following comments on the usefulness of the system:

> *"I've found it very valuable, and it really concentrated minds"*
> *"I liked the way it forced you to think and be consistent, whereas normally you just waffle"*
> *"(the Research Funding organisation) gets more information than before, with significantly more precision"*

7. Discussion

Many decisions are made through groups and committees meeting in face-to-face situations. There may not always be agreement, nor that all members of the group will be entirely happy with the decision outcomes. But through using a GDSS similar to the one described in this paper, it is more likely that there will be a greater understanding of all opinions and views and a greater understanding of the effects of alternative assumptions and options.

Decision-making processes within groups may be conceived as one in which consensus emerges through interactive communication among participants. It may also be viewed as a learning process both for individuals and the group as a whole. This view of the strategic process is admittedly controversial; it may be criticised by those who see strategy as a 'top-down' process and those who emphasise the dominant role of 'the great man' in the creation of strategy. But whatever position is taken on the emergent/top-down debate, it can be recognised that the complexity of decision making is such, especially in the large and complex modern corporation, that there will be many threads which make up the overall process.

These ideas have a diverse parentage, which includes Herbert Simon's early critique of the lonely captain on the bridge model of decision making (Simon, 1945). And just

as ‘the market system has elaborate methods for communication and joint decision making’ (Arrow, 1974), so the business enterprise, within a structure of rules, roles and controls – formal and informal – has its modes of interactive communication. It is appreciated that there may be a trade-off between the requirements of the organisation as a whole, as seen by the top authority and the interests of particular sub-groups. It is also recognised that there is competition as well as consensus within organisations. But as Pfeffer (1981) pointed out, there are characteristic situations in which the formation of consensus is regarded as crucially important, arguing that: *“It is the process of co-optation, the process of interest representation and the process of meeting and confirming which is critical in providing acceptance and legitimacy of decisions”.*

It is recognised that there are serious questions to the idea of groups as decision making entities, especially if groups are regarded as microcosms of organisations as a whole. There may be conflict between the demands of self-regarding rationality by individuals, and the need to arrive at collective choice. There is also the important question of the appropriate size of groups from the point of view of securing concerted action. In any group, moreover, there is the factor of individual bias, not only in respect of entrenched points of view, but also in different abilities to respond to styles of presentation. For example, the GDSS feedback screen has been used as a device for displaying group inputs and it may be that this favours individuals who are particularly responsive to the visual exposition of data.

Whatever view is taken on themes of that description, the critical factor is that many business decisions require a variety of inputs: these are expressed by different individuals with different personal and functional perspectives. The face-to-face group meeting is a common method used to make decisions by a group. There will not necessarily always be full agreement by the group, nor will all group members always feel completely content with the outcome. But, through using a system similar to the one discussed in this paper, there is a greater possibility that there will be a wider appreciation of options and improved knowledge of other’s perspectives, views and assumptions, which will lead to a greater understanding of both the options under discussion and the possible identification of new options which might be considered by the group. The GDSS used in the field study described in this paper has enabled

members of the decision making group to easily identify the full range of opinion, and the individual views and opinions which underpin any differences of opinion. These differences can be explored through discussion, and it is this process of encouraging discussion as a basis for decision making that is one of the benefits of using a GDSS.

In this paper, emphasis has been placed on decision making and on decision making processes even more than outcomes: *"...decision making is an arena for symbolic action, for developing and enjoying an interpretation of life and one's position in it……..understanding organizational decision making involves recognizing that decision outcomes may often be less significant than the ways in which the process provides meaning in an ambiguous world…… (and such meanings) may be as local as the ego needs of individuals or groups within the organization"* (March and Shapira: 1982).

As demonstrated by the field example, a Group Decision Support System can support the decision making process in complex situations involving many options and competing views as well as focussing on differences of view and encouraging discussion. The support given by the GDSS should be designed for the context in which it is being used, to enable differences to be easily identified, and also for analyses of these differences which may be significant for decision outcomes, to enable the group to quickly and easily focus its time and attention onto those areas where differences of view are of the most significance.

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