THE IMPACT OF ORGANIZATIONAL CHARACTERISTICS ON
MIS DESIGN AND IMPLEMENTATION

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Abstract. The appropriate design for an information system depends not only on the characteristics of the system users, but also on certain characteristics of the organization, e.g., technology, structure, and environment. Implementation is likely to be most successful when there is a "fit" between the system and the organization. This paper describes an emerging theory of how organizational characteristics determine information system requirements.

Introduction

Information systems (IS) do not exist in a vacuum. Rather, they exist within an organizational context. The elements of that context include (1) people -- e.g., system users, system deisgners, non-users -- (2) tasks, some supported by information systems and some not supported, (3) the formal structure of the organization, (4) the informal organization, and (5) the organization's environment. All of these elements are interrelated, both with one another and with the information system. And, the success (or failure) of an information system depends in large measure on how well it "fits" with the remaining elements of the organizational context. (see Tushman & Nadler, 1978, for a discussion of the notion of "fit" and its impact on organizational performance).

Fit can be assessed on multiple levels -- e.g., individual, group, organization. While fit at all levels is important to IS success, this paper focuses only on the most aggregate level, that of organizational level variables. Two primary questions are explored in this paper:

(1) In what ways do organizational characteristics limit information system design alternatives? and

(2) In what ways do organizational characteristics limit information system development process possibilities?

Key Organizational Level Variables

Before considering the questions posed above, we must identify the organizational characteristics relevant to this analysis. The most widely used basis for characterizing organizations is Leavitt's (1964) four-component description. The scheme adopted for this paper is based on Leavitt's and is a attributable to Nadler & Tushman (1977). This scheme recognizes five major components to an organization:

(1) people,

(2) environment,

(3) task/technology,

(4) formal organizational arrangements ("structure"), and

(5) informal oganization ("culture").

The first of those components, people, represents an analysis at a more disaggregate level than the other four components, and will not be considered further in this paper.

The organization's environment could be characterized in a number of ways. However, most researchers have found the degree to which the environment is stable and predictable to be a particularly important attribute (e.g., Gordon & Miller, 1976; Katz & Kahn, 1966).

Clearly, when one is focusing on information systems, the most salient characteristics of the task/technology are the attributes of the IS itself. One other frequently mentioned aspect of the task/technology is "routineness" -- the number of exceptional cases or problems that are presented, and the degree to which problem analysis and solution are well structured (Waterhouse & Tiessen, 1978).

Four aspects of formal organizational arrangements are mentioned frequently in the literature. They are (1) the degree to which the organization is bureaucratic and follows formal rules and procedures, (2) the degree to which decision making authority is centralized, (3) the degree of differentiaion among organizational sub-units, and (4) the extent to which there are mechanisms to integrate sub-units.

Two aspects of the informal organization have received consistent attention in the literature (e.g., Bariff & Galbraith, 1978; Nadler & Tushman, 1977). They are (1) the degree to which the norms for intergroup interaction

are cooperative vs. competitive, and (2) the evenness of the horizontal distribution of power across groups in the organization.

(Insert Figure 1 about here.)

Those eight organizational level characteristics are summarized in Figure 1. In the remainder of the paper we will explore some potential impacts of these organizational characteristics on the process and output of information system design and implementation.

Personal vs. Organizational Systems

Before proceeding to the substance of this paper, one more clarification is necessary. Information systems are designed to support tasks which must be accomplished in an organization. Some tasks are meant to be performed by a single individual, some by a small group of individuals who are members of the same organizational sub-unit, and still others by a group of individuals which spans sub-unit boundaries.

The impact of most organizational level variables will be felt most strongly in the case of those systems supporting tasks which span sub-unit boundaries. Systems to support the tasks performed by single individuals will often be completely unaffected by organizational level factors. In the discussion which follows, it should be assumed that there is no expected impact on the design and implementation of systems for single users unless such an impact is explicitly stated.

Impacts on the Development Process

It is widely argued that successful implementation of an IS requires the participation of the system users in the design process. Certain organization-

al characteristics, however, may inhibit true participation of potential system users, and thus, may endanger implementation success.

Consider first the formal structure of the organization. In highly centralized organizations, control over decision making about a system (particularly a system to support users in multiple sub-units) may be reserved to a level above that of the system users. Thus, even if users are encouraged to "participate" in the design process, their inabiity to influence that process implies that this is only "pseudo-participation" (see Lucas, 1976) and does not carry the benefits of real participation.

Another potential problem for the development of systems supporting tasks which span sub-unit boundaries is organizational differntiation (see Lawrence & Lorsch, 1967). Highly differentiated sub-units may differ in goals, methods, time horizons, languages (jargon), etc. Drawing such diverse elements together during the development process may be quite difficult. This problem will be exacerbated if the organization does not already have integrating mechanisms in place to facilitate communication among these dissimilar units.

The informal organization, too, can present roadblocks to user participation in development. True participation implies an open sharing of ideas and information among the participants. Such sharing is unlikely to occur in organizations which do not have norms of cooperation among groups. Further problems are likely if the groups to be supported by the proposed system differ significantly in power. One key way to maintain power is to maintain control over information. Thus, members of an already strong group will likely resist participation in a process which will almost certainly reduce their power by eliminating their information monopoly.

Impacts on Design Alternatives

Information systems can serve a wide variety of purposes. Perhaps the most common purpose for an IS is communication and coordination among individuals (or groups) who need to share information in order to accomplish a task or set of tasks (e.g., Galbraith, 1977). More recently it has been recognized that IS are often used to monitor and control the activities of individuals and groups within the organization (e.g., Hoyer, 1976; Markus, 1979).

Within the past ten years, the focus of much IS development has shifted from coordination and control to decision making (see Keen & Scott Morton, 1978). For such systems, the principal purpose is to support a manager's (or managers') decision process in unstructured decision situations. Related to decision making, another use somtimes made of IS is decision rationalization or legitimization -- i.e., the use of an IS to create an after-the-fact justification for a decision which has already been made (see Alter, 1976; Feldman & March, 1980).

While most discussions of information and systems identify one or more of the purposes discussed above, Feldman & March (1980) suggest one additional purpose which an IS might serve -- surveillance. Systems designed to provide surveillance tend not to be well focused on particular decisions, activities, or information items. Instead, they are likely to assemble an eclectic set of information which enables the IS user to "keep an eye on" his environment, to assure him that no important changes occur without being recognized.

Each of these purposes will fit well in some organizations but not in others. That is, some of the organizational characteristics discussed above are not compatible with certain types of systems, but may be particularly compatible with systems of a different type. The organization design literature

strongly suggests that effectiveness is enhanced when the components of the organization fit with one another (i.e.; are compatible). Conversely, effectiveness is impaired when components do not fit. Thus, if the overriding purpose of any IS is to improve organizational effectiveness, we must recognize that organizational characteristics do place limits on the feasibility of design alternatives. These limits are discussed in a somewhat informal fashion in the remainder of this section. For a more formal treatment see Ginzberg (1980).

Systems for Communication and Coordination

All organizations require some degree of communication and coordination among sub-units. The greater the degree of task interdependence among these sub-units, the greater the need for mechanisms to support communication and coordination. Formal IS are one mechanism which can provide this support.

Both environment and technology impact the degree to which formal IS can serve as communication and coordination devices. Unstable environments and non-routine technologies both present many exceptional conditions. This, in turn, presents a need for non-routine communications among interdependent sub-units. Formal information systems are designed to support routine communication. Thus, they are unlikely, by themselves, to provide adequate support for communication and coordination in organizations facing highly unstable environments or employing very non-routine technologies.

Organizations which are very formal and bureaucratic place implicit limits on the design of IS to support communication and coordination. Bureaucratic organizations resist changes to their practices and procedures. IS can be designed to support communication along existing communication channels or

along an alternate set of channels. In bureaucratic organizations, only the former approach is likely to succeed.

Highly differentiated organizational sub-units have a great need for communication and coordination mechanisms to facilitate the performance of interdependent tasks. However, the differences in goals, methods, jargon, etc. among highly differentiated sub-units will make it very difficult to define the elements of a shared system which can serve as the needed communication channel.

Closely related to the problems raised by high differentiation are those rasied by low integration. Galbraith (1973) suggests that the integrating mechanisms used by organizations can be thought of as a hierarchy with IS at the top. Thus, IS are used to provide additional integration (i.e., coordination and communication) once other mechanisms are in place. In organizations where these lower level mechanisms are not in place, a formal IS is unlikely to have the communication capacity needed to be successful.

The informal organization is likely to have a similar impact on systems for communication and coordination to that discussed in the previous section. That is, norms of inter-group competition and an uneven lateral distribution of power are both likely to result in resistance to systems which require substantial sharing of information (as is the case for systems to support communication and coordination).

Systems for Control

Many IS are used primarily to enhance control over the activities of individuals or groups in the organization. These systems are imposed from above and provide control either by establishing standard procedures which must be followed to accomplish certain tasks, or by providing management with a mechanism for monitoring task performance.

The effects of an unstable environment or a non-routine technology on systems for control are similar to but more pronounced than those on systems for communication and coordination. The large number of exceptional cases imply that non-routine communication and/or action will often be necessary. If the system is to provide control by establishing standard procedures, it is likely to be inadequate because the pre-defined, standard procedures will often be inadequate. If the system is to provide control by monitoring the actions taken to perform a task, it is likely to record many apparently "out of control" situations which simply reflect a proper response to changed inputs. Control in such situations is better attained by monitoring outputs.

Systems for control reflect a hierarchical, bureaucratic view of organizations. This view is antithetical to the structure and functioning of organic/informal organizations. Thus, systems for control will be resisted in these organizations.

In decentralized organizations, much decision making autority is held at lower organizational levels. Systems for control represent attempts to limit the discretion of lower organizational levels, and are essentially inconsistent with decentralization. Thus, these systems are likely to be strongly resisted.

The impact of the informal organization is not likely to be as strong in the case of systems for control as in the cases discussed earlier. Norms of competition may lead to some resistance; but, since these are essentially hierarchical (rather than lateral) systems, the resistance is not likely to be strong. The lateral distribution of power should not be a serious issue for these systems.

Systems for Decision Making

Systems for decision making, often referred to as DSS, attempt to improve the quality of decision making in the organization through the institutionali-

zation of better decision models. These systems may be used by individuals performing independent tasks or by multiple people performing interacting tasks. While most of the DSS literature focuses on the former situation (independent tasks), there is little impact of organizational level variables in such cases. The discussion in this section, therefore, focuses on systems to support decision making in interacting tasks.

Systems for decision making vary substantially in the degree to which they structure and constrain the decisions. At one extreme, they may provide only general support to the decision maker by incorporating one or more useful analytic structures -- e.g., risk analysis, decision trees, statistical routines. At the other extreme, they may provide complete models of the decision situation -- both its structure and its parameters -- and may even recommend a decision and course of action. In unstable environments, systems of the latter type are unlikely to be successful, as the rapid environmental change would lead to the system's quickly becoming out-of-date and no longer appropriate.

Organizations employing non-routine technologies require substantial communication, often of a non-routine nature, among individuals performing interacting tasks. Systems for decision making can often support such communication better than other types of systems, because they tend to be less rigidly structured. Thus, an organization employing a non-routine technology should prove to be a hospitable environment for this type of system.

Systems for decision making often require doing things differently from the way they have been done in the past. Indeed, changing the decision making process is a basic tenet of the DSS school (see Ginzberg, 1978). Bureaucratic orgaizations resist changes to their established procedures. Thus, systems for decision making are unlikely to succeed in such organizations.

The effect of high differentiation is likely to be similar here to what has been described for other system types. That is, the major differences in goals, orientations, jargon etc. among potential system users will make it very difficult to define a common system.

The informal organization will affect systems for decisions making much as it does systems for communication and coordination. That is, norms of intergroup competition and an uneven lateral power distribution will both engender resistance to systems which require substantial sharing of information.

Systems for Decision Rationalization

The use of an IS to rationalize or legitimize a decision which has already been made is more likely to be an individual, rather than a shared, activity. Thus, most of the organizational level variables would not be expected to impact this type of IS use. The one aspect of the organization which would be most likely to impact systems for decision rationalization is the informal organization.

Systems for decision rationalization are likely to flourish in organizations with norms of intergroup competition or with uneven lateral distributions of power. In both cases, individuals and groups will attempt to bolster the arguments for their positions on decisions through the apparently "scientific analysis" of data using an IS. In the case of norms of competition, this will be one more weapon in the arsenal designed to maintain the existing win-lose structure in the organization. In the case of uneven power, less powerful parties may be able to improve their position by creating their own information monopolies through use of and control over the IS.

Systems for Surveillance

Systems for surveillance are not designed to support any particular task. They serve individuals or groups in the organization by gathering information that is generally relevant to the functions performed by those individuals or groups. Since these systems do not support specific interdependent activities, the impact of organizational level variables is probably less pronounced than for other system types. However, some impacts might be expected.

The purpose of systems for surveillance is monitoring, assuring that no important changes go undetected. As such, these systems are more likely to be found in organizations facing a great deal of change; that is, organizations operating in unstable environments.

A similar argument can be made for organizational sub-units. A major part of the sub-unit's environment is the remainder of the organization. In organizations with few existing integrating mechansims (i.e., low integration), information about this important part of the sub-unit's environment may not come to the sub-unit through normal communcation. Thus, IS for surveillance may be developed in order to provide this type of environmental information.

Bureaucratic organizations are rigidly structured to perform specific tasks. Further, a major operating principle in these organizations is to maintain the status quo. Systems which serve no particular task-related purpose do not fit in such organizations. This is particularly true if those systems would also tend to introduce change into the organization. Thus, bureaucratic organizations are unlikely to implement IS for surveillance, unless there is a group in the organization which has intelligence gathering as its assigned function.

Discussion and Implications

(Insert Figure 2 about here.)

Figure 2 summarizes the projected impacts of organizational level variables on the IS development process and on the various types of IS discussed above. Turning first to the development process, it is apparent that certain organizational characteristics are likely to have an unfavorable impact on IS success for all IS which cut across sub-unit boundaries. These characteristics inhibit true user participation in system design. Thus, system development in organizations having these characteristics is unlikely to have the degree of user participation commonly believed to be necessary. Clearly, not all IS development efforts in such organizations will fail because of this lack of participation; but, the frequency of implementation difficulties may be quite high. From the IS designer's point of view, the ideal solution is to change the characteristics of the organization so that participation is ensured. Often, however, this will not be a realistic solution, and the designer would do better by adopting a strategy which attempts to compensate for the lack of participation (see Alter & Ginzberg, 1978, for some alternative strategies which have been employed).

When we consider the impact of organizational characteristics on the IS itself, it is readily apparent that the likely impact depends very much on the type of system being considered, i.e., on the function to be performed by the system. For example, while highly decentralized decision making mitigates against the use of a formal IS for control of shared tasks, IS for communciation and coordination or for decision making would be unaffected by this environment.

The effective IS designer, thus, must consider the characteristics of the organization and ask whether the function of the proposed system is consistent with those characteristics. If it is not, the designer has four options. First, he may try to change the organizational characteristics so that the proposed system will fit. However, as suggested before, this is not often a realistic solution to the problem.

Second, he might change the system function to one which is more compatible with the organization. The same end can often be achieved in many ways. For example, assuring the proper completion of interacting sub-tasks might be accomplished by using formal IS to control each of the sub-tasks or by providing an IS for communication and coordination among the groups assigned these sub-tasks. If the organization is organic/informal, IS for control are likely to run into difficulties while IS for communication should succeed. On the other hand, if the organization is highly differentiated, the opposite pattern of success and failure should be expected.

Third, an organization/IS mismatch might be addressed by adopting a non-IS solution. Control, coordination, and decision making can be supported with structural or people arrangements as well as with formal IS. For example, if the organizational characteristics are unsuited to a formal IS for coordination (e.g., because of an unstable environment), one might achieve the same end through the use of joint task forces or committees or through creation of a liaison role.

Finally, there is always the option to "tough it out;" attempt to implement the system even though it does not fit well with the organization. This approach runs a higher risk of failure than do the others, but there may be times when it is appropriate -- e.g., if management determines that having a system of a certain type is so important that is outweighs the difficulties and risks attendent to its development.

Which one of these four options should be selected is very much dependent on the specific case. In most cases, only one or two will be feasible solutions to the problem. In other cases, though multiple options are feasible, some will introduce new problems, and should be rejcted for that reason. The trade-offs among these options have received little attention in the past and are an interesting area for future research.

More generally, the issue raised by this paper -- that organizational characteristics impact IS design and implementation -- have not been well studied. The relationships presented here should be viewed as hypotheses based on research in organization design which could (and I believe, should) be tested empirically. They suggest a type of contingency analysis which can be performed as part of the system development process. If these relationships are correct, then acting in accordance with them should reduce the amount of difficulty experienced in IS design.

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CHARACTERISTICS OF ORGANIZATIONS

COMPONENT	DIMENSION	OPERATIONAL MEASURE(s)
ENVIRONMENT	STABILITY/PREDICTABILITY	rate of change in relevant environment
TECHNOLOGY	ROUTINENESS	number of exceptional cases; analyzability of problems
FORMAL ORGANIZATION		
	BUREAUCRACY	degree to which formal rules, procedures and channels guide actions; number of hierarchical levels
	CENTRALIZATION	degree of diffusion of decision making authority in the organization
	DIFFERENTIATION	degree of sub-unit difference in goals, orientation, etc.
	INTEGRATION	extent of integrating mechanisms
INFORMAL ORGANIZATION		
	NORMS	cooperative vs. competitive intergroup interactions
	POWER DISTRIBUTION	even vs. uneven lateral distribution

Figure 1.

SUMMARY OF IMPACTS OF ORGANIZATIONAL VARIABLES

Organizational Variable	Participation in the Development Process	Systems for Communication & Coordination	Systems for Control	Systems for Decision Making	Systems for Decision Rationalization	Systems for Surveillance
1. Unstable environment		-	--	-¹		++
2. Non-routine technology		-	--	+		-
3a. Bureaucratic/formal	--	-	--	-		
3b. Organic/informal						
4a. Centralized						
4b. Decentralized						
5. High Differentiation	--	--	--	-		
6. Low Integration	--	--				+
7. Norms of Competition	--	--	-	-	+	
8. Uneven power	--	--		-	+	

- = unfavorable impact
-- = highly unfavorable impact
+ = favorable impact
++ = highly favorable impact

¹Only for highly formalized systems, not for those providing general support.

Figure 2.