Detailed Narrative of Results Summarized in Appendix A of DeSanctis, Poole, Zigurs, et al. (2008)

This is a more detailed narrative of the results summarized in the main body and appendix of DeSanctis, Poole, Zigurs, et al. (2008). Section numbers correspond to the sections in the body and table designations correspond to tables in the Appendix to that article.

4.4.1 (Table 1) GDSS Groups Versus Traditional Groups

This section and the results in the table address the question: What effects do GDSS have on group processes and outcomes? Our initial studies focused on differences between groups using the GDSS and groups employing more traditional modes of operation. Normatively we were interested in the question of whether there was any net improvement in decision outcomes such as quality, satisfaction, and commitment due to GDSSs. To address these questions we compared three conditions: (1) groups with no support which were given a task and left to their own deserts (Baseline groups), (2) groups with a manual version of the procedures built into the GDSS (Manual groups), and (3) groups with a GDSS (GDSS groups). The contrast of conditions 1 and 2 with condition 3 identified the effects due to computerization, while the contrast of condition 1 with conditions 2 and 3 identified the effects due to structured procedures, whether automated or not. This enabled us to sort out impacts due to procedures, which could be employed manually as well as with the GDSS, from impacts due to computerization.

Laboratory experiments by Gallupe (1987), Watson, DeSanctis and Poole (1988), Zigurs (1988; Zigurs, Poole, & DeSanctis, 1989), and Sambamurthy and DeSanctis (1990), and a field experiment by Niederman (1990) compared GDSS with Manual and Baseline groups in terms of various outcome variables that included objective quality, consensus change, satisfaction with the solution and the decision process, and confidence in and commitment to the decision. Studies by Zigurs et al. (1989), Poole, Holmes and DeSanctis (1991), Sambamurthy and Poole (1991), Poole, Holmes, Watson and DeSanctis (1993), and Poole and Holmes (1995) analyzed the interaction in subsets of groups drawn from the three conditions, comparing GDSS, Manual, and Baseline groups in terms of amount and types of communication, nature of the decision process, quality of discussion and analysis, and conflict management.

Objective Metrics. Several studies incorporated objective metrics, such as quality (for tasks with determinable answers) and quantity of production. For the Marketing Case task, Gallupe et al. (1988; Gallupe, 1987) found that Level 1 GDSS groups identified higher quality problems than Baseline groups. On the other hand, Zigurs et al. (1989; Zigurs, 1988) found that Level 1 GDSS and Baseline groups improved their performance compared to their average member performance, whereas Manual groups did not. Task moderated the impact of GDSS in the Gallupe study: for high complexity tasks, GDSS groups outperformed Baseline groups, whereas there was no difference between the two conditions for low complexity tasks.

What do we make of these results? Gallupe's study demonstrated a clear advantage of the GDSS over nonsupported groups for complex tasks, but Zigurs's did not. The difference is probably not due to task, since both tasks were complex and required a good deal of complicated information processing. The finding that the Manual groups performed worse than the GDSS groups on the Admissions task suggests that the Manual found the required procedure difficult to manage without computer support. Based on analysis of the decision process in the groups it seems likely that, although the procedure built into SAMM did enable groups to make good decisions, it was not the course of reasoning groups would naturally follow. The Baseline groups performed at an equal level to the GDSS groups because they applied different, but equally effective heuristics. The Manual groups, constrained from applying these "natural" heuristics, tried to follow the same procedure that SAMM embodied, but were not able to do so, as indicated by higher levels of confusion about the procedure observed in Manual groups than in GDSS groups. In short, the GDSS procedures used in the Zigurs study worked well, but were not what traditional groups would have adopted.

In terms of productivity, Gallupe et al. (1988) also found that Level 1 groups generated more problem statements than Baseline groups. On the other hand, Poole, Holmes, Watson and DeSanctis (1993) found that Manual groups generated more ideas than Level 1 GDSS or Baseline groups. The difference in results for the number of items generated is probably moderated by task, because Gallupe's task was more open-ended in terms of solutions than the Foundation task.

Consensus. For the many problems and tasks without demonstrably correct answers, one good outcome measure is the degree of agreement which members are able to achieve as a result of their deliberations. For the Foundation and Planning tasks, groups using procedures, delivered manually or via the GDSS, achieved higher levels of consensus than Baseline groups (Watson et al., 1988), and Manual groups achieved higher levels of consensus than did GDSS groups (Watson et al., 1988; Sambamurthy & DeSanctis, 1990). Sambamurthy and DeSanctis (1990) found that for the Business Case Problem Identification task, Baseline groups had higher levels of agreement with the final decision than did Level 1 groups. This result points to a possible problem with some applications of GDSSs: the ratings elicited by the GDSS may well have made members aware of disagreements, which in turn lowered their agreement with the group's final decision.

Time. Baseline groups took less time than GDSS and Manual groups in the study reported by Watson et al. (1988), but there was no difference between Baseline and Level 1 GDSS groups in Gallupe et al. (1988). This may be traceable to differences in the task: The Foundation task provides predefined alternatives and it is easy for groups to prioritize them quickly and with limited discussion, whereas analysis is needed to identify problems in the business case, whether or not the group is following a procedure.

Subjective Outcomes. In general *Perceived Quality of Decision* was lower for GDSS than for Manual or Baseline groups. Watson et al. (1988) found that Perceived Quality was higher for Manual groups than for Level 1 groups and that there were no differences

in perceived quality for the Manual-Baseline and Level 1-Baseline comparisons. Gallupe et al. (1988) found that members' Satisfaction with the Decision was significantly greater in Baseline groups than in Level 1 groups. In a field experiment, Niederman (1990) found no difference in Perceived quality for sessions in which the groups used the Level 2 GDSS and when they did not. GDSS groups had significantly lower *Decision Scheme Satisfaction* than Manual and Baseline groups in Watson et al. (1988). Niederman (1990) found no differences in Decision Scheme Satisfaction between Level 2 and Baseline sessions. There was no difference in *Confidence in the Decision* for Level 1 and Baseline groups in the Gallupe et al. (1988) study. Watson et al. (1988) reported that Manual groups were more confident in their decisions than either GDSS or Baseline groups. In his field experiment on a single group that used either a Level 2 GDSS or equivalent Manual procedure in repeated trials, Niederman (1990) found that Confidence was higher for the Level 2 GDSS than for the decisions made with the Manual procedure. Finally, Niederman's (1990) field experiment found that the group's *Commitment to Implement* decisions was higher when it used the GDSS than when it used the Manual procedures.

Amount of Communication. Manual and Level 1 groups engaged in significantly more communication than did Baseline groups (Watson et al., 1988; Zigurs et al., 1989). However, the lack of difference in time on task reported for Gallupe's study suggests that Baseline and GDSS groups had equivalent amounts of communication. Again, this may be a function of differential task requirements.

Quality of Discussion and Analysis. Critical discussion of ideas was positively correlated with Decision Scheme Satisfaction in Watson's data, and this suggests that it is important to consider the quality of the interaction fostered by the three conditions. Poole, Holmes, Watson, and DeSanctis (1993), in a process study following up on Watson's data, found that Manual groups spent significantly more time discussing criteria for making their decision than Baseline and Manual groups, although there were no differences in the degree to which members of GDSS, Manual, or Baseline groups connected solutions to criteria. Baseline groups generated the most new solutions and elaborated on solutions more than Manual groups, which generated and elaborated more than GDSS groups (Poole et al., 1991). It may have been that entering the ideas into the GDSS effectively "froze" the set considered more than did having no list or entering them on a flipchart, as the Manual groups did. There was evidence that GDSS groups relied more on written documents (including displays and printouts generated by the GDSS) than Manual or Baseline groups, which would lend support to this speculation. Members indicated on a post-session questionnaire that issues explored in the Baseline and Manual groups were more substantial than those in the Level 1 GDSS. However, in his field experiment, Niederman (1990) found that members perceived greater depth of analysis when using the Level 2 GDSS than in Baseline groups.

Evaluation procedures—rating, ranking, and voting—have the potential to either improve or degrade analysis. They improve it if the results of evaluation stimulate further discussion among members about the bases for disagreements and analysis and elaboration that attempts to overcome the problems that surface during this discussion. They degrade analysis if the rating, ranking or vote is regarded as a final outcome that

cuts off further discussion. Poole et al. (1991; 1993) found that Level 1 and Manual groups used formal evaluation more than Baseline groups. Moreover, they found that Manual groups used evaluations to promote discussion more often than did GDSS groups and that GDSS groups were more likely to use them in ways that degraded discussion. This may have been because the computerization of the evaluation made it seem more authoritative. It might also have reflected many GDSS groups' felt need to "get on with it" and make a decision after having spent considerable time learning to use the system and overcoming problems. In a follow-up analysis, Poole et al. (1991) found that those groups that used the GDSS productively—using rating/voting as a stimulus for further discussion, balancing participation, clarifying roles and process—had higher levels of consensus change than GDSS groups that did not. Nonproductive uses of evaluation were negatively correlated with Consensus, Perceived Quality, and Decision Scheme Satisfaction.

Poole et al. (1993) also developed an overall measure of task-communication fit, which compared the distribution of group activities devoted to problem analysis, criteria definition, solution analysis, and orientation to an ideal profile of activity for the Foundation task. They found that Manual groups more closely approximated this ideal than GDSS or Baseline groups. They also found that task-communication fit was positively correlated with Consensus, Perceived Quality, and Decision Scheme Satisfaction.

Decision Process. Several studies suggested that GDSS groups devoted significant effort to learning, understanding, and managing the system. Zigurs et al. (1989) found significantly more influence behavior in Level 1 GDSS groups than in Manual groups, and analysis of specific categories of behavior suggested that GDSS groups were more focused on procedures than were Manual groups, though there was no difference in task focus. Manual groups had significantly more information integration and goal oriented statements than GDSS or Baseline groups, suggesting a more substantive task focus. However, the proportions of information integration and goal statements were negatively correlated with performance. This may be a byproduct of having trouble with the task: groups that are having difficulties may spend more time trying to clarify and define goals and process information than groups for whom the task is fairly straightforward.

Poole et al. (1993) found that Level 1 GDSS groups in Watson's study experienced more difficulties using their procedures initially than did Manual groups. GDSS groups also experienced more problems with their procedures and had more disagreements over procedures than did Manual groups. On a post-session questionnaire, Watson's participants indicated that the GDSS problem-solving process was more confusing than the Manual process, which was more confusing than the Baseline problem-solving process. Manual and GDSS groups also rated their task as being more difficult than the Baseline groups in Watson's study, suggesting that the procedure either made the groups work harder or made them aware of complexities in the task of which Baseline groups were unaware. Problems with using the GDSS were negatively correlated with Decision Scheme Satisfaction in Watson's groups.

Groups that focused extensively on procedures also exhibited more learning relative to procedures. Poole et al. (1993) found that Level 1 groups exhibited significantly higher levels of procedural insight—measured through effectiveness in overcoming problems with the procedure or technology—than did Manual groups and Baseline groups; Manual groups, in turn, exhibited significantly higher levels of Procedural Insight than Baseline groups. Procedural insight was negatively correlated with Decision Scheme Satisfaction.

Poole and Holmes (1995) conducted an in-depth analysis of decision-making phase sequences (decision paths) in 40 groups drawn from Watson's study. They focused on differences in decision paths between GDSS, manual, and unsupported groups in terms of their sequences of phases of distinct activities such as problem definition, solution generation, solution elaboration and social integration. Specifically Poole and Holmes expected that groups using SAMM would have decision paths that closely approximated a widely-advocated normative decision-making sequence in which groups first oriented themselves to the task, then analyzed the problem before them, then generated and evaluated solutions, and finally chose a solution. This sequence easily mapped onto SAMM features. Manual or unsupported groups should have more complex decision paths that did not match the normative sequence, because they did not have to use a system that made the sequence as salient to their members. Results indicated that decision paths of GDSS, Manual, and Baseline groups were different, as expected. GDSS and Baseline groups tended to have simpler decision paths than the Manual groups. Contrary to expectations, Manual groups had decision paths more similar to the normative sequence than GDSS or Baseline groups. The GDSS groups deviated from the normative sequence largely because they repeatedly had to orient themselves to how to use SAMM and match it to the task. This is consistent with earlier results from analyses of the Watson data. There was also evidence that paths that resembled the normative sequence led to more consensus change and satisfaction with the decision process than those that did not. However, the progression through the normative sequence did not have to be highly orderly; more complex paths in which groups recycled to early phases (e.g., going back to reconsider the problem during solution development) for brief periods seemed to be useful, so long as the overall decision path largely followed the normative sequence. This suggests that micromanagement of the decision process is less important than using procedures—either GDSS or Manual—to chart the global decision path. So long as the group is progressing from problem analysis to solutions and doing a thorough job, it is likely to be effective.

Participation and influence are important dynamics in any group, and the GDSS had the potential to affect both. We expected the GDSS to be an equalizer, because its procedures were designed to promote participation. However, results were mixed. Watson et al. (1988) found no differences in perceptions of equality of influence in four person groups, but in three person groups, Baseline groups perceived themselves to be most equal, followed by Manual groups, with Level 1 GDSS groups perceiving themselves as having the least equality of influence. Follow-up process analysis of Watson's groups indicated no differences in equality of influence on several coding categories between GDSS, Manual and Baseline groups (Poole et al., 1993). However, a few members did tend to engage in more orientation and process related interaction than

others, suggesting that management of the decision process was concentrated in a few. On a post-session questionnaire, members of Baseline groups indicated that leadership in their groups was significantly clearer than did members of GDSS or Manual groups. Equality of influence on these categories was positively correlated with consensus and decision scheme satisfaction for all conditions in Watson's study. Zigurs et al. (1989) found that GDSS groups were more equal than Manual groups in terms of control of the group and the group process, but that there was no difference in equalization for task oriented behavior.

Conflict Management. In Gallupe et al. (1988), members of Level 1 GDSS groups reported significantly more conflict than members of Baseline groups. In a process analysis of conflict management in Watson's (1987) data, Poole, Holmes & DeSanctis (1991) found that Manual groups managed disagreement by keeping up a low key debate, whereas Baseline and Level 1 groups surfaced opposition openly and used open discussion to manage conflict. Level 1 groups had more integration behavior during their conflicts than Baseline or Manual groups, suggesting that they were using humor and socialization to mitigate the conflict. Baseline groups had more protracted open conflict than Manual or Level 1 groups in four person groups. In a contrast of selected groups with high change toward consensus and low change toward consensus, Poole et al. (1991) found that in high change Manual groups there was hard bargaining that combined distributive and integrative interaction but little open opposition, whereas low change Manual groups avoided the conflict. High change GDSS groups used avoidance in combination with integrative and distributive behavior, a combination which introduces ambiguity into the discussion and enables parties to move away from positions that may have hardened during the open opposition which characterized the initial stages of conflict in GDSS groups. Direct hard bargaining was less effective in GDSS groups, because it tended to re-open opposition. Baseline groups often had long open conflicts. Effective Baseline groups used avoidance to deal with conflicts; hard bargaining was strongly related to low consensus change in Baseline groups. Sambamurthy and Poole (1991) conducted a process analysis of Sambamurthy's (1989) data and also found that there was more open confrontation of conflict in Level 2 GDSS groups than Manual-Level 2 groups.

Poole, Holmes and DeSanctis (1991) catalogued eight distinct impacts that a GDSS and procedures could have on conflict management, some with positive effects and some with negative effects. They scored the GDSS groups from Watson's study on positive and negative impacts observed in their interaction and found that groups with a net balance of positive impacts had significantly higher consensus change than groups with a net negative balance or zero balance.

4.4.2 (Table 2) Level 1 Versus Level 2 Groups

This section addresses the question: What meaningful dimensions nderlie the design of GDSSs and how do these dimensions affect group processes and outcomes? To address this question, we conducted studies that compared groups using three Level 2 procedures—Multicriteria Decision Analysis, Stakeholder Analysis, and Problem

Formulation based on principles from Synectics—to groups working on the same task using the problem solving agenda employed in the first set of studies. The groups worked on tasks appropriate to the procedures. With one exception, we did not employ a manual control group because it would have taken members too long to conduct the same operations, and seemed to be an inappropriate comparison.

Consensus. For the Planning task, Sambamurthy and DeSanctis (1990) found that Level 2 groups achieved higher levels of Consensus than Level 1 groups, provided they had high levels of initial disagreement. There was no difference between Level 1 and Level 2 for groups when they had low levels of disagreement. Post-meeting Consensus was negatively correlated with pre-meeting Consensus for Level 2 groups, whereas it was positively correlated for Level 1 groups. Watson (1987) also found a positive correlation between pre-meeting Consensus for Level 1 groups. However, Dickson, DeSanctis, Poole and Limayem (1990) found no difference in Consensus between Level 1 and Level 2 groups for the Foundation task, nor did groups with higher levels of conflict benefit more from the Level 2 GDSS than from the Level 1 GDSS, as found in the Sambamurthy study. Moreover, for the Problem Identification task, Niederman (1990) also found no difference between Level 1 and Level 2 groups.

Dickson et al. (1990) observed that groups had problems using the Level 2 system and there was some evidence of this in Niederman's study. In the Sambamurthy study, groups were observed closely and coached if they had any problems. It may well be the case that more active facilitation or guidance is required to use higher order procedures such as those built into the GDSS, an issue addressed in the third set of studies.

Time. Niederman (1990) found no difference in the length of meeting between Level 1 and Level 2 groups.

Subjective Outcomes. Sambamurthy and DeSanctis (1990) and Niederman (1990) found no differences between Level 1 and Level 2 groups in *Perceived Quality* for planning and problem identification task. While Sambamurthy and DeSanctis (1990) reported no differences between Level 1 and Level 2 groups on *Decision Scheme Satisfaction*, Niederman (1990) found that Level 2 groups had higher levels of Decision Scheme Satisfaction than Level 1 groups. Sambamurthy and DeSanctis (1990) found that Level 2 groups had significantly higher *Confidence* in their decision than Level 1 groups. However, for the problem identification procedure, Niederman (1990; Niederman & DeSanctis, 1995) found no difference in Confidence between Level 1 and Level 2 groups. Niederman (1990) also found that Level 2 groups had a higher level of Commitment to Implement their decision than Level 1 groups.

Sambamurthy and Chin (1994) found that the attitudes Ease-of-Use and Usefulness mediated the relationship between Level and a composite outcome measure—Group Decision Making Performance—which employed Consensus, Perceived Quality, Decision Scheme Satisfaction, and Confidence in the Decision as indicators. Sambamurthy and Chin (1994) also found that attitudes toward the GDSS after a short

period of use were predominantly dependent on ease of use, while attitudes after a longer period of use were predominantly dependent on usefulness.

Quality of Discussion and Analysis. Sambamurthy, Poole, and Kelly (1993) found no differences in Perceived Task Focus in Level 1 and Level 2 groups, but they also found that Level 1 groups had a significantly greater proportion of solution elaboration statements than Level 2 groups. Level 2 groups had a significantly greater number of statements linking criteria and solutions than Level 1 groups. The proportion of criteria definition statements and linkages had positive correlations with Perceived Quality. Proportion of linkages also had positive correlations with Consensus, Confidence in the Decision, and Decision Scheme Satisfaction. The proportion of negative solution evaluations and rigid interacts was negatively correlated with Consensus Change and Decision Scheme Satisfaction.

Sambamurthy et al. (1993) found that Level 1 groups had significantly more assumptions in their final decisions than Level 2 groups. This suggested that the Level 2 system enabled members to evaluate stakeholders more thoroughly and reduce them to a core set of the most important stakeholders, and hence be more discriminating than Level 1 groups. However there was no difference in Perceived Understanding of Other Members in the two conditions. Neiderman (1990) found that Level 2 groups perceived that they had covered the significant issues more than Level 1 groups did, but also no difference in Perceived Depth of Analysis or Understanding of Other Members.

Sambamurthy et al. (1993) also found that Level 2 groups had significantly greater use of formal evaluation procedures than Level 1 groups and significantly less nonproductive use of formal evaluation outputs than Level 1 groups. There was a negative correlation of nonproductive evaluation and Consensus and a negative correlation of use of formal evaluation with Perceived Quality and Decision Scheme Satisfaction.

Decision Process. Niederman (1990) found that Level 2 groups had a greater number of information search and equivocality reducing statements than Level 1 groups. Information search and equivocality reduction was positively correlated with consensus and perceived coverage of important issues in both Level 1 and Level groups.

In terms of the phase sequence followed during the decision-making process, Sambamurthy et al. (1993) found no differences in the degree of organization in Level 1 and Level 2 groups. In both conditions, degree of organization was positively correlated with Consensus and Confidence in the decision.

Sambamurthy et al. (1993) found that there were more problems in getting started using the procedure for Level 1 than for Level 2. Startup problems were negatively correlated with Decision Scheme Satisfaction. However, once started, there was no difference in the number of problems encountered (which implied that Level 2 groups were still doing worse than Manual groups would, based on findings in the previous section). However, there was evidence that Level 2 GDSSs helped members to understand group processes better: Sambamurthy et al. reported that Level 2 groups exhibited more procedural insight

than Level 1 groups. Procedural insight had positive correlations with Consensus and Confidence in the decision

Conflict Mananagement. In a followup process analysis of Sambamurthy's data, Sambamurthy and Poole (1992) found more open confrontation of conflict in Level 2 groups than in Level 1 or Manual-Level 2 groups. Phasic analysis of conflict management interaction indicated that most Level 2 groups engaged in open oppositions that developed into open discussions and negotiation. Most Level 1 groups had open opposition but were unable to use discussion to move toward consensus; instead Level 1 groups tended to table the conflict or avoid the conflict. Manual Level 2 groups did not have open opposition, but critically discussed issues. There were differences in how conflict was managed among the groups in each condition. Consensus was positively correlated with confrontation of conflict for Level 1 and Level 2 groups. For Manual-Level 2 groups there was also a positive correlation between confrontiveness and consensus, but in these groups only one was more than moderately confrontive**.**

4.4.3 (Table 3) Effects of Altering the Internal Group System by Adding External Support

This section addresses the question: What additional types of support facilitate GDSS use? Various avenues of external support were a logical concern with a complex technology like GDSS. The project investigated the impact of heuristics, role training, facilitation, and Level 3 guidance.

Heuristics. The simplest type of support, procedural guidelines incorporated into basic training in using the GDSS, was investigated by DeSanctis, D'Onofrio, Sambamurthy and Poole (1989). This study compared the impacts of various heuristics—guides to making decisions—on GDSS use and outcomes. They contrasted heuristics that varied in terms of *comprehensiveness* and *restrictiveness*. This study employed a 2X3 (restrictiveness x heuristic) design. The comprehensiveness of a heuristic refers to how detailed and specific its instructions are. In this study two types of heuristics were used, a broad set of principles for effective problem solving and conflict management (The Consensus Approach: Hall and Watson, 1970) and a detailed agenda and description of how to apply SAMM to the problem at hand, similar to the SAMM training provided in the rest of the experiments. Comprehensiveness was varied across three levels by giving subjects (1) the detailed agenda alone (Specific Heuristic) (2) both the detailed agenda and The Consensus Approach (Coupled Heuristics), or (c) a procedure that integrated the detailed agenda and Consensus Approach (Integrated Heuristic). The Restrictiveness of a heuristic refers to the degree to which it limits or channels the group's behavior. In this study groups were either instructed to follow the instructions for decision making exactly as they used the GDSS (High Restrictiveness) or to select features that seemed most useful and apply them in any meaningful order (Low Restrictiveness).

This study employed the Foundation decision-making task. Results indicated that Restrictiveness had no impact on Consensus, but that groups using the Coupled Heuristics had significantly higher levels of Consensus than groups with either the

Specific or Integrated Heuristics, suggesting that the Heuristic manipulation had more complex effects than expected. These results suggest that giving groups a general set of principles as well as specific instructions enabled them to use the GDSS to better effect than if they were only focused on the specific steps in the GDSS. The Integrated Heuristic was likely less effective than the coupled heuristics because it was quite complex and may have been difficult for the groups to implement: groups using the Integrated Heuristic took longer to complete their sessions than those in the other conditions, though they did not differ in terms of amount of communication. A follow up study indicated that groups using the Consensus Approach alone (with no detailed agenda) also had higher levels of Consensus than did groups using either the Specific or Integrated heuristics.

An unpublished follow-up study of group processes in the D'Onofrio et al. study by Poole and Lee-Partridge (1992) sheds some light on the results for Comprehensiveness. Integrated groups spent significantly more time defining and discussing criteria than groups with Coupled heuristics. Integrated groups also connected criteria to other ideas than did Coupled groups, which in turn engaged in more ideational connection than did Specific groups, also a good thing according to normative decision theory. However, groups with Coupled heuristics had more leadership emergence than groups with Specific heuristics. And Specific groups had the most organized decision paths, followed by Coupled groups, with Integrated groups having the least organized decision paths. Integrated groups also had a significantly lower proportion of orientation behavior than groups with Specific or Coupled heuristics. Though the interaction in groups in all conditions was very focused on their task, there was significantly less task focus in Integrated groups than in Specific or Coupled groups. Of interest, however, task-communication fit in Integrated Groups was significantly greater than in Coupled groups, though no differences were found between either condition and the Specific groups. This was probably due to the fact that Integrated groups spent more time on criteria than did the other groups. In addition, the Integrated and Coupled groups used the GDSS procedures more faithfully than did the Specific groups. There were no differences due to Heuristics in number of problems encountered in using the GDSS. There were also no differences in procedural insight due to the conditions.

Overall, Poole and Lee-Partridge's analysis suggests that groups following the Consensus Approach used the GDSS more effectively than those that only followed the Specific Agenda. However, there was a divergence between Coupled and Integrated groups in how well they meshed the Consensus Approach into their work. Those following the Integrated Heuristic devoted themselves to carrying out the agenda in the spirit of the Consensus Approach (hence good task-communication fit and use of criteria), but doing so led them to engage in less structured interaction than the other groups (hence more complex decision paths). As a result, despite their best efforts, the Integrated groups did not seem to be able to follow the Consensus Approach in their decision making as well as the Coupled groups (which had a separate short digest of the seven rules that make up the Consensus Approach rather than having these rules embedded in the GDSS agenda). It may well be that over time, as they become more proficient in following their complex procedure, Integrated groups would perform as well as Coupled groups, or better.

This analysis also yielded some insights into the process impacts of Restrictiveness. High Restrictive groups were less equal in participation and had more indicators of leadership emergence than Low Restrictive groups, though there were no differences in perceived leadership across conditions. High Restrictive groups also engaged in more formal idea evaluation than Low Restrictive groups, though there was no difference among any of the conditions in productive uses of evaluation. Overall, High Restrictive groups also used the GDSS more faithfully than did Low Restrictive groups. No differences in the number of problems were observed between High and Low Restrictive conditions.

Training. Chelley Vician (Vician, Vician & DeSanctis, 2000) studied the delivery of training regarding how to use the GDSS. Her study focused on training users to perform four roles in using the GDSS: chairperson, recorder, technology operator and member. Each of these roles had specific duties attached to it. For instance, the recorder entered problems, options, and criteria into the GDSS. She had two different types of training: (1) Training in which members were trained in all four roles (Rotating Roles); and (2) Training in which each member was trained in only one role, but practiced that role through several different tasks (Fixed Roles). These two conditions were compared to a control group in which members were trained in SAMM but not roles for using it (No Training). SAMM training was given to the two Role conditions as well. Groups performed three creativity tasks which required them to generate ideas and an intellective task in which they evaluated one of the sets of ideas.

Results showed that there were no differences in Number of Ideas Generated, Quality of Ideas as rated by observers, Perceived Quality of Ideas, Decision Scheme Satisfaction, or Time on Task between the conditions. There were no differences in orientation time among the conditions, with one exception. For the intellective task there were shorter orientation times for the groups with assigned roles than in the control groups. The analysis also indicated that members were more comfortable with Fixed Roles than with Rotating Roles. In the Rotating Roles condition, members reported significantly more Understanding of Multiple Roles than in the Fixed Roles condition. There was, however, no difference in Understanding of Roles or Role Ambiguity across conditions.

Facilitation. Following up on the unusual results from the Level 2 multi-criteria decision study, Joo-Eng Lee-Partridge conducted a study that compared different facilitation styles for GDSS sessions (Dickson, Lee Partridge, & Robinson, 1993; 1996). In this study a Firm Facilitation style in which the facilitator led the group through the procedure was contrasted with a Flexible Facilitation style in which the facilitator helped the group carry out steps in the decision process, but let the group decide which steps to undertake. The groups carried out the Foundation task using Level 2 multicriteria decision analysis.

Facilitated groups had higher levels of Consensus change than did groups with No Facilitator, supporting the contention that guidance is helpful with Level 2 procedures (similar results were found in a preliminary study by Dickson, Lee, Robinson & Heath, 1989). In addition, groups with Flexible Facilitation had higher degrees of Consensus than did those with Firm Facilitation, suggesting that groups desire some measure of

control over their decision process. Groups with Flexible Facilitation had significantly higher Perceived Quality and Decision Scheme Satisfaction than groups with Firm Facilitation or No Facilitation. Groups with Flexible Facilitation and No Facilitator had higher levels of Confidence in their decision than did groups with Firm Facilitation. Groups with Flexible Facilitation also achieved higher levels of Coorientation (understanding of one another's feelings about the decision) than did groups with Firm Facilitation. Facilitated groups achieved higher levels of understanding of the GDSS and its outputs than Non-facilitated groups. Facilitated groups had significantly higher Perceived Depth of Analysis than Non-facilitated groups, but only for groups with low initial levels of consensus (similar to Sambamurthy's results). Consistent with this, Facilitated groups took longer to make their decisions than Non-facilitated groups. Of interest is the finding that there was no difference in Satisfaction with the Facilitator between Flexible and Firm Facilitation groups.

There were also some observations of the process in the groups. Facilitated groups generated significantly more criteria than did Non-facilitated groups and they used these criteria in evaluating ideas more. Dickson et al. (1993) also conducted a follow-up study of high versus low performing groups from each condition. High performing groups in all conditions: (1) Had a member or facilitator who knew and took charge of the process; (2) Engaged the task seriously and in-depth; (3) Tried several different combinations of weights in the allocate step and discussed the ratings thoroughly; (4) When conflicts arose, groups engaged in constructive conflict management discussion rather than negotiation/bargaining/tradeoffs in making their decision.

Level 3 Guidance. The Lee-Partridge studies and a number of studies of GDSSs conducted by other researchers have pointed to the importance of facilitation in the effective use of complex procedures. This type of support could be provided by a human facilitator, but it could also be provided by a Level 3 GDSS that incorporated rules for guiding groups through complex procedures. Moez Limayem's (1994) dissertation studied a prototype Level 3 GDSS that guided groups through multiattribute decision making (Limayem & DeSanctis, 2000). An add-on to SAMM was constructed that displayed screens explaining each step of the procedure and how to interpret system results. It incorporated three types of guidance: (a) Backward Guidance, in which the system gave the group feedback on its activities, such as uncompleted steps so that members could rectify omissions or items which had great divergence in ratings that required further discussion; (b) Forward Guidance, which led the groups through the steps of the procedure and explained their purpose and how to do them; and (c) Preventive Guidance, which "warned" the group about possible errors or problems so it could avoid them. All guidance was provided through text messages that, in effect, automated facilitation. The system was not as flexible as a human facilitator, but it was quite consistent and perhaps more thorough than many facilitators would be. The study employed the Foundation task. Groups using the Level 3 GDSS were compared to groups using a Level 2 GDSS to conduct the multi-criteria decision analysis. Level 2 groups were trained in the procedure and given a printed guide to help them through the steps.

Results indicated that Level 3 groups achieved higher levels of Consensus than Level 2 groups. Level 3 groups had significantly higher levels of Perceived Quality and Decision Scheme Satisfaction than Level 2 groups. There were no differences in Confidence in the Decision between Level 2 and Level 3 groups. Level 3 groups also had significantly greater Perceived Depth of Analysis than Level 2 groups. Level 3 groups also took significantly longer to make their decision than did Level 2 groups. Limayem, Banerjee, and Ma (2006), replicating the study with a different sample, found the same results.

Level 3 groups had significantly better Understanding of the Procedure and the meaning of GDSS outputs than did Level 2 groups with no guidance. Level of Understanding mediated the impacts of Level on other outcomes: in an SEM analysis it positively predicted change in Consensus, Perceived Decision Quality, Decision Scheme Satisfaction, Confidence in the Solution, Depth of Analysis, and attitudes toward the GDSS.

Adding Level 3 guidance, then, significantly improved groups' ability to benefit from Level 2 decision aids. The study did not try to sort out the impacts of the backward, forward and preventive guidance, and this would be a good subject for future research.

4.4.4 (Table 4) Adaptive Structuration Findings

This section addresses the question: How does the process of using a GDSS mediate its impacts on group processes and outcomes? It focused on structuration processes in GDSS use. We employed three strategies in our analysis of structuration: (1) We looked for within cell variation in processes and outcomes; (2) We developed analytical methods to study structuration directly; and (3) We developed scales to measure user attitudes related to structuration (challenge, comfort, respect). Each of these will be discussed in turn.

Within Condition Variability in Use of GDSS. Findings on differences between high performing and low performing groups within conditions, summarized in previous sections, provide preliminary evidence that structuration influences the impacts of GDSSs. Poole, Holmes, and DeSanctis (1991), previously summarized, provided evidence that groups that used the GDSS in ways that contributed to effective conflict management (e.g., discussing the results of votes instead of using the vote as a forcing device) had higher levels of consensus change than groups that did not. They identified nine activities that promoted or inhibited effective conflict management and calculated whether groups had net promotive or inhibiting use of the GDSS. This proved to be related to consensus change. Qualitative analysis by Zigurs et al. (1989) found that group use of influence strategies related to the GDSS and its outputs in interaction differed within cells and was related to group performance. Sambamurthy and Poole (1992) found that the sequence of conflict management activities differed within conditions and that some sequences were associated with higher levels of consensus change than others. Limayem and DeSanctis (2000) found that learning of the system mediated the impact of Level on outcomes within both Level 2 and Level 3 conditions.

While more direct evidence of the role of structuration in producing these within condition effects is required, they do provide prima facie evidence for the effect of structuration processes on outcomes.

Fidelity of Appropriation. The Appropriation Checklist provided us with an overall score for fidelity of appropriation for each experimental group. These were then used to assess the impact of GDSSs on various outcomes. Poole, Lind, Watson, and DeSanctis (1992) sampled Manual and Level 1 GDSS groups from Watson's study. In addition to the Fidelity score, they developed a measure of the degree to which the group's communication fit the demands of the task. An SEM analysis indicated that Fidelity increased Task-Communication Fit and that Task Communication Fit was positively related to Consensus Change, Perceived Quality, and Decision Scheme Satisfaction.

In an unpublished follow-up analysis Sambamurthy and Poole (1994) measured faithfulness and task-communication fit for a sample of Level 2 and Level 1 groups from Sambamurthy's dissertation. They found that Fidelity positively influenced amount of Conflict in the group discussions and that Conflict was positively related to Consensus Change and negatively related to Confidence in the group's recommendations. There were also direct negative relationships between Fidelity and Consensus Change and Confidence in the group's decision. There was no relationship between Fidelity and Task-Communication fit in this analysis. Instead the mediator between Fidelity and outcomes was level of Conflict interaction in the groups. This positive mediated relationship was stronger than the negative direct effect of Fidelity on Consensus Change, and the overall relationship between Fidelity and Consensus Change was positive.

Limayem, Banerjee and Ma (2006) studied the impact of Fidelity on Level 3 system use. The main theoretical proposition advanced by the authors is that decisional guidance by way of cognitive feedback and feedforward at decisional breakpoints leads to higher Fidelity of appropriation of the GDSS and consequently leads to better decisional outcomes and perceptions of the decisional process used to arrive at the outcomes. A laboratory experiment was conducted to test this proposition. The experimental design consisted of two treatment conditions: (1) control groups using the GDSS with no decision guidance; and (2) experimental groups using the same GDSS enhanced with the decision guidance mechanisms described in the previous section. Groups were randomly assigned to the treatment conditions. A total of 40 groups of 5 members each (200 upper level undergraduate students from the business school of a university in Canada) were randomly assigned to one of the two treatment conditions (20 control groups and 20 experimental groups) that carried out the Foundation Task. In order to avoid the drawbacks usually associated with zero-history groups, groups that were selected had been working together on a series of class projects. Faithfulness of appropriation was measured using the Chin, Gopal and Salisbury (1997) scale that measured the members perceived faithfulness of appropriation. The results indicated that the Level 3 groups had higher levels of Fidelity than the Level 2 groups, which were related to higher levels of Consensus, Perceived Quality, and Decision Scheme Satisfaction. This study indicates the need to tailor the training and decisional guidance in a manner that promotes faithful

appropriation of the structure of the GDSS, thereby leading to better decision outcomes and perceptions of the decision process.

Studies of Microlevel Appropriation. Poole and DeSanctis (1992) conducted a follow-up study in which they used the Appropriation Move Coding System described above to study structuration in 18 groups drawn from the Watson and D'Onofrio studies. They sampled groups that varied in level of Restrictiveness of structures and in terms of effectiveness, as measured by Consensus Change during the discussion. Results indicated that there was considerable variation in how the groups appropriated the GDSS. The Restrictiveness of the GDSS had a strong impact on structuring behavior. Specifically, members using a Highly Restrictive GDSS were able to focus on appropriating the outputs of the GDSS, such as vote totals, whereas those with a Low Restrictive system had to spend more time determining how they would appropriate the system. Faithful appropriation of the system was related to Consensus Change: All nine High Consensus Change groups appropriated SAMM faithfully, whereas seven of nine Low Consensus Change groups appropriated the GDSS ironically. Mechanical, rote use of the GDSS was also related to lower levels of Consensus Change. Groups high in Consensus Change also tended to have one or two members who managed the process of GDSS use, whereas management of the groups with lower Consensus Change was shared. However, amount of Consensus Change was unrelated to conflict over using the GDSS. The study showed that effective appropriation of the GDSS depended on being able to use it in a discriminating fashion that adapted it to the task.

In this analysis, Poole and DeSanctis also found two distinct dynamics in the structuring of interaction. First, there was the *continuous* production and reproduction of structures as they are employed in activities. This continuous process often has a subtle "directionality," setting up a momentum toward stabilizing or changing existing structures. Changes due to continuous structuration processes emerge very slowly and may introduce almost imperceptible changes in the structure.

Second, there were *junctures* at which groups made major choices concerning which structural features to appropriate, how they were appropriated, and whether and how would be reproduced. Whereas members often were not aware of continuous structuring activities, they were conscious of junctures and often tried to control structuration at these points. Observation of groups using a GDSS indicated five types of regular events (breakpoints) that could serve as junctures: the first bid to appropriate a given structure; conflict over an appropriation; a problem with the GDSS; explanations of how to use the GDSS or what its outputs or features meant; and transition points between task steps or activities. Each of these presents an occasion for introducing a new structure or a different interpretation of a structure; for combining or dissociating structural features; and for reaffirming or challenging a previous structure-in-use. The ensuing interaction sets the course for another period of continuous structuration and contributes either to maintenance or to change of the existing ensemble of structures-in-use.

Both dynamics weave together in structuration processes, with the junctures corresponding to structural "revolutions" and the continuous processes corresponding to structural

"evolution". How groups dealt with junctures related to their level of consensus change. High consensus change groups used the agenda to guide their work and actively worked to match the GDSS features to features of the task. Low consensus change groups did not mesh SAMM with the task particularly well and tended to see the GDSS as additional work, lowering the effectiveness with which they applied the technology. There is also evidence that guidance can affect how groups deal with junctures. Limayem (1995; Limayem & DeSanctis, 2000) reported qualitative evidence that the Level 3 support helped groups manage breakpoints in their discussion more smoothly than Level 2 groups.

Armstrong, Perez, and Sambamurthy (1993) conducted an analysis using the Microlevel Appropriation Coding Scheme with a sample of 19 Level 1 and Level 2 groups drawn from Sambamurthy's (1989) data. They found that Level 2 groups exhibited more direct appropriation—which reflects non-problematic, facile use of the GDSS—than Level 1 groups. In addition, Level 1 groups exhibited more conflict over appropriations of the GDSS than Level 2 groups.

Armstrong et al. (1993) also subdivided their groups into high and low consensus sets within each condition. They found that High consensus change Level 2 groups focused on GDSS structures less, GDSS Outputs more and External structures more than low consensus change Level 2 groups. In contrast, High Consensus Change Level 1 groups used GDSS structures less, GDSS Output more than Low Consensus Change Level 1 groups. These authors found that the overall proportion of GDSS structure use was negatively correlated with Consensus Change and Proportion of External Structure use was positively correlated with Consensus Change, which accounts for at least part of the difference in overall Consensus Change between Level 2 and Level 1 groups that was noted above.

Attitudes Toward the GDSS. One measure of appropriation is the attitudes that members form toward the GDSS in terms of Challenge, Comfort and Respect. Comfort is the degree to which the experience of using the GDSS is enjoyable and comfortable for the member, Challenge is the degree to which the GDSS enables the group to challenge itself to do its best; and Respect is the degree of positive affect the member has toward the system. These attitudes influence appropriation by affecting how groups apply the GDSS and whether they use its procedures with sufficient vigor and confidence to gain benefits from them. These attitudes form a type of feedback loop whereby, once formed, positive attitudes promote appropriation of the system and encourage further use and exploration. Negative attitudes dampen use by creating a distrust in the technology and, sometimes, even disdain toward it.

Sambamurthy (1989) developed measures for these and found no differences between Level 1 and Level 2 groups in Comfort, Challenge, or Respect. However, in a follow-up analysis Sambamurthy, DeSanctis, and Poole (1995) found that the three attitudes defined one underlying factor and that this factor, Attitude toward the GDSS, was positively related to Confidence in the group's recommendations, Perceived Quality of the decision, and Decision Scheme Satisfaction. In Vician's study of training modes, there were no differences in Comfort, Challenge or Respect among the three conditions. Lee-Partridge's

groups did show differences, with Facilitated groups reporting significantly more Challenge, Comfort, and Respect than non-Facilitated groups and Flexible Facilitator groups reporting significantly more Comfort and Respect than Firm Facilitator groups. In Limayem's groups Level 3 groups reported significantly higher levels of Challenge, Comfort, and Respect than Level 2 groups. These results imply that facilitation and guidance can cultivate positive attitudes toward the system.

Limayem (2006) used the Adaptive Structuration Theory to investigate the tradeoffs associated with Human Facilitation and Automated Facilitation. Groups using a Level 2 multicriteria decision model to work on the Foundation Task were exposed to one of two experimental conditions: (1) Human Facilitation, or (2) Automated Facilitation (a Level 3 system). Results indicated that Automated Facilitation was as effective as Human Facilitation in enhancing the Fidelity of appropriation of the GDSS.

While they did not measure the three attitudes, Zigurs, Poole and DeSanctis (1988) observed that GDSS and Manual groups that had positive approaches to their technology/procedures and adapted them to their tasks had much more productive discussions than those that did not.

Other Observations on Structuration of GDSSs. Another way to tap global use is to study the terms members use to describe the system. These give a holistic picture of how members regard the GDSS. DeSanctis et al. (1994) asked users to suggest metaphors and descriptions for SAMM. Users of the Level 2 features tended to choose action-oriented descriptive terms (e.g., "organized," "gathers information") while those who only used Level 1 features tended to use trait-like descriptors (e.g. "intelligent," "unknowledgeable," and "quiet"). This suggests that those using Level 2 features see the system as more complex than those using Level 1 features.

5.0 Field Studies (Table 5)

Field studies began in the third and fourth years of the program. Two major field sites were involved: the Internal Revenue Service (IRS) and the Texaco oil company. Our collaborators at the field sites were interested in applying GDSSs in their organizations, and we used the opportunity for longitudinal analysis of a variety of team processes and activities. In both cases, the field sites provided the hardware and room facilities while we provided licensing and free support for the SAMM software. In return, we were given significant access to the teams, with the opportunity to videotape team meetings and assess team member perceptions through interviews and questionnaires.

5.5.1 Do GDSSs Make a Difference in the Field?

Group decision support systems clearly *did* make a difference in these two field sites. In the IRS teams, team members generally had favorable attitudes toward SAMM and voluntary use of the system was high (DeSanctis, Poole, Lewis & DeSharnais, 1991-1992). For example, the polling feature helped teams see both where they agreed and

disagreed in a clear way, leading one team to find that it had been "arguing over nothing" once they saw the actual agreement reflected in the poll.

Timing of the introduction of the GDSS seemed to make a difference in effectiveness. SAMM was used more and with better results when it was introduced soon after the formation of the team than when it was introduced mid-stream with a team that had already been working together (DeSanctis, Poole, DeSharnais & Lewis, 1991). Existing problems or conflicts within a team tended to carry over into its use of the GDSS, lessening the benefits that could be derived from the system (Poole, DeSanctis, Kirsch, & Jackson, 1994).

Another major factor in the success of SAMM was the extent to which the team's task process was well-matched with SAMM's capabilities. In the IRS teams, for example, the quality procedure steps fit well with the functionality of SAMM, and teams were able to map quality steps with system functions. However, a straightforward task-technology fit did not fully explain all instances of effectiveness. A counter-example was provided by one of the Texaco teams, in which SAMM was most beneficial to the team that had relatively poor fit between the tools and their task requirements (DeSanctis, Poole, Dickson & Jackson, 1993). The latter team became more and more competent in using SAMM over time through a continuous learning process (Vician, DeSanctis, Poole & Jackson, 1992).

Effective use was dependent not only on timing and match with task process, but with effective alignment among the system, the team's tasks, and group norms and other structures. This alignment requires a continuous process of adjustment and reflects a more complex set of relationships that simple task-technology fit.

Michele Jackson and Poole (2003) studied 37 brainstorming sessions conducted by the IRS quality teams and also a few teams from Texaco (see below), comparing sessions in which teams used SAMM to brainstorm to those in which they recorded their brainstorm on flipcharts or paper. They found that GDSS groups typically generated fewer ideas than groups recording their ideas manually, which was a surprise. Moreover, the teams generated significantly fewer ideas than did groups of the same size in lab studies of GDSSs conducted by our research team and by other researchers. This seemed to be due to two reasons. In some groups, quantity of ideas seemed to be less important than other functions that idea generation served. For example, some groups seemed to use brainstorming as a ritual to manage transitioning to a new activity; since members had been trained to generate ideas at the beginning of the quality process, coming up with a list of ideas was a way to signal a fresh start. Second, some topics had natural limits on the number of possible ideas. In some cases, for instance, teams were limited in the range of options they could consider by legal regulations and organizational rules, and this constrained how far they could go in brainstorming.

Jackson and Poole also found that when the teams used the GDSS, they spent more time managing the brainstorming process than when they used a flipchart or paper to record ideas. When the teams used flipcharts they spent more time elaborating and criticizing

ideas than did teams in sessions that used the GDSS. On average, only 15% of the time in each session was devoted to actually generating ideas. Most of the remainder of the time not spent on procedures was spent making sense of the ideas and putting them into the bigger scheme of things.

5.5.2 Is More Sophisticated Support Better?

One of the clear findings from the field studies was the wide variation in degree and type of use of SAMM. Many of the early studies of GDSS took a relatively monolithic view of the meaning and use of the technology. Our studies confirmed that GDSS technology is neither deterministic nor monolithic.

In the IRS teams, Level 1 features such as brainstorming and evaluation were the most frequently used parts of the system(DeSanctis et al., 1991). Level 2 features required more support from the facilitator and more training, though they did have powerful effects on group process when they were used. Timing of introduction of the technology interacted with level of tools used, in that teams that started using SAMM early in the life of the team tended to use Level 2 features more often (DeSanctis et al., 1991-1992).

Overall, the use of Level 2 tools increased group effectiveness when the group faced complex tasks and disagreements among members. Level 2 features enabled teams to gather and display multiple viewpoints, provide structure for complex tasks, and enhance efficiency of meetings.

5.5.3 What Difference Do Facilitators Make?

We observed clear differences among teams as a function of the facilitator or leader in the team. Even for the low use teams, when facilitators could guide the group through SAMM, the groups seemed to make better progress (Poole, DeSanctis, Kirsch, & Jackson, 1995). For example, in the Texaco team that had the most effective use of SAMM, the leader's influence played a significant role. The leader emphasized participation and made an effort to use quality management procedures and SAMM tools extensively in the team's work. The leader also helped the team to map its complex tasks to SAMM features. Her repeated efforts promoted learning of the system and enabled the team to appropriate the technology in ways that facilitated its work (Vician et al., 1992).

The facilitator or leader has a role to play in guiding the GDSS and encouraging members to use the system during the learning process. Effective appropriation depends on a continuous learning process on the part of all or most of the members of the team.

5.4.4 What Patterns of Appropriation Make a Difference?

Identifying different patterns in appropriation helps to make sense of the complexity of the rich data that comes from field sites. One study set out to explicitly identify patterns in appropriation and alignment by examining teams across both of the field sites (Poole, Jackson, Kirsch, & DeSanctis, 1998). Five global appropriation types were identified,

each of which characterized a team in terms of a combination of its mastery of the GDSS, range of uses of the technology, consistency with spirit, comfort with the technology, and role of facilitation. The typology helped to show that effective use of the GDSS is most likely if the team becomes independent in the use of the system, either functionally autonomous and able to manage the system itself or able to determine the procedures it wants to use and to direct the facilitator or resident expert as to how it wishes to use them.

The same cross-site study also identified four patterns of alignment among the structure of the GDSS, the team's task, internal relationships among team members, and pre-existing structure other than the task, such as work procedures or power relationships within the team. The patterns are:

(1) *Task-driven implementation* focused on aligning the task, GDSS structures, and pre-existing structures, placing relatively little emphasis on internal relationships. This is a very work-focused appropriation.

(2) *Task-driven rejection* focused primarily on the task and pre-existing structures. The GDSS structures are not activated or aligned with the other structures, because the group does not perceive them to have potential to facilitate the group's work.

(3) *Technologically-supported navel gazing* is focused on aligning the GDSS structures with the internal system of relationships among members. The group uses the GDSS to evaluate group practices and analyze relationships, with very little attention to the task. Groups with this alignment are not very productive, though they may learn about themselves and their members.

(4) *Technologically-mediated struggle* the focus is on aligning the GDSS with pre-existing power structures in the group and internal relations in the group. Often this involves a conflict between the leader and a group of members who have different attitudes toward the GDSS. This pattern may cause problems for the group, because it underemphasizes the task at the expense of relationships.

This typology implies that effective appropriation of the GDSS depends on emphasizing task and process uses and on constraining power-related uses of the system to those that move the group toward its goals.

We can also identify patterns in a more informal sense, that is, as recurring themes in the data. One such theme was in the balance of process versus task orientation. Too much emphasis on internal group processes to the exclusion of work lead to ineffective appropriation of the GDSS. For example, the comparison of brainstorming sessions in which teams used SAMM versus sessions in which they did not revealed an over-emphasis in the SAMM sessions on procedures rather than ideas. Teams spent too much time managing the brainstorming process and the result was fewer ideas generated.

A second theme relates to the balance of member versus facilitator initiation of the use of SAMM. In the IRS teams in particular, members initiated the use of SAMM about as often as team leaders or quality facilitators did (DeSanctis et al., 1991). Member initiation was positively correlated with observers' ratings of the team's comfort with SAMM, the adequacy of SAMM for the task at hand, and the adequacy of training in SAMM. This observation reflects consistency with the spirit of the system, which embodies a democratic approach and equal participation.

DeSanctis et al. (1991-1992) studied instrumental uses of the GDSS using the coding scheme described above. Most instrumental uses involved the task and process functions. SAMM was also used for power and individualistic functions in two groups. Interestingly, these were the groups in which members were most in control of the use of the system. In groups in which members and leaders/facilitators had about equal initiation of SAMM use, task oriented use predominated. Closer inspection of the power moves suggested that most served team-oriented functions, such as redirecting the team to task activities, getting the team back on track, or to move the team on to action from discussion.

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