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ABSTRACT

With the advancement of group decision support systems (GDSS), facilitation has been regarded as one of the most important means in enhancing the outcome of group decisions. Many researchers have spent great efforts in creating useful methodologies and techniques to better support group facilitation. However, most of the research in the current literature deals more with facilitation targeted at a group-level than an individual level. With the increasingly available personalization techniques found in e-commerce, personalized facilitation seems to be a natural direction in group system facilitation research to deal with the needs of individual members for the overall gain of the group. In this paper, we address the needs for personalized facilitation in the context of the "EasyWinWin" framework in software requirements analysis by proposing a conceptual framework of personalized facilitation, developing a system architecture towards personalized facilitation and identifying key functions for a personalized facilitation system.

Keywords

Distributed Facilitation, Collaboration, Group Decision Support Systems, Personalization

INTRODUCTION

With the rapid growth of networked economy, the number of virtual organizations formed by connecting independent companies together via networks is increasing rapidly. In order to improve these emerging distributed group sessions, group decision support systems (GDSS) have been increasingly used. As an integral component of GDSSs, facilitation has been regarded as one of the most important means in enhancing the outcome of group meetings. Therefore, many researchers have spent great efforts in creating useful methodologies and techniques to better support group facilitation. However, despite the increasing progress made on distributed facilitation research, there are still many important questions remaining unanswered. For example, how to help group members better manage their interaction with each other during group sessions? how to facilitate group meetings by directing right members to right discussion points? How to provide appropriate facilitation assistance to individual group members without disrupting group facilitations in general?

We believe that recent progresses on personalization technologies in e-commerce seem to be able to provide at least some of the answers to the above questions. Personalization in e-commerce allows online companies to provide products and services tailored to each individual shopper, thus increasing profits for the company. Similarly, in distributed group meetings, personalization may hold the potential to provide facilitation assistance tailored to the characteristics of each individual group member for the overall gain of the group. That is, with personalized technologies, certain facilitations can be provided automatically and selectively to only those members who are in need, thus alleviating burdens of human facilitators and reducing information overload for both facilitators and group members. More importantly, the provision of personalization facilitation assistance is also likely to compensate for the absence of professional facilitators in distributed environment. However, most of the current facilitation developments seem to focus on group level with little attention paid to individual group members. That is, they fail to differentiate between the varying needs among group members during facilitation. Given that group members have different needs during facilitation, the lack of attention to individuality significantly limits the scope and depth of potential benefits of distributed facilitation.

Our research goal is to propose a framework of personalized facilitation and investigate the applicability of various personalization techniques used in e-commerce to the distributed group facilitation environment. In this paper, we explore ways to integrate personalization techniques into distributed group facilitation in GDSS, automate personalized facilitations functions and utilize intelligent agents to carry out personalization techniques for the purpose of automating group facilitation. The contributions of this research include a personalized facilitation framework, a system architecture integrating personalized facilitation system with GDSS and potential personalization functions to be used in personalized distributed facilitations.

The remainder of this paper is arranged as follows: Section 2 reviews the relevant literature, and section 3 introduces the EasyWinWin context and a GDSS scenario, which is followed by an overview of a personalized facilitation framework in section 4. Section 5 discusses the system architectural of the components of personalized facilitation and section 6 introduces a list of personalization functions. Finally, we summarize the paper and outline future research directions in section 8.

LITERATURE REVIEW

Distributed Facilitation in Groupware Research

To support distributed group meetings in the global business world, IS researchers have built groupware systems to help businesses to effectively manage group collaborations, among which are GroupSystems (Nunamaker, Dennis, Valacich, Vogel and George, 1991), Distributed Facilitation Systems (Dubs and Hayne, 1992), Group Work Environment (Ygwenyama, Bryson and Mobolurin, 1996). These tools offer useful facilities to manage many aspects of group decision making such as group processes and tasks.

Distributed group facilitation is to enable effective group collaboration among users who are geographically dispersed (Dubs and Hayne, 1992; McQuaid, Briggs, Gillman, Hauck, Lin, Mittleman, Nunamaker, Ramsey and Romano, 2000; Niederman, Beise and Beranek, 1993). Many studies have been conducted on distributed facilitation over the past decade (Antunes and Ho, 1999; Miranda and Bostrom, 1999; Romano, Nunamaker, Briggs and Mittleman, 1999). With the loss of rich media existing in face-to-face situations, distributed facilitation has posed new challenges for facilitators. In search of a solution, researchers have developed many facilitation techniques and systems to assist in distributed facilitation. However, it has been found through real world lessons that facilitation in a virtual meeting is difficult due to the communication barriers over a long distance. Therefore, it is difficult to facilitate distributed meetings manually (Romano et al., 1999).

Another stream of research on personalization in e-commerce has created many useful techniques for personalized service to online customers. The availability of these personalization techniques offers an interesting possibility to enable personalization in distributed facilitation for groupware systems. Next, we will discuss personalization in e-commerce and in distributed facilitation respectively.

Personalization in E-commerce

Personalization in the context of e-commerce typically adapts web-based content to deliver relevant information tailored to the customer so as to enhance profits for the commercial website. The principal components of web personalization include (a) the categorization and preprocessing of Web data, (b) the extraction of correlations between and across different kinds of such data, and (c) the determination of the actions that should be recommended by such a personalization system (Mobasher, Cooley and Srivastiva, 2000).

As one of the important reference fields for personalization in e-commerce, information filtering is concerned with the problem of delivering useful information to a user while preventing an overload of irrelevant information. Personalization approaches adopted by various information filtering and recommendation systems in e-commerce all share a similar mechanism of predicting the future based on user profile information collected through the past. The literature suggests that personalization techniques in e-commerce can be classified into 3 categories: content-based (CB), collaborative filtering (CF) and hybrid approaches.

1. Content-based methods base predictions on the contents of the artifacts (Krulwich and Burkey, 1996; Lang, 1995). Content-based approaches typically consist of two parts: (1) describing items of user interest; (2) comparing item descriptions to locate close matches (Hirsh, Basu and Davison, 2000). One major advantage of CB methods is that they can uniquely characterize each user.
2. Collaborative filtering methods operate through predicting the utilities of items for a particular user based on the rating information for the same set of items given by many other users (Goldberg, Nichols, Oki and Terry, 1992; Resnick, Iacovou, Suchak, Bergstrom and Reidl, 1994; Shardanand and Maes, 1995). Basically, CF methods based on users by comparing a target user's choices with those of other users to identify a group of 'similar-minded'

people. Compared to CB methods, CF methods have some key advantages over them (Herlocker *et al*. 1999); First, CF methods can perform well where there is not much content associated with items, or on ideas or opinions, which are difficult for computers to interpret; Second, they can recommend items that are relevant to the user without requiring content from the user. However, CF methods also suffer major flaws such as sparsity and first-rater problems.

3. Hybrid approaches combine both content-based and collaborative filtering method. By overcoming shortcomings from CB and CF methods, hybrid approaches provide better performances than pure CF and CB methods (Balabanovic and Shoham, 1997; Melville, Mooney and Nagarajan, 2002).

Personalization in Distributed Group Facilitation

Despite the potential of applying personalization concepts to distributed facilitation environment, there have been limited studies on personalized facilitation. One of the related studies is the concept of personalized groupware in Roseman's work (Roseman and Greenberg, 1993). Roseman argues that some aspects of groupware system could remain flexible and thus allow personalization for users. While Roseman's concept of personalization is related to client side improvements on groupware tailored to each user, it does not involve server side facilitation for user tasks and interactions, which consist of the majority of the personalized facilitation in this paper. Recently, Zhao et al. introduced the idea of profiling group members to provide appropriate levels of technology support based on different experience levels with technology (Zhao, Nunamaker and Briggs, 2002). They recognized the importance of profiling in providing tailored technology support, but did not mention other possible forms of personalized facilitation. To summarize, the extant facilitation literature does not pay attention to the issue of personalized facilitation in distributed environment. Therefore, the objective of this paper is to extend the idea of distributed facilitation by making personalization an integral part of the facilitation concept.

After all, a group is composed of different individuals. It is reasonable to expect that the personalization should fit well with facilitation in distributed group environment. Given that most of the facilitation techniques such as transition management between group processes are applied to group level instead of individual level, there is substantial potential for facilitating individual users' interaction during group sessions, thereby helping the group as a whole to achieve better decisions. Specifically, personalization can help answer questions such as: How to provide right information to right users during group sessions? How to keep group users focused on group tasks? How to stimulate users' thinking processes so as to produce better results? For example, of the 16 dimensions categorized for facilitators by Clawson, five of them could be potentially assisted by personalization (Clawson and Bostrom, 1993). That is, the roles traditionally performed by human facilitators could be helped with automated personalization tools, which provided personalized facilitation assistance to individual group users. In table 1, we list the facilitation tasks and the corresponding personalization features.

Facilitating tasks (numbers refer to the original number in Clawson & Bostrom 1993)	**Personalized Assistance**
4. Listens to, Clarifies, and Integrates Information	Relevant information can be recommended to interested users, who can then clarify and integrate it rather than relying on human facilitators.
5. Develops and asks the "right" questions	Users with proper knowledge can be distributed with relevant information and then are in better position to ask "right" questions.
6. Keep group focused on outcome/task	Members will be more focused if provided with relevant information assistance in group tasks such as brainstorming and categorizing
7. Creates comfort with and promotes understanding of the technology and technology outputs	Those who identify themselves as different levels of familiarity can receive different levels of technology assistance tailored to their experience levels.
9. Actively builds rapport and relationship	With personalized facilitation, group members can identify others who express similar interest and have similar ideas, thus actively building rapport and relationship

Table 1. Facilitation Tasks and Personalization Features

THE EASYWINWIN FRAMEWORK AND A SCENARIO FOR PERSONALIZATION

In order to simulate a distributed environment, we use "EasyWinWin", a framework for software requirement negotiation in figure 1, as our reference context to explain personalized facilitation tasks (Gruenbacher and Briggs, 2001).

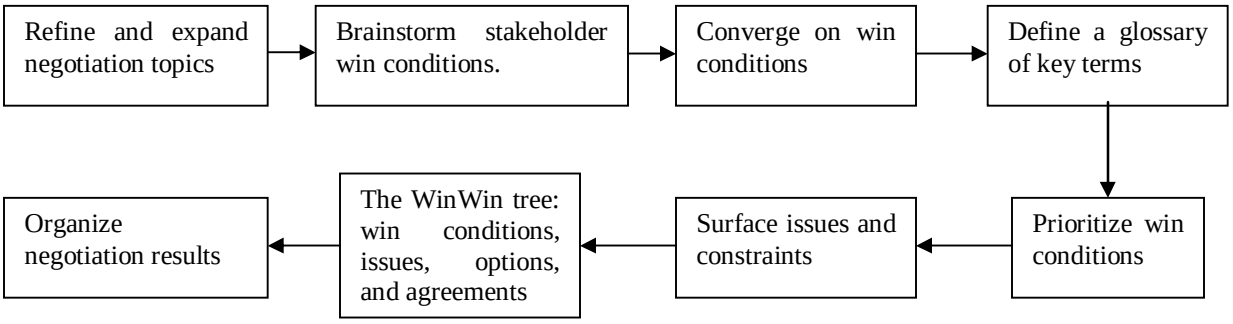

Figure 1: The EasyWinWin Framework, adopted from (Gruenbacher and Briggs,

Consider a personalization scenario featuring the initial two steps of EasyWinWin. Suppose that company A organizes the first distributed requirements elicitation session for a purchasing approval system with company B, an offshore company to which the system is outsourced. The first session is attended by various groups of people on both sides, users, developers and analysts, etc. This scenario focuses on Tom, a management user for this new system with company A and Harry, a system analyst with company B.

The initial profile setup is important for personalization. At the beginning of the session, Tom is given a questionnaire on his knowledge on several aspects of tasks such as familiarity with each step in the EasyWinWin process flow, expertise level on GDSS, knowledge level on purchasing requirements as a user. Tom indicates he has no experience with all eight stages in the EasyWinWin framework, also no experience with the GDSS technology, a high level of expertise on purchase approval as a manager, and no experience with requirements elicitation before. In addition, he is asked for several keywords in the brainstorming step, and he identifies "manager, supervise". Given the same questionnaire, Harry indicates that he is very familiar with the EasyWinWin framework and GDSS and identifies "manager, supervise" as keywords.

1. Refine and expanding the negotiation topics: This step reviews all possible topics and then makes suggestions to refine topics. In addition to the explanation of a human facilitator, Tom is also greeted with a context help window with information links on EasyWinWin stating the purpose, examples of completing this step, etc. and with another technology help window detailing technology guidance. In contrast, Harry does not get these two windows in this step.
2. Brainstorming stakeholder win conditions: Similarly, EasyWinWin and GDSS help windows are available to Tom but not Harry. Additionally, during brainstorming, another window dynamically provides links to others' comments including the keywords he specified in the initial step. Tom finds that these comments are related to his role and prompts him to think about what win conditions for him as a manager would be. He also gives feedback rating to these recommendations and increasingly the recommendations he gets is more accurate. Harry also gets recommendations related to his interests without himself looking for them manually. These relevant comments inspired him to offer more ideas and prompts him to clarify some important concepts.

Each of the following steps may be personalized in some different ways, but they are similar in providing information, context and technology help tailored to each individual.

A CONCEPTUAL FRAMEWORK OF PERSONALIZED FACILITATION

Personalized approach to distributed facilitation is based on the observation that human facilitators alone could not achieve a successful distributed facilitation. The acquisition and processing of useful personal information could prove a useful way to lessen the burden of the human facilitators and increase the matching of facilitation assistance with individual preference. The successful personalization of facilitation could provide a concrete and consistent way of ensuring a quality facilitation level across different sessions and different groups.

As shown in Figure 2, the conceptual framework of personalized facilitation distinguishes between two kinds of facilitation:

1. Generalized facilitation, which refers to facilitation directed at the group level; that is, every member within the group is assisted by the same set of facilitation techniques. For example, transition management as a conventional type of facilitation technique can be classified as a generalized facilitation because during transition, every group member is proceeding to another process or task with no exception.
2. Personalized facilitation, which is facilitation targeted at the individual level; that is, the facilitation assistance received by one group member may differ from another. For example, information delivery can be tailored to users' preferences.

Generalized facilitation operates through group level mechanisms. Group level mechanisms include all the methodologies and techniques to facilitate the entire group as a whole. One notable example is the effort by Briggs et al. (2001) in developing thinklets for group facilitation (Briggs, de Vreede and Nunamaker, 2001). Through group level mechanisms, generalized facilitation is able to facilitate all group members in terms of the processes, tasks and structures.

Personalized facilitation focuses on the individual-level mechanisms to assist group interaction. Given a particular process and task for the group, there are still needs to provide proper adjustment and knowledge assistance to individual users. Individual-level mechanisms include all personalization techniques appropriate for distributed facilitation. For example, personalized mechanisms may take the form of relevant information and appropriate technology help depending on users' preferences. In addition, individual members can also provide information and feedback as inputs into the individual-level mechanisms, through which personalized facilitation operates to better assist individual group members. Please note that the proposed framework works under the assumption of synchronous mode for personalized facilitation. Synchronous mode in collaboration refers to the real time interaction between group members to accomplish tasks whereas in asynchronous mode, group members work at different times.

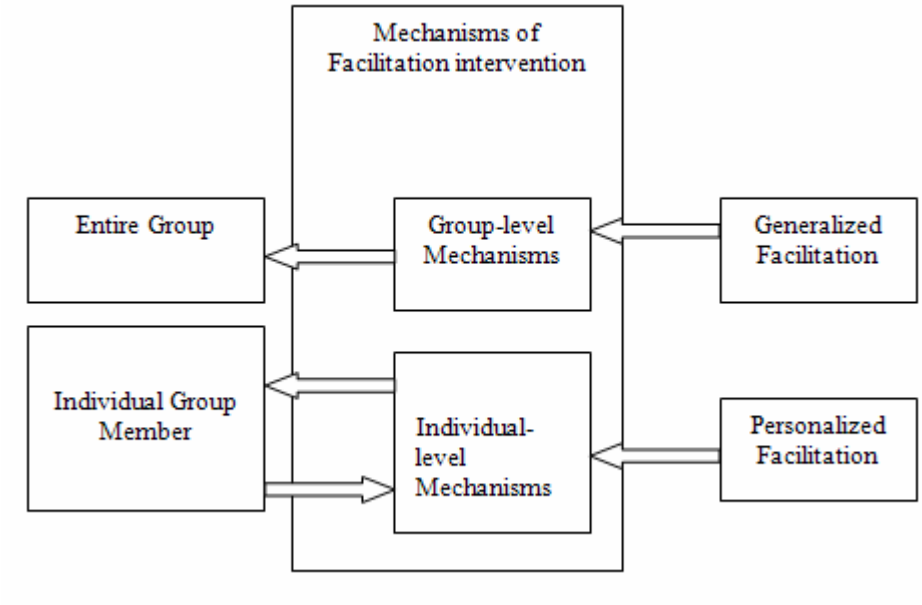

Figure 2.The Framework of Personalized Facilitation

SYSTEM ARCHITECTURE OF PERSONALIZED FACILITATION

Figure 3 illustrates the system architecture for personalized facilitation. Essentially, all the personalization work is done by the personalized facilitation system, which consists of personalization engine, software agents, personalized option interface, DBMS and profile database. The personalized facilitation system provides facilitation help to each user in the group session by integrating with group decision support systems.

In the personalized facilitation system, the internal engine is responsible for interacting with components such as personalized option interface, software agents and DBMS. Multiple software agents are distributed on a network with each specializing in one of the main personalization tasks. Users can interact with personalized option interface to activate and deactivate personalization features, which leads to corresponding changes in the personalization engine. DBMS retrieves

personal and interaction information from the profile database and feeds it into the personalization engine. Based on the personal preference and interaction patterns retrieved from the profile database, the personalization engine is in charge of when and what software agents to dispatch to each user. The profile database is established and populated via GDSS.

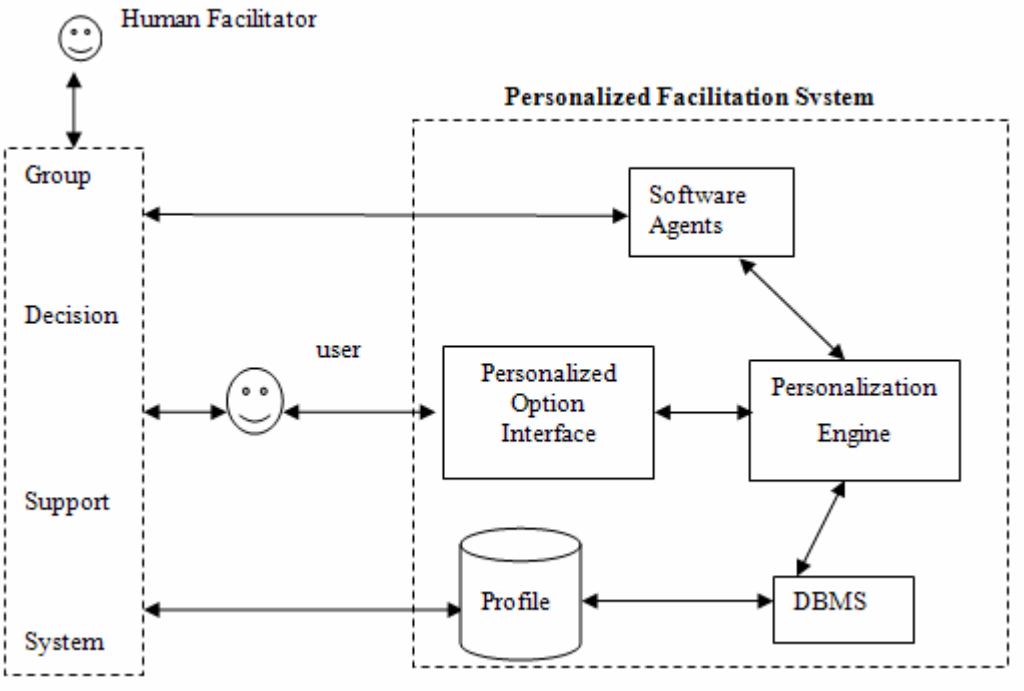

Figure 3. System Architecture

PERSONALIZED FACILITATION FUNCTIONS

In order to implement personalized facilitation during a distributed GDSS session, there needs to be a number of functions to support the personalized facilitation system illustrated in figure 3.

Acquiring and maintaining the user profiles

Individual differences may be utilized for personalization purposes. Of these differences, personal preferences and interests can be particularly helpful in personalizing facilitation in GDSS. For example, given varied knowledge and experience with technology, group processes and tasks structures, help can be provided to tailor to each user's particular needs. Similarly, people may also have varied level of domain expertise; therefore, assistance can also be provided to suit each user according to their domain expertise. To assist the personalization process, the concept of profiles is essential. The profile in distributed facilitation environment may be both static and dynamic. Static profile consists of information related to users' technology expertise and task knowledge. Technology expertise is similar to 'user profiling' as described by (Zhao et al., 2002). Task knowledge, more related to the tasks for the current session, asks users questions related to their expertise/domain knowledge level on the subject matter. Static profile can be collected at the beginning of each group session. Dynamic profile, consisting of each user's activities and comments recorded in the database, comes from the behavioral patterns recorded during each session.

These profiles serve as important informational input that can be fed into personalization engines to provide tailored facilitation. Privacy remains an issue, especially for GDSS where anonymity remains one of important functions. It is an interesting question how to deal with the possible interference between identifying any particular member in the system for personalization purpose and maintaining anonymous functionality in GDSS.

Ranking and delivering personalized information

Supported by various personalization techniques and collected profile information, personalized facilitation may vary based on different stages of a facilitation process. For example, for brainstorming session, personalized facilitation help can take the

form of delivering and ranking relevant comments by others based on user preferences. One possible personalization feature may include dynamically generating and ranking the information links based on each user's preferences; that is, facilitation can provide individual users with real time comments and inputs entered by other users in the same session. One of the benefits is that the relevant and ranked information can inspire individual user to generate more useful ideas and reduce redundancy. In addition, by matching relevant information to users, they can focus their attention on information interesting to them, which may help alleviate the information overload problem. Furthermore, individual users may be more motivated to participate in a discussion with the knowledge that facilitation system can help them find out others' relevant inputs.

Providing personalized technology support

The technology part of the static user profile can serve as a roadmap for personalized technology support. Besides the user technology profile, an initial technology help file could be generated and stored in database based on four different experience levels including novice, intermediate, matured and expert, as suggested by Zhao et al (2002). The purpose of these technology help files is to map different technology expertise level of each user to an appropriate technology help file. Initially human facilitators can help generate such a profile including possible questions, which can be later refined based on frequency of access by all users.

By delivering technology help links to each user based on their comfort level at different stages of a group session, personalized facilitation can alleviate the burden of the human facilitators significantly. In addition, the dynamic nature of technology help links can adapt to the learning curse of each individual user, thus helping them learn along the way without disrupting the pace of the group session.

Allowing personalized configuration

A key design feature of personalized facilitation is the ability to allow users to activate and deactivate personalized facilitation options. As time goes by, it should be expected that group members will gradually get used to the technical, process and even informational side of group session. As needs increase and decrease, the system must provide a way for users to identify possible ways to help them if they opt to personalize some options. By providing a mechanism to allow individual users to activate and deactivate personalized options, members may be in a better control of their interactions in a group session.

Allowing personalized memory space

Group memory has been advocated as one of major contributions of GDSS. However, there are cases where users in a group may want to extract relevant information from the group memory and transform them into a personalized memory space. With a good number of sessions needed in software requirements elicitation using the EasyWinWin framework, the group memory may be accumulating a huge amount of information, which makes searching and evaluating information very difficult. The concept of personalized memory space enables each individual user to make personally relevant information available at their fingertips, thereby increasing their ability to interact and digest information.

Carrying out personalization tasks via intelligent agents

Intelligent agents or software agents are special kinds of software that can conduct numerous decision-making and problem-solving tasks that traditionally require human intelligence, such as information filtering and retrieval, data classification, planning, or negotiation. In addition, they can even answer email messages, search through the internet for useful information and compare prices online for customers.

One important concern in designing a personalized facilitation system is to adopt modularized software approach and automate personalization tasks. Intelligent agents fit the goal well by acting as proxies for human to "intelligently" and autonomously perform a given task while maintaining a modularized approach (March, Hevner and Ram, 2000). In the context of personalized facilitation, intelligent agents are expected to implement various personalization techniques discussed in the next section and then be dispatched to users to carry out various personalization tasks. For example, during each phase of a group session, intelligent agents can be dispatched to each user based on their technology profile. If a group member indicates that he is a novice in brainstorming task, the personalized facilitation system retrieves a help profile for novice users related to brainstorming task and dispatch software agents to provide personalized help. Software agents can also interact with users by collecting feedback from users on the recommendations later to improve personalization.

The functions provided here are by no means exhaustive. Potentially, there can be many more functions to personalize facilitation in GDSS as we obtain better understanding of individual needs during group facilitation. Therefore, the

techniques provided above only represent our preliminary attempt towards exploring the area of personalized facilitation to achieve a desired group outcome.

CONCLUDING REMARKS

In summary, this paper argues that personalized facilitation is crucial to improve the usability of distributed GDSS, increase users' satisfaction on group processes, provide users with relevant technical assistance tailored to their technology expertise level, and filter and retrieve information which best matches users' preferences. For these benefits, we believe that a personalized facilitation approach better achieves the goal of building flexible facilitations at the individual level, which may in turn improve facilitation at the group level.

Furthermore, we have proposed a conceptual framework and system architecture for personalized facilitation and discussed personalization functions to be used in distributed facilitation setting. Our ongoing work includes designing and developing information filtering algorithms for personalized techniques, implementing a prototype and integrating it with GDSS based on the personalized facilitation framework. The future work also includes modeling of personalized facilitation, automating personalization tasks, conducting user studies on personalized facilitation system, and identifying more personalization tasks in different stages of group decision processes.

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