Distributed Design groups: A case study

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Today's organizations are faced with a dynamic and turbulent environment. Many organizations have responded by becoming decentralized, teambased and dispersed (DeSanctis and Jackson, 1994). As a result, distributed groups that use electronic mail (email) to communicate and coordinate their work are growing in popularity. However, little is known about the tasks, structures and communication patterns of distributed groups.

Although much research has been done on the process of design (Curtis et al. 1988), the roles of interaction networks and structures in design have not been studied. The usual concerns of communication and coordination found in any type of software design are magnified in distributed groups. In this study, we examine the tasks, information type, structure, and communication patterns in the context of a distributed design group. We identify the tasks as well as structures and the communication patterns in the task groups. We also examine the effect of role on structure. The relevant roles are that of user and developer.

Specifically, the research questions addressed here in the context of distributed design groups concern the relationships between tasks and structure and roles and structure? We also examine the relationship between individual communication patterns and the role the individual is playing? We ask, what are the communication patterns of members who act as users or developers?

Organizational theorists have long proposed that informal interaction among organizational members is as important a determinant of structure as the formal structure (Burkhardt and Brass, 1990). Many have used social networks to study informal interactions (Krackhardt, 1991; Krackhardt and Porter, 1985) and the resultant informal structure (Brass, 1985; Burkhardt and Brass, 1990). Social network structure is defined as "the enduring characteristics of an organization reflected by the distribution of units and positions within an organization and their systematic relationships to each other" (James and Jones, 1976; p. 76). In this study, we adopt the social network view of structure.

Soar

To bound the study, we will study the in-depth processes and structures of one distributed cooperative research and design group Soar. This group is developing a general artificial intelligence architecture that later developed into a cognition theory. The Soar group communicates extensively by email. The data were collected by saving all messages sent and received by the Soar group members over the period of one month. A total of 396 messages were exchanged during this period.

Structure and the potential effect of email communication on structure

Extensive use of electronic mail might play a major role in determining the structure in design groups. Email allows a group to be disperse but frequent in its communication. Email also allows a group to be large and may collapse boundaries raised by status and roles (Markus and Culnan, 1987). On the other hand, electronic communication in large groups is often conducted through distribution lists and mailboxes, which can make the communication rigid and formal. This can reinforce the hierarchical structure of the organization. The context for which email is used may determine which one of these two possible effects occurs.

Tasks and roles individuals play are among the factors contributing to the overall context for which email is used. By determining the information processing requirements of the group, the task determines the group's communication structure (Galbraith, 1977). A task can be described in terms of its routineness or nonroutineness (Perrow, 1967, 1970). Degree of routineness is a function of the extent to which the task contains variety and is analyzable (Perrow, 1967). Routine tasks are characterized by low variety or a small number of exceptions and high analyzability (Daft and MacIntosh, 1981). Nonroutine tasks are less predictable and require creativity. Perrow (1970) has suggested that routine tasks benefit from the bureaucratic structures of hierarchies in that they can get the tasks done without delay and errors. A team structure is required when the task is complex and demands innovativeness.

The roles of senders and receivers as users and developers may also determine structure.

Task

Group maintenance, resource management and design were the three tasks considered in this study. These tasks were particularly interesting because they constitute the three core tasks of the Soar group. To determine the perceptions of task characteristic in terms of routineness, we utilized the instrument developed and validated by Daft and Macintosh (1981). The Daft and Macintosh instrument consists of a 5 item scale each for task analyzability and task variety.

The questionnaire was administered at a semiannual Soar workshop. The questionnaire was distributed to 57 participants. A total of 43 usable questionnaires were returned resulting in a response rate of 75%.

An analysis of variance was performed to determine whether the three tasks were significantly different in their routineness. Overall, resource management was found to be the most routine task, followed by group maintenance. The design task was perceived to be the most nonroutine. Thus, the resource management task is expected to be most hierarchical. The design task is expected to be team oriented.

Role

Developers are individuals who are engaged in developing the LISP code for the Soar architecture. Users use the Soar architecture to build artificial intelligence models or applications. Roles played by members in the group were determined by interviewing core individuals in the Soar group.

Task and Structure

Krackhardt's measure of graph hierarchy shows degree of hierarchy decreasing as nonroutineness of tasks increases. The resource management (89%) and group maintenance (85%) tasks are more hierarchical than design (71%). This is consistent with the literature on organization design. It has been repeatedly observed that nonroutine tasks have a greater need for information processing than routine tasks (Tushman, 1978; Leavitt, 1951). Research on innovation has shown that design task group members benefit from substantial exchange of information within and across locations on different approaches to solve technical or conceptual problems (Utterback, 1971). It has also been suggested that the implementation phase requires effective coordination and problem solving among all locations (Morton, 1971).

Role and Structure

The degree of hierarchy was higher for the developer group (87.5%) than the user group (76.5%). This observation is counterintuitive because users use the system in a prescribed (routine) way for their applications. However, users exhibited a more centralized structure (63% centralization) as compared to developers (14% centralization). It is conceivable that the degree of hierarchy measure will also support this finding with a larger sample.

Role and Communication Patterns

We expect that the communication needs of users and developers will be different in their level of participation in group discussions. We examine whether they send or receive more messages, and with whom do they communicate. Individuals were classified into the categories of users and developers by an informant who is a core member of the Soar group.

A total of 107 messages were sent by 29 developers and 47 users sent 289 messages. Because the sizes of user and developer populations were not comparable (47 users and 29 developers), chi-square analysis was performed to distinguish between communication patterns of user and developer groups. Chi-squares for resource management and design messages across two dimensions of subtask type (classification varies with task) and role (users and developers) were found to be significant at .062 and .019 respectively indicating that the communication patterns of the two roles are significantly different in these categories. Chi-square for Group maintenance was not significant.

Space limitations prevent us from interpreting the communication patterns and their implications in detail. Overall, users communicated heavily about implementation, bugs and patches. Developers, on the other hand, were mostly concerned with resource management. They discussed file management and hardware issues. Developers also communicated about scheduling meetings. This indicates that they performed a considerable amount of their work in face-to-face meetings.

Conclusion

The results show a promising pattern of task, structure and communication relationships. Routine tasks showed more hierarchical structures than nonroutine tasks. Communication patterns were found to be markedly different for users and developers in resource management and design task groups. It is important to understand the processes of these increasingly popular types of groups in design context to be able to design computer support for distributed design groups.