MIS Problems and Failures: A Socio-Technical Perspective

PART I: THE CAUSES

By: Robert P. Bostrom
J. Stephen Heinen

Abstract

Many of the problems and failures of Management Information Systems (MIS) and Management Science/Operations Research (MS/OR) projects have been attributed to organizational behavioral problems. The millions of dollars organizations spend on MIS and MS/OR development are of little benefit because systems continue to fail. Steps can be taken to understand and solve these behavioral problems.

This article argues that in most cases these behavioral problems are the result of inadequate designs. These bad designs are attributed to the way MIS systems designers view organizations, their members, and the function of an MIS within them, i.e., systems designers' frames of reference. These frames of reference cause faulty design choices and failures to perceive better design alternatives. Seven conditions are discussed which reflect current systems designers' points of view.

The discussion of these conditions demonstrates the need to reframe MIS design methodology within the Socio-Technical Systems (STS) design approach and change systems designers' perspectives. The STS approach is introduced as a realistic view of organizations and a way to change them.

This article is the first of two to appear in consecutive issues of the **MIS Quarterly.** *The purpose of this first article is to demonstrate the need for the STS approach. The second will present the basic concepts and principles of the STS methodology and how it can be utilized in the design of an MIS.*

Keywords: MIS problems and failures, behavioral problems, MIS design and implementation, socio-technical design, systems designers

Categories: 1.3, 2.10, 2.40, 3.30, 3.50

Introduction

The major reason Management Information Systems (MIS) have had so many failures and problems is the way systems designers view organizations, their members, and the function of an MIS within them.[1] These views are imbedded in a design methodology or approach which guides development and implementation of an MIS. This article is the first of two which will appear in consecutive issues. The intent of the two articles is to provide the MIS practitioner and researcher with an overview of a design approach which is based on a more realistic view of organizations. This design approach is referred to as the Socio-Technical System (STS) design. STS is a fairly recent development in the quest for organizational systems which are both more satisfying to their members and more effective in meeting task requirements. This approach is used for redesigning existing work systems as well as for new site designs. We believe that the utilization of the STS approach will solve many of the problems facing MIS and substantially reduce the number of MIS failures.[2]

The STS approach assumes that an organization or organizational work system, e.g., a department, can be described as a socio-technical system. In other words, a work system is made up of two *jointly* independent, but correlative *interacting* systems — the social and the technical. The technical system is concerned with the processes, tasks, and technology needed to transform inputs to outputs. The social system is concerned with the attributes of people (e.g., attitudes, skills, values), the relationships among people, reward systems, and authority structures. It is assumed that the outputs of the work system are the result of joint interactions between these two systems. Thus, any design or redesign of a work system must deal with both

1. Although we will use the term MIS, our arguments would generally apply to any computer-based information systems effort. The basic difference between MIS and other information systems is its decision-making support orientation.

2. Since the STS design approach is an organizational design technique, we would also stress its applicability for the design and management of an MIS department. Many of the organizational and other types of problems facing an MIS department could be effectively attacked with the STS approach.

systems in an integrated form. The purpose of this article is to demonstrate the need in MIS design for the STS approach. The second article will present the basic concepts and principles of STS and how they can be utilized in the design of an MIS.

In these articles, MIS is viewed as an intervention strategy. To intervene is to enter into an ongoing work system for the purpose of improving its function. The terms interventionist, change agent, and organizational designer will be used interchangeably. They all imply someone who is changing, designing, or redesigning a work system. An MIS designer is a specific example of an interventionist. We will also use the terms intervention strategy, change program, and new organizational design synonymously; they all denote a planned change effort. An MIS is an example of an intervention strategy. When discussing concepts that have general application we will use the term *change agent*, and when discussing specific issues regarding MIS, the specific term *systems designer* will be used. The use of the these general terms is to stress to the reader the change aspects of MIS implementation and to make the point that MIS design cannot be isolated from organizational design. It is important to note that the use of the terms "design" and "planned change" make explicit the view that organizations are not "natural" phenomena but are artificial, man-made inventions.

When one intervenes in a work system, two potential improvements are possible. The first is an improvement in task accomplishment, *i.e.*, improvement in productivity and/or quality of the product, reduced costs, etc. The second is an improvement in the quality of working life (QWL) of the work system's members. Historically, the idea of QWL has included only the issues of wages, hours, and physical conditions. These issues are still included in any definition of QWL, but the concept is expanding to include other concerns such as meaningful and satisfying work, control and influence, and opportunities for learning. Consistent with the expanding definition of QWL, we will consider a high-quality worklife as one that involves an interesting, challenging, and responsible job as perceived by the job holder. We would be the first to admit that there are individual differences which make unanimity about what constitutes a high or low quality worklife almost impossible. It is important then to be able to adapt as much as possible this general definition of high quality worklife to individual differences. The typical goal of an intervention into the technical system is an improvement in task accomplishment, while interventions which focus on the social system tend to look for improvement in QWL. The STS approach argues that any intervention must deal with these goals *simultaneously*.

Background

Lucas [40] summarized the results of his empirical research involving over 2000 information system users in 16 organizations as follows:

> It is our contention that the major reason most information systems have failed is that we have ignored organizational behavior problems in the design and operation of computer-based information systems [40, p. 6].

The behavioral problem argument is supported by other authors and researchers in the field of MIS [2, 27, 31, 36, 49, 51, 55, 56, 64, 65]. In addition, support for the above thesis is growing in the related field of Management Science and Operation Research (MS/OR) [57, 59]. The behavioral problems range from outright sabotage to non-usage of the MIS [23]. The implication of these findings is that if steps are not taken to understand and solve these organizational behavioral/social system problems, the millions of dollars organizations spend on the development of information systems will be of little benefit because systems will continue to fail.

Many would argue that these social system problems are the result of the inflexibility of computer-related technology. Further, they would argue that this technology must be accepted as a necessary requirement if we want to maximize our wealth and comfort. *People will adapt!*

We would disagree. Our basic premise is that computer-related technology is essentially neutral; whether its application succeeds or fails depends entirely on the decisions that are made on how it shall be used.[3] This position is some-

3. This basic premise applied to all technologies is one of the basic building blocks of the STS approach.

where between two extreme positions, one indicating that to maximize the use of technology, and the other be wary of technology for it will only lead to disaster. The neutral position becomes clearer and the extreme positions tend to dissolve as one realizes that when technology is mentioned, the reference is not to basic technology, but a technical design put together by designers for a given set of technical requirements. The problem is that the basic technology is only one input into the design process. Other major forces which influence the technical design are the designer's knowledge, skills, values, and assumptions about people and organizations. For example, a technical design which feeds back information from a machine to someone other than the person operating the machine says something about the designer's assumptions about people. This feedback loop is certainly not a technical requirement of the design. But once designed this way, it is passed on to the user as a technical requirement. Thus, most technical system design includes some social system design. Failure of designers and users to recognize this fact leads to many dysfunctional consequences in the social system.

These forces mold frames of reference which serve as perceptual filters through which one perceives the world and provides guides for actions. Thus, a work system designer's frame of reference serves as a foundation for examining, understanding, and changing organizations. In terms of the design and implementation of an MIS, the system designer's frame of reference helps determine the perceived design alternatives and the chosen design alternative. They also influence the perceived change strategies and chosen change strategy. Design alternatives include combinations of hardware, software, operating procedures, work flow, etc. Change strategies include decisions on issues such as user involvement, user education and training, project team development, and implementation plans. Change strategies are important because people respond to the manner in which changes are determined and implemented as much as they do to the actual change [4, 19, 20, 51, 59]. The current social system/behavioral problems associated with an MIS originate in the lack of awareness of available design alternatives and change strategies and faulty decisions concerning perceived options [see 31 for case examples]. Both problems stem from the current frames of reference of system designers.

This article describes seven conditions which are the major causes of inadequate designs and unsuccessful change strategies, and which collectively reflect the existing frames of reference. We will demonstrate the need for the diffusion of the STS design methodology into the field of MIS by making the current frames of reference explicit through the discussion of the seven conditions. Figure 1 summarizes the basis for this approach.

The term "systems designers" is being used to include all people who actually influence MIS design decisions, *i.e.*, systems analysts, users, union officials, top management, computer system designers, etc. As pointed out in Condition 2, today the dominant power resides with the computer specialists, *i.e.*, analysts, designers, programmers, etc.; they consciously or unconsciously direct the development and use of computer technology in organizations. It is very *important* not to place the blame for the inappropriate designs and change strategies entirely upon the person who occupies the systems designer's role. The formation of frames of reference, reflected in the conditions, described in Figure 1 is a very complex process which is not completely under the conscious control of the person. This fact also implies that people are not always aware of the content of their frames of reference. In addition, the resulting actions or behaviors of designers in a given situation are not always based on their frames of reference. For example, the organizational reward system may force or support behaviors incongruent with the designer's frame of reference.

Conditions

Condition 1: Systems Designer's Implicit Theories

Systems designers clearly make assumptions about people — *e.g.*, "people are poor information processors;" about organizations — *e.g.*, "information flow downward must be controlled;" and about the change process — *e.g.*, "we must get users to participate or they will not accept the system." Whatever the level of sophistication, these assumptions or set of beliefs, taken as a set, could be described as the systems designer's implicit theories about people, organizations, and the change process. These theories are "implicit" because systems designers have never attempted to develop a carefully worked through, "logical" description of their assumptions and beliefs. The designer's assumptions about people and organizations affect which design alternatives are considered and chosen. Additionally, the designer's assumptions about how one should change organizations influence the change strategies chosen. The case study research of Pettigrew [53] and Hedberg, *et al.* [31] clearly supports these conclusions.

No general theory will reflect precisely the implicit theories of any single designer. Nevertheless, scholars have attempted to capture the main thrust of key concepts and assumptions. Two theories which scholars have been presenting are *Theory X,* traditional or machine theory, and *Theory Y,* human resource theory. Theory X assumes a person is one who likes order, wishes to work within tightly specified boundaries, and does not want to have a great deal of personal control over one's activities. Theory Y assumes a person is a responsible, self-achieving individual who can take full control of one's work environment. Schein [58] points out that there is a great deal of confusion about Theories X and Y. They are viewed as managerial philosophies, management styles, types of organizations, etc. Thus, we should stress again that Theories X and Y are sets of assumptions about human nature that a given person holds, consciously or subconsciously.

These basic assumptions about people shape one's approaches to organizational designs, work and job designs, and change strategies. For example, a design based on Theory X assumptions would tend to create a tightly structured organization, with precise job definitions and clear lines of hierarchical authority, emphasizing order and stability as necessary to obtain technical efficiency. On the other hand, a design based on Theory Y assumptions would tend to create a flexible organization which has a great deal of self-direction and self-control at all levels because the integration of individual growth with technological improvement is seen as the key to organizational effectiveness.[4]

Which theories do systems designers hold? It is quite apparent that system designers in general hold a Theory X view. The systems designer's primary role today seems to be one of servant to the technical system needs, consistent with Theory X assumptions. Hedberg and Mumford [30, 31] have empirically verified that European systems designers' operational model of a non-management person and the appropriate organizational structure for non-management people is closer to Theory X than Theory Y. Unpublished studies by Bostrom and by Taylor [61] have found in the U.S. a similar Theory X orientation toward management and non-management persons.[5] Finally, one needs only to examine the MIS literature to see the extent of the Theory X orientation.

An illustration of the systems designer's Theory X view is the "operating unit" concept of Boguslaw [6]. Boguslaw concluded from his research that the "new utopians" or systems designers retain an aloofness from the human and social problems by treating the human component as just another operating unit within the system with people taking their places alongside computers, display consoles, and other forms of system operating units. Taking this view, the systems designer is the expert who analyzes the problem, defines it, and provides the solution. Any human problems are treated by adjusting the operating units through training, incentives, etc., to suit the technical system.

---

4. It is beyond the scope of this article to give any more than a brief description of the theories. For further discussion of the theories, see Miles [47], McGregor [45], Davis [15, 19] and Schein [58]. Miles, in his treatment, adds a third major theory, Human Relations. We did not include the Human Relations theory because from a design framework it makes the same basic assumptions as Theory X.

5. The research done by Bostrom was a pilot study focusing on a number of issues in this article. The sample was 34 graduate students at the University of Minnesota who had an average of three years computer systems design experience. This study will be referenced throughout the paper.
All of the data referenced represents computer systems designers' views. Hedberg and Mumford indicate that the views on the user side are more Theory Y. The U.S. data does not support this difference found in Europe [see 47].

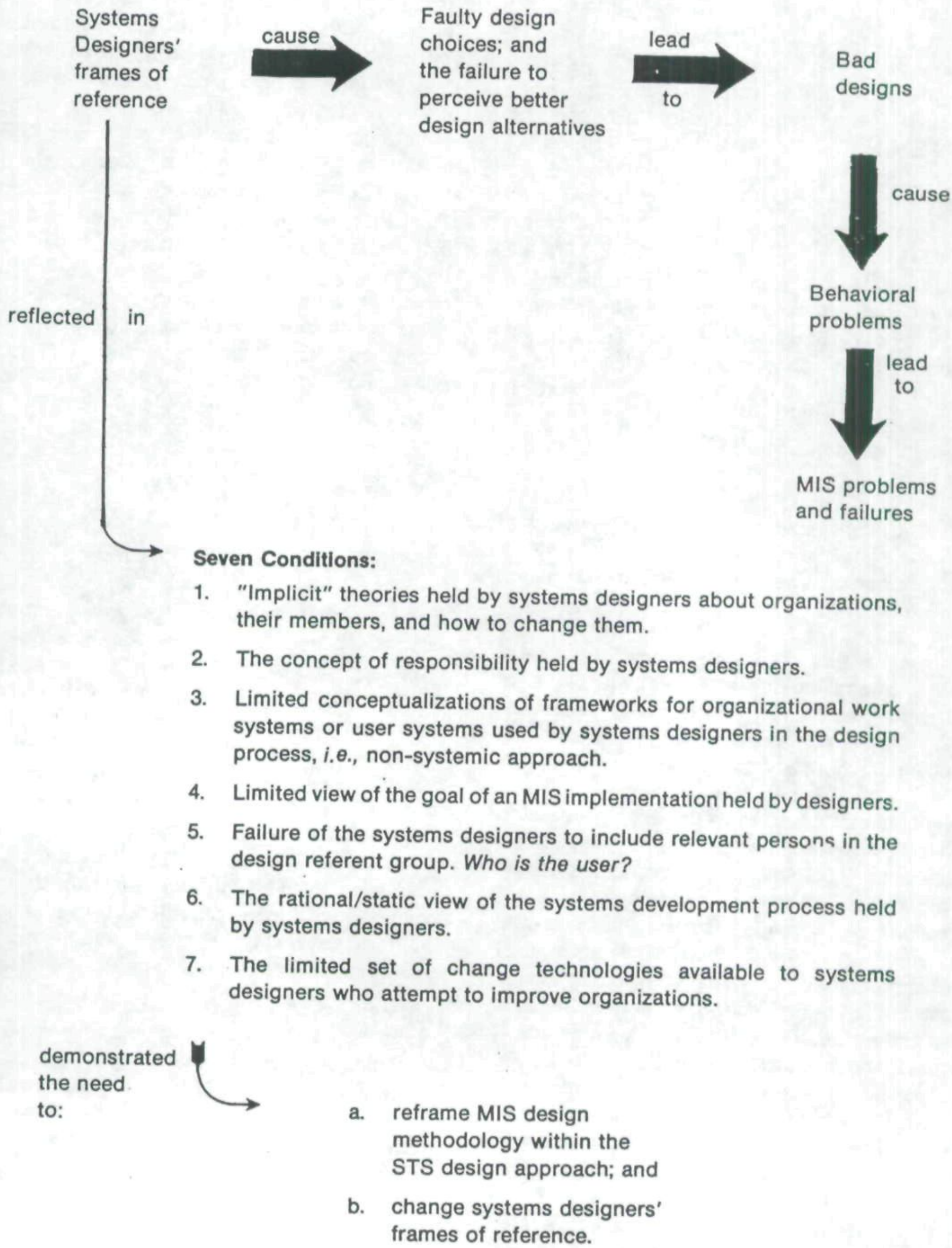

Figure 1. The Rationale for the Socio-Technical Design Methodology

Greater emphasis on user involvement in the recent MIS literature might at first seem to indicate a shift toward a Theory Y orientation; however, in most cases the approach is used to gain acceptance by the users of the systems designer's solution, rather than create an effective reciprocal relationship between the MIS resource and the user system. Argyris [2] and Bostrom both found participation by users was a means to gain acceptance rather than collaborative problem solving.

Theories X and Y assumptions focus on the motivational patterns of individuals. The tendency of systems designers to hold Theory X assumptions is related to the implicit theories they hold about people as information processors. Two somewhat paradoxical assumptions tend to be emphasized in the literature:

1. Decision-makers are not getting enough of the right information.
2. The person is not a very efficient information processor.

Designs based on the "give them more" theory have been convincingly attacked by a number of authors [1, 29]. Thus, one no longer sees this idea referenced in the literature, but many applications continue to appear in practice.

The research on human information processing generally supports the "inefficient" theory. This leads many MIS writers to advocate a design approach which would automate as many decisions as possible. Decision aids should be supplied, if the decision is not fully programmable. The difficulty with this design approach is that it is congruent with a Theory X view that a person is replaceable by a machine. It neglects the fact that persons have information processing strengths. We would agree with Hedberg [28] that an MIS design should be based on a detailed knowledge of both the strengths and weaknesses of human beings as information processors. The division of labor between the person and the computer in their respective roles in the MIS design should be guided by the principle of comparative advantages, keeping in mind the motivational consequences.

Implicit theories are a key input into the formation of the systems designer's frame of reference. It will be virtually impossible to alleviate the remaining conditions discussed in this section without first establishing an understanding of the basic assumptions. Theory X assumptions currently are reflected in MIS designs, design procedures, and design methods. Based on available evidence from other fields [15, 16, 35, 45, 47, 58] and problems in MIS, there is a very strong indication that these Theory X assumptions are inaccurate. Thus, more effective MIS designs will result from making designers' implicit theories explicit and determining if their assumptions about their clients are accurate and congruent. Knowledge about motivational patterns and information processing capabilities of people need to be developed and diffused to support this latter stage.

Condition 2: Systems Designer's Concept of Responsibility

The concept of responsibility is a very important aspect in change theory, but it has received very little discussion in the literature.[6] The focus here will be on the concept of responsibility as it applies to one type of change, the introduction of a new MIS. The critical question is, "Who is responsible for the change effort?" Based on available research, the systems designers are the ones taking responsibility for the system development process [6, 31]. This concept of responsibility is congruent with the Theory X assumptions that people will not take and do not want responsibility. Therefore, some external source must take responsibilty for the client.

The difficulty with this whole approach to responsibility from a change theory perspective is that it overlooks the fact that the change agent can never truly assume the responsibility for another's change because only that individual is capable of changing his/her own behavior. The change agent can only facilitate or inhibit individual change through the handling of

6. We cannot begin to develop the importance of this aspect in this article. It is sufficient to say that this issue — "Who is responsible: change agent or client" — will sooner or later have to be dealt with by someone in a change agent or helping role.

the change programs.[7] Therefore, we would argue that an MIS change effort can be successful only if the client assumes the responsibility for its success. The systems designer then should act in such a way that the user retains the responsibility.

Typically systems designers would deny completely that they assume responsibility: "I only do what the customer tells me to do. I implement the values [implicit theories] of someone else, rather than my own. And in the absence of specific instructions, I use a guideline of technical efficiency or cost or speed or something similar" [6, p. 198]. This response raises a number of issues. First, it highlights the issue of "who is the user?" Discussion of this point is presented under Condition 5. Secondly, it stresses the point that designers make decisions based on the goal of technical optimization of cost speed, etc., which is discussed in Condition 4. Finally, the response clearly recognizes that the user has the responsibility for all components of the system provided that the user can specify them in complete and rigorous detail; however, the designer assumes responsibility for all items that cannot be specified in this fashion. Since users are not experts and are unable to specify detailed design guidelines, the designers end up taking responsibility through their *de facto* decision making.

The belief that the client should assume responsibility for the MIS change effort is congruent with the Theory Y assumptions. This belief further assumes that both the systems designers and clients work collaboratively, but are able to identify and to understand situational constraints which necessitate a noncollaborative relationship.

Some attempts have been initiated to implement greater user responsibility:

1. a) The user departments are given financial responsibility for the MIS.
   b) The systems analysts are placed within the user departments with primary responsibility for the final detailed design [53].
2. a) The user is made the head of the project team.
   b) A user steering committee is established.
   c) User representatives are placed on the project team.
3. Power is shared during the system development process, a collaborative design approach [28, 36, 41].
4. Ongoing management of the system is done by the user.

Approaches 1 and 2 and other similar structural techniques may be useful in certain situations, but they do not attack the responsibility issue directly. Approach 4 is too late for the implementation of responsibility. Once the system design is completed, there is typically very little that can be done about it for a period of time.

Note that options 2a and 2c are structural mechanisms for implementing some type of sharing of power between users and systems designers during the development process.[8] They were not included under 3 because in most situations which stress user participation, users do not significantly influence the chosen design alternative. The major reasons for using these mechanisms appear to be the acceptance of the new MIS by the users and/or the gathering of information in order to design the system. An example of this latter approach is shown in

7. A similar argument is developed by Bowers, *et al.* [9] in their development of the Principle of Succession. The indirect nature of change is difficult to see in certain situations. For example, suppose a new machine is brought in to improve task accomplishment, *i.e.*, more productive behavior on the part of machine operations. The new machine will force new behaviors and constrain other behaviors of the operators. But the operators may develop various defensive behaviors: a norm of low productivity, physical withdrawal, or absenteeism. The defensive behaviors may cause the change effort to fail, *i.e.*, no improvement or even a decrease in productivity. Thus, although the change, the new machine, appears to have direct effects, the success of the change effort is still basically the responsibility of the operators, *i.e.*, success based on indirect effects.

8. It is important to note that there are really three parties that have influence or power in the design of an MIS. Besides the user and the designer, there is the computer equipment manufacturer whose technical designs have a large influence in the ultimate design of an MIS. Users and designers need better mechanisms to influence the design of components of systems supplied by computer manufacturers.

Argyris' [2] research on an MS/OR project team. The team continually attempted to elicit information about decision-making from the line management. The line management felt a tremendous need to be open with the MS/OR team, but saw the team as unrevealing and secretive in their use of the information given. The MS/OR team viewed itself as a rational reform group that would supplement the "inadequate" line managers with efficient systems.

Even if the situation existed for a truly collaborative design, there still would be a major problem in the complete focus on the system design process. Problem solving takes place in the language and abstractions of the computer specialists and leads to the need for educating and training of user representatives in computer and systems design skills. Given this focus, the only way one can have a truly collaborative design is to train the user to be an expert so that he/she can help the computer specialist create detailed design plans. However, as Hedberg argues, "including employee representatives in actual design activities and training them to become good systems analysts may be a waste of time and skills" [28, p. 219]. As an alternative, Hedberg [28] proposes that users focus on the strategic design which precedes the system design stage, formulating and reformulating the goals and policies which guide the systems design activities.

Hedberg's approach affords the best mechanism for implementing user responsibility. The major task of the designers is to translate the output of the strategic design process into technically operational solutions. The problem today is that the strategic design process is not clearly recognized. Reference to anything resembling a strategic design process is clearly absent in the literature and/or the system life cycle models and project management schemes that are used in practice. Thus, the strategic decisions usually are dealt with implicitly during the system design process, giving systems designers the dual role of policy maker and interpreter [31]. This observation helps explain the apparent paradox that designers do not perceive themselves as decision-makers or organizational designers [30, 31]. They feel they have very little influence in the design process and few alternative design choices. The explanation is that designers' existing frames of reference implicitly determine the domains of lower level decisions. Improved design methods must aim at making strategic criteria and rules explicit and subject to design.

Currently, systems designers are taking responsibility for MIS designs, but they do not effectively use the power it provides. The real power resides in the prevailing frames of reference which implicitly guide many design decisions. The reciprocal part of the problem is that users let designers take the responsibility, although on the user side there seems to be an apparent paradox. Guthrie [27] in his empirical research on 2000 middle managers in Canada, found that 80% of the responding managers wanted to have a lot of influence in the MIS design and implementation, but were unwilling to devote the study, time, and effort required to make their participation meaningful. The large user commitment is a result of the reliance on technical models for user/designer interaction. More attention needs to be given to the strategic design phase and the appropriate sharing of models, assumptions, and goals between users and designers in order to develop meaningful collaboration. MIS designs, in our opinion, have a high probability of failure if the users do not assume responsibility for them.

Condition 3: Limited Frameworks — Non-systemic View

The third condition responsible for inadequate designs was the limited conceptualization of work systems/user systems used by systems designers in the design process. The primary targets of an operational information system or decision-support MIS are the decision-making, data collection, data manipulation, and data transmission tasks of the work system. Upon completion of an analysis of information requirements and flow, the MIS is designed to reallocate data processing and decision-making tasks between people and computer-related technology, and to create new tasks and modify old ones to support this reallocation. This limited focus on decision-making and data processing tasks is reflected in the traditional framework

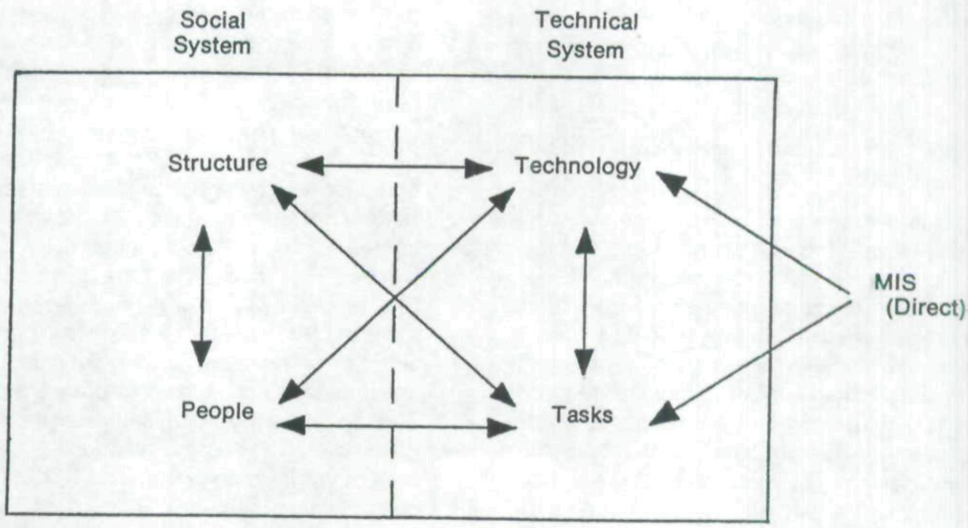

Figure 2. The Interacting Variable Classes Within a Work System

which views work systems in an information processing system. This framework is presented in almost every book dealing with MIS. An example is the book by Blumenthal [5] in which he concludes that the systems designer should conceptualize a work system as a set of complementary or interdependent information systems.

The limited focus on particular changes in the task and technology variables leads the systems designer to ignore the fact that these changes cause more changes within other variables in the work system. These other changes are labeled secondary changes or effects, because they were not given primary consideration in the MIS design. Substantial changes in the work relationships among people accompany changes in task structure. The strong association between these work relationships changes and the attitudes, motivations, and the interpersonal behavior of the individuals within the system [3, 4] is of particular *importance* [3, 4]. An equally *important* relationship exists between these people variables and the changes in the task structure [12, 17, 19, 25, 34, 38]. These secondary changes in the work relationships and people variables are as important as the changes in the task and technology variable. All of these types of changes should be designed to complement and reinforce each other as shown in Figure 2. The Mumford [49] and Whisler [65] studies of operational information systems illustrate the importance of secondary effects. Some of the direct and secondary effects found were:

DIRECT

D1. Modification of old tasks or the creation of new tasks which lack interest and challenge.

D2. Many decisions made by clerks and their supervisors have been automated or passed up to middle management. The focus of decision-making moves upward.

SECONDARY

S1. The direct changes indicate a de-enrichment of the supervisor and clerk jobs which can lead to lower motivation, decreases in job satisfaction, etc.

S2. Clerks seem to work less at their own pace and are more tied to deadlines for computer runs.

S3. Clerks and supervisors tend to communicate less with each other, while middle managers increase their interactions with each other.

S4. Strong trend toward increased centralization of control.

These secondary effects clearly indicate a lower quality of working life for the clerks and supervisors. Argyris [2] discusses the possible secondary effects of a decision-supported MIS intervention. He concludes that a manager whose decisions and alternatives are prescribed by sophisticated decision-making algorithms may feel his/her action alternatives reduced and opportunities for effective, satisfying performance diminished or lost.

As MIS practitioners and researchers, we pride ourselves on being very system-oriented people. It should be clear by now that this is not the case; we are not very systemic. We do not understand the relationship between the variables we manipulate and other variables within the work system. This statement is not intended to negate the importance of the information processing view. Many researchers and practitioners across multiple disciplines have concluded that information is the critical resource on which organizations operate. Our point is that if systems designers want to improve the information processing system of an organization, they must incorporate their information processing view into a more complete systemic framework.

Condition 4: Limited Goal Orientation — Optimizing the Technical System

The non-systemic view held by systems designers reflects their servant role to the technical system. Thus, we would expect to find that the designer's view of the goal of an MIS would be the typical goal of an intervention which focuses on the technical system, *i.e.*, improvement in task accomplishment. Even those changes in the social system explicitly designed into the MIS are attempts to improve task accomplishment through better control of the variations in the technical system. An instance of this situation would be a performance-monitoring MIS where a *design choice* must be made to feed back data concerning individual performance and performance-related problems either to a manager or to the employee performing the tasks. Current frames of reference identify the manager as the most efficient choice, *i.e.*, a better control mechanism. Our point is that this choice is made without concern for quality of working life issues. It is also worth noting that the research literature would certainly not support the choice of the manager in this situation either from an improvement in task accomplishment, better control, or QWL [10, 13]. The MIS literature clearly indicates the dominant goal of an MIS intervention is technical system optimization. Empirically this fact has been demonstrated by Hedberg and Mumford [30, 31] in Europe and by Bostrom and by Taylor [61] in the U.S. These researchers found that system designers mentioned most frequently that "greater efficiency" and "better information for management" were the prime contributions of an implementation of an MIS. In addition, one can examine almost any text and find authorities in the field stating such things as:

> The computer resource exists solely to help staff offices and operating units to execute their responsibilities better through *cheaper processing* of data, *more efficient* organization of information systems, and procurement and development of information that is too expensive to obtain otherwise. The resource has no reason for existing except to provide such services, and these services should *result in greater profits.* In short, the resource has a *purely economic purpose.* [20, p. 68]. [Emphasis in quote by authors.]

MIS is still a relatively young technology. Besides the notable exception of operational information systems [7, 40, 43, 44, 46, 48, 49, 56, 60, 65], little field research exists on the effectiveness of MIS interventions in terms of technical system optimization. Some of the indirect effects of these operational information system interventions were cited in Condition 3. The effects clearly indicated a lack of concern for the improvement in the quality of working life for certain users, clerks, and supervisors. This situation is usually rationalized by systems designers as being inevitable due to the cherished assumption that the two goals are at opposite ends of the same continuum, *i.e.*, productivity/efficiency vs. quality of working life. Some of the learnings and tentative conclusions from international experiments indicate that viewing productivity/efficiency and quality of working life as opposing points of view is an inappropriate concept [18]. They are not opposite ends of a continuum, but two different scales. Enhancing one does not necessarily require diminishing the other. Given the appropriate organizational design, experience shows that both can increase together [13, 18, 35].

Even though designers are operating under the dominant goal of technical system optimization, all empirical effects in terms of quality of working life are not negative; however, negative outcomes dominate the literature. The indirect effects cited in Condition 3, although negative for clerks and supervisors, appear to be positive for middle managers — jobs were enriched. Other examples of positive effects are discussed by Lucas [39] and demonstrated in the research by Mueller [48], Mann and Williams [43], and Marenco [44]. However, the conclusions of these studies are obscured by what appears to be inappropriate ongoing management of the new organizational design. Although social system improvement was not planned, its potential is clearly shown in the above empirical research. Also, European researchers [31] recently found that there were a number of unexplored, possible alternative designs for existing MIS designs that would have improved not only task accomplishment, but also quality of working life. These results support the opinion that both goals can increase together for an MIS intervention.

Further evidence of the importance of MIS intervention on social system change can be found in the research by Taylor [61]. He concluded that the direct effect of a technical system intervention on the social system seems to create constraints on employee behavior. He found, on the other hand, the technical system intervention provides an "unfreezing force" on the social system. There seems to be a freedom provided by the new technology to seek new ways of behaving. This new freedom may make a planned social system change possible. Technical system intervention can actually facilitate social system change.

MIS development efforts must take seriously the task of using computer technology to broaden the concept of organizational efficiency to include QWL issues. The social system improvement needs to be considered jointly with the technical system improvement in the design of an MIS.

Condition 5: Limited Design Referent Group — Who is the User?

Tichy [63] in his empirical study of 91 change agents classified systems designers as "analysis for the top" (AFT's). This classification resulted from the commitment by AFT's to aid, advise, and design for the heads of systems. The secondary effects of an MIS intervention discussed in Condition 3 further support the limited referent group position. Their results indicate that middle management was the primary referent group and received the main benefits of the system while the secondary users of the system, the supervisors and clerks, were ignored. This lack of concern for secondary users resulted in a de-enrichment of the supervisor and clerks' jobs. We are left with the conclusion that systems designers design systems for a very small set of primary users, usually managers who receive the outputs of the information system.[9]

The significance of the limited referent group condition is that even if the systems designer no longer operates under conditions 1, 2, 3, and 4, he or she may do so for only a select group of people, the primary users. The secondary users, the clerks, data collection people, customers, etc., on the periphery of the MIS are ignored in the design. This situation is very unfortunate for three reasons. First, the secondary users are usually those people who have continual day to day contact with the system. Second, the sucess of the secondary users doing their jobs in many cases determines how successful the MIS will be. Third, the design of the MIS critically affects the jobs of the secondary users. Little attention has

9. It should be noted that the introduction of database technology in the U.S. is forcing a larger referent group orientation in certain areas. But this larger referent group still remains a set of primary users.

been paid to the alternatives available for these job designs.

A related problem is that an MIS often feeds information to people who cannot take action on that information [10, 21, 33]. The magnitude of this problem grows larger as one looks at the findings of Cummings, *et al.* [13] in their comprehensive review of 2000 references on the empirical literature on job satisfaction, industrial organization, and productivity. They found that information/feedback appears to have the greatest impact on productivity. They argue that the probable reason for the increase in productivity is that information/feedback provides workers with an indication of performance-related problems and, more importantly, provides them with meaningful feedback on their own performance. Therefore, if the information/feedback is not given to the people who can respond to it with action, little improvement in organizational efficiency will result.

Systems designers must take a "total system" referent group orientation in order to improve their designs. Total system orientation implies that consideration be given in some degree to all people affected by the design.

Condition 6: Rational/Static View of the Systems Development Process

The traditional approach to the development process of an MIS treats design and implementation as a rational, systematic process that proceeds in a static environment. The organization is assumed to have a set of well-defined information processing problems which the MIS designer expertly analyzes. A rational decision-making process which examines alternative designs in terms of the goals of the system is followed to select the specific design. Implementation of this expert solution is then assumed to transform the organization immediately into a more effective state. This viewpoint overlooks many of the dynamic properties of the environment in which the design decisions are made. It can be labeled rational/static.

Attempts at what is seen as rational, decision-making in the development process frequently become distorted and overlaid by political or power issues which are not always recognized nor made explicit [26, 54, 55]. Political issues arise due to conflicts of interest among various groups [2, 39, 55] and/or anticipated shifts in the balance of power caused by the implementation of an MIS [37, 39, 55]. There is no correct or ideal solution in the development of an MIS. Each set of involved parties will have its own preferences. This means that the constraints and alternative designs emerge only in the social interaction among the people who represent different roles and positions of power. The choice between alternatives quite often is based on the mobilization of power resources by individuals [26, 37, 55].

Also unrecognized in the design and implementation of the MIS is the fact that the organization continues to change and does not remain in some suspended state. The implementation is not immediate and several transitional states may be passed through by the organization during the implementation process. More attention needs to be paid to the adjustment and on-going management of the new MIS design. The actions carried out during the design process may also create organizational changes. For example, gathering data from users may raise expectations or create fears. Dickson and Powers [24] found that users undergo significant learning during the design process. Similar learning may also occur for systems designers. This learning may be reflected in new problems, alternatives, criteria, constraints, etc. The implication is that the design process is a fluid, iterative process and not a linear sequence of steps as in the rational/static view.

The rational/static view could be useful in short, simple MIS projects, but it is rather obvious that this view does not accurately reflect the MIS development process in real life. Yet most organizations use project planning and control techniques based on this view. In addition, most textbooks and training materials emphasize this view. Based upon this, it is no surprise to find that current project control techniques can be dysfunctional to project success [24]. We are not negating the importance of project planning and control techniques or training. We are merely stressing that the current emphasis on the rational/static view must be replaced by a more realistic view of the political/dynamic dimensions of MIS development.

Condition 7: Limited Change Technologies

Tichy [63] found in his study that systems designers use a limited set of change technologies. Conditions 2 - 6 cannot be effectively resolved with the limited change technologies at the disposal of systems designers. Systems designers essentially draw from MIS and MS/OR technology.

An integration between the MIS technology and other technologies is needed to produce a more effective intervention. It should be clear from our previous discussion that the techniques should be those that tend to facilitate the improvement of both social and technical systems. These techniques coupled with an MIS intervention would allow us to pursue the goal of joint optimization. For example, the problems of de-enriching jobs might be solved through job design techniques, such as job enrichment, job enlargement, etc. [12, 17, 19, 25, 34]. The ineffective work organizations supporting information systems might be improved through the use of autonomous or semi-autonomous group structures [19, 32]. In addition, many of the techniques that focus on the social system could be utilized during the development process. For example, the interpersonal problems of the MS/OR project team identified by Argyris [2] might be eliminated through team building interventions. The problem of getting more participation by secondary users in the MIS design process could be handled by using the survey-feedback method [4]. These techniques along with many other interventions are part of the field known as Organizational Development (OD). The OD practitioner, usually a behavioral or social scientist, is simply translating what is known about people and organizations from the behavioral sciences into applicable programs whose primary intervention point is usually the social system.[10] A further discussion of integration of MIS and OD can be found in Bostrom and Heinen [8].

10. The most notable exception to this is the job design and redesign techniques which focus on the tasks in the technical system.

Successful integration of the change technologies requires new roles for both the systems designer and the behavioral scientist. First, they must develop some type of mutual design theory so that they can effectively communicate with each other. Second, the design effort must be a truly collaborative effort.[11] This means that the behavioral scientist whose past role has been primarily to help implement predesigned interventions must assume a new design role. Third, for a collaborative design effort to be successful, each party will have to learn more about the other's change technologies. Thus, the behavioral scientist needs to have a good understanding of MIS related technology while the systems designer must understand the usefulness and consequences of OD type interventions.

These new roles offer a new challenge to both the systems designer and the behavioral scientist. The new design role for the behavioral scientist offers the enormous challenge of helping to find systematic ways of introducing quality of work considerations into a sophisticated technical design. The systems designers on the other hand, will have their skills and creativity severly tested by the necessity of developing a substantial number of alternative technical designs which allow more choices in social system design within which quality of work considerations and constraints can be evaluated. For an excellent description of this collaborative process and the challenge of the new roles, see the short case history by Lupton [42] describing the design of a new manufacturing process by engineers, behavioral scientists, and users.

Conclusion

When examining the social system/behavioral problems associated with the introduction of a new MIS, three questions become crucial:

1. What are the human or behavioral problems?
2. What are the causes of the behavioral problems?

11. For a more detailed discussion of this point, see Mumford, *et al.* [52] or Clark [11].

3. How can the causes be eliminated to solve the behavioral problems?

MIS practitioners and researchers spent a great many years focusing on question 1, with some very futile attempts at question 2; this could be called the story telling phase. This focus on the story telling phase was due to inadequate frames of reference to help better explain and deal with these situations. Today, we seem to have switched our focus to question 3 without a complete understanding of the answer to question 2. This instant solution phase, focusing on question 3, has resulted from the development of techniques that appear to solve some of these behavioral problems. User participation and the utilization of job-enrichment schemes are examples of these techniques. This type of approach is piecemeal and ignores the contingencies in each unique situation. The missing link is an effective design approach, such as the STS design methodology.

Our focus in this article has been on question 2. It was argued that the social system problems are the result of inadequate designs and unsuccessful change strategies which arise from the failure of systems designers to perceive available opportunities. Designers' existing frames of reference must be made explicit in order to understand and change this situation. Seven conditions were identified and discussed as the major causes of the inappropriate designs and change strategies to aid this process. The goal was to demonstrate the need for the diffusion of the STS approach into the field of MIS.

The problem of inadequate designers' frames of reference is not unique to MIS, and tends to be a universal problem with change programs in the U.S. This problem is reflected in the piecemeal approach in which people try to change organizations. Job enrichment experts tend to view a work system as a set of jobs. Their interventions focus on enriching a particular set of jobs. They fail to realize that one person's enrichment is often another's impoverishment. Production engineers view a work system as a technical production system. They fail to realize that their designs contain many social system design decisions which are made by default or as a byproduct of optimizing some technical variable. Many organizational development (OD) practitioners see a work system only as a social system. They accept the technical system as given and then try to adapt the social system to it. This type of OD approach deals only with a small portion of organizational life. All of these approaches are appropriate and contain useful techniques and interventions. But these approaches are marginally effective because they fail to take into account all of the important elements of the work system.

What is needed is a more realistic view of organizations embedded in a solid design methodology through which various interventions can be integrated into effective change programs. The STS approach argues that any design/redesign of a work system must deal jointly with the social and technical systems. The application of the STS approach to MIS design provides an adequate frame of reference to eliminate the seven conditions outlined. The joint focus on social and technical systems implies that the STS design approach facilitates efforts in dealing with the technical system. For example, one of the major problems in MIS design is determining information needs of a work system. The STS approach via its technical system analysis techniques provides a means for directly determining certain information needs.

The success of the application of the STS approach to MIS can only be determined through its monitored use in a variety of organizational settings and situations. The STS design approach must be diffused to MIS practitioners and researchers before this can be done. As a first step in this diffusion process, our subsequent article to appear in the next issue of the **MIS Quarterly** will present the basic concepts and principles of the socio-technical system design approach, demonstrating how they apply to MIS design.

References

[1] Ackoff, R. L. "Management Misinformation Systems," *Management Science*, Vol. 14, No. 4, December 1967.

[2] Argyris, C. "Management Information Systems: The Challenge to Rationality and Emotionality," *Management Science*, Vol. 17, No. 6, 1970, pp. B275-B292.

[3] Beer, M. "The Technology of Organization Development," in *Handbook of Industrial and Organizational Psychology*, M. Dunnette (ed.), Chicago: Rand McNally, 1976.

[4] Bell, C. and French, W. *Organization Development: Behavioral Science Interventions for Organization Improvement*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1973.

[5] Blumenthal, Sherman C. *Management Information Systems: A Framework for Planning and Development*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1969.

[6] Boguslaw, Robert. *The New Utopians: A Study of the System Design and Social Change*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1965, 213 pages.

[7] Borodin, A. and Gotlieb, C. C. "Computers and Employment," *CACM*, Vol. 15, No. 7, 1972, pp. 695-702.

[8] Bostrom, Robert P. and Heinen, J. Stephen. "Organization Development: Its Relationship to MIS," *Midwest AIDS Proceedings*, 1974, pp. P1-P12.

[9] Bowers, David G., Franklin, Jerome L., and Percorella, Patricia A. "Matching Problems, Precursors, and Interventions in OD: A Systemic Approach," *The Journal of Applied Behavioral Science*, Vol. 11, No. 4, 1975, pp. 391-409.

[10] Cherns, Albert B. "The Principles of Socio-Technical Design," *Human Relations*, Vol. 29, No. 8, 1976, pp. 783-792.

[11] Clark, Peter A. *Organizational Design: Theory and Practice*, London: Tavistock, 1972.

[12] Cooper, Robert. *Job Motivation and Job Design*, London: Institute of Personnel Management, 5 Winsley Street, Oxford Circus, WIN 7AQ, England, 1974.

[13] Cummings, T. G., Malloy, E. S., and Glen, R. H. "Intervention Strategies for Improving Productivity and the Quality of Work Life," *Organizational Dynamics*, Summer 1975.

[14] Davis, G. B. *Management Information Systems: Conceptual Foundations, Structure and Development*, McGraw Hill, New York, 1974.

[15] Davis, L. E. "The Coming Crisis for Production Management: Technology and Organization," *International Journal Production Research*, Vol. 9, 1971, pp. 65-82.

[16] Davis, L. E. "Job Satisfaction Research: The Post-Industrial View," *Industrial Relations*, Vol. 10, No. 2, May 1971, pp. 176-193.

[17] Davis, L. E. and Taylor, James C. *Design of Jobs*, Penguin Books, London, 1972.

[18] Davis, L. E. and Trist, E. L. "Improving the Quality of Work Life: Experience of the Socio-Technical Approach," A background paper commissioned by H.E.W. for a report on work in America, June 1972.

[19] Davis, L. E., Cherns, Albert B., and Associates. *Quality of Working Life, Volume One: Problems, Prospects, and The State of the Art*, Free Press, New York, 1975.

[20] Davis, L. E., Cherns, Albert B., and Associates. *Quality of Working Life, Volume Two: Cases and Commentary*, Free Press, New York, 1975.

[21] Davis, L. E. Talk given at National AIDS Conference, November 1975.

[22] Dearden, J. and Nolan, R. L. "How to Control the Computer Resource," *Harvard Business Review*, November/December 1973, pp. 68-78.

[23] Dickson, G. W., Simmons, J. K., and Anderson, J. C. "Behavioral Reactions to the Introduction of a Management Information System: Some Empirical Observations," Management Information Systems Research Center Working Paper 69-3, University of Minnesota, 1969.

[24] Dickson, Gary and Powers, Richard. "MIS Project Management: Myths, Opinions, and Reality," *California Management Review*, Vol. 15, No. 3, Spring 1973.

[25] Ford, R. *Motivation Through Work Itself*, American Management Assoc., New York, 1969.

[26] Gibson, Cyrus F. "A Methodology for Implementation Research," in *Implementing Operations Research/Management Science*, Randall L. Schultz and Dennis P. Slevin (eds.), American Elsevier Publishing Company, New York, 1975.

[27] Guthrie, Art. "Attitudes of the User-Managers Towards Management Information Systems," *Management Informatics*, Vol. 3, No. 5, 1974, pp. 221-232.

[28] Hedberg, Bo. "Computer Systems to Support Industrial Democracy," in *Human Choice and Computers*, E. Mumford and H. Sackman (eds.), American Elsevier Publishing Co., New York, 1975.

[29] Hedberg, Bo. "Towards A Credo of MIS Design," International Institute of Management, Berlin, Preprint I/73-52, May 1973.

[30] Hedberg, Bo and Mumford, Enid. "The Design of Computer Systems: Man's Vision of Man as an Integral Part of the System Design Process," in *Human Choice and Computers*, E. Mumford and H. Sackman (eds.), American Elsevier Publishing Co., New York, 1975.

[31] Hedberg, Bo, Mumford, Enid, Anderson, Niels, *et al.* *Computer Systems, Work Design and Job Satisfaction*, Pergamon Press, New York, (to be available Fall 1977).

[32] Herbst, P. G. *Autonomous Group Functioning: An Exploration in Behavior Theory and Measurement*, Tavistock Publications, London, 1962.

[33] Herbst, P. G. *Socio-Technical Design: Strategies in Multidisciplinary Research*, Tavistock Publications, London, 1974, 242 pages.

[34] Herzberg F., Paul, W. J., and Robertson, K. B. "Job Enrichment Pays Off," *Harvard Business Review*, January/February 1968.

[35] Katzell, R. A. and Yankelovich, D. "Improving Productivity and Job Satisfaction," *Organizational Dynamics*, Summer 1975.

[36] Kling, R. "Towards a Person-Centered Computer Technology," *Proceedings of the ACM National Conference*, 1973, pp. 387-391.

[37] Kling, R. "Computers and Social Power," *Computers and Society*, Vol. 5, No. 3, Fall 1974.

[38] Lawler, Edward E., III. *Motivation in Work Organizations*, Brooks/Cole Publishing Company, Monterrey, California, 1973.

[39] Lucas, Henry C. *Computer Based Information Systems in Organizations*, Science Research Associates, Palo Alto, California, 1973.

[40] Lucas, Henry C. *Why Information Systems Fail*, Columbia University Press, New York, 1975.

[41] Lucas, Henry C. *Toward Creative Systems Design*, Columbia University Press, New York, 1975.

[42] Lupton, Tom. "Efficiency and the Quality of Worklife: The Technology of Reconciliation," *Organizational Dynamics*, Autumn 1975.

[43] Mann, F. C. and Williams, L. K. "Organizational Impact of White-Collar Automation," *Industrial Relations Research Association Proceedings*, 1959.

[44] Marenco, C. "Gradualism, Apathy, and Suspicion in a French Bank," in *Office Automation*, W. H. Scott (ed.), OECD, Paris, 1965.

[45] McGregor, D. *The Human Side of Enterprise*, McGraw-Hill Book Company, New York, 1960.

[46] Meyers, Charles A. (ed.). *The Impact of Computers on Management*, The MIT Press, Cambridge, Mass., 1967.

[47] Miles, Raymond E. *Theories of Management: Implications for Organizational Behavior and Development*, McGraw-Hill Book Company, New York, 1975.

[48] Mueller, E. *Automation in an Expanding Economy*, Institute for Social Research, Ann Arbor, Michigan, 1969.

[49] Mumford, E. and Banks, O. *The Computer and the Clerk*, The Villafield Press, Slasgow, England, 1967.

[50] Mumford, E. and Ward, T. B. *Computers: Planning for People*, B. T. Badsford Ltd., London, 1968.

[51] Mumford, E., Mercer, D., Mills, S., and Weir, M. "The Human Problems of Computer Introduction," *Management Decision*, Vol. 10, No. 1, 1972, pp. 6-17.

[52] Mumford, E., Mercer, D., Mills, S., and Weir, M. "Discuss the Suggestion that No Project Team Concerned with the Implementation of the MIS Should Be without a Trained Social Scientist," *The Computer Bulletin*, July 1972, pp. 356-358.

[53] Nolan, Richard L. and Gibson, Cyrus F. "Managing the Four Stages of EDP Growth," *Harvard Business Review*, January/February 1974, pp. 76-88.

[54] Pettigrew, Andrew. "Towards a Political Theory of Organizational Intervention," *Human Relations*, Vol. 28, No. 3, pp. 191-208.

[55] Pettigrew, Andrew and Mumford, Enid. *Implementing Strategic Decisions*, Longman, New York, 1975.

[56] Pollock, Ken, *et al. Improvements Needed in Managing Automated Decision-Making by Computers Throughout the Federal Government*, Report to the Congress by the Comptroller General of the United States (FGMSD-76-5), 1976, available from U.S. General Accounting Office, Distribution Section, P.O. Box 1020, Washington, D.C., 20013. D.C., 20013.

[57] Rubenstein, A. H., Radnor, M., Buker, N., Heiman, D., and McCally, J. B. "Some Organizational Factors Related to the Effectiveness of Management Science Groups in Industry," *Management Science*, Vol. 13, No. 8, April 1967, pp. B-508 - B-518.

[58] Schein, Edgar H. "In Defense of Theory Y," *Organizational Dynamics*, Summer 1975, pp. 17-30.

[59] Schultz, Randall L. and Slevin, Dennis P. (eds.). *Implementing Operations Research/Management Science*, American Elsevier, New York, 1975.

[60] Sollenberger, Harold M. *Major Changes Caused by Implementation of a MIS*, Research Monograph 4, National Association of Accountants, 1968.

[61] Taylor, James C. *Technology and Planned Organizational Change*, CRUSK: Institute for Social Research, The University of Michigan, Ann Arbor, Michigan, 1971, 151 pages.

[62] Taylor, James C. "A Report of Preliminary Findings from February 1976 Work Organization Pilot Study," Center for Quality of Working Life, UCLA, Los Angeles, California, 90024.

[63] Tichy, Noel M. "Agents of Planned Social Change: Congruence of Values, Cognitions and Actions," *Administrative Science Quarterly*, Vol. 19, No. 2, 1974, pp. 164-182.

[64] Tomeski, Edward A. "Building Human Factors into Computer Applications: The Computer Profession Must Overcome a 'Jackass Fallacy'!" *Management Datamatics*, Vol. 4, No. 4, August 1975, pp. 115-120.

[65] Whisler, T. L. *The Impact of Computers in Organizations*, Praeger, 1970.

About the Authors

Bob Bostrom is an Assistant Professor of MIS in the Department of Operations and Systems Management at the Graduate School of Business, Indiana University - Bloomington. He has been involved with STS design approach for over two years through collaborative efforts with the Center for Quality of Working Life (CQWL) at UCLA. The CQWL is a major source of STS knowledge in this country. He holds a B.A. and MBA from Michigan State University, an MS in Computer Science from SUNY at Albany and a Ph.D. in MIS from the University of Minnesota. He also has extensive consulting experience especially in the areas of database management and MIS design. Professor Bostrom is currently engaged in research related to the STS approach.

Steve Heinen is an Assistant Professor of Managerial Psychology at the University of Minnesota. Steve has been involved with problems of organizational change and development and has consulted with several companies in Minnesota and Michigan on more effective management of people. Steve has an AB degree from Xavier University of Ohio and an MA and Ph.D. in psychology from Michigan State University.