Association for Information Systems
AIS Electronic Library (AISeL)

BLED 2003 Proceedings | BLED Proceedings

December 2003

Mobile Services for Group Decision Support

Hans van der Heijden
Vrije Universiteit Amsterdam, Faculty of Economics and Business Adiministration

Jerry van Leeuwen
Vrije Universiteit Amsterdam, Faculty of Economics and Business Adiministration

16th Bled eCommerce Conference

eTransformation

Bled, Slovenia, June 9 - 11, 2003

Mobile Services for Group Decision Support

Jerry van Leeuwen, Hans van der Heijden

Vrije Universiteit Amsterdam, Faculty of Economics and Business Administration, The Netherlands
JvanLeeuwen@feweb.vu.nl, HHeijden@feweb.vu.nl

Abstract

In this paper we study a new role for smart mobile devices: their potential assistance in group-based decision making. Assuming that smart devices implement wireless short range scanning technology, they have the capacity to scan other devices and by doing so, group members can exchange information and decision preferences with other group members. We introduce four mobile services that exploit this technology for the purpose of group decision making: information gathering, information matching, preference gathering, and preference matching. The paper continues by outlining to what extent these services will have value for specific types of group tasks. We conclude that information gathering and matching are appropriate for simple tasks and problem tasks, and preference gathering and matching are appropriate for judgement tasks and "fuzzy" tasks.

1. Introduction

With the increasingly widespread adoption of smart mobile devices, researchers are beginning to study the deployment of these devices to improve business process performance (Lyytinen & Yoo, 2002; Smith, Kulatilaka, & Venkatramen, 2002; Varshney & Vetter, 2001). Empirical evidence is increasingly supportive of the usefulness of mobile devices in business environments, for example by increasing the opportunities for coordination and control (Van der Heijden & Valiente, 2002), workflow and emergency conditions (Luff & Heath, 1998) and by providing personal decision support for mobile tasks (Van der Heijden & Sørensen, 2002).

What is less developed in this literature is the potential role of mobile services for group decision support. To the best of our knowledge we know of no study in which this specific role has been considered. To further explore these possibilities, we conduct a preliminary analysis on the opportunities for mobile group decision support in this paper. We do so by proposing a set of mobile services to be used in this domain, and by theorizing about the effectiveness of these services for specific task types.

In this paper, we focus on groups with local mobility. Local mobility refers to the movements of group members in a shared location. Users may be mobile, but they are still in close proximity, and therefore they are able to hold face to face meetings (Belotti & Bly, 1996). We assume that groups have face to face meetings, and the mobile services possessed by the group members should support these meetings. We leave the opportunities for remote mobility (the movements of group members in distant locations (Kristoffersen & Ljungberg, 2000)) for other researchers to explore.

Why would mobile group decision support be different from traditional group decision support (GDSS)? One could image traditional GDSS software (e.g. Group Systems, see www.groupsystems.com) being implemented on mobile devices, using wireless connections and a base station. In that case, there may seem to be little difference between the mobile and the immobile situation, and the mobile "condition" is not likely to be of sufficient theoretical interest. There are, however, two advantages to a mobile GDSS that we believe make the study of these technologies relevant.

The first is that a mobile GDSS is – in theory - less complex to set up than a traditional GDSS. In the case of a traditional GDSS, employees often need to schedule a timeslot and they need to relocate to a special group decision room, often not available at the employees premises. This is costly not only because of opportunity costs, but also because group decision rooms are scarce resources and their use often has a price. Using mobile devices, however, one can envision *ad hoc* group meetings, in any room. Because users need not be assigned to fixed terminals in a room, they can start using GDSS applications straight away.

The visibility and 'presence' of the technology has been reported as an explanation of the lack of benefits of GDSS (see e.g. Watson, DeSanctis, & Poole, 1988). If set up and implementation costs are decreased, mobile GDSS may provide benefits in circumstances where GDSS provide less benefits. This is one reason why mobile devices may be applicable for more ad hoc group decision making. It is also one reason why it would be theoretically interesting to study these systems in more detail.

The second advantage of a mobile GDSS over a traditional GDSS is that new features can be introduced that are enabled by the mobile technology. For example, the set of features that we will propose in this paper requires the implementation of short-range wireless scanning technology. This technology allows group members to scan each other's mobile devices and learn about their alternatives and preferences. Current GDSS cannot, by their immobile nature, make use of these services.

The paper proceeds with an introduction to four new mobile services to enhance group decision support. The rest of the paper is devoted to a preliminary theory about the usefulness of these mobile services. This is grounded in theory related to "traditional" group decision support systems (GDSS). Section 3 briefly reviews this GDSS literature. In section 4, we provide three propositions that relate the mobile services to group decision making performance. Last, section 5 discusses the contributions and limitations of the paper, and provides areas for further research.

2. Emerging Mobile Services for Group Decision Support

We envision a number of new features for mobile devices to aid group decision making. These are all based on the assumption that the mobile device can *scan* the mobile device of another user. A second assumption is that the user needs to scan by *pointing* his or her device towards the device of another user. In other words, the mobile device does not scan other users in the background. Technically, this active scanning could be implemented using infrared technology or RFID technology (Radio Frequency Identification).

Active scanning will enable group members to learn and evaluate each other alternatives and preferences. The first and simplest feature is *information gathering*. Here, users scan other users to identify possible alternatives for a solution to a decision problem. For example, suppose that the problem is to generate a wish list of qualifications for a new employee. Users could each create their own wish lists on their mobile devices, and by scanning each other they could complement their wish lists with the lists from the other users.

The second, more advanced feature is *information matching*. In this situation, the mobile device not only imports the wish lists from other users, but also compares them against the wish lists already stored on the device. By doing so the device could provide cues if there are new items on the wish lists. It could also count the occurrence of the items, thereby providing some indication about the relative importance of such an item in the group.

The third feature, again more advanced, is *preference gathering*. In this situation, users gather preferences regarding specific alternatives. In the wish list example, users could rank each item on the wish list. The device would then be able to scan not only the items, but also their ranking. This enables the user to retrieve some information about the relative importance of these items for the separate users.

The fourth and final feature that we envision is *preference matching*. In this situation, preferences are taken in by the mobile device and an overall picture is given of the degree to which these preferences match with the preferences stored on the device. In the wish list example, the user could see to what extent another user agrees on the importance of a qualification.

3. Some Findings from the GDSS Literature

The remainder of this paper explores some of the theoretical issues involved in understanding the usefulness of the mobile features that we have just introduced. In order to do so, we will briefly introduce some of the results from the GDSS literature.

A large body of research has accumulated on the usefulness of information systems for group decision making (for reviews, see e.g. Chun & Park, 1998, and Fjermestad & Hiltz, 1997). One conclusion that can be drawn from this literature is that deriving value from group support systems is anything but straightforward. In fact, a number of empirical studies have produced inconclusive evidence on the benefits of GDSS (see for example Aiken, Krosp, Shirani, & Martin, 1994, Sharda, Barr, & McDonnell, 1988, and Gallupe & McKeen, 1990). These and other studies reported neither benefits on objective measures such as decision quality nor on more subjective measures such as perceived decision confidence.

These findings have led to a growing recognition that GDSS performance is the result of a complex set of interactions between task characteristics, group characteristics, and the GDSS technology (Nunamaker, Dennis, Valacich, Vogel, & George, 1991). The technology can support both the exchange of information between the groups (Dennis, 1996), as well as the decision making processes, for example with mathematical modeling aids. This has led to the distinction of two types of GDSS (DeSanctis & Gallupe, 1987): Level 1 systems are those systems that provide features for communication support, such as anonymous messaging, idea recording, preference rating and voting. Level 2 systems also make use of decision modeling or mathematical techniques. Depending on the task and the group, these types of systems may vary in their suitability and effectiveness.

Task characteristics can account for fifty percent of the variance in GDSS performance (El-Shinnawy & Vinze, 1998). The usage of GDSS would be expected to have more impact on complex tasks. However one study showed that usage of GDSS in simpler tasks was more efficient (Benbasat & Lim, 1993).

Other factors that have been subject to study are related to group characteristics. One group characteristic that is known to moderate effectiveness is group size. More specifically, the benefits of GDSS increase as the group sizes increases (Dennis, Haley, & Vandenberg, 1996). For example, one study found no increase in decision quality with two people in the group, but an increase with four, six or twelve people in the group (Gallupe, Dennis, Cooper, Valacich, & Bastianutti, 1992). It has also been reported that decision makers tend to economize on cognitive effort rather than decision quality (Todd & Benbasat, 1992). This implies that some groups may settle for the same decision quality with less effort. Also, a group tends to force individual members to conform the position of the majority. Communication by means of a GDSS may significantly lessen the power of a group to influence an individual group member (Clapper, McLean, & Watson, 1991)

The use of GDSS has some inherent disadvantages. It has been acknowledged in the literature that using a GDSS can be cumbersome to use, and very visible to the group members, thereby attracting attention away from the decision itself (Watson et al., 1988). These costs of using a GDSS may actually impede decision quality because the attention of the users is attracted to the technology rather than the decision. Group decision supported groups tend to have more cohesion and better perceived processes (with poorer performance) than groups not having the use of a group decision support tool (Anson, Bostrom, & Wynne, 1995).

One conclusion reviewing the GDSS literature is that the effectiveness of the mobile service will depend on the task characteristics and the group characteristics. In this paper, our propositions will focus on the interactions between tasks and mobile services. We acknowledge that group characteristics are likely to moderate the relationships also, but we will assume that these are constant, for clarity of exposition.

4. Propositions

GDSS theory suggests that the benefits of the mobile services that we have defined in section 2 are dependent on the task characteristics (Zigurs, Poole, & DeSanctis, 1988). In other words, a fit between the group tasks and the mobile decision aids should result in greater group decision effectiveness. For this reason, we do not propose that the mobile services will produce better decisions *per se*. Rather, we propose that this is contingent to the task that is assigned to the group.

In line with previous GDSS literature, we will adopt the terms *outcomes* and *solution schemes* in the remainder of this paper. An outcome is a possible solution to a decision, a solution scheme is one possible direction from raw data to an outcome. Tasks are often classified by their level of task complexity (Campbell, 1988), i.e. by the nature of their outcomes and their solution schemes.

The level of task complexity is determined by four dimensions (Zigurs & Buckland, 1998). The first dimension is *outcome multiplicity*. As the name suggests, this implies that there is more than one outcome of a task. A second dimension is *solution scheme multiplicity*, meaning that there is more than one possible course of action to attain a goal. The third dimension is *conflicting interdependence*. In this case, adopting one solution scheme means a conflict with another solution scheme. The last dimension is solution scheme/ outcome *uncertainty*. This is the extent to which there is uncertainty about whether a given solution scheme will lead to a desired outcome. Permutations of these four dimensions result in sixteen distinctive types of group tasks, which can be aggregated into five overall task types (Zigurs & Buckland, 1998). These are *simple* tasks, *problem* tasks, *decision* tasks, *judgement* tasks, and *fuzzy* tasks.

Three propositions are formulated for a combination of the five task types. These propositions are based on Table 1.

A *simple* task has low scores on all four dimensions of task complexity level. Examples of simple tasks are group brainstorming sessions. The goal of brainstorming is to arrive at a large number of ideas, irrespective of their feasibility or desirability. There is empirical evidence in the GDSS literature that information systems can effectively support brainstorming tasks. In one experiment, groups equipped with electronic brainstorming tools performed better than those who were deprived of these tools (Gallupe et al., 1992).

Table 1: *Group Tasks and Mobile Decision Aids (based on Gallupe & DeSanctis, 1988; Zigurs & Buckland, 1998)*

Group tasks	Example tasks in previous GDSS research	Possible contribution of mobile decision aids
Simple task	Idea generation Brainstorming	Information gathering in ad hoc meeting environments
Problem task	R&D Project Planning Task Chess problems Personnel scheduling Personnel placement	Information gathering and matching in ad hoc meeting environments
Decision task	Choosing a house	Information gathering and matching in ad hoc meeting environments
Judgement tasks	Sales territory problem Intelligence analysis Stock market analysis Probability learning tasks	Information gathering and matching, and preference gathering and matching in ad hoc meeting environments.
Fuzzy tasks	Foundation task	Information gathering and matching, and preference gathering and matching in ad hoc meeting environments.

In a mobile setting, we argue that an information gathering service provides the most use in these types of tasks. The main purpose of the mobile decision aid will be on the importing of information from other users and to preserve the diversity of information. This leads to our first proposition.

Proposition 1

In the context of simple tasks, groups will perform better if equipped with mobile decision aids for the purpose of gathering information.

A *problem* task has a single, well-defined desired outcome but consists of multiple solution schemes, often with outcome uncertainty. An example of a problem task is the R&D Project Planning Task (McLeod & Liker, 1992). In this task, the group members need to reach consensus on the appropriate sequence of management activities for a research project. In deciding about the appropriate sequence they have to deal with conflicting interdependencies. But they also have to deal with uncertainty, as it is unclear which of the possible sequences would give the required outcome. The focus for *decision* tasks is to select a solution that best meets a number of possibly conflicting outcomes. There is not a defined outcome, there are multiple solution schemes, there is outcome uncertainty and there is conflicting interdependence.

In a mobile setting, one could argue that for problem tasks and decision tasks, the gathering of information would also be beneficial, for reasons similar to those applicable to simple tasks. Besides information gathering, however, information matching would also be useful. The main purpose of the decision aid would then be to import information and to deal with conflicting interdependencies and uncertainty. In the example above, the group members would compare the temporal sequences that they have identified with each other, and the mobile devices would try to match these sequences with sequences already stored on the device.

Proposition 2

In the context of problem and decision tasks, groups will perform better if equipped with mobile decision aids for the purpose of gathering and matching information.

Judgement tasks are tasks where personal preferences are getting involved. In contrast to the earlier types of tasks, users can have potentially conflicting preferences in judgement tasks. For instance one study used a task that required group members to generate potential solutions for a sales territory problem (Dennis, Easton, Easton, George, & Nunamaker, 1990). This is a task demonstrating uncertainty and potential conflicts. Other judgment tasks are intelligence analysis, stock market analysis and (in laboratory situations) probability learning tasks. In general judgment tasks consist of two parts. First there is the gathering and matching of different sources of information, and second there is the judgment or prediction a certain event will happen (Campbell, 1988).

Fuzzy tasks have multiple outcomes, multiple scheme multiplicity, conflicting interdependencies and solution scheme/ outcome uncertainty. In a fuzzy task we see all the complexity level dimensions in effect. The problem itself is not well defined, many different solutions are available, choice have to be made about different preferences and there is a certain degree of uncertainty (Zigurs, Buckland, Connolly, & Wilson, 1999).

An example of a fuzzy task used in experimental GDSS settings is the Foundation task. In this task, users have to distribute funds from a foundation to a number of competing projects. Each project represents a specific value that the user can be attached too (e.g. religious value, monetary value). Since users are quite likely to have different value profiles, these preferences are in principle competing (Poole, Holmes, & DeSanctis, 1991; Watson et al., 1988).

The purpose of the decision aid will be to load information and to deal with information diversity, conflicts and uncertainty. In the example above, the group members would try to make a selection out of a diversity of possible funds by gathering information about the different projects and matching the gathered information with their own preferences.

Those temporal sequences will be compared with those of the other group members and the mobile devices would try to match these sequences with the temporal sequences of the other group members.

Proposition 3

In the context of judgement and fuzzy tasks, groups will perform better when equipped with mobile decision aids for the purpose of gathering and matching information, and gathering and matching of preferences.

5. Discussion

In this paper we have drawn attention to an important new role for mobile devices: their assistance in group decision making. We have attempted to underscore the relevance of studying this role by looking at four specific mobile services that can be envisioned: information gathering, information matching, preference gathering, and preference matching. Although this is not the first study to recognize the value of mobile services for groups see e.g. (Lyytinen & Yoo, 2002), to the best of the authors' knowledge, this is the first study that specifically proposes services for use in group decision environments.

To illustrate the effects of these group decision aids, we have developed three propositions. Each proposition links the features with specific task characteristics. By doing so we recognize earlier findings in the GDSS literature that the effectiveness of group support is contingent upon the type of task that the group is supposed to resolve.

We have provided a preliminary theory that is constrained by a number of assumptions. The first assumption is that all users possess smart mobile devices with the necessary mobile services. In practice, this may not be the case. The adoption of smart mobile devices, however, is expected to increase. Also, the downloading of applications in the form of web services is gaining increased acceptance. It may well be that in the near future, an ad hoc group will be able to download these types of services on the spot.

Major software design issues with respect to these services are end-to-end security, as well as the handicapped interface between user and GDSS. Because mobile devices have small screens and rely on very limited data entry capabilities, it is not possible to interact with the mobile GDSS in the same way as one would with a traditional GDSS. In addition, one useful functionality of the traditional GDSS, the so-called "public screen", is not available in an ad hoc network setting. It remains to be seen to what extent traditional GDSS capabilities can be carried over to a mobile setting.

The second qualification to our work is that all members of the group will have an equal share and an equal influence in the decision. To put it another way, our work has not taken into account the group dynamics inherent to any group decision making. This is, of course, a fascinating object of study in itself. Power relationships between group members, competence in expressiveness and negotiation, user decision strategies that go beyond the boundaries of the group task: all these forms of group behavior are weakening the validity of our propositions. We encourage other researchers, therefore, to extent these propositions by including group dynamics.

Another direction for further research is empirical rather than theoretical. Clearly our argument that these mobile services will support group decision making requires empirical backing. Experiments are likely to be the most appropriate research methods to examine the validity of the propositions. In experiments, researchers are able to isolate the task and reduce the impact of potentially confounding variables. Also, experiments enable the inference of causal relationships, in the sense that improved decision effectiveness can unambiguously be attributed to the availability of the mobile service.

References

Aiken, M., Krosp, J., Shirani, A., & Martin, J. (1994). Electronic brainstorming in small and large groups. Information & Management, 27, 141-149.

Anson, R., Bostrom, R., & Wynne, B. (1995). An experiment assessing group support systems and facilitator effects on meeting outcomes. Management Science, 41(2), 189-208.

Belotti, V., & Bly, S. (1996). Walking away from the desktop computer distributed collaboration and mobility in a product design team. Paper presented at the ACM 1996 conference on Computer Supported Cooperative Work, Cambridge.

Benbasat, I., & Lim, L. (1993). The effects of group, task, context, and the technology variables on the usefulness of group support systems. Small Group Research, 24.

Campbell, D. J. (1988). Task complexity: a review and analysis. Academy of Management Review, 13(1), 40-52.

Chun, K. J., & Park, H. K. (1998). Examining the conflicting results of GDSS research. Information & Management, 33, 313-325.

Clapper, D. L., McLean, E. R., & Watson, R. T. (1991). An experimental investigation of the effect of a group decision support system on normative influence in small groups. Paper presented at the Twelfth International Conference on Information Systems, New York.

Dennis, A. R. (1996). Information exchange and use in group decision making: you can lead a group to information, but you can't make it think. MIS Quarterly(December), 433-457.

Dennis, A. R., Easton, A. C., Easton, G. K., George, J. F., & Nunamaker, J., J. F. (1990). Ad hoc versus established groups in an electronic meeting system environment. Paper presented at the 23rd Annual Hawaii International Conference on System Sciences, Alamitos, CA.

Dennis, A. R., Haley, B. J., & Vandenberg, R. J. (1996). A meta-analysis of effectiveness, efficiency, and participant satisfaction in group support systems research. Paper presented at the Seventeenth International Conference on Information Systems, Cleveland Ohio.

DeSanctis, G., & Gallupe, R. B. (1987). A foundation for the study of group decision support systems. Management Science, 33(5), 589-609.

El-Shinnawy, M., & Vinze, A. S. (1998). Polarization and persuasive argumentation: A study of decision making in group settings. MIS Quarterly(June), 165-198.

Fjermestad, J., & Hiltz, S. R. (1997). Experimental studies of group decision support systems: an assessment of variables studied and methodology. Paper presented at the 30th Hawaii Conference on System Sciences, Alamitos, CA.

Gallupe, R. B., Dennis, A. R., Cooper, W. H., Valacich, J. S., & Bastianutti, L. M. (1992). Electronic brainstorming and group size. Academy of Management Journal, 35(2), 350-369.

Gallupe, R. B., & DeSanctis, G. (1988). Computer-based support for group problem-finding: An experimental investigation. MIS Quarterly(June), 277-296.

Gallupe, R. B., & McKeen, J. D. (1990). Enhancing computer -mediated communication: An experimental investigation into the use of a group decision support system for face-to-face versus remote meetings. Information & Management, 18, 1-13.

Kristoffersen, S., & Ljungberg, F. (2000). Mobility: from stationary to mobile work. In K. Braa & C. Sorensen & B. Dahlbom (Eds.), Planet Internet. Lund, Sweden: Studentlitteratur.

Luff, P., & Heath, C. (1998). Mobility in collaboration. Paper presented at the ACM 1998 Conference on Computer Supported Work, Seattle.

Lyytinen, K., & Yoo, Y. (2002). Research commentary: the next wave of nomadic computing. Information Systems Research, 13(4), 377-388.

McLeod, P. L., & Liker, J. K. (1992). Electronic meeting systems: evidence from a low structure environment. Information Systems Research, 3(3), 195-223.

Nunamaker, J., J. F., Dennis, A. R., Valacich, J. S., Vogel, D. R., & George, J. F. (1991). Electronic meeting systems to support group work. Communications of the ACM, 34(7), 40-61.

Poole, M. S., Holmes, M., & DeSanctis, G. (1991). Conflict management in a computer supported meeting environment. Management Science, 37, 926-953.

Sharda, R., Barr, S. H., & McDonnell, J. C. (1988). Decision support system effectiveness: a review and an empirical test. Management Science, 34(2), 139-159.

Smith, H. A., Kulatilaka, N., & Venkatramen, N. (2002). Riding the wave: extracting value from mobile technology. Communications of the AIS, 8(32).

Todd, P., & Benbasat, I. (1992). The use of information in decision making: an experimental investigation of the impact of computer-based decision aids. MIS Quarterly(September), 373-393.

Van der Heijden, H., & Sørensen, L. S. (2002). The mobile decision maker: mobile decision aids, task complexity, and decision effectiveness (Working paper 2002-25): Copenhagen Business School.

Van der Heijden, H. & Valiente, P. (2002). The value of mobility for business process performance: evidence from Sweden and the Netherlands. Paper presented at the European Conference on Information Systems, Gdansk, Poland.

Varshney, U., & Vetter, R. (2001). A framework for the emerging mobile commerce applications. Paper presented at the 34th Hawaii International Conference on System Sciences, Hawaii.

Watson, R. T., DeSanctis, G., & Poole, M. S. (1988). Using a GDSS to facilitate group consensus: some intended and unintended consequences. MIS Quarterly(September), 463-478.

Zigurs, I., & Buckland, B. K. (1998). A theory of task/technology fit and group support systems effectiveness. MIS Quarterly(September), 313-334.

Zigurs, I., Buckland, B. K., Connolly, J. R., & Wilson, E. V. (1999). A test of task technology fit theory for group support systems. The database for advances in information systems, 30(3,4), 35-50.

Zigurs, I., Poole, M. S., & DeSanctis, G. (1988). A study of influence in computer-mediated group decision making. MIS Quarterly, December, 625-644.