

COGNITIVE SCIENCE AND ORGANIZATIONAL DESIGN: ASSESSING THE IMPACT OF INFORMATION TECHNOLOGY ON ORGANIZATIONS

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RESEARCH PROBLEM

Since the invention of computers, researchers have investigated the relationship between information technology (IT) and organizational structure and processes. Our research involves a new technique to investigate this link. The technique analyzes information processing in organizations using concepts of object-oriented programming from artificial intelligence to characterize the information processing in terms of the kinds of messages people exchange and the ways they process those messages. The resulting models have more of the precision and flavor of cognitive science theories than most previous models based on the information processing view of organizations.

BACKGROUND LITERATURE

One limitation of past approaches was pointed out by Robey (1983), who noted that organizations are designed to achieve certain goals and that these designs include the information systems as well as the formal organizational structure. Studies that view IT as a cause of change rather than one of many factors that enable change may therefore find inconsistent results. Although IT is likely to have multiple effects, many studies have focused on only a single aspect of organizational structure. With no theory predicting multiple effects and few comprehensive studies, it is difficult to gauge the total effect of IT on an organization.

To do this, however, we need a theory in which the effects of IT are more easily interpretable. For this purpose, the information processing (IP) view of organizations (Galbraith, 1974, 1977; Tushman and Nadler, 1978) seem likely to be fruitful. Tushman and Nadler (1978) outline three basic assumptions of IP theories: organizations must deal with work-related uncertainty; organizations can fruitfully be seen as information processing systems; and organizations can be viewed as composed of sets of groups or departments (which they refer to as subunits, and which we will call agents). In this view, organizational structure is the pattern and content of the information flowing between the agents and the way they process this information. The IP view has a major, although as yet mostly unexploited advantage for investigating possible effects of IT since it directly includes what IT can do: process information.

IP theories of organizations grew from the "Carnegie school" of decision making (March and Simon, 1958; Cyert and March, 1963), whose authors attempted to model how organizations make decisions. They noted such key factors as the limited rationality of human beings. Their analysis emphasized factors such as the steps involved in decision-making and did not focus on the

amount and kinds of communication between different agents. Galbraith (1974, 1977) expanded on their work, explicitly considering an organization's need to process information and reduce environmental uncertainty, and strategies by which it could achieve this goal. Tushman and Nadler (1978) hypothesized that different organizations face different levels of uncertainty and that an organization's effectiveness would depend on the fit between its information processing capacity and its environment. The concepts discussed in these studies are still very aggregate, however. Such simplifications are useful for general studies, but permit only very limited conclusions.

RESEARCH DESIGN

Our technique attempts to make a finer analysis. Like many earlier IP theories, we treat the organization as a collection of intercommunicating agents, but instead of simply looking for the presence of information or uncertainty, we attempt to identify the content and purpose of the messages being exchanged and the actions that these messages trigger in the agents. The resulting model is similar to a program written in an object-oriented language (Goldberg and Robson, 1983; Stefik and Bobrow, 1986), since it specifies the different classes of agents, the messages they understand, and the processing they do for each message.

Our simple theories do not have any particular advantage for analyzing issues such as power, opportunism or satisfaction. Although we do not consider such features unimportant, omitting them and concentrating on those features which seem easier to model makes it possible for us to derive unambiguous conclusions, which may still explain substantial parts of the behavior of the organizations we study.

CONTRIBUTION OF THIS RESEARCH

Our theory has several advantages for study in the areas it does address. First, it offers an integrated framework for studying organizational structure. In previous studies, different aspects of organizational structure had unrelated definitions, drawn from many different reference disciplines. Our theory provides coherent definitions for many of these aspects, based on the flow of messages. The different sets of messages exchanged implement different organizational processes. The structure is the pattern of messages exchanged, that is, which agents are communicating and which messages they send. The set of messages to which a given agent responds, and the processing it therefore does, can be seen as the agent's role. With these definitions, we can begin to assess the link between IT and the whole structure of an organization.