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PANEL

STUDYING DESIGN TEAMS -- CONTRASTING APPROACHES

Chair: **Joyce J. Elam**
University of Texas, Austin and
Harvard Business School

Panelists: Patricia J. Guinan, Boston University
John C. Henderson, MIT, Sloan School of Management

More than half the cost of producing large, complex software systems is related to "upstream" design activities. While formal design methodologies, development strategies, and requirements analysis techniques offer some direction for the management of this aspect of software development, studies indicate that their use does not necessarily result in proper problem definitions or adequate solutions to the users' needs. Ultimately, the answer to improved software productivity and quality must find its basis in research which attempts to understand the processes underlying the design and construction of large software systems.

Because such systems are generally designed by a group of cooperating experts, a study of design processes must include both group and individual dimensions. Experimental studies of small group behavior are quite numerous in the social science literature and would appear to be relevant to understanding the behavior of design teams. Typically, however, the tasks studied differ from the software development task with respect to several (interrelated) factors: the complexity of the project, the duration of the project, the structure of the decision problem, and the motivations of the team members. Because these factors can be reasonable determinants of group behavior and/or performance, it is difficult to generalize the findings of this literature to the group design of software systems.

Another area of research which is relevant to the study of design teams is software psychology. Software psychology emphasizes the development of models and theories of behavior that specifically describe human interaction with software. From the research in software psychology on individual software design, a common picture emerges. Individuals formulate mental models of the design problem, which lead them to be able to formulate initial mental models of their design. In general, these models are refined and expanded and they proceed from abstract toward more concrete levels of representation. Individuals tend to decompose problems into more manageable subproblems. They evaluate and explore solution models by mental simulation. Breakdowns in the individual design process occur as a result of cognitive limitations and/or lack of knowledge. It is precisely because of these breakdowns that the analysis and design of a complex software system is often assigned to a team.

An analysis of the processes involved in designing large-scale software systems can draw upon the research on small group behavior and individual software design by recognizing the diversity of team members' underlying conceptualizations, emphasizing the transformation of abstract goals into concrete systems, and distinguishing between those breakdowns in the design process which are a part of the individual design function and those which are the results of the group process itself. While there is a rich intellectual base to drawn upon in performing these analyses, no formal theories exist to explain the process of group design. Research in this area must be by necessity "theory-building."

This panel is composed of a group of researchers who are currently engaged in empirical studies of software design teams. Each study, however, is very different in terms of the research questions being addressed, the reference discipline upon which the research is based, and the research approach employed. The purpose of the panel discussion is to highlight the differences and similarities between the studies and provide some insights into the central issues being addressed by research in this area.

The research questions being addressed by the various studies are representative of the diverse set of behavioral, technical, and managerial issues that arise in studying design teams. Guinan's research addresses primarily behavioral issues. She points out that, even after years of experience and research, the IS profession is still criticized for building systems over budget, over deadline, and under the expectations of the user. Hence, our attention as IS researchers needs to focus on performance-based/pragmatic questions such as: "What characteristics and behaviors of developers help them to excel in developing effective systems?" and "Given user goals, what behaviors do excellent developers exhibit to meet those goals?" Elam's research addresses both behavioral and technical issues. Her research questions focus on identifying breakdowns that occur in the group design process and determining the requirements of computer-based tools that can be used to alleviate these breakdowns. Henderson's research addresses managerial issues. He is interested in understanding how different levels of involvement by team members affect design team performance and how such an understanding can be used to manage the design process more effectively.

Given the diversity of the research questions being asked by each study, it is not surprising that each study utilizes a different research approach. Elam adapted a well-known interaction analysis coding scheme from the group dynamics literature to use in validating a process model of group design activities. Video-tapes of design team meetings over a seven month period provided the base data for the study. Guinan also used a process tracing method to analyze simulated interactions between an individual who played the role of a user and an actual designer. Henderson developed a questionnaire that was used to collect data from a large number of design teams and utilized sophisticated statistical techniques to examine the link between involvement and performance.

With continued research and replication of studies such as those described by this panel, we can begin to understand how processes that occur during the design of large-scale software systems affect the overall quality of software systems. Such an understanding is the first step in developing new and improved tools, techniques, and project management procedures that will consistently improve the design and construction of software systems.