OBSERVATIONS ON THE USE OF BEHAVIORAL MODELS IN INFORMATION SYSTEMS RESEARCH AND PRACTICE

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ABSTRACT: Much of the gap between the potential of Information Systems and their realization can be explained by behavioral and organizational issues. This paper outlines the scope of behavioral research in information systems using selected examples, identifies several principles underlying this work, and suggests reasons why the results of this research are of value.

KEYWORDS: Information Systems, Behavioral Research, Organization Theory, Models, Computer Applications, Implementation.

1.0 INTRODUCTION

It is generally agreeded that a gap exists between our skill in producing computer hardware and our ability to use it effectively to construct information systems. After more than two and a half decades of experience in implementing computer application systems a surprisingly large number of them still end in failure. My impression, based on discussions with a number of executives in both private and public sector organizations, is that somewhere between one third to a half of the systems (or major system modifications) that survive feasibility study never complete implementation or have negligible use two years after their completion. This opinion is supported by Thayer, et al. [18] who concluded that one third of the 60 large software projects they studied were failures.

Part of this short fall can be attributed to behavioral, political, or organizational issues rather than to technical characteristics of computer equipment. That is, these implementation failures can be explained by the behavior of people either building or using systems, or by factors in the organizational setting instead of issues, such as, equipment performance or the specific mix of hardware and operating system features.

A considerable body of behavioral science research applied to information systems has developed over the past few years. While practitioners are experienced in the techniques and principles of managing system implementations, they may not be familar with the results of this research.

This paper reviews and interprets some of the behavioral research in information systems with the objective of organizing this material and distilling several important, general themes. The material included is selective; it is intended to be representative of the type of research performed rather than being a compendium. See Kling [7] for a more complete discussion of the research in this field.

2.0 CLASSIFYING THE RESEARCH

One way to classify behavioral research in information systems is by the unit or level of analysis of the study. This approach has the advantage of clustering material that might be useful in investigating a particular problem. Borrowing heavily from Leavitt [10], table 1 presents one proposed arrangement. Behavioral research in information systems is divided into four levels or categories of analysis: individuals, pairs, small groups, and large groups.

At the individual level the objective is to understand human behavior. The issues are similarities among people, individual differences, attitudes, values, learning and problem solving, and roadblocks to achieving individual goals. At the second level, pairs of people, the principle issues are those of communication between people and the methods of influencing their behavior. These methods include pressure, coercion, manipulation, and collaboration. At the small group level, the issues are communication networks, communication content, and group processes. The evaluation of group processes raises issues of individual independence, conformity, conflict, and competition; a major focus is on group decision making. Consideration of people in large numbers raises issues of group interdependence, structure, process, technology, and environment.

It is this last category that many people associate with the word 'organization'. However, much of the work in information systems involves individual users and implementors, small project development teams, and steering committees. This argues for a broader definition of organization theory that includes issues associated with individual behavior, pairs of individuals, and small group dynamics, as well as those of large numbers of people.

Behavioral models are used in information systems research in two general ways: to represent the implementation process and to describe the consequences of computer use. Several examples from each classification are provided to illustrate the method and problems investigated.

2.1 Implementation Research: Implementation research has, as its central theme, the process of systems development. Much of this work derives from experience with Management Science implementations, little distinction being made between management science and information systems, even though the projects tend to be of different types and scale. Building information systems is viewed as bringing about planned organizational change. Researchers attempt to identify those factors or courses of action that positively contribute to system quality or to the probability of successful implementation.

For example, at the individual level, Ginzberg [5] explored users' pre-implementation expectations about an MIS as indicators of the likely success of the project. The results of his study suggest that users holding realistic pre-implementation expectations are more satisfied with the delivered system and use it more than those whose pre-implementation expectations are unrealistic. As Ginzberg observes, this finding holds considerable potential for improving the practice of system development by identifying (at an early stage when corrective action can still be taken) those systems that are likely to experience subsequent implementation difficulty.

In another individual level study, Lucas [11] found that, in the implementation of a large operations research model in a brokerage firm, favorable user attitudes, decision style, situational and personal factors, and performance were associated with successful implementation as measured by model use. Lucas suggests that system implementors should help the users develop favorable attitudes toward a system, for example, by encouraging heavy user involvement and control over design decisions.

An approach to overcoming barriers to user involvement has been suggested by Boland [2] in a study of pairs of individuals. He showed that the quality of interaction between the user and designer had an important influence on the resulting system design. In Boland's characterization of the traditional approach to system design, designers are technical specialists who initiate and control change. In his alternate implementation strategy based on mutual teaching, designers and users are viewed as equal members of the problem solving team. Boland found that the teaching approach to implementation produced designs that were of higher quality and used different types of control strategies than the traditional design approach.

In an organizational level study, Powers and Dickson [14] attempted to identify the factors affecting MIS project success. They concluded that a tremendous difference existed between the factors MIS professionals believed to be important for project success and the factors that were found to be important. First, they found that the success factors were different for each project type, that is, for data processing, MIS, and generalized software projects. Second, factors that were positively related to one success measure might well be inversely related to another success measure. For example, the organizational level of the top DP executive was positively related to one success criterion while also negatively related to another. Powers and Dickson concluded that a simple relationship did not exist between success measures and the factors that were supposed to be predictors of success.

These studies deal with the attitudes, expectations, involvement and control of participants in the implementation process; the theme behind many of them being that resolution of these issues play an important part in determining implementation outcomes.

2.2 Consequenses Research: Information systems consequenses research centers on the changes that occur in the task environment, organization structure, performance, and attitudes of workers when they use computer based application systems in performing their job. Researchers strive to understand what application system factors contribute to poor worker reactions and to discover ways in which jobs can be redesigned to improve working life quality.

In an individual level study of the use of computer application systems by clerical workers performing the same job, Turner [16] concluded that productivity, mental strain symptoms, and job dissatisfaction were all positively associated with computer use intensity. Work related stress was shown to be the primary factor influencing these outcomes. Furthermore, a trade-off was found in systems design: systems with batch processing organizations were both more productive and more stressful than interactive systems. The study suggests that these negative outcomes can apparently be corrected by creating jobs with more individual decision latitude and structural arrangements that promote problem solving.

Mann and Williams [12] studied the task and attitudinal changes that took place in the accounting department of a large utility after the introduction of a computer application system. They concluded that, after the system was implemented, the level of formalization in the job increased, individual autonomy in setting the work pace was reduced, the interdependence among workers increased, control over work became more centralized, and errors in work products became more apparent and assignable to individual workers.

In another individual level study, Henderson and Nutt [6] concluded that an executive's decision style influenced the strategic choices he made. The prospect of decision adoption and perception of risk were both found to be related to an executive's psychological makeup. These results suggest that an executive's personality should be considered in designing a system for his use.

Kling [8], in studying the social dynamics of computing development and use in complex organizations, has identified the social and political contexts in which the computer-based system is embedded, the infrastructures for supporting system development and use, and the history of local computing in the organization as important factors influencing service quality. These models link the development of computing to routine organizational activities and to negotiations, stressing the ways in which systems are valued by different participants.

Olson and Chervany [13] found, in an organizational level study, that highly specialized and standardized companies tended to decentralize their systems analysis function or to have permanent project development teams organized along functional lines. Companies that practice decentralized decision making in their functional areas also tended to have decentralized system development activities. Olson and Chervany concluded that the information services function experienced increased performance pressure and conflict when its structure was not consistent with that of the remainder of the organization.

These studies concern the changes in task, structure, and power that take place when computing systems are used in organizations. The notion being that these changes must be planned and managed if system implementations are to be successful.

3.0 DOMINANT PARADIGMS

A number of paradigms underly much of this research:

* The contingent nature of organizations, that is, the notion that the form of an organization is related to what it does and the environment in which it functions [9]. This suggests that the specifics of a situation will determine which of the many possible organizational variables are critical to an information system implementation.

* Organizations can be conceived of as information processors with organizational performance being a function of the match between the structural capacity to process information and the information needs of the organization [4]. In general, high capacity structures are more costly than low capacity ones suggesting that they should not be used unless necessary.

* Success, in terms of the benefits to be derived from an information system, is likely to be a function of the fit between the critical organizational variables and the characteristics of the information system [17].

* Information systems tend to involve managerial issues, such as changes in responsibility, structure, or power, which should be resolved separately from the system implementation.

* The implementation of an information system is a dynamic process. At each stage of the process, certain issues must be resolved in order for the implementation to be successful.

* Individual differences will influence how workers respond to information systems.

* The politics of the situation are likely to be critical in determining implementation outcomes. While technological issues are important, they tend to be easier to deal with than political factors because they lend

themselves to rational decision making.

These themes are particularly useful for diagnosing problem situations and suggesting courses of action for problem resolution.

4.0 APPLYING BEHAVIORAL RESEARCH IN PRACTICE

There are a number of reasons why behavioral models are important in practice. First, organizations are the context in which all application systems reside, and thus, an understanding of the ways organizations function can only improve information system implementation. Systems theory states that boundaries and interfaces are important factors in determining system performance and that setting of the system boundary is one of the most important design decisions. Yet, this decision is seldom made explicitly, with an understanding of organizational implications. Boundaries are often selected to suit other factors, creating problems that only become apparent later.

Consider the following example. An information systems specialist was asked to build an integrated payroll/personnel system because his organization was required to supply affirmative action data to the government and this data was not available from the existing, mostly manual systems. A package marketing representative had pointed out to executive management that because there was about 60% duplicate data in the two manual systems, one application system could serve both functional areas. However, in this situation the two functional departments reported to different vice presidents who both reported directly to the president. The departments were located in different parts of the country and they had a long history of interdepartmental conflict. The information systems specialist pointed out that one system serving both departments implied a managerial action - the combination of the two functions into one department - because a common system couldn't be developed for groups that wouldn't work together or agree on system requirements. He suggested that a managerial change be made combining the departments and realigning the vice presidents' responsibilities prior to the design of the system. Had system development gone forward before this managerial change was made, the project would have encountered resistance from members of both departments who perceived the system as a threat to their independence (which, in fact, it was).

The second reason behavioral models are important is that all information system implementations involve people, and an understanding of people's needs and why they behave in particular ways can improve the probability of success. There is a tendency, especially when working with machines, to presume that people work mechanically. Behavioral models stress the contingent and political nature of interacting with people and therefore serve to balance rational models.

Third, although there is a lot of prescriptive material about what should be done during implementation, there is relatively little on how to accomplish it. Behavioral models frequently provide useful clues about what factors may be important in translating ideas into action. For example, it is almost universally accepted that user involvement is a key to successful systems, but how do you involve reluctant users or users that are threatened by the uncertainty surrounding a new system? In this case obtaining user involvement may require identifying barriers to involvement and removing them, which is a different mind set than simply desiring user involvement and presuming it will take place by providing users the opportunity to become involved. Behavioral models also tend to suggest issues that are often overlooked, such as who actually controls key development decisions.

Fourth, the stepwise, iterative life cycle model of system development omits many of the variables that implementation research has shown to be important, suggesting that this model is incomplete. Missing are process and political variables which may be used to recognize potential failures and to influence project outcomes. In practice, the life cycle phases are seldom completed and the mass of documentation is almost never read, again suggesting that the model captures only a portion of the implementation process. Other implementation strategies, such as prototype systems, expanding subsets of system capabilities, or socio-technical design [3] that better capture both the technical and human aspects of system design may be more appropriate descriptors of successful implementation processes.

Fifth, information system design involves a mapping from real world activities to precise descriptions of these activities (i.e., computer programs). Performing this transformation in a way that captures all the richness and complexity of the real world is the fundamental problem of design. Much of a person's ability to understand what is going on in work situations depends on the models used for interpretation; e.g., if an analyst assumes a rational model of decision making, then that person concentrates on understanding the sources of information needed to make the decision, the likely alternative courses of action, and the implications of these actions. This view stresses the evaluation of competing alternatives. On the other hand, the analyst who adopts a political view of decision making may be concerned about dominant coalition composition, the distribution of power among players, and realistic bargaining strategies, as well as the specifics of the decision. This view stresses the redistribution of power associated with various outcomes and the process of decision making.

The point is not that one or the other of these models is correct or even better; they capture different aspects of the situation. Rather, the model used by the analyst determines what factors will be considered. If the model involves behavioral as well as analytic factors, then both of these will be represented. By being sensitive to and experienced with behavioral and organizational models (as well as economic and technical models), a person is in a better position to take these issues into account in information system design and implementation.

Sixth, much of the current prescription for correct system development practice is best understood in behavioral terms. For instance, project teams with a 'chief programmer' as leader have been recommended for medium sized implementations [1]. The chief programmer should be a senior practitioner with considerable experience, rather than just a manager. This can be explained in organizational terms by observing that a leader, in order to be effective, must be accepted by the members of his work group. One of the strongest bases of power among professionals is knowledge of the particular discipline. Therefore, the choice of a system development group leader based primarily on technical knowledge and experience is likely to produce strong acceptance on the part of group members.

Structured walk-throughs provide another example of using organizational theory to explain system development practice. The presentation of program design to colleagues with a critical review reduces the ego aspects of programming. By not allowing programmers to debug their own programs (and making them aware of this in advance), a project leader can instill a feeling that work products are the property of the team rather than any <u>one</u> member. Thus, knowledge of behavioral theory can explain why certain development prescriptions work and others do not. One becomes more aware of group processes and moves quickly to resolve group conflict. Perhaps a better understanding of programmer and programming group behavior will lead to new, more productive development methodologies.

5.0 CONCLUSION

Behavioral models have much useful information for practical information system development. A sound technical design that meets functional requirements may fail because political factors were not considered, or because signs of resistance were not properly interpreted. A good system design is only half the story! No matter how creative the technical design, when the behavioral aspects of systems are overlooked, the risk of failure is high. Indeed, in Europe organizational psychologists are often part of the information system development team in order to cope with some of these issues.

Typical systems analyst education programs deal much more thoroughly with the mechanics of system design (e.g., specification formats, decision tables, data flow diagrams, forms layouts, etc.) than they do with understanding human behavior or improving communication among people. While knowledge of the mechanics are necessary, they should be balanced by coverage of behavioral topics, such as those in Semprevivo's [15] monograph on teams in system development. The assumption that most people are familar with behavioral material is not supported by experience.

Instilling a behavioral prospective in information systems development requires more than cosmetic changes to educational courses. It comes from adopting a people oriented approach to system implementation, which implies value changes on the part of those involved with development and a willingness to deal with messy issues, such as motivation, control, and work life quality.

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TABLE 1

Categories of Behavioral Research in Information Systems

Category	Key Issue	Broad Topics	Example	Specific Topics
Individuals	Understand human behavior	Similarities Differences Attitudes Values Learning Problem Solving Removing Road Blocks	Ginzberg (1981) (1)	Pre implementation expectations as indicators of system success.
			Lucas (1979) (1)	Favorable user attitudes associated with system success.
			Turner (1980) (2)	Changes in task, attitudes and productivity related to computer system use.
			Manns and Williams (1960) (2)	Changes in task and group process related to computer use.
			Henderson and Nutt (1980) (2)	Executive's cognitive style influences his decisions.
Pairs	Communication between people Methods of influencing behavior	Pressure Coercion Manipulation Collaboration	Boland (1978) (1)	Interaction between user and designer influences resulting system.
Small Groups	Group Dynamics and decision making	Networks Message Content Group Processes	Kling (1982) (2)	Computing development is explained in terms of the social and political contexts and the infrastructure for supporting development.
arge Groups	Promoting the organization	Interdependence Structure Process Technology Environment	Powers and Dixon (1973) (1)	Identify factors affecting system success.
			Olson and Chervany (1980) (2)	Relationship between firm structure and information services.
			Kling (1982) (2)	Politics of system implementation.

OTE: Example Classifications
(1) Implementation research
(2) Consequences research