MIS Problems and Failures: A Socio-Technical Perspective, Part II: The Application of Socio-Technical Theory
Author(s): Robert P. Bostrom and J. Stephen Heinen
Source: *MIS Quarterly*, Vol. 1, No. 4 (Dec., 1977), pp. 11-28
Published by: Management Information Systems Research Center, University of Minnesota
Stable URL: http://www.jstor.org/stable/249019
Accessed: 15-09-2016 07:42 UTC

MIS Problems and Failures: A Socio-Technical Perspective

PART II:
The Application of Socio-Technical Theory

By: Robert P. Bostrom
J. Stephen Heinen

Abstract

This article provides, by means of a hypothetical example, the procedures to be followed in applying the Socio-Technical-Systems Approach to information systems design. The need for this approach was presented in the first part of this article which appeared in the September Issue of the MIS Quarterly. *Here the authors provide an overview of the Socio-Technical-Systems procedure and show how it could be used in redesigning an information system used by the circulation department of a large newspaper. The step by step approach is intended to illustrate the process to those practitioners feeling that more needs to be done in the area of using computer-based systems to improve the quality of working life of the system users.*

A large metropolitan newspaper is considering the redesign of a system used by its Circulation Department. Major problems with the current system include:

- inaccurate and incomplete data in the database
- inability to satisfy requests for information quickly
- large number of customer complaints concerning delivery of their newspaper
- poor information for advertising purposes
- high staff turnover
- high staff absenteeism
- communication problems within the staff
- communication problems with MIS Department
- low quality work
- low productivity.

The newspaper's management has concluded that the problems have become so severe that the system must be changed. One of the managers suggested that this project might be a good opportunity to apply the Socio-Technical Systems (STS) approach.[1] It was decided that an STS consultant ought to be brought in to assist with the project. The remainder of this article presents, by development of the hypothetical example of a newspaper circulation department, how the STS methodology can be applied.

The facts which convinced the management that taking an STS approach was worth a try included:
- Current MIS designs have been shown to make no clear distinction between the techniques, strategies, and technologies used and the organizational views, assumptions, and values implicit in their use.
- Many new technologies (e.g., database, distributed systems, data entry devices) allow opportunities to improve work design. However, it is typical to find that sophisticated equipment is installed without changing any of the existing work procedures.
- Acceptance of new or modified systems has been a problem in the past and there is no reason to expect that this case will be

---

1. Rather than review the reasons why STS methodology is appropriate in the MIS context and repeat an overview of the STS philosophy, we urge the reader to review Part I of this article in the September 1977 issue of the *MIS Quarterly*.

different. Any alternative that can help this problem is worth trying as long as it is not excessively expensive.

The Case Situation

The Circulation Department of the newspaper serves 250,000 subscribers. The system involves registration of subscribers, updates to subscriber information, and transactions triggered by subscriber inputs. This system is similar to "registration" systems in use by many organizations such as welfare systems (food stamps, Medicaid), immigration systems, and credit bureaus. Regarding the newspaper system, only the information relevant to the major steps in the STS design process will be presented.

The current circulation system

The organization of the Circulation Department is shown in Figure 1. This department is responsible for the starting, updating, and maintaining a data file of information concerning current newspaper subscribers. 32 people are directly involved with the circulation system. Three groups of the MIS department of the paper which provide major support for the Circulation Department's activities are: data entry, data control, and application support/system maintenance.

The processes used by the Circulation Department can be understood best by describing the transactions which take place. The Subscription Order Section, with a supervisor and nine staff people, takes phone calls from subscribers and writes up a multiple part order form to indicate whether to start or to stop the paper, to register a complaint, or to leave a message for a carrier. These orders are batched together and picked up on an hourly basis by either the preparation section or request section, depending on the nature of the transaction.

An order to start or to stop the paper is taken to the Preparation and Follow-up Section which verifies the address information, checks a map to assign the appropriate route number, and codes the information for data entry into the system. Six

people process the normal orders with two people assigned to handle exceptions that cannot be prepared in the normal manner. A copy of the order is then sent to the Dispatcher for input into a manual system to update the number of papers a carrier receives. An order copy also goes to a Distribution Department to indicate to the district manager and his carriers what changes in their routes may have occurred.

Complaints and messages are routed to the appropriate parties. If these represent requests for information, they are sent to the Request Section supervisor. Requests handled by this section may be routine or special. The requests may come from subscribers through the Subscription Order Section or from other departments of the newspaper directly to the Request Section supervisor. Any request may receive a rush status which means response within an hour for routine requests and three days for special requests. Request handlers answer routine requests by searching one or more printouts which are filed in a special printout room. If the request cannot be filled by examining the printouts, a request handler will write up a MARK IV query to obtain the information. This request is sent to MIS Application Support Group for verification and processing. If the request cannot be written into a MARK IV query, a request for service form is completed and sent to the Application Support Group. The support group will obtain the information with the best technical mechanism, *e.g.*, a new program.

A supervisor, two clerks, and four request handlers currently process the information requests. The clerks log in and out all requests for information; they are responsible for maintaining the printout room and keeping the printouts up to date and filed correctly. Three request handlers deal with regular requests while one deals only with special requests. After the request is answered it is given to the supervisor who notifies the subscriber or the department requesting the information.

The Maintenance Section is responsible for maintaining and updating the manual files and machine database. They work with the District Managers on updating or changing the routing system and the file codes. They also work closely with the MIS department on any changes in the
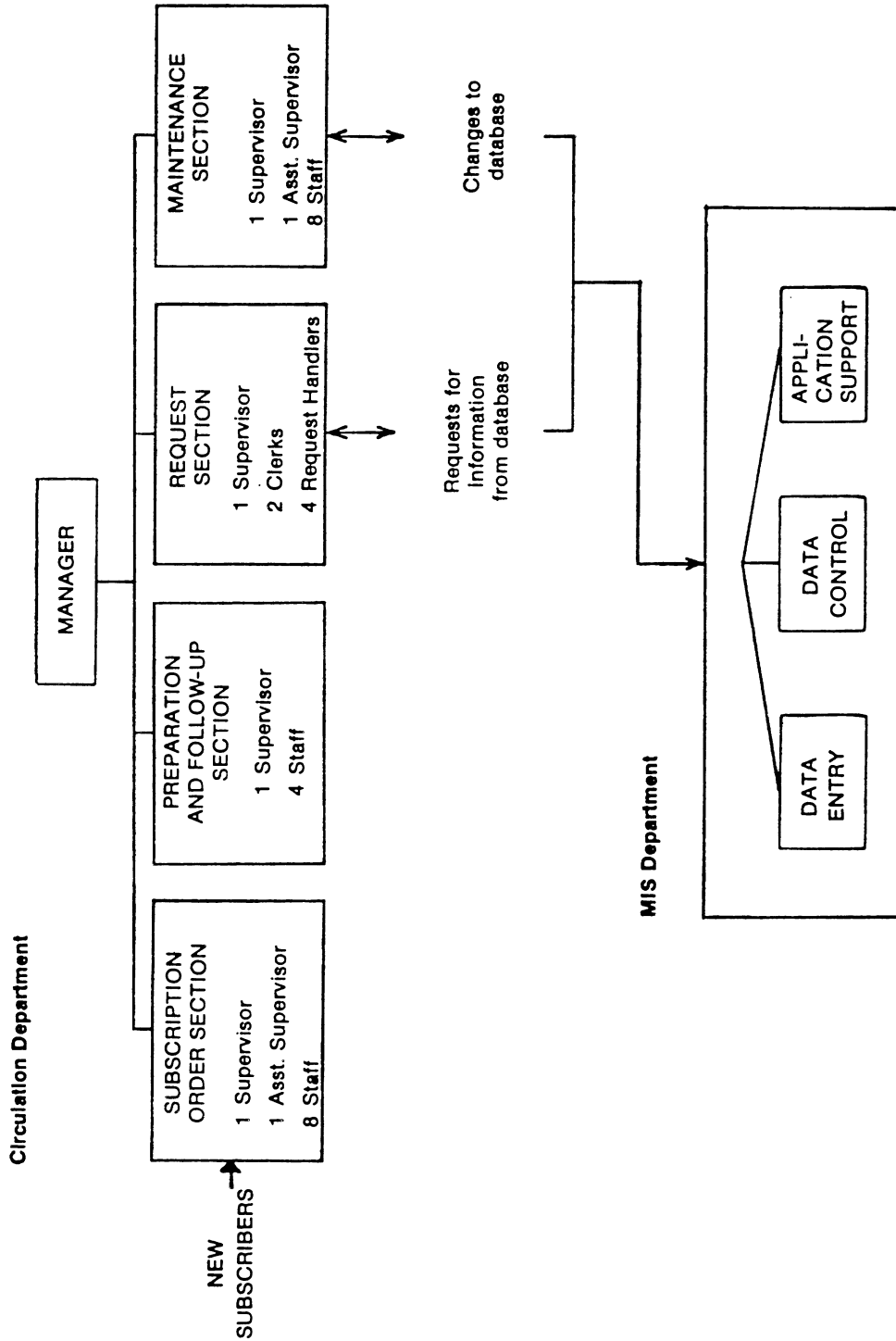
Figure 1. Circulation Department Organization

system. A supervisor, assistant supervisor, and eight staff people work on maintaining the system.

The procedure followed after the selection of a specific STS consultant was to:

1. Present an overview of the STS methodology to the management.
2. Examine the organization and the nature of the problem.
3. Conduct the STS design.

Presentation of the STS Approach

The STS consultant presented to the management the philosophy of the STS approach and an overview of the steps involved. The remainder of this section summarizes this presentation.

The STS approach views the organization as a work system with two interrelated subsystems, the technical system and the social system; the traditional MIS approach views the organization as an information processing system. The technical system is concerned with the processes, tasks, and technology needed to transform inputs such as raw materials to outputs such as products. The social system is concerned with the relationships among people and the attributes of these people such as attitudes, skills, and values. The outputs of a work system are a result of the joint interaction between these two systems.

STS tends toward a Theory Y or human resource set of assumptions in viewing the people within the work system. The individual is viewed as someone who wants to contribute to organizational goals and wants to use not only his/her skills and abilities, but also to become increasingly competent in mastering his/her environments. These assumptions about people impact not only what the design should include, but how the design is derived.

Given its assumptions about people and its view of organizations, the goal of the STS design is to optimize the uniqueness of the organization's technical requirements along with the needs and values of its individual members into a

productive organization with a high quality of working life. The typical MIS approach adapts the social system to the technical system requirements. The technical and production requirements of work under an STS framework are jointly optimized with the psychological and social aspects of the individual and group requirements. This jointly optimized design is defined in terms of each individual work system.

An additional goal of the STS approach is to create a flexible "learning system" — a work system which is able to adapt and adjust within a constantly changing environment. In order to create a learning system, members of the work system must have usable and understandable "maps," or clear pictures, of both the social and technical systems. STS analysis produces such maps.

The implementation of an MIS is normally viewed as improving communication and control within an organization. A fact often overlooked is that changes in one aspect of an organization can create unplanned changes or effects in other systems within the organization. The MIS usually is coupled with a substantial amount of job design and redesign. In addition, new social support systems, e.g., changed pay systems, may need to be created. The STS approach through its analysis attempts to examine these systematic interactive effects in the development of socio-technical design alternatives.

The STS approach involves three phases which are:

Phase I: Strategic Design Process
The purpose of the strategic design process is to make the goals and responsibility for the project explicit. The issues of user participation and responsibility can be dealt with by having users focus on this stage. The users formulate and reformulate the goals and policies which guide system design activity over time. This phase in the past largely has been ignored or under-attended in MIS design.

Phase II: Socio-Technical System Design Process
This phase in the past has received the most emphasis, but its focus has been almost exclusively on technical problems. The analysis of the problem and the formulation of the design includes joint consideration of the technical

system requirements and the social system requirements. This design process emphasizes not only the procedural aspects of design, but also the change process.

Phase III: Ongoing Management Process

This is what is known as an action research process. The new system is constantly monitored to see if it is meeting its goals. If necessary, adjustments are made on the basis of the STS approach. This stage conforms to the STS principle of incompletion which stipulates that as soon as a design is implemented, its consequences indicate the need for redesign. The implementation process should be viewed as an iterative process.

Strategic Design Phase

The purpose of the strategic design phase is to combine relevant MIS and user personnel into a steering group in order to define the values and goals which direct the project. Several key questions need to be addressed in this phase including:
- What are the specific problems facing the work system?
- What is the definition of the relevant work system boundaries?
- Who will have "ownership" of the system?
- What is the organizational climate for change?
- How will the new system be implemented and diffused?

The first critical step in the strategic design phase is to select the people to serve on the steering group. This selection can be very critical. The group will be most effective if it includes a cross section of people from the MIS department and the total user group. Typically the MIS designer has a limited view of the user group and is only concerned with the involvement of a limited set of primary users, as we pointed out in our first article. Also, the individual members selected must be credible sources not only with the other steering group members, but also with the total system being designed. The effective operation of the system depends on the degree to which these individuals are open to change, possess good interpersonal communication skills, and have a unique talent, knowl-

edge, or experience required in the design of the system. The composition of the Steering Committee to redesign the Circulation Department was:
- Manager of Circulation Department
- 4 Supervisors from Circulation Department
- 2 Systems Analysts from MIS Department
- Personnel Department representative
- VP of Newspaper Operations.

The steering group began its work with an initial scan of the work system for which the information system is being designed in order to define the boundaries of the work system and to identify the major problems. The steering group identified, for the system being examined:
- the primary inputs, transformations, and outputs needed;
- the existing organizational structure and the groupings within it;
- the objectives of the system;
- the primary environmental characteristics;
- other historical or current factors impinging on the organization related to this system design.

The main task of the steering group during the strategic design phase was to produce a working document of the policies, goals, and philosophy of the project which would guide the STS design. The members developed a common understanding of the parameters of the system to be created, the goals to be achieved, and a specification of areas of responsibilities and needed resources in order to produce the working document.

The Steering Committee, in order to develop such a policy document, has to examine their beliefs regarding people in the workplace. The questionnaire in Figure 2 was used to do this examination. Composite profiles for the Steering Committee were prepared and discussed by the entire team.

A simplified version of the steering group policy document might be:

> "Any changes made in the design of the Circulation Department system should provide for better customer service to our subscribers and advertisers as well as provide jobs that are more challenging, responsible, and interesting to the department members. The

Sample Questionnaire

Instructions: Place an 'x' on each scale which reflects your opinion regarding the typical worker.

A. Leaves other people to make most of the decisions on things which affect them at work.　: 1 ┃ ┃ ┃ ┃ ┃ 7 : Will protest if they are not consulted on all matters which affect them at work.

B. Capable of handling only a limited range of tasks in their job.　: 1 ┃ ┃ ┃ ┃ ┃ 7 : Capable of doing a job involving a variety of different tasks.

C. Not concerned about having social contact at work.　: 1 ┃ ┃ ┃ ┃ ┃ 7 : Regards opportunities for social contact at work as important.

D. Can tolerate boring work.　: 1 ┃ ┃ ┃ ┃ ┃ 7 : Demands interesting work.

E. Work best if the pace of the work is outside control.　: 1 ┃ ┃ ┃ ┃ ┃ 7 : Has complete control over the pace of work.

F. Needs or wants to have a well defined job (area of operation) which he/she sticks to most of the time.　: 1 ┃ ┃ ┃ ┃ ┃ 7 : Works well and enjoys working in a job (area of operation) which is not clearly defined.

G. Needs to be told what to do next and how to do it.　: 1 ┃ ┃ ┃ ┃ ┃ 7 : Can organize the sequence of work and choose the best methods.

H. Unable to undertake responsibility for decisions, and unable to take initiative.　: 1 ┃ ┃ ┃ ┃ ┃ 7 : Able to undertake responsibility for decisions, and able to take initiative.

I. Has a low level of skill and/or knowledge (expertise).　: 1 ┃ ┃ ┃ ┃ ┃ 7 : Has a high level of skill and/or knowledge (expertise).

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

Figure 2. Sample Questionnaire to Examine Steering Group Members' Assumptions About People

design team should allow the greatest involvement possible for the people whose work is being designed, but in conjunction with broad company guidelines."

Having developed a policy document and having identified system boundaries, interactions, and problems, a "Design Team" was selected to carry out the actual modification of the system. This team was composed of:
- 4 employees, one from each section of the Circulation Department
- 2 Circulation Department supervisors
- 2 Systems Designers
- The STS consultant.

Note that the Design Team is representative of the work system to be redesigned. A broad slice of people from various job levels and viewpoints in the work system to be affected were selected in order to avoid the problems identified in Part I of this article with respect to who the user is and regarding the concept of the responsibility. The Design Team proceeded through many of the same steps as the Steering Committee with regard to their own goals, values, processes, and needed training.

Socio-Technical-System Design Process

The first task for the Design Team in the redesign process is to perform an extensive diagnosis of the technical system and the social system. These diagnostic results are used to generate alternatives for jointly optimizing the two systems. The social system analysis is done after the completion of the technical analysis in order to discover the personal controls used, to examine coordination around the technical requirements especially at the boundaries, and observe the interpersonal functions of the people. These data should be generated at all stages in the analysis by the people actually performing the activities, *i.e.*, primary and secondary users, in their own language and frameworks.

Technical system analysis

Step 1: Identification of unit operations.
The team began by identifying the transformation process of the work system's primary task and broke it down into its various unit operations in order to facilitate a detailed examination. A "unit of operation" is any of the phases of technology in which an identifiable state change in the input occurs. Figure 3 describes the primary transformation system performed by the Circulation Department. These units of operation represent the main phases in which some change in the input occurs that leads to eventual outcomes of the system. The units of operation focus on *inputs*, not processes or techniques. This forces examination of the technical requirements independent of current jobs or task assignments. The trap many people fall into is to define the conversion process in terms of current activities undertaken by people rather than the process that changes the input.

Inputs	Transformation	Outputs
Calls to start or stop the paper ⟶		⟵ Subscription added or deleted
Requests for information on subscribers ⟶	**Transformation**	⟵ Information on subscribers
Information to update subscription file ⟶		⟵ Updated database, for computer and manual files

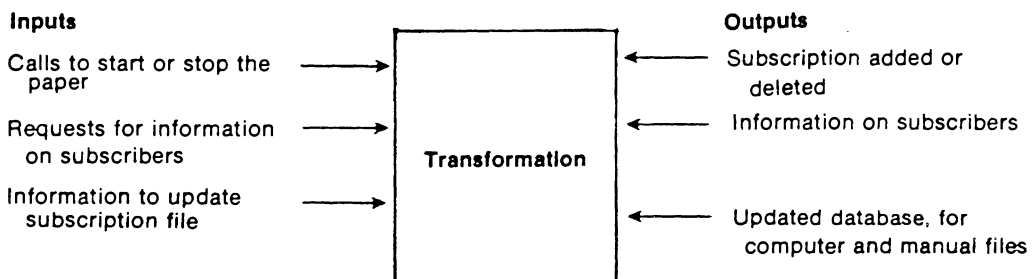**Figure 3: The Technical System In the Circulation Department Depicted In Terms of Inputs and Outputs**

The team broke down the transformation process into four units of operation:

1. **Receipt of order** — a phone call from a subscriber is received and transformed into an order to be inputted into the system, a request to be answered, or a message to be channeled to another area.
2. **Analysis of the data and preparation for Input** — the order or information request is verified for correct information and coded for entry into the system.
3. **Command the system** — the subscription data is entered into the system, updated, or information requested from the database.
4. **Distribution** — the order or information request is prepared and delivered to the appropriate person or unit.

Step 2: Identification of key variances.
Figure 4 presents the variance matrix table constructed by the Design Team for the Circulation Department. *Variance* is a critical concept in the STS analysis. A variance is any deviation in the process from some standard or norm which will affect the system performance or output. The link to effective performance in an STS operation is the identification of the key process variances that impact system performance and the design of the social and technical systems to control effectively the impact of these variances. Only variances which represent some deviation in terms of input variables or the nature of the transformation process itself should be considered.

The following tasks should be done in order to identify the key variances.

a) List all important variances which affect each unit operation in accomplishing its objectives. It may be necessary to review this list two or three times for accuracy and completeness.
b) Construct a variance matrix table. This is a square matrix of the data gathered in step (a) in order to identify systematically the interrelationships among variances which may provide information on control problems and necessary information loops critical to the MIS design/redesign. The variance number is inserted in the table wherever it affects another variance.

c) Identify the key variances. Several criteria can be used to sort these out. Key variances may be those which: 1) impact one or more variances within a unit operation; 2) impact one or more variances in subsequent unit operations; 3) are considered key by participants based on past knowledge and experience within the system; or 4) significantly affect quantity of output, quality of output, operating costs, or social costs such as hazards or high stress for people performing the tasks.

The variance matrix table shown in Figure 4 must be reviewed and approved by appropriate people working in the department. Key variances are circled. Two general types of variance are shown as critical to the effectiveness of the Circulation Department: a) the volume of orders and information requests; and b) the adequacy of information in terms of completeness, correctness, and currentness.

Step 3: Construction of variance control table.
Figure 5 presents the variance control table for the Circulation Department. A variance control table lists for each key variance: the unit operation in which the variance originates or occurs; where it is observed; where it is controlled; who or what controls it; what actions are taken to control it; and what information is used from what source to be able to control the variance. Extra space is provided for generating possible technical system change and/or social system change alternatives to handle the key variance. Not much is done, however, at this stage with these last two columns. This data provides the basic input for subsequent design efforts and can be very important to MIS design. It often points out control problems created by long feedback loops or ineffective control activities.

The key input needed for the MIS design is who should get what information. The variance analysis technique provides such input by identifying information requirements needed to control key variances. In addition; the variance analysis technique provides a useful map of the user work system. Lack of useful work system maps is a primary cause of the user's failure to understand or identify their actual information needs.

Units of Operation

Variances

I. Receipt of order

1. volume of phone calls
2. volume of messages
3. volume of routine information requests
4. volume of rush information requests
5. duplicate orders or requests
6. incorrect address information
7. incorrect or changes in carrier information
8. incomplete information on subscriber

II. Analysis of data preparation for input

9. illegible order forms
10. printouts missing or misfiled
11. lack of current information in database
12. availability of forms

III. Command System

13. volume of command representatives
14. forms submitted on timely basis
15. correct representation
16. forms and information returned in timely basis

IV. Distribution

17. changes in distribution points
18. correct distribution

Figure 4.   Variance Table for Circulation Department

Key Variance	Name of Unit Operation*			Controlled by whom	Control Activities	Information Needed	Technical Systems Options	Social Systems Options
	where occurs	where observed	where controlled					
1. Volume of phone calls	1	1	1	supervisor	work overtime, extra people	volume estimates based on history		
3. Volume of routine information requests	1, 2	1, 2	2	supervisor	determines priorities works overtime	volume estimates based on history		
4. Volume of rush information requests	1, 2	1, 2	2	supervisor of request section	determine priorities, additional time devoted to rush jobs, work overtime	volume estimates by types of requests		
6. Incorrect address information	1, 2	2	2	supervisor staff and member of request section	check with subscription operator, research maps	correct information on order or in file		
7. Incorrect or changes in current information	2	2	2	supervisor or staff member in maintenance, district manager	follow-up with district manager to verify data	correct information from district manager		
8. Incomplete information on subscriber	1	2	2	supervisor of preparation section	check with subscription operator	correct information on order		
11. Lack of current information in database	2	2, 3	3 another section outside boundary	maintenance supervisor	check manual files check with subscription order section	correct information on order		
12. Availability of forms	outside boundary	3	3 another section outside boundary	request handler supervisor	forms ordered on timely basis	current inventory of forms		
13. Volume of command representations	3	2, 3	3	supervisor	work overtime, additional time devoted to special requests	estimated volume by type		
18. Correct distribution	4	4	4	clerk	no control	number and type of errors		

*The numbers shown in the squares in the table refer to Units of Operation: 1—Receipt of Order; 2—Analysis of the Data and Preparation for Input; 3—Command the System; 4—Distribution. (These Units of Operation are discussed in this article in Step 1 of the Technical Systems Analysis).

Figure 5. Variance Control Table for the Circulation Department

Social system analysis

The concern in the social system analysis is to describe how the various individuals in the work system accomplish their tasks and receive their need satisfactions from the work. The social system is not a friendship system, but the way in which people relate to each other in their working relationships in order to get their jobs done. There are a number of options for the work system that would be effective in accomplishing a task for every technical system. The purpose of the social system analysis is to derive additional important parameters for the total system design. Since variance control is crucial to the work system performance, the social system is studied in terms of its usefulness and nonusefulness to variance control.

No single strategy has been defined for analyzing the social system. Primarily the focus has been on the design of jobs and responsibilities to accomplish the work system's task. Most of the analyses have started from the existing system, major problems, and then pursuing the analysis of these areas. Thus, all social system analysis should include some investigation of problems identified by the steering group in their preliminary scan of the system. An internal or external behavioral science consultant may be necessary in order to conduct these investigations. This is one major role played by the STS consultant in the example given in this article.

The social system analysis usually includes an investigation of four general areas:
1. individual needs, characteristics, and abilities of people in the work system;
2. internal work system characteristics;
3. external environment of the work system;
4. support systems for that work system.

These steps are not always followed in the depth or the order in which they are described here, but for illustrative purposes a step by step presentation for the case example will be used.

Step 1: Initial scan of social system problems.
The analysis starts with a description of the characteristics of the work force within the system and any signs of problems in the social system (see Figure 6). The purpose of this procedure is to document some of the factors within the system that either indicate problem areas to be solved or factors which may constrain or at least impact social system functioning.

The Circulation Department found that turnover and absenteeism were particular problems. The high levels tended to increase productivity problems because new or substitute people tended not to get the information accurately from the subscriber nor did they recognize potential errors in the database. Absenteeism and turnover also created more overtime work to keep up with the backlog.

Some interviewing and surveys of the work force were conducted to obtain the workers major reactions to the Circulation Department and the work they were doing. The questions were open-ended, such as a) What do you like about your job, your department and the organization? b) What do you dislike about these? c) What major problems are causing you to be less productive than you would like to be? d) What suggestions for change do you have?

The general consensus in the Circulation Department was that people liked being identified with the major newspaper in town and their role of serving client needs. However, they often found their jobs boring, because they were doing many of the same things over and over again. They also disliked the fact that most of the feedback they received on the job only occurred when problems developed. A sense of frustration developed when a customer was upset about a previous request not being fulfilled. The subscription order entry person never knew what had happened and could only say "I'll check."

The delays in responding to customers requests created additional problems. People also reacted to the fact that they had very little interaction with other people in the department; most of the communications passed through supervisors. The workers felt if they could communicate with each other more often, some of the errors would be avoided, and if they could get the information more rapidly they could give better service to the customer.

Step 2: Map of the communication role network.
The Design Team made a listing of who each individual worked with or contacted in fulfilling

1. Environment — characteristics of local labor market
— characteristics of local community
— relationships company/community

2. Social Settings— description of working conditions
— description of layout
— description of departments, etc.

3. Indicators of social system functioning: Source: records where available

    a. **Turnover:**   by department
by grade   : special recording by agreement.
by category
by age, sex, time with firm/marital status

    b. **Sickness:**   frequency, duration by department, etc., as in "a" above.

    c. **Absence:**   as in "b" above.

    d. **Timekeeping:**   lateness — frequency, time lost as in "a" above.

    e. **Overtime:**   voluntary/compulsory — as in "a" above.

    f. **Grievances:**   number, type, how resolved, number of stoppages, duration.

    g. **Accidents:**   type, severity, number as in "a" above.

    h. **Fluctuation in Earnings:** ratio typical good week to typical bad week as in "a" above.

    i. **Union membership rates:** as in "a" above.

4. Unions   — membership
— relations

5. Sociographical data
description of work force — age

                                       — sex

                                       — etc.

(Developed by Albert B. Cherns, Center for Quality of Working Life, UCLA.)

Figure 6.   Analysis of Social Systems

his or her responsibilities. The focus was primarily on task-based interactions with people. Figure 7 provides a partial listing of some of the very important task-based interactions in the Circulation Department.

It is useful in many cases to identify whether the individual is within or outside the work system being studied. Sometimes, other interactions are significant such as social, professional, transportation-related, or those concerning special organizational tasks. These are significant if in the initial scan, particular problems in these areas are encountered which may have a bearing on the system design.

The information collected normally includes who the individual works with, the nature of the interaction, the importance of the interaction,

and the frequency of the contact. The variances identified in the technical analysis often create certain communication needs. The listing of an interaction network provides a link for integrating the social system analysis to the technical system variance control analysis.

Several aspects stand out in the Circulation Department example in the network analysis:

1. Staff members do not have much interaction with each other.
2. Most communication of the staff within and among sections is through the supervisors.
3. The department has extensive communication with all the district managers, several people in the MIS Department, Advertising, and Distribution.

Name	With Whom	Nature	Importance	Frequency
Mary Smith, Subscription Order Staff	Frank Jones, Supervisor Subscription Order Section	Problems with orders	V.I.	2-3 times daily
	Alex Akers	Message from carrier	V.I.	once a week
	Roger Jackson, Dist. Mgr.			
Frank Jones, Supervisor Subscription Order Section	Larry Kann, Supervisor, Follow-up Section	Problems on orders	V.I.	2-3 times daily
	Mary Smith	Problems on orders	V.I.	2-3 times daily
	Subscription Order Staff			
Sam Thompson, Supervisor Request Section	Sam Thompson, Supervisor Request Section	Information requests	V.I.	many times daily
	Jean Jacklin, Supervisor Maintenance	Changes in codes	V.I.	once a week
	Request Section Staff	Work assignments	V.I.	twice a day
	Bob Berglin, Advertising	Information subscribers	V.I.	once a week
	Roger Jackson	Information on subscribers for their area	V.I.	once a week
	District Managers			
Jean Larsen, Supervisor Maintenance	Pat Williams, Applications Support Staff	Help on special request	V.I.	twice a week
	Frank Jones, Supervisor Subscription Order Section	Requests needed	V.I.	daily
	Maintenance Staff	Work assignments	V.I.	once a week
	Steve Smith, MIS Manager	Changes in system	V.I.	twice a week
Carol Olson, Request Handler	Sam Thompson, Supervisor	Work assignments	V.I.	2 times daily
	Beverly Johnson, Request Clerk	Request information	V.I.	many times daily

Figure 7. Map of Role Network

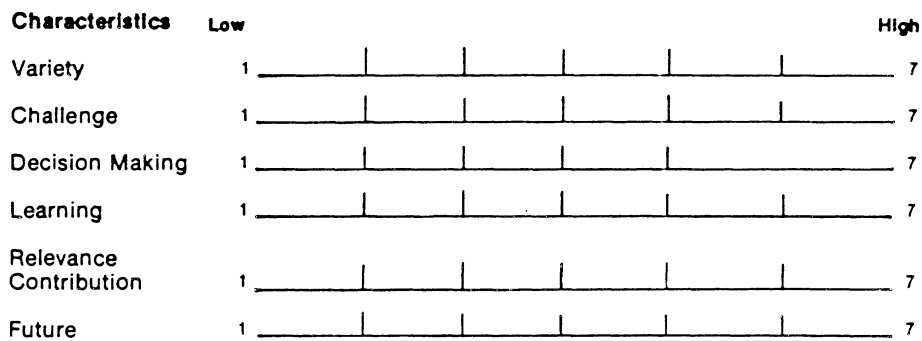| Characteristics	Low						High
Variety	1						7
Challenge	1						7
Decision Making	1						7
Learning	1						7
Relevance Contribution	1						7
Future	1						7

Figure 8. Psychological Characteristics in Circulation Department

Step 3: Individual role analysis.

Figure 8 provides a profile of the psychological characteristics of jobs in the Circulation Department which the STS consultant developed. A major goal of the social system is to optimize the match between the individual needs or what the employee is seeking from work and the organizational requirements or what the organization provides. Several crucial areas where a match is needed have been identified: knowledge, psychological, control-support, and task needs. Assessing how well current job designs match work needs can be accomplished in several ways. Interviews with people about the nature of these is one approach. A short, quick method is to have each worker assess his job on a six criteria scale.[2] The six criteria are variety, challenge, decision making, learning, relevance and contribution, and future. A seven-point scale ranging from 1 which represents none to a 7 which represents maximum in the job is used.

Another alternative is to use a Job Diagnosis Survey (JDS).[3] The survey method is longer but provides a much richer data source for design purposes. It is predicted in the model that a person's motivation depends on three critical, psychological states: experienced meaning-

fulness, experienced responsibility, and knowledge of results. The three states in turn are affected by five core job dimensions: skill variety, task identity, task significance, autonomy, and feedback. The JDS provides information on each of these eight factors plus information on the strength of one's need for growth and general job satisfaction data.

Using the JDS, briefly what was found was that the staff members within the Circulation Department expressed low levels of experienced responsibility and knowledge of results. The primary reason for this was the fact that everything passed through the supervisors and that people only received negative feedback on their work. Task identity was also negligible since each person did assignments as they were given. Skill variety was present for some, but not for all members of the department.

Step 4: Analysis of existing work group.

Attitudes about the existing work group performance provide other suggestions for redesign. Perceptions concerning leadership style, coordination, decision making practices, organizational climate, work group cohesiveness, and goal clarity and effectiveness can be used to supplement the role network data on the existing system.

Cohesiveness within the Circulation Department was found to be relatively low. The goals were well understood, but people were frustrated by their inability to respond quickly and to get necessary information. Supervisors were perceived as restrictive and unwilling to share

2. This scale was developed by F. E. Emery and E. Thorsrud in their STS work in Norway which is described in their book: *Form and Context of Industrial Democracy*, London: Tavistock, 1969.
3. The Job Diagnosis Survey was developed by J. R. Hackman, G. R. Oldham, R. Janson, and K. Purdy and is described in their article, "A New Strategy for Job Enrichment," *California Management Review*, Summer 1975, p. 57-71.

information. The information was even less available under periods of heavy workload because people were too busy to keep in touch. A number of people commented that one section would take an action but would not notify the other section immediately and this caused mistakes.

Step 5: Analysis of work system external environment.

Constraints on the work system that might affect any change should be identified. These constraints may be within the organization, but others are outside the work system or outside the total organization. These may include various kinds of turbulence or pressures in the environment, societal attitude, norms, lifestyle changes, significant changes in other parts of the organization, etc.

The Circulation Department has to work closely with a number of other departments. Their work initiates the whole cycle of interactions with subscribers. Difficulties encountered here can create variances in other departments.

- Advertising on occasion has expressed some dissatisfaction with obtaining useful, timely information from Circulation for their purposes.
- Circulation also works directly with the MIS Department. A number of problems exist in data entry and data control. Much of their work has been poor in quality, which creates variances for the Circulation Department.
- The district sales managers play a crucial role in keeping carrier information current and providing feedback to the Circulation Department. It is often difficult to get the district sales managers to update their carrier data and to provide it appropriately to the Circulation Department.

Step 6: Analysis of support system.

The final step in the social system analysis is to examine how the various support systems of the organization impact the behavior of the people within the work system. The primary support systems to analyze are the pay system, appraisal process, budgeting procedures, training needs, and promotion process. These systems in many cases interfere with the present socio-technical optimization and limit some changes

for future redesign. No major problems were found in these areas in the Circulation Department.

Design/redesign phase

The Design Team, after collecting the data, operationalized the goals developed by the Steering Committee in order to generate appropriate alternative MIS designs. The goals served as a criterion against which the various social system and technical system options could be evaluated. Many design alternatives were examined by the team. Premature evaluation of alternatives has a tendency to reduce the quality and innovativeness of the final product. The proposals for redesign to be effective should be relevant to the specific work system being designed/redesigned and not merely a transport design from somewhere else. In other words, the alternatives should be developed out of the data collected in line with the goals for the redesign.

Within the circulation department the goals were:

Technical System Goals

1. Reduce the time necessary to initiate a subscription or fulfill a request.
2. Improve the quality of the data, completely and correctly, in the database.
3. Provide better data for improving advertising revenue.
4. Keep the same number or reduce the number of staff required.
5. Simplify the procedures within the department.
6. Reduce the amount of coordination necessary to control the key variances.

Social System Goals

1. Increase the amount of feedback people receive on their performance.
2. Redesign jobs to improve communication within the department.
3. Organize the department to give non-supervisory employees more individual and group control.
4. Increase the degree of task identity and work variety in the jobs.

5. Provide for the progressive development of employee's skills and knowledge.

Given these goals, several alternatives were generated by the team. Examples of three in each area are shown below.

Technical System Options

1. Remain the same technically.

2. Assign persons from MIS to work in circulation department to help on data entry and data control problems.

3. Use an online system with visual display units with possible paper output. Set up online retrieval to the database and online update capabilities.

Social System Options

1. Keep same social system.

2. Allow people to rotate jobs from one section to the next.

3. Form groups of workers which perform all the departmental task functions for a given subscriber district or territory.

Each alternative was examined for advantages and disadvantages in meeting the task improvement and social system improvement goals. Additionally, the proposals were examined in terms of cost, resource, and situational constraints.

For example, it was determined that the online system proposed would speed up servicing the customer and retrieving information. Mistakes on input could be corrected more quickly. However, it was judged to be a costly type of change. The online system would increase feedback from a social system perspective, especially to the subscription operator. Without any other social system changes, it does not change any of the task identity or variety problems, however. Employing a job rotation system would provide more variety in the job and could improve communication by getting more exposure to problems. It would increase the training problems and might complicate some of the supervision and efficiency problems.

Forming work groups to serve each distribution district has a major advantage because it would give people an identifiable task responsibility area. Combining all the tasks would improve the communication and coordination problems. Given that people within the group could rotate among the various functions, it would also allow variety as well as the opportunity to set their own goals and to regulate their own performance. Task combination would also establish clear lines of communication with other departments. However, the disadvantages of making such a change would be that it requires extensive training and major changes in the way phone calls are initially handled.

After selecting the online system with work groups alternatives, the Design Team reexamined the various support mechanisms. This is a very important step which, if ignored, could destroy an effective change. It was recommended that the Circulation Department's pay system be changed to provide increases on the basis of the number of different skills learned to enhance flexibility and individual learning. Training needs for the new system and group structures were also defined and programs designed.

Management of the change process

The successfulness of a new MIS is often based on how the change is planned and carried out. Managing the change process begins with day one, moment one. Unfreezing the system or getting it ready begins in the strategic design phase and carries through to implementation.

STS designers eschew the traditional expert role of the designer in favor of a collaborative or action research mode. Involving the user in the total design follows the assumptions that people want to use and to develop their abilities and can help make joint optimization possible. A comprehensive and stable work system is developed from people pooling their detailed knowledge, no matter how fragmented. More importantly, the necessary motivation, responsibility, and commitment to effective implementation is present only when the people involved work out their own designs. Inevitable difficulties which may be overwhelming are encountered in the initial phases of the implementation if designs are imposed by upper management or by external agents such as consultants. The people

must *own* their section of the organization. Full participation is particularly important in the problem definition stage. Active participation of this type can be very difficult to maintain without effective tools and techniques such as those used in the STS approach. The designers and users operationalize the goals, develop action alternatives, and evaluate their effectiveness through the Design Team. This is a joint role and responsibility, not an expert process.

A critical problem in this Circulation Department design, as is the case with others, is that the speed of the social system change lags behind that of the technological system. A great deal of patience was required to help people develop new patterns of behavior appropriate to this new work context. The people did not have the necessary skills required for the new system and were apprehensive about the change. A climate was created which allowed people to raise their concerns. Weekly sessions were held to discuss the work group concept and the new MIS changes during the transitional phase. Rather than providing people with more and more technical information on the new system to help them understand or to sell them on the system, people were given the opportunity to experience the new system in simulated form and to test their concerns. Terminals were set up in the lunch room area to allow people to become familiar with the devices. Input and output CRT screens were set up to allow people to experiment with the format before determining the final design.

All of these steps were taken to help people make the transition and to keep them responsible for and committed to the new design.

Ongoing Management Phase

The third major phase of the STS procedure is the continual examination of the new or redesigned system after it is installed. This monitoring is done to ensure that the system is meeting its goals. If it is not, then adjustments must be made in the MIS/STS solution and/or in the support system. After these adjustments are installed, then the diagnosis phase continues. At any point one could loop back into the

complete STS design phase or return to the strategic design phase if there were a change in the strategic policies or assumptions on which the current design is predicated. Although this is a very important step in the STS process, its similarity to what has already been presented makes further elaboration unnecessary. This step involves an iterative process which continues the action research approach.

Conclusion

We do not expect that MIS practitioners can, on the basis of our two articles, implement STS processes in their organizations. We realize, in particular, that the detail presented by the example given in this article is far short of what would be needed to actually conduct an STS design. Our example may have appeared to some technically outdated; this choice of an example was purposively made to illustrate that design changes occur at *two different levels.*

Several people have pointed out that the introduction of computer technology into organizations has led to white collar factories. The Circulation Department described in this article before the redesign would certainly qualify. The introduction of a new MIS, online system using CRT terminals, provides many possibilities for flexible work design. However, following the traditional MIS design approach would have changed the technology which would have been an attempt at a more efficient "factory." This represents one level of change. The use of the STS approach offers a whole new concept for viewing the work system objectives which represent a second level of change. We believe it is this new view or approach to MIS design that is most important in order to combat the causes of inadequate designs identified in our first article.

MIS through its many experiences has recognized that many of its failures have been due to behavioral problems. A great deal of effort has been devoted to developing effective techniques to combat these problems. However, these efforts have been attempts to make adjustments to the technical system or compensate for its problems. What has been lacking is an appropriate framework for the total design.

STS not only provides a more appropriate framework for the total design, but also a useful methodology for carrying out the design. For those of you who may be interested in learning more about STS approaches to STS design, assistance may be provided by the following:
* the authors,
* the MIS Research Center at the University of Minnesota,
* the Center for the Quality of Working Life at the University of California — Los Angeles, and,
* Hedberg in Sweden and Mumford in Britain.

Suggested Reading

The following readings represent some recent efforts in MIS that incorporate similar principles or views to STS.

Gilb, Tom and Weinberg, G. M. *Humanized Input,* Cambridge, Massachusetts: Winthrop Publishers. 1977.
Discussion of techniques for designing reliable keyed input utilizing the principle of joint optimization.
London, Keith. *The People Side of Systems,* New York: McGraw-Hill, 1976.
Provides the MIS designer with the most useful reference guide available for dealing with the problems of developing and implementing computer-based systems using the principle of dual optimization.
Lucas, Henry C. *Toward Creative Systems Design,* New York: Columbia University Press, 1975.
Discusses creative systems design approach, including some STS concepts.
Mumford, Enid. *Systems Design for People,* England: National Computer Centre, 1971.
This book describes some of the critical pioneering work in the development of the STS approach for the design and implementation of MIS.

Strassman, Paul A. "Managing the Costs of Information," *Harvard Business Review,* September - October 1976, pp. 133-142.
This article clearly recognizes the need for an STS view and for interventions based on the dual optimization of the social and technical system designs.

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.