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A Conceptual Model Toward a Flexible GSS Coordination Structure

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ABSTRACT

Though many GSS research findings suggest the benefits of restricting group interaction to GSS-prescribed procedures and rules, called a coordination structure, these findings cannot be generalized for all situations of group interaction supports with GSS. There are also many studies that argue for a flexible coordination structure to overcome the negative effects of restrictive coordination. Flexibility in a coordination structure is more significant in supporting asynchronously interacting distributed groups because interacting is only through Computer-Mediated Communication Systems, and takes place anytime and anywhere. In this study, the concept of restricitveness of a coordination structure is reviewed, and a conceptual model is developed to describe how restrictiveness is determined, and affect group performance. The study recommends that a more flexible coordination structure be appropriate for asynchronously interacting distributed group.

INTRODUCTION

Ellis et al. (1991) argue that support for group interaction must attend to communication and collaboration, and the effectiveness of interaction support can be enhanced if group's activities are coordinated. Coordination is an activity in itself, and a necessary overhead when several parties are performing a task to avoid conflicting or repetitive actions (Malone and Crowston 1990). Poole and DeSanctis (1990) characterize a coordination structure with Group Support Systems (GSS) as an arrangement of rules and resources to structure interaction process, to which group interaction is expected to conform. A coordination structure is also referred to as coordination strategy (Horton and Biolsi 1994), decision-making heuristics (Mennecke et al. 1992, Wheeler and Valacich 1996), or work structure (Bendifallah and Scacchi 1989) in other GSS literature.

Coordination is particularly important in supporting decision-making groups because group decision-making is a coordination process of individual problem-solving (Tindale, 1989). Indeed, interaction process structuring for coordination was one of the most important key variables in GSS studies over the last ten years (Fjermestad and Hiltz 1999). Therefore, the effectiveness of group decision-making is contingent upon a group's ability to coordinate a series of individual problem-solving and group interaction. Each group member performs individual problem-solving between group interaction. During group interaction, the results of individual problem solving are communicated, feedback generated, and inputs from others collected for the next round of individual problem solving.

Though it is relatively easy to provide an effective coordination structure for face-to-face group interaction, asynchronous (anytime-anywhere) interaction of distributed groups requires special coordination structures (Chidambaram and Jones 1993; Turoff 1991; Turoff et al. 1993). The difficulty of coordinating asynchronous interaction comes from the fact that group communication is not only through Computer-Mediated Communication Systems (CMCS) but also can take place anytime and anywhere. Because mediated communication makes it difficult for groups to exchange information effectively (Hightower and Sayeed 1996), these groups usually take longer to complete tasks and are less likely to reach consensus than face-to-face groups (McGrath and Hollingshead 1994). If coordination of asynchronous group interaction is restricted only to system-defined procedures, however, a group with interacting through CMCS would fail to achieve a critical mass of interaction, which is essential for the success of mediated communication systems (Grudin 1994; Turoff et al. 1993). It is because of the negative effects of mediated communication such as the lack of social presence (Short et al. 1976) and limited bandwidth of an interaction medium (Hiltz and Johnson 1990). Besides, for anytime-anywhere interaction support, coordination should include the ways to support larger decision groups, to improve participation of uncooperative subgroups, to incorporate better meta-models for both individual and group problem solving, and to provide software support for leadership and facilitation roles (Turoff et al. 1993).

FLEXIBLE COORDINATION AND SYSTEM RESTRICTIVENESS

What would be an appropriate coordination structure for effective group interaction support? And what would affect the effectiveness of a coordination structure? Which GSS design features are necessary to help groups overcome the negative effects of GSS-mediated interaction? Anson et al. (1995) argue that coordination of group interaction, or facilitation, should be flexible in response to evolving group needs. Because a coordination structure determines who can talk to whom, when, how and about what (Poole 1986), strictly enforcing rules and procedures of a coordination structure could constrict effective communication of a group. As a result, the group may fail to generate the critical mass of interaction necessary for effective group decision-making, which negatively affects group outcomes (Grudin 1994), particularly in asynchronously interacting groups (Turoff et al. 1993). Too much freedom in coordination, however, is a problem in computer-mediated group interaction because social context cues (Siegel et al. 1986) and social presence (Short et al. 1976) are already missing

Recently emerging GSS research concerns system restrictiveness of a coordination structure in supporting group interaction through Computer-Mediated Communication Systems (CMCS) (Chidambaram and Jones 1993; DeSanctis et al. 1989, Dickson et al. 1993; McLeod and Liker 1992; Mennecke et al. 1992; Wheeler and Valacich 1996). DeSanctis et al. (1989) define system restrictiveness as the extent to which process intervention limits or channels groups' use of activities and sequences inherent in process intervention. It either gives a group freedom to adopt any features in any manner, or forces to use a prescribed structure, where a structure refers to the arrangement of interaction activities and sequences. There are two perspectives on restrictiveness of a coordination structure (McLeod and Liker 1992). One view holds that restrictiveness is innate to technology (Silver 1990); the other view sees it as the ability to impede the use of other structures not prescribed in a coordination structure (Anson et al. 1995; Wheeler and Valacich 1996).

Groups will not always use coordination structures designed with a deterministic view in ways intended by system designers. As the adaptive structuration theory states (DeSanctis and Poole 1994), groups will actively appropriate technology to their own ends. In doing so, a group tries to re-structure technology as it becomes meshed with its interaction system. With a restrictive structure, groups may lose group cohesiveness, social presence, and most of all, synergistic benefits of group interaction if they fail to adapt the structure to their own needs. When this happens, a group may simply produce the mere sum of individual work, which is one of the characteristics of poorly coordinated groups (Horton and Biolsi 1994).

A few studies on group coordination corroborate the need to provide a less restrictive structure to give more flexibility. McLeod and Liker (1992) report that in low structure systems for face-to-face interaction where a low structure refers to a less restrictive structure, groups exert more influence over technology than technology exerts over groups. DeSanctis et al. (1989) observe that excessive restrictiveness may cause groups to lose their sense of ownership and control over technology and, thus, may reduce consensus. Wheeler et al. (1993) find that groups with a restrictive coordination structure develop a sequential interaction pattern while groups with a less restrictive coordination structure adopt a cyclical pattern and generate better group outcomes. When interacting through CMCS, in particular, where bandwidth is already limited, additional introduction of coordination structures further constricts the breadth of a communication channel and the nature of communication (Chidambaram and Jones 1993). Other studies also observe the negative impact of restrictive coordination and recommend flexible facilitation (Anson et al. 1995; Dickson et al. 1993).

In general, the research findings on system restrictiveness of GSS coordination structures are leaning toward flexible coordination to help groups develop their own decision strategies that are compatible with groups' contingent factors. Flexible coordination structures do not enforce any pre-determined interaction procedures, but may result in better group productivity by allowing groups to choose the most effective decision-making strategy, which maximizes the individual's freedom to concentrate on those aspects of a problem to which each individual can best contribute (Turoff et al. 1993). Anson et al. (1995) also argue that facilitation of a group process should be flexible in response to evolving group needs.

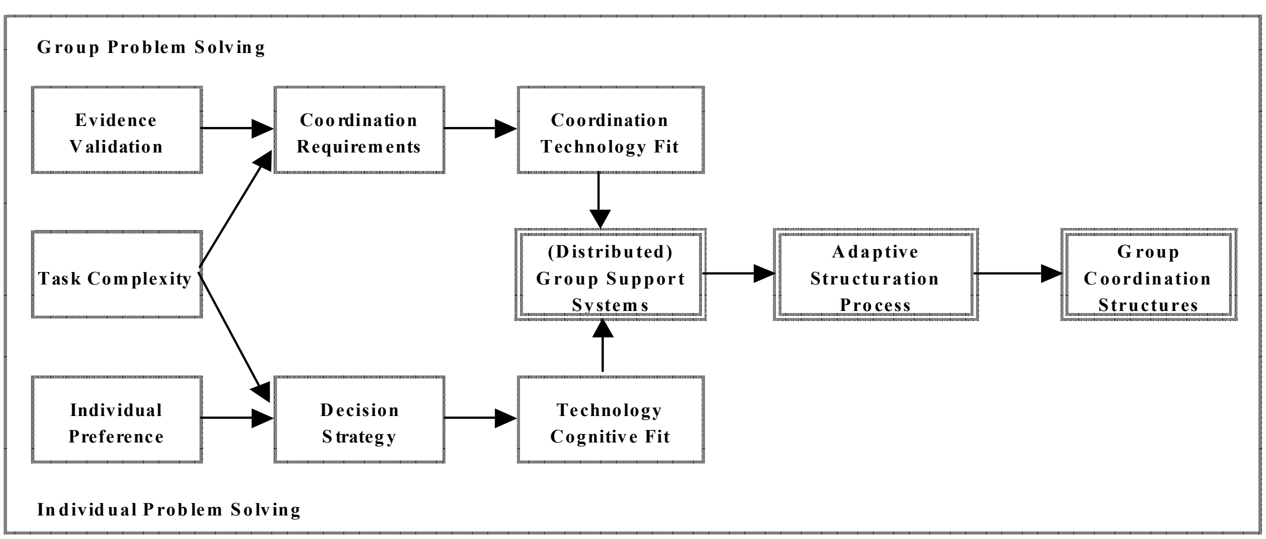
However, there have also been many decision room studies with face-to-face groups, which argue that restrictive structures can improve group processes and outcomes. Most studies focus on restrictive intervention into a group process by providing structures to impact and change the behavior of groups, and limiting group interaction to GSS-prescribed rules and procedures. Among these studies, the majority results point out that restricting group interaction to some degree with GSS structures generates better group outcomes and processes. For example, the study of anonymity using synchronous GSS has shown that groups generate more ideas using structured interaction than freely interacting face-to-face groups (Jessup et al. 1990).

A CONCEPTUAL FOUNDATION FOR FLEXIBLE COORDINATION: COORDINATION-COGNITIVE FIT MODEL

How much restrictiveness is appropriate, and what determines the most effective degree of restrictiveness of a coordination structure? The Coordination-Cognitive Fit Model in Figure 1 hypothesizes that restrictiveness of a coordination structure of GSS (Turoff et al. 1993) must match coordination requirements that are determined by task complexity (Zigurs and Buckland 1998). Task complexity affects coordination requirements by entailing a specific communication structure. In constructing a task representation from a given task environment, a group develops a decision logic (Poole 1986) which determines communication requirements to coordinate activities or the sequence of these activities, by describing who may communicate with whom, how, when, and under what condition. These communication requirements influence how flexible or restrictive a coordination structure should be. Because the characteristics of CMCS affects significantly the extent of information exchange (Hightower and Sayeed 1996), task complexity is particularly influential in asynchronous GSS, or Distributed GSS where CMCS is an only communication medium.

Hiltz and Turoff (1978/1993) assert that a validation ap-

Figure 1 The Coordination-Cognitive Fit Model



proach, which refers to the way a group determines what is a valid result in examining a problem, also imposes certain coordination requirements. Each approach prefers different information, and thus requires a different coordination process to get valid information. Hiltz and Turoff (1978/1993) argue that if GSS provide restrictive structures, some individuals may resist or break these structures or even leave groups because of the difference between an individual preference for a particular validity approach and group norms for synchronizing individual work.

Zigurs and Buckland (1998) argue that if GSS impose structures on a task to the extent that the task is modified to the tools and agenda enforced by GSS, it is possible that the assigned task may not be the one actually performed by a group. Therefore, by providing a flexible coordination structure, GSS should allow a group to tailor the most effective and efficient interaction structure through an adaptive process. This will enable a group to determine a coordination structure that best fits its needs. This leads to the first proposition of the model:

Proposition 1: A coordination structure should be compatible with coordination requirements that are determined by task complexity and validation approach.

The model also posits that an individual preference for a certain decision strategy is another determinant of restrictiveness of a coordination structure. Therefore, a coordination structure should be flexible enough to allow each individual to exercise his/her most preferable decision strategy. A highly structured, and thus more restrictive, coordination structure of GSS has a high probability of being incongruent with some decision-makers' cognitive preferences. As a result, it would lead to increased decision time or decreased accuracy. When an individual cognitive preference and a group decision-making strategy are incompatible, the inertia of adapting an individual problem solving preference to a group strategy becomes one of the sources of productivity loss.

Evidence indicates a need to support an individual's cognitive preference in group decision-making. A literature review shows the existence of multiple decision-making paths during a group decision-making process (Lacoursier 1980; Mintzberg et al. 1976; Poole 1983), which cannot be hashed into one system-defined path without negatively affecting group outcomes. Putnam (1979) states that individuals enter groups with a relatively inflexible preference for the particular cognitive map of decision-making, described as the 'preference for procedural order' construct. Payne (1982) also points out the tendency of individual persistency with the same problem solving approach, regardless of previous success or failure of the approach. Mason and Mitroff (1973) suggest the need to support all kinds of decision-makers who have different information gathering and evaluation preferences. These studies argue that though individuals are working in a group, they still maintain their own, relatively inflexible, preferred approach to decision-making. Thus, this discussion leads to the second proposition of the model as follow:

Proposition 2: A coordination structure should allow each group member to customize Group Support Systems features for his/her preferable decision strategy.

In sum, the Coordination-Cognitive Fit Model postulates that the degree of restrictiveness of a coordination structure is determined not only by task complexity and group's validation approach, but also by the cognitive preference of each individual. Coordination requirements, technology, and cognitive preference will go through an adaptive structuration process (DeSanctis and Poole 1994) to emerge a coordination structure with the appropriate degree of restrictiveness for effective group interaction. Therefore, GSS research needs to study how to provide a flexible coordination stricture so that individuals keep their preferred decision-making strategies, while maintaining group cohesiveness (Mennecke et al. 1992). The foregoing discussion of the Coordination-Cognitive Fit Model leads to the third proposition:

Proposition 3: The degree of restrictiveness of a coordination structure emerges through an adaptive structuration process among coordination requirements, decision strategy preferences, and GSS-defined procedures and rules.

CONCLUSION AND FUTURE RESEARCH

Conclusion

Though it is generally acknowledged that structuring group process is recommended by restricting group interaction with a GSS-defined coordination structure, a coordination structure should not be designed in a highly restrictive manner with rigid prescriptive protocols for coordination. Rather, it should be designed to allow a group flexibility to customize GSS features to be compatible with group's contingent factors. Though the term 'system restrictiveness' is used in most studies, the term 'system flexibility' or 'system tailorability' (Turoff et al. 1993) explains better the conclusion of this study and the underlying meaning of 'system restrictiveness.' A coordination structure should be designed in such a way that a group is allowed to "tailor" GSS features to individual and group preferences and contingent factors.

Future Research

Without a doubt, one extension of this study is to empirically verify the validity of the proposed model in this paper. Another direction is to examine the impact of a group adaptation process of GSS tools and procedures in a distributed group. This study could identify intervening factors that may explain why a group generates certain group outcomes with a particular arrangement of GSS features. The conclusion of this study is the need to provide flexible coordination tools and procedures so that a group can customize these tools. Without understanding the adaptive structuration process (DeSanctis and Poole 1994) of a group with these tools and procedures, however, it is difficult to generally apply the findings of this study in designing GSS to support unique coordination requirements of technology-mediated group interaction. If a study of an adaptation process can reveal the causal relationships among these variables, it would be very valuable to provide more meaningful guidelines in designing flexible coordination structures with GSS features.

Another direction is to establish a better theoretical foundation to explain the role of individual problem-solving in group decision-making. The lack of theoretical understanding of the role of individual problem-solving in a group has limited the experimental design and its manipulation, thereby making it difficult to study a coordination process between individual and group problem-solving. To date, very little research has been conducted to provide theoretical understanding of how individual problem-solving operates, is coordinated, and affects group decision processes and outcomes (Tindale 1989). A better theoretical foundation for individual and group decision-making processes and their relationship is necessary for further investigation of individual problem-solving processes in a decision-making group. This is particularly important in designing a GSS-defined coordination structure for asynchronously interacting distributed group where decision making is essentially a coordination and synchronization process of individual problem-solving.

REFERENCES

Anson, R., Bostrom, R., and Wynne, B., "An Experiment Assessing Group Support System and Facilitator Effects on Meeting Outcomes," *Management Science*, 41,2 (February 1995), pp. 189-208.

Bendifallah, S. and Scacchi, W., "Work Structures and Shifts: An Empirical Analysis of Software Specification Teamwork," *Proceedings of the Eleventh International Conference on Software Engineering*, 1989, pp. 260-270.

Chidambaram, L, and Jones, B., "Impact of Communication Medium and Computer Support on Group Perceptions and Performance: A Comparison of Face-to-Face and Dispersed Meetings," *MIS Quarterly,* 17, 4 (December 1993), pp. 465-491.

DeSanctis, G., D'Onofrio, M., Sambammurthy, V., and Poole, M.S., "Comprehensiveness and Restrictiveness in Group Decision Heuristics: Effects of Computer Support on Consensus Decision Making," *Proceedings of the Tenth International Conference on Information Systems*, 1989, pp. 131-140.

DeSanctis, G., and Poole, M.S., "Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory," *Organization Science*, 5, 2 (1994), pp. 121-147.

Dickson, G., Partridge, J.L., and Robinson, L., "Exploring Modes of Facilitative Support for GDSS Technology", *MIS Quarterly*, 17, 2 (June 1993), pp. 173-194.

Ellis, C.A., Gibbs, S., and Rein, G., "Groupware: Some Issues and Experiences," *Communications of the ACM,* 34, 1 (January 1991), pp.37-5

Fjermestad, J, and Hiltz, S.R., "An Assessment of Group Support Systems Experimental Research," *Journal of Management Information Systems*, 15, 3 (Winter 1998-1999) pp. 7-149.

Grudin, J., "Groupware and Social Dynamics: Eight Challenges for Developers," *Communications of the ACM*, 37, 1 (January 1994), pp. 92-105.

Hightower, R., and Sayeed, L., "Effects of Communication Mode and Prediscussion Information Distribution Characteristics on Information Exchange in Groups," *Information Systems Research*, 7, 4 (December 1996), pp. 451-465.

Hiltz, S.R., and Johnson, K.J., " User Satisfaction with Computer-Mediated Communication Systems," *Management Science,* 36, 6 (June 1990), pp. 739-764.

Hiltz, S.R. and Turoff, M., *The Network Nation: Human Communication via Computer*, Addison-Wesley Co, Reading MA, 1978/1993.

Horton, M. and Biolsi, D., "Coordination Challenges in a Computer-Supported Meeting Environment," *Journal of Management Information Systems,* 10, 3 (Winter 1993-1994), pp. 7-24.

Jessup, L.M., Connolly, T. and Galegher, J., "The Effects of Anonymity on GDSS Group Process with an Idea-Generating Task," *MIS Quarterly,* 14, 3 (September 1990), pp. 313-322.

Lacoursiere, R.B., *The Life Cycle of Groups: Group Developmental Stage Theory*, Human Sciences Press, New York NY, 1980.

Malone, T.W., and Crowston, K., "What Is Coordination Theory And How Can It Help Design Cooperative Work Systems?" *Proceedings of the Conference on Computer-Supported Cooperative Work*, 1990, pp. 257-270.

Mason, R., and Mitroff, I., "A Program for Research on Management Information Systems," *Management Science,* 19, 5 (January 1973), pp. 475-487.

McGrath, J.E., and Hollingshead, A.B., *Groups Interaction with Technology: Ideas, Evidence, Issues and an Agenda*, Sage Publications, London, 1994.

McLeod, P.L. and Liker, J.K., "Electronic Meeting Systems: Evidence From a Low Structure Environment," *Information Systems Research,* 3, 3 (September 1992), pp. 195-223.

Mennecke, B.E., Hoffer, H.A., and Wynne, B.E., "The Implications of Group Development and History for Group Support System Theory and Practice," *Small Group Research,* 23, 4 (November 1992), pp. 524-572.

Mintzberg, H., Raisinghani, D., and Theoret, A., "The Structure of Unstructured Decision Processes," *Administrative Science Quarterly*, 21 (1976), pp. 246-275.

Payne, J.W., "Contingent Decision Behavior," *Psychological Bulletin,* 92, 2 (September 1982), pp. 382-402.

Poole, M.S., "Developmental Processes in Group Decision-Making," in *Communication and Group Decision-Making*, R. Hirokawa and M.S. Poole (eds.), 1986, pp. 35-61.

Poole, M.S., "Decision Development in Small Groups III: A Multiple Sequence Model of Group Decision Development," *Communication Monographs*, 50 (1983), pp. 321-341.

Poole, M.S. and DeSanctis, G., "Understanding the Use of Group Decision Support Systems: The Theory of an Appropriation Process," in Fulk, J. and Steinfield, C. (eds.), *Organizations and Communication Technology*, 1990, Sage, Newbury Park, CA.

Putnam, L.L., "Preference for Procedural Order in Task-oriented Small Groups," *Communication Monographs,* 46, (1979), pp. 193-218.

Short, J., Williams, E., and Christie, B., *The Social Psychology of Telecommunications*, John Wiley, New York, NY, 1976.

Siegel, J., Dubrovsky, V. and Kiesler, S., "Group Processes in Computer-Mediated Communication," *Organizational Behavior and Human Decision Processes,* 37, (1986), pp. 157-158.

Silver, M.S., "Decision Support Systems: Directed and Nondirected Change," *Information Systems Research,* 1, 1 (March 1990), pp. 47-70.

Tindale, R.S., "Group vs. Individual Information Processing: The Effects of Outcome Feedback on Decision Making," *Organizational Behavior and Human Decision Processes,* 44, (1989), pp. 454-473.

Turoff, M., "Computer Mediated Communication Requirements for Group Support," *Organizational Computing,* 1, 1 (1991), pp. 85-113.

Turoff, M. and Hiltz, S.R., Baghat, A., and Rana, A., "Distributed Group Support Systems," *MIS Quarterly,* 17, 4 (December 1993), pp. 399-417.

Wheeler, B.C., and Valacich, J.S., "Facilitation, GSS, and Training as Sources of Process Restrictiveness and Guidance for Structured Group Decision Making: An Empirical Assessment," *Information Systems Research,* 7, 4 (December 1996), pp. 429-450.

Wheeler, B.C., and Mennecke, B.E., Scudder, J.N., "Restrictive Group Support Systems as a Source of Process Structure for High and Low Procedural Order Groups, *Small Group Research,* 24, 4 (November 1993), pp. 504-522.

Zigurs, I., and Buckland, B.K., "A Theory of Task/Technology Fit and Group Support Systems," *MIS Quarterly*, 22, 3 (September 1998), pp. 313-331.