2006

Idea consolidation process in face-to-face meetings : a new approach to organize and integrate individuals perspectives

Adel Hendaoui
University of Lausanne, adel.hendaoui@unil.ch

Moez Limayem
Lausanne University, moez.limayem@unil.ch

IDEA CONSOLIDATION PROCESS IN FACE-TO-FACE MEETINGS : A NEW APPROACH TO ORGANIZE AND INTEGRATE INDIVIDUALS PERSPECTIVES

(RESEARCH IN PROGRESS)

Hendaoui, Adel, Information Systems Institute, University of Lausanne, Dorigny 1015, Switzerland, adel.hendaoui@unil.ch

Limayem, Moez, Information Systems Institute, University of Lausanne, Dorigny 1015, Switzerland, moez.limayem@unil.ch

Abstract

Meetings supported by group support systems (GSS) usually follow a manual and sequential approach to analyse, reduce and organize a large amount of information generated during the brainstorming task. The subsequent task, idea consolidation, represents the stage where relevant information is captured from the large set of comments, ideas, requirements, etc. and is a very critical task for the whole decision process. Unless an understandable, meaningfully agreed upon list of items are produced among participating members, subsequent decision-making action (e.g., multi-criteria voting and rank order prioritization) can be viewed as artificial and meaningless, leading to a false consensus and thus to a low degree of commitment and chance of future success. There is a lack of research investigating this critical phase of group decision making, particularly for problem-solving-directed or complex tasks (Kerr and Murthy 2004, Martz and Shepherd 2004).This paper propose a new research perspective for the design of group support systems and specifically addresses the idea consolidation problem by providing a method for surfacing, reconciling and integrating views of group members, using hierarchical clustering and multidimensional scaling techniques. Future directions and implications of this research are also discussed.

Keywords: group support systems (GSS), group decision-making, information overload, idea consolidation, decision guidance, consensus.

1 INTRODUCTION

Information technologies used to support groups in a collaborative decision-making, also termed group supports systems (GSS) or electronic meeting systems (EMS), are generally defined throughout the literature as a set of computer and communication based softwares, tools, and procedures that help group members in formulating and resolving problems by interacting simultaneously and anonymously (Bostrom et al. 1992; DeSanctis & Gallupe 1987; Jessup & Connolly & Tansik 1990). GSS have been designed to minimize the process losses and maximize the process gains (Huber 1984; Numamaker et al. 1991; DeSanctis & Gallupe 1987). More recently, the restrictive aspect of this definition led Ackerman et al. (2005) to depict GSS as socio-technical systems composed of a technology, a group of participants and facilitation. Recently, as globalization implies multi-organizational collaboration, there is a renewed interest in GSSs, as they could possibly support distributed teams with different management styles, cultures and operating modes (Ackermann et al. 2005).

Abundant research indicates that members in an electronic meeting setting generate more ideas than in a traditional verbal setting (Santanen et al. 2004, Dennis, Wixom and Vanderberg 2001; Gallupe et al. 1992, Dennis 1996, Dennis & Valacich 1993). However, the ability offered to members to input ideas and comments in parrallel and anonymously rapidly results in an information overload experience

(Grizé & Gallupe 2000, Gallupe et al. 1994, Gallupe & Cooper 1992). Moreover, Watson et al. (1988) argue that parallel communication can hinder the decision process because of the large amount of information to be processed.

The problem arises when members have to take a large set of ideas covering many different issues and generate a mutually agreed upon list of items which not only is more parsimonious, but optimally captures the relevant issues in an unambiguous manner. Without establishing an unambiguous list of ideas which optimally integrates the expertise and dimensions of the entire group, subsequent actions can lead to "false consensus" on what the group's course of action should be. To our knowledge, prior research in GSS has focused more on the perspective of productivity and creativity, but few efforts have been done to investigate the consolidation problem in electronic meetings (Kerr & Murty 2004, Grizé & Gallupe 2000, Chen et al. 1994).

Our research objective, therefore, is to design and evaluate a new GSS approach that allows for surfacing, reconciling and integrating the views of group members to arrive at an optimal list of ideas for subsequent action. Specifically, this research will provide a new approach for organizing and integrating the individuals' dimensions with the use of hierarchical clustering and multidimensional scaling procedures. This method will be further implemented into a software tool providing decision guidance throughout the consolidation process thereby representing possibly the first implementation to date of a "level 3" group support system tool for idea consolidation (DeSanctis & Gallupe 1987).

This paper is organised as follows. First, an overview of prior research is provided to understand the consolidation problem in electronic group meetings. This will lead to appreciate the need for a better approach in idea consolidation. Next, we propose a new approach providing clustering and statistical techniques that help in organizing and integrating the members views during the consolidation process. Finally, we discuss the future directions of our research and its possible implications for both theory and practice.

2 PRIOR RESEARCH

During face-to-face meetings, group dynamics produce positive effects (e.g., cognitive synergy, better understanding of problems) and negative effects (imitation, social pressure, domination) that significantly affect the decision-making process outcomes. Many researches attempted to identify benefits and dysfunctions of collaborative work (Shaw 1981; Albanese et al. 1985, Steiner 1972; Van de Ven & Delbecq 1971; Diehl & Strobe 1987), providing theoretical foundations for a better understanding of group decision-making process. Numamaker et al. (1991) found that depending on the group characteristics (e.g., group size, social and hierarchical composition, nature of the problem to be resolved), the group process would generate one or many (or none) of these effects.

The main common features of GSS are the following: parallel communication, anonymity, structured decision-making process and organizational memory (DeSanctis & Gallupe 1987; Nunamaker et al. 1991; Dennis & Gallupe 1993). Reinig and Shin (2002) note that each of theses characteristics will have an impact, positive or negative, on the group dynamics effects. For example, simultaneous communication will reduce temporal fragmentation of verbal communication, production blocking, cognitive inertia and social formalisms. Similarly, anonymity would reduce social pressure, domination, evaluation apprehension and cognitive conformism (Denis & Reinicke 2004, Dennis 1996). However, anonymity could lead members to account on others in the objectives achievement, because of their lack of knowledge or commitment (Nunamaker et al. 1991).

As previously mentioned, a major advantage in the use of GSSs has been to facilitate brainstorming of ideas (or requirements, actions, etc.) by allowing members to generate comments in parallel and then collecting them together in a shared environment. But as Chen et al. (1994, p.56) noted, while software has been successful in the idea generation (i.e., *divergent task*) context, "the process of identifying crucial ideas embedded in meeting comments and generating a consensus list of important topics (idea organization), a *convergent task,* is more difficult". The large number of ideas or brainstorming comments that are produced by the GSS software (usually 100 or more for a group of 5 on a particular subject in less about half an hour) creates a burden among participants during idea organization. Thus, while there is an increase in productivity in the creation of ideas/issues using current GSSs, there comes dissatisfaction with the next step of organizing them. Chen et al. (1994, p. 57) state that "we need to improve upon the methods for consolidating ideas and reaching consensus". Chin et al. (1992, p. 15) noted that the "traditional approach implemented in current group support systems often follows a difficult and time-consuming, serial process". The standard procedure is to fall back to traditional face-to-face verbal discussion on how ideas should be organized. This serial process can dominated by a few members and often taxes the abilities of members in the meeting. This, in turn, lead to the creation of a suboptimal list. Examples of poor consolidation include leaving out good ideas, grouping ideas at different levels of abstraction, or even producing meaningless groupings. The extent to which participants disagree with the final consolidated list or are unclear make any subsequent task (i.e. voting and prioritization) artificial. Thus, idea consolidation represents a critical part of the chain of events in a meeting process.

To date, very little has been done addressing the idea consolidation problem. Recent studies still point out the lack of research in optimizing convergent tasks in electronic meetings (Kerr and Murthy 2004, Grizé and Gallupe 2000). To our knowledge, the most interesting approaches that have been put forth as alternatives to the traditional design are those of Chin et al. (1992) and Chen et al. (1994), as well as the information overload framework proposed by Grizé and Gallupe (2000). The first, given by Chin et al. (1992) follows a decision support mode which attempts to augment the combined expertise of group members. Their design attempts to resolve differences in opinions in order to yield an integrated solution that is understandable and agreeable to all members. Although not embedded in their software, Chin et al. also showed how individual sortings can be aggregated to produce relevant information to meeting participants. In particular, they noted that the traditional approaches may result in groupings that represent different level of specificity (i.e., level of abstraction). The second approach suggested by Chen et al. (1994) was tailored to a specific GSS (GroupSystems). It bypasses the judgments of group members and follows a natural language/automatic indexing process. The results of this approach were contrasted to the consolidated lists created by four expert facilitators and indicated that overall, the automated list was equivalent to two facilitators, but were outperformed by the other two. The two approaches can be viewed as complimentary in nature. The automatic indexing procedure requires no effort from meeting members and thus represents an efficient design applicable for a large list of ideas generated by large groups. But it ignores the real world knowledge and expertise of participating members. Furthermore, the consolidated list automatically provided to members may be viewed as artificial and does not provide information for resolving and integrating differences in perspective among members. The group augmented design, on the other hand, with its goal of yielding better understanding and consensus among group members may be taxing for group sizes of 10 or more. More recently, Grizé & Gallupe (2000) suggested a conceptual framework that could be helpful in identifying tools and techniques that reduce information overload, in order to better organize and integrate these information. They suggest that "future research might focus on the development and investigation of the use of information and communication technologies process enablers to reduce the problem of information overload in electronic group processes'.

In contrast to current procedures, it seems critical to provide a new design for idea consolidation. In this research, we propose a new design that 1) highlights differences in understanding among group members regarding how ideas should be consolidated, 2) resolve theses differences, and 3) integrate these ideas into a meaningful set without overburdening the meeting participants. Specifically, our design will benefit from automatic indexing procedure approach (Chen et al. 1994) and will extend the group augmentation design proposed by Chin et al. (1992).

3 PROPOSED APPROACH

As a basis for the design and study of computer-based group support systems, we follow the information exchange framework provided by DeSanctis and Gallupe (1987). According to this view, the main activity during group meetings is interpersonal communication. The role of a GSS is to ameliorate communication processes by reducing process losses and enhancing process gains to foster optimal understanding and integration of ideas to solve the task at hand. This perspective, led DeSanctis and Gallupe to suggest three levels of GSSs : 1) Level 1 systems that provide the group with technical features aimed at removing common communication barriers, such as large screens for instantaneous display of ideas; 2) Level 2 systems that provide greater structure to the group through models and techniques aimed at reducing uncertainty and “noise” that occur in the group meeting process; 3) Level 3 systems that are characterized as machine-induced group communication patterns and that can include expert advice on how to facilitate and manage the meeting process. They suggested that research into the design and use of GSS should “proceed in an iterative manner, beginning with level 1 and level 2 systems and advancing to the study of level 3 systems after some understanding of the needed features and impacts of lower level systems has been achieved”. Most of the research to date has involved primarily level 1 and 2 systems.

Therefore, rather than simply providing a set of tools for evaluating the level of consensus and integrating perspectives during idea consolidation, this proposed research design will incorporate mechanisms of “decision guidance”. The concept of “decision guidance” is defined as the enrichment of decision-making models with the use of indicators guiding the decision makers to a successful structure and application of theses models. Specifically, our design will embed expert advice using the procedure proposed by Limayem and DeSanctis (2000) who suggest three types of decision guidance mechanisms that can be implemented to produce a level 3 system: 1) forward decision guidance which provides instruction prior to the execution of each major step in the idea consolidation process; 2) backward decision guidance which provide feedback explanation as to how the results presented are determined, why this information and procedure for deriving it is critical for the overall meeting process; 3) preventive decision guidance which provide expert advice to help the group in interpreting and distilling the output provided by the system. Thus, all three decision guidance mechanisms are meant to influence the communication pattern in the group by providing explanation in a normative fashion. The exact form of these guidance mechanisms cannot be specified in advance. As noted by Limayem (1996), the level 1 and 2 systems developed for idea consolidation need to be used in both positive and problematic “scenarios” to understand how group members learn to use such systems without formal guidance.

As discussed earlier, the goal of the proposed approach (materialized in the level 2 system to be further developed) is to take a large set of ideas covering many different issues and generate an unanimously agreed upon list of items which not only is more parsimonious, but optimally seizes the relevant issues in an unequivocal manner. Optimality constitutes a number of features. First, the list of items must be at the same level of abstraction. For example, items at a strategic level should not be mixed with items representing an operational level (if the meeting theme is the creation of a corporate website, an idea like “establish a e-business module” which is at a conceptual level cannot be mixed with an idea like “develop dynamic components in Java” which is at a more operational level). Second, the final list of items should be relatively independent of one another. A situation in which an individual views two items as similar can lead to problems in subsequent action such as voting (e.g. emphasizing one over the other or evenly distributing votes between the two). To avoid this, the basis on which the list of ideas are consolidated need to be surfaced and agreed upon. Often, members disagree upon how to consolidate a list of ideas for varying reasons (e.g., strategic versus operational item list, feasibility, cost, etc.). If some of the reasons were never used in creating the final item list, individuals may view ideas consolidated under one item as similar to ideas under another item leading to confusion. Thus, the underlying reasons for how group members see various ideas as similar need to be surfaced, discussed, and integrated. Finally, the list of items should be at the appropriate degree of abstraction for all members involved.

To our knowledge, current GSSs adopt the traditional linear technique where members in a meeting verbally suggest in serial on how ideas should be consolidated. Instead, our new design follows a Delphi approach where members work in parallel sorting ideas (see figure 1). These sortings are then combined using statistical sorting and clustering algorithms in order to optimally integrated the opinions of all group members to form an overall group solution as well as highlight differences in opinion among members. Theses results are then presented in a graphical fashion to provide a basis for further discussion.

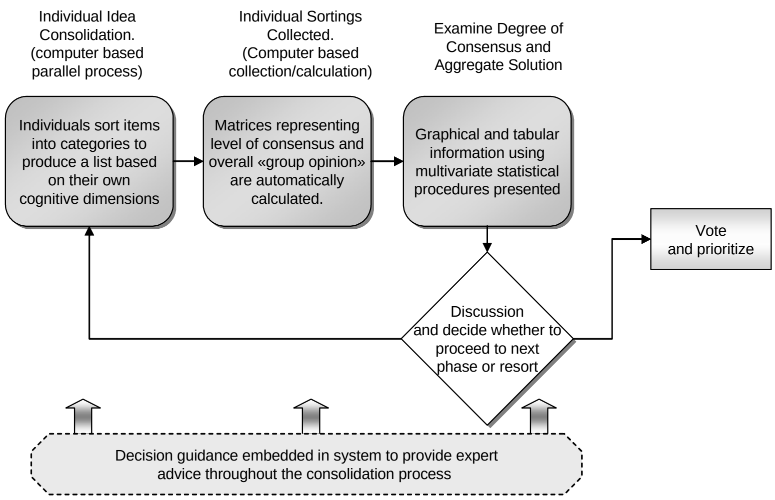

Figure 1. Proposed new GSS design to optimize the consolidation process

Thus, the level 2 system to be created that implement the new design supports a number of logical steps:

- Individual idea consolidation: first, via a drag and drop interface, each member sort items into groupings based on its own cognitive dimensions.
- Individual sortings collected : when individual groupings are completed, members can electronically send their solution to the central computer which in turn combines all sortings using specific algorithms to yield two specific matrices:
  - One matrix provides the group aggregate solution as to how similar items are to one another.
  - The second matrix, which can be termed as group dispersion matrix, compares how similar group members are in their sortings.
- Examination of the aggregate solution and degree of consensus: the group aggregate matrix and the group dispersion matrix will be submitted to a hierarchical clustering analysis and multidimensional scaling algorithms respectively. The system in turn would provide the solution in graphical format allowing participants to discuss and decide to proceed to subsequent actions.

The next subsections formally describe the underlying steps of the consolidation method proposed in our new approach depicted in figure 1.

3.1 Step 1: Individual idea consolidation

This is the step where members organize and sort their ideas into groupings or categories. Our assumption is that these groupings are done holistically, without taking into account specific criteria or other weights. In other words, generated ideas will be consolidated according to each individual's cognitive dimensions.

Let's assume $M = \{M_1, M_2, \ldots, M_n\}$ with card(M)=n represents the set of n members of a group and $I = \{I_1, I_2, \ldots, I_t\}$ with card(I)=t represents the t ideas generated by the group M. A part of I is a subset C such that $C = \{I_1, I_2, \ldots, I_p\} \subseteq I \Leftrightarrow I_k \in I$ pour $1 \leq k \leq p$. Therefore, C represents a possible grouping or category of ideas from the ideas set I. The set constituted of all parts of I is usually noted $\wp(I)$ with card($\wp$(I))= $\mathbf{2^t}$. We also assume that a generated idea (or comment) belongs to a single and unique category and can constitute by itself a single category. Consequently, an individual list of categories corresponds to a partition of I, which is a collection of disjoint subsets of I whose union is I. For example, if M= {M1, M2} and I = {I1, I2, I3} then L1 = {{I1}, {I2, I3}} is a possible individual list of categories provided by M1 and L2 = {{I1, I3}, {I2}} is possible individual list of categories provided by M2. For a better understanding, we will represent an individual list of categories with a square matrix that respect the following rules:

Let M with card(M)=n and I with card(i))=t and $L_k=\{C_1, C_2, \ldots, C_K)$ the partition associated to member M_k. For each member M_k (with $1 \leq k \leq n$), we associate a square matrix termed as *individual consolidation matrix* noted $\mathbf{X_k}$ of dimension t that corresponds to his individual list of categories such as:

For each couple (I_i, I_j), with $1 \leq i \leq t$ and $1 \leq j \leq t$, $\mathbf{X_k = (a_{IiIj})}$ where a_{IiIj} is a correlation binary value (0,1) such as:

- $\forall I_i \in C_{p\ (1 \leq p \leq K)} \forall I_j \in C_{q\ (1 \leq q \leq K)}$, $\mathbf{a_{IiIj} = 0 \Leftrightarrow p \neq q}$ (signifying that a_{IiIj}=0 when I_i and I_j don't belong to the same category of ideas).
- $\forall I_i \in C_{p\ (1 \leq p \leq K)} \forall I_j \in C_{q\ (1 \leq q \leq K)}$, $\mathbf{a_{IiIj} = 1 \Leftrightarrow p = q}$ (signifying that a_{IiIj}=1 when I_i and I_j belong to the same category of ideas).

Therefore, using the prior example, we have:

X_1	I1	I2	I3
I1	1	0	0
I2	0	0	1
I3	0	1	0

X_2	I1	I2	I3
I1	0	0	1
I2	0	1	0
I3	1	0	0

Figure 2. Examples of individual consolidation matrices

3.2 Step 2: Collection of individual sortings

In this step, the goal is to collect individual consolidation matrices and produce 1) a group aggregate matrix which is a co-occurrence matrix measuring the association degree between ideas after individual consolidations and 2) a group dispersion matrix which is a dissimilarity matrix that will measure the level of dissimilarity (then, the level of consensus) between members in their sortings. The aggregation procedure chosen to calculate the group aggregate matrix is very simple: it consists in summing the individual consolidation matrices. Thus, if M is a set of members with card(M)=n and $\{X_1, X_2, \ldots, X_n)$ the according individual consolidation matrices of each member, the group aggregate matrix A is then calculated as follows:

$$\mathbf{A} = \sum_{k=1}^{k=n} X_k$$

For example, if M = {M_1, M_2} et I={I_1, I_2, I_3, I_4} and L_1 = {{I_1}, {I_2, I_3, I_4}, L_2 = {{I_1, I_3, I_4}, {I_2}}, then we obtain the following group aggregate matrix:

A	I1	I2	I3	I4
I1	1	0	1	1
I2	0	1	1	1
I3	1	1	0	2
I4	1	1	2	0

Figure 3. Example of a group aggregate matrix

The question underlying the group dispersion matrix is: how can we identify differences among members so as to optimize the group consensus? Theory in data analysis provides various approaches to measure the similarity between partitions of a set: the Rand Index, the Adjusted Rand Index or Fawlkes and Mallows measure, the Jaccard index (see Rand 1971, Hubert and Arabie 1985, Fawlkes and Mallows 1983). In general, these measures are based on the enumeration of the item couples co-grouped in the partitions. For simplicity reasons, and because it is widely used, we adopted the Rand index to measure the distance between members partitions. A normalized notation of the distance of Rand can be: $d(L_1, L_2) = \frac{(b+c)}{\Gamma(\pi(I))}$

where L_1 and L_2 are two partitions of I (set of ideas), b is the number of item couples co-grouped in L_1 and not in L_2, c is the number if item couples co-grouped in L_2 and not in L_1, and $\Gamma(\pi(I))$ the cardinal of π (I) which is the set of all joint couples of I (a mathematical explanation should be here provided but due to page constraints we're compelled to provide a short description of this formula). To determine (b+c), that is the number of differences in associating couples of ideas, we used a XOR matrix applied on two individual consolidation matrices. Thus, we determined that :

$d(L_1, L_2) = (\sum_{i=1 j=1}^{i=n j=n} x_{ij}) / (\Gamma(\pi(I)))$ where x_{ij} is the value of the i^{th} line and j^{th} column of the XOR matrix X_{12} resulting from X_1 and X_2.

Therefore, having M={M_1,M_2,..,M_n) and the n consolidation lists {L_1, L_2, …,L_n) of each member respectively, the matrix D termed as group dispersion matrix that measures the dissimilarity level between all members (and inversely, that measures the consensus level), is defined as follows:

D	M1	M2	M3	...	Mn-1	Mn
M1	0	d(L1,L2)	d(L1, L3)	,,,	d(L1, Ln-1)	d(L1,Ln)
M2	d(L2,L1)	0	d(L2,L3)	,,,	d(L2, Ln-1)	d(L2, Ln)
M3	d(L3, L1)	d(L3, L1)	0	,,,	d(L3, Ln-1)	d(L3,Ln)
.	…	,,,	,,,	,,,	,,,	,,,
...	d(Ln-1, L1)	d(Ln-1, L2)	d(Ln-1, L3)	…	0	d(Ln-1, Ln)
Mn	d(Ln, L1)	d(Ln, L2)	d(Ln, L2)	…	d(Ln, Ln-1)	0

Figure 4. The group dispersion matrix (measure the dissimilarities between members after individual consolidation)

The more the distance between two members is close to 0, the more they agree in their idea consolidation. This matrix will be the instrument to measure the consensus level between each couple of members.

3.3 Step 3: Examination of the aggregate solution and degree of consensus

In order to further analyse the overall opinion and the degree of consensus among the group members, the group aggregate matrix and the group dispersion matrix will be submitted to hierarchical clustering analysis and multidimensional scaling algorithms respectively. The hierarchical clustering algorithm we adopted is an ascendant single linkage clustering algorithm (see Johnson, 1967) that will provide a hierarchical tree termed as dendrogram (see figure 5). The system to be developed in turn would provide this solution in a graphical format, that provides information to assist the group in deciding the level of detail (i.e., level of abstraction). Depending on the degree of specificity preferred by the group, the graphical output provide the solution as how best to consolidate the items. Assuming the solution is correct, the group can avoid poor consolidations where groupings represent different levels of abstraction. Using human computer interaction design guidelines, the software to be developed will provide the capability of a "drilldown" examination where the entire graphical picture is not automatically presented. Rather, by clicking a particular box, the more detailed level items associated with it are then presented.

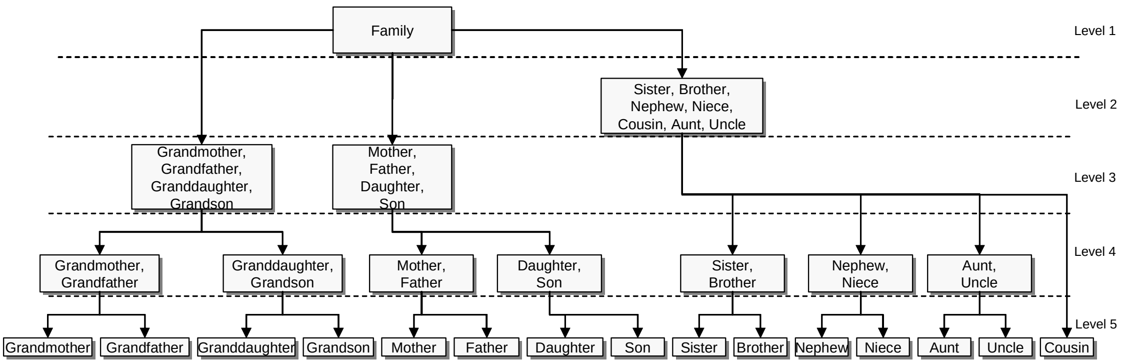

Figure 5. Example of a dendrogram resulting from hierarchical clustering (rounded boxes represent ideas)

Beyond the average difference in abstraction level, we might wish to provide detailed information as to how similar group members sortings are to each other. In other words, we wish to surface differences in opinions. According to this perspective, a multidimensional scaling procedure based on a S-Stress function (Kruskal 1964) will be applied on the group dispersion matrix in order to provide a spatial representation of group members dispersion also termed as common space or perceptual map (see Torgerson 1952, Young & Hamer 1987, Green & Carmone & Smith 1989, Desarbo et al. 1992). With the help of such a dispersion map (see figure 6), we would be able to point out various dimensions that may not have been considered among group members. Once understood, all dimensions can then be combined to produce an integrated view so as to appreciate the overall degree of consensus.

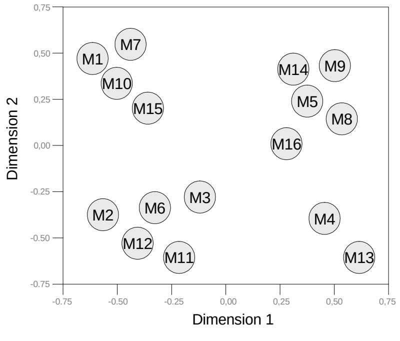

Figure 6. Example of a group dispersion map using multidimensional scaling (small circles represent group members)

When differences surfaced among group members are significant, communication should be directed towards reconciling them. The decision guidance mechanisms discussed earlier will then come into play. Due to page constraints, the details and examples provided here unfortunately are sparse, but hopefully gives substantial information on the system that we plan to create. We have, for example, left out the algorithmic details which can be found in the references provided. Other instruments such as consensus graphing via fuzzy voting (Spillman and Spillman and Bezdek 1980) will also be included.

4 CONCLUSION

In general, the suggested design represents a departure from current GSS designs for idea consolidation. Its goal is to provide group members with a basis to surface and resolve differences in opinion such that the final list is understandable. This should result in greater satisfaction, commitment to subsequent decisions, and quality of solution. We are currently developing a level 3 group support system embedding the consolidation approach just described as well as the decision guidance mechanisms illustrated above. The final step of this research in progress will consist of conducting a laboratory experiment in order to assess the merit of our proposed approach. Specifically, we plan to have two experimental treatments: 1. groups using a basic version of the system with a traditional (manual and in serial) idea consolidation process; 2. groups using the same system with the proposed (automated and in parallel) approach for idea consolidation. Based on the theoretical development above, we hypothesize that groups using the new approach for idea consolidation will not only experience higher consensus with the final list of ideas generated, but also greater satisfaction with the ideas generated as well as the entire decision making process. We hope to present the complete findings of these laboratory experiments at ECIS in June 2006. Furthermore, we think that this research in progress is a timely answer to Martz and Shepherd (2004)'s call for research. They suggest that from a practical point of view, and in order to reach a better consensus, computer-mediated collaborative systems designed to handle complex tasks should include tools that help in integrating the sets of information generated during the process. They also suggest that such tools should help facilitators to lead participants to produce integrative comments. We believe that our proposed approach addresses theses suggestions. Moreover, we hope that this approach will be useful for decision makers tackling complex decisions such as: important strategic tradeoffs, new product design and negotiation.

References

Ackermann, F., Franco, L.A., Gallupe, B. and Parent, M. (2005). GSS for multi-organizational collaboration: Reflection on process and content. Group Decision and Negociation, Vol. 14, 307-331.

Albanese, R., and Van Fleet, D.D. (1985). Rational Behavior in Groups : The free riding tendency. *Academy of Management Review.* Vol. 10, pp. 244-255.

Bostrom, R., Watson, R., Kinney, S. (1992). Computer Augmented Teamwork: A Guided Tour. *New York., NY: Van Nostrand Reinhold.*

Chen, H., Hsu, H., Orwig, R., Hoopes, L. and Nunamaker, J.F. (1994). Automatic concept classification of text from electronic meetings. *Communications of the ACM.* Vol. 37, No. 10, pp. 56-73.

Chin, W. and Gopal, A. (1992). The group consolidation problem during GSS usage: a new approach and initial empirical evidence. *The Journal of Information Technology Management.* Vol. 3, No. 2, pp. 15-27.

Dennis, A. (1996). Information Exchange and Use in Group Decision Making: You can lead a group to information, but you can't make it think. *MIS Quaterly.* December 1996, pp. 433-457.

Dennis, A. and Gallupe, R. (1993). A history of group support systems empirical research: Lessons learned and future directions. *Group Support Systems: New Perspectives. Jessup L. and Valacich, J.. New York: MacMillan.*

Dennis, A. and Reinicke, B.A. (2004). Beta versus vhs and the acceptance of electronic brainstorming technology. *MIS Quarterly.* Vol. 28 No. 1, pp. 1-20.

Dennis, A. and Valacich, J. (1993). Computer brainstorms: more heads are better than one. *Journal of Applied Psychology.* Vol. 78, 4 (1993), pp. 531-537.

Dennis, A.R., Wixom, B.H. and Vandenberg R.J. (2001). Understanding fit and appropriation effects in group support systems via meta-analysis. MIS Quarterly, 25(2), 167-193.
DeSanctis, G., and Gallupe, R. (1987). A foundation for the study of group decision support systems. *Management Science.* Volume 33, pp. 589-609.
DeSarbo, W. S., Howard, D. J. and Jedidi, K. (1991). MULTICLUS: A new method for simultaneously performing multidimensional scaling and cluster analysis. *Psychometrika*. No. 56, pp. 121-136.
DeSarbo, W. S., Jedidi, K. & Johnson, M. D. (1991). A new clustering methodology for the analysis of sorted or categorized stimuli. *Marketing Letters*. No. 2, pp. 267-279.
Diehl, M., and Stroebe, W. (1987). Productivity loss in brainstorming groups: Toward the solution of a riddle. *Journal of Personality and Social Psychology*. No 53, pp. 497-509.
Fawlkes, E. and Mallows, C (1983). A method for comparing two hierarchical clusterings. Journal of the American Statistical Association, Vol. 78, pp. 553–584.
Gallupe, B. and Cooper, W. (1992). Brainstorming electronically. *Sloan Management Review*. Vol. 35, 1, pp. 27-36.
Gallupe, R., Cooper, W., Grisé, M.L. and Bastianutti, L. (1994). Blocking electronic brainstorms. *Journal of Applied Psychology.* Vol. 79, No. 1, pp. 77-86.
Gallupe, R., Dennis, A., Cooper, W., Valacich, J., Bastianutti, L. and Nunamaker, J. (1992). Electronic brainstorming and group size. *Academy of Management Journal.* Vol. 35, No. 2, pp. 350-369.
Green, P. E., Carmone, Jr., F. J. and Smith, S. M. (1989). Multidimensional scaling, Concepts and Applications. *Boston: Allyn and Bacon.*
Grizé, M.L. and Gallupe, B. (2000). Information Overload: Addressing Productivity Paradox in Face-to-Face Electronic Meetings. *Journal of Management Information Systems*. Winter, Vol. 16, No. 3, pp. 157-185.
Huber, G. (1984). Issues in the design of group decision support systems. *MIS Quaterly*. September, pp. 195-204.
Hubert, L. and Arabie, P. (1985) Comparing partitions. *Journal of Classification*. Vol 2. pp. 193–218.
Jessup, L.M., Connolly, T. and Tansik, D.A. (1990). Towards a theory of automated group work: The deindividuating effects of anonymity. Small Group Research, 21(3), 333-348.
Johnson S. C. (1967): "Hierarchical Clustering Schemes. *Psychometrika*, 2:241-254.
Kerr, D.S. and Murthy, U.S. (2004). Divergent and convergent idea generation in teams: A comparison of computer –mediated and facte-to-face communication. Group decision and Negociation, Vol. 13, 381-399.
Kruskal, J.B. (1964), " Multidimensional scaling by optimizing goodness of fit to a non-metric hypothesis ". *Psychometrika.* No. 29, pp. 1-27.
Lymaiem, M. (1996). A Design Methodology for Embedding Decision Guidance into GDSS. *Group Decision and Negociation*. Vol. 5, pp. 143-164.
Lymaiem, M. and DeSanctis, G. (2000). Providing decisional guidance for multicriteria decision making in groups. *Information Systems Research.* Vol. 11, No. 4, pp. 386-401..
Nunamaker, 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*. Vol. 34, No.7.
Rand, W. Objective criteria for the evaluation of clustering methods. Journal of the American Statistical Association, 66(336):846–850, 1971.
Reinig, B. A. and Shin, B. (2002). The Dynamic Effects of Group Support Systems on Group Meetings. *Journal of Management Information Systems*. Vol. 19, No, 2, pp. 303-325.
Santanen, E.L., Briggs, R.O and De Vreede, G-J. (2004). Causal Relationships in creative problem solving: comparing facilitation interventions fori ideation. *Journal of Management Information Systems.* Vol. 20, No. 4, pp. 167-197.
Shaw, M. (1981). Group Dynamics: The Psychology of Small Group Behavior. *3rd edition, McGraw-Hill, New York.*
Spillman, B., Spillman, R. and Bezdek, J. (1980). A fuzzy analysis of consensus in small groups. In P.P. Wang and S.K. Chang (Eds), Fuzzy Sets, Theory and Applications to Policy Analysis and Information Systems, New York, Plenum Press, 291-308.
Steiner, I.D. (1972). Group process and productivity. *Academic Press.* New York.
Torgerson, W.S. (1952), " Multidimensional scaling : I. Theory and method ". *Psychometrika*, No. 17, 401-419.
Van de Ven, A. and Delbecq, A. (1971). Nominal Versus Interacting Group processes for Comitee Decision-Making Effectiveness. *Academy of Management Journal.* 14, pp. 203-212.
Watson, R., DeSanctis, G. and Poole, M. (1988). Using a GSS to facilitate group consensus: Some intended and unintended consequences. *MIS Quaterly.* September, pp. 463-478.
Young, F.W. and Hamer, R.M. (1987). Multidimensional scaling: History, theory, and applications. *Hillsdale, N.J. : Lawrence Erlbaum Associates*.