Introducing Mis: a Process of Directed Organizational Change

Ronen Bar-Nahor
Faculty of Industrial Engineering & Management
Technion, I.I.T., Haifa, Israel
Tel: 04 861-072

Chanoch Jacobsen
c/o Department of Sociology
University of California
Riverside, California 92521

Abstract

Despite the importance of computerized information systems, many MISs are left idle or used only partially, having exceeded their budgets or time allocations. The basic problem is that critical interactions between software engineers, users, and the organization have been neglected. The reason for this neglect is the inter-disciplinary nature of the problem. There is a basic conflict of interests between managers' need for efficiency, users' desire for quality of working life, and software engineers' quest for sophisticated technical solutions.

We have developed an integrated theory of the detailed processes and transformed it into a System Dynamics model. Running the model against three time series of data from one organization that has introduced an MIS, we reproduced an average of 84% of the variances in the data. Our tentative conclusion is that introducing MIS is a special case of directed organizational change that requires cooperation between software engineers and OB experts.

Introducing MIS: A Process of Directed Organizational Change

Introduction. Despite the importance attached to management information systems (MIS) in organizations, many studies have found their implementation fraught with problems (Lucas 1975; Kling 1980; Turner 1982). The term "software crisis" came into use in the 1970's as more and more MIS's either stood idle or were only partially utilized, or were incompletely developed, or else overran their budgets or time allocations (Gladden 1982). The main reason for these problems has been identified. It is the relative neglect of critical interactions between MIS's and their organizational environments - particularly in the transitional stages (Alter 1980; Lyytinen 1987). We attribute this neglect to the following factors:

* The software experts who develop MIS are typically not acquainted with the theory and research of organizational behavior.

* The problems encountered by organizations and MIS users require a research methodology that integrates individual psychology and organizational behavior with MIS. Such methodological pluralism is rare in academe, leaving research segmented and short of empirical data (Lyytinen 1987).

* The difficulty of identifying relevant variables and defining them as independent, intervening or dependent, leads to naive cause-and-effect explanations of practical problems.

* The conventional research by cross-sectional analyses of static samples makes monitoring any process over time impossible. Thus there are no hard data about what happens in the process of introducing an MIS into an organization.

We have developed an integrated theory to conceptualize the implementation process more realistically. On the basis of that theory we then constructed a System Dynamics model to simulate the process over time. Finally, we tested the model's behavior with empirical time-series of the process as it actually occurred in an organization that has introduced an MIS.

Conceptualization. Introducing MIS involves interactions between three types of social actors: The top managers who order the MIS and have to support its implementation, the technical experts who are responsible for its development, and the individual users who have to work with it. The characteristics of each of these impinge on how the other two relate to the change, and therefore affect the whole process. Moreover, each side has a different focus of interest, and since these are likely to conflict they will affect its response to the others' legitimate concerns.

Management is typically concerned with effectiveness and efficiency of operations, and will evaluate the MIS, the experts who develop it and the employees who have to use it by these criteria. The software engineers, on the other hand, having little knowledge of organizational dynamics or psychological problems, focus their efforts on technical solutions rather than on the organization's problem. Finally, the employees who ultimately have to use the MIS are concerned with the quality of their working life (QWL), and with the tensions that accompany any major change in their work environment.

Thus when management wants to introduce an MIS, employees' fears can easily lead to opposition and unwillingness to cooperate with the software experts. The experts' conception of a sophisticated technical solution may run counter to employees' current work habits, as well as endanger middle managements' status positions. Managers' expectations of the MIS can be either too optimistic or too pessimistic - depending on their prior experience with computers.

On the other hand, each has legitimate expectations of help from the others. The engineers expect from management that it give the necessary financial and manpower support, and from the users that they make the effort to learn how to operate the system. Management expects from the software experts to come up with solutions to their practical problems, and from employees that they cooperate with the experts to make the system work. Finally, employees expect the software engineers to solve

any problems they encounter while using the system, and from management to encourage and support their learning efforts. The stage is thus set for a three-cornered conflict of legitimate interests, which must be resolved in order to successfully introduce an MIS into the organization.

The process of introducing an MIS begins when management perceives a gap between the current and the desired effectiveness or efficiency, a gap that cannot be overcome by normal work procedures. The decision to change and the design of a strategy are typically affected by management's previous experience, and the pressures, conflicts of interests and power plays among management, shareholders, internal lobbies, important customers, suppliers, and labor unions. Any or all of these can influence the resources allocated to the change, the urgency with which it is introduced, and the amount of patience shown with the almost inevitable initial lag in improvement (Samuel and Jacobsen 1989).

Once the preferred strategy has been decided on, the change must be incorporated into the organization's internal system. Such a system contains five major elements: tasks, employees, structure, remuneration, and procedures (Galbraith 1977). Introducing an MIS affects most of these, and therefore means a comprehensive system change, not merely technological, but also political and cultural (Tichy 1983).

All five organizational elements and the interactions between them must be considered in this process, particularly the employees who will ultimately use the MIS. To minimize obstructions (whether deliberate or not), employees must be involved in the decision making processes regarding the MIS and its implementation. This calls for participatory management and support in order to build a basis of trust from realistic expectations (Daft 1986; Carnall 1986). Not only workers need consideration and involvement, different management levels are also interested to have a say and influence decisions (Guthrie 1974), even if they typically do not want to invest the time and effort to learn how to operate an MIS. If, however, the organization's problems are of a political nature, involvement may exacerbate power struggles and retard the process (Tichy 1983; Nadler 1981).

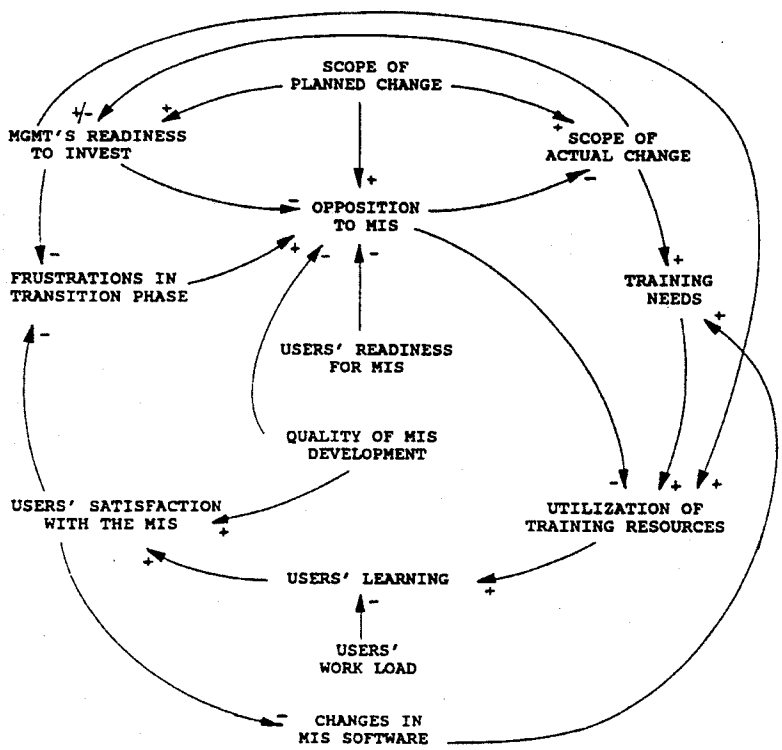
An MIS has a number of characteristics that set it apart from other technological innovations. First, the new technology (i.e., the software) is always *untested* because it has to be made to fit a particular organization in a given situation. Therefore frequent changes in the software have to be made after its introduction (Manna and Waldinger 1978; Schneidewind 1979). Second, much learning is required from users before the MIS can reach its optimal usefulness. Third, an MIS tends to disturb the hierarchy of authority in an organization, giving increased power to those familiar with its operation. Fourth, to realize its maximal usefulness, an MIS depends on the data input from other users. All these characteristics make it hazardous to infer from other technological changes directly to the process of introducing MIS. A separate approach is required.

From the employees' point of view, the introduction of an MIS has major impacts on the quality of their working life. QWL is not just salary, working hours, physical conditions or similar matters. More germane to this discussion are such intangibles as a desire for meaning and satisfaction in work, for autonomy and influence, for challenge and opportunities for self-actualization (Bostrom and Heinen 1977). Some examples of how these are affected follow.

An MIS affects employement conditions by rationalizing work-processes. This can lead to layoffs for some, and job enrichment for others by adding to their tasks and areas of responsibility. But, as the required work load and pace of operations increase, it also adds to work strain. MIS also tends to increase the number and the level of required work skills. This can make work more varied and thus more interesting, but it may also lead to de-skilling, fragmentation and narrow specialization, which have the opposite effect (Mumford and Whistler 1977).

In sum, the transitional phase in any organizational change process is critical, because in it workers and managers must leave accustomed behavior patterns and adjust to a new situation. But a newly introduced MIS especially so, because it affects many aspects of QWL, as well as the authority structure, communication patterns, and control mechanisms within the organization. It is the neglect of these potential danger spots that is responsible for many of the problems encountered.

FIGURE 1. CAUSAL-LOOP DIAGRAM



THE MODEL. The population that is to work with the MIS is defined by five sequentially ordered levels (Figure 2). When management decides to introduce the MIS 100% of the population are candidates [CANDIDS]. Some of these will immediately accept the change [ACCEPT], others will oppose it [OPPOSE]. Some of the accepters will in time get sufficient training to become active operators [ACTIVE], and some of these [ELITE] will enthusiastically work with the system. But there is always the possibility of movement back and forth between these categories, as defined by the rates.

These nine rates of interchange between the population categories are affected by 21 auxiliaries (one of which, FUNCTION, has been made a level to avoid simultaneous equations), five exogenous variables, and 8 initialized constants. (The complete and documented code is available from the authors).

Data for testing the model come from the records of a large Government agency that had introduced an MIS in the last few years. Three time series of 30 data points each, recorded at two-weekly intervals were obtained. DATA1 is the percentage of employees who are in one or other of the levels beyond CANDIDS. We have called these the USERS, defining: USERS = 100 - CANDIDS. DATA2 are those who should be using the MIS but do so for less than 25% of the planned functions. This corresponds to the level OPPOSE. DATA3 is the percent of the employees' operations that have been changed as a result of the MIS. These data correspond to the level

FUNCTION in the model.

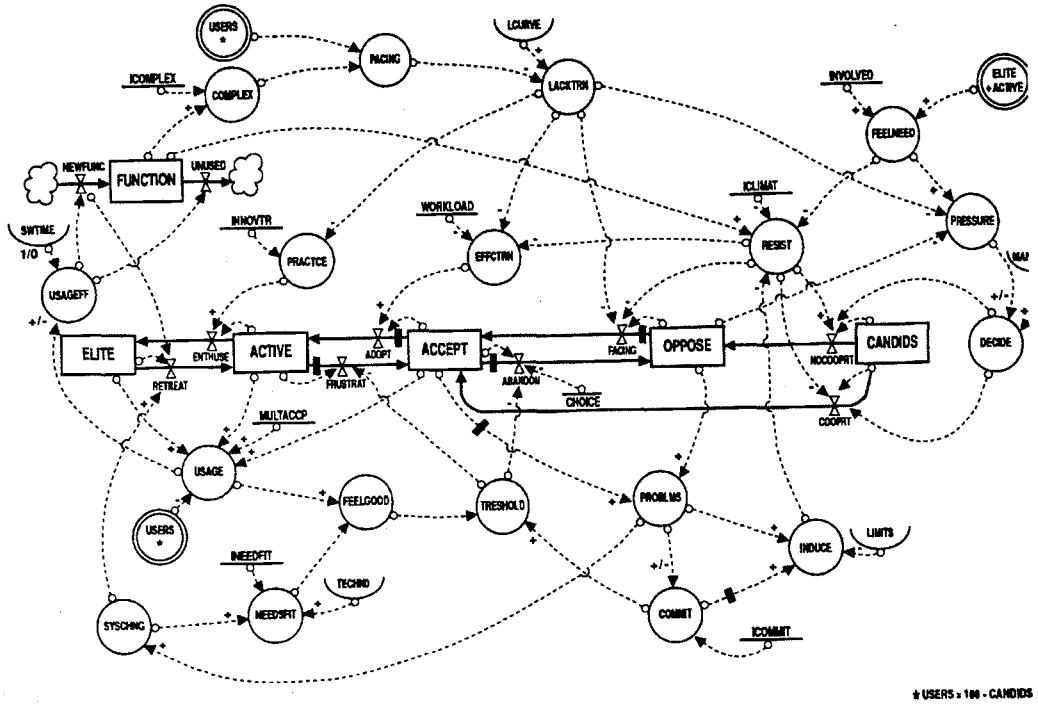


FIGURE 2
FLOW DIAGRAM

To initialize the model three persons who had been involved with the project estimated a reasonable range for each parameter. Within these estimated ranges we then chose the actual initial values that gave the best reproductions of the data trends (Figure 3). A summary measure of fit, the Trend Index (TI), is the percent of data variance reproduced by the model variable (Theil 1966). The TI value for DATA1 was 79.3%, for DATA2 it was 81.0%, and 91.7% for DATA3. The mean TI for the three data sets is 83.99%.

The model's sensitivity to the estimated initial parameters was tested by systematically varying the initial values up and down until TI < 70%. Table 1 shows that, except for ICLIMAT (the probability of readiness for MIS), the model is robust and not sensitive to the precise initial values we have chosen. The sensitivity of ICLIMAT indicates the importance of a favorable climate in the organization's culture for introducing an MIS.

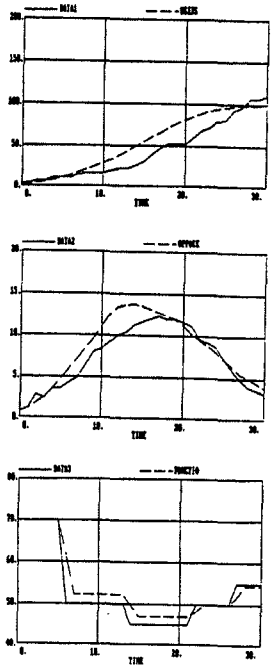


FIGURE 2
MODEL OUTPUT AND EMPIRICAL DATA

Table 1. RESULTS OF SENSITIVTY TESTS OF INITIAL VALUES

VARIABLE & SCALE	LOWER LIMIT	ASSUMED VALUE	UPPER LIMIT	RANGE
CHOICE (prob)	0.45	0.65	0.80	0.35
MEAN TI	79.8	84.0	80.8	
INNOVTR (%)	1	7	25	24
MEAN TI	83.5	84.0	78.5	
INEEDFIT (%)	45	55	85	40
MEAN TI	80.7	84.0	75.4	
WORKLOAD (prob)	0.50	0.75	1.00	0.50
MEAN TI	76.7	84.0	77.1	
ICLIMAT (prob)	0.60	0.65	0.70	0.10
MEAN TI	76.5	84.0	78.3	
ICOMMIT (prob)	0.60	0.70	1.00	0.40
MEAN TI	81.5	84.0	79.5	
ICOMPLEX (index)	1.00	1.50	1.90	0.90
MEAN TI	74.5	84.0	80.6	
MULTACCP (%)	30.0	40.0	47.5	17.5
MEAN TI	76.0	84.0	74.3	

Discussion. Two model variables measure the degree to which the MIS was successfully introduced. FUNCTION, the percent of planned MIS functions in operation, indicates the *scope* of implementation. USAGE is the population percent who are actually *using* the MIS.

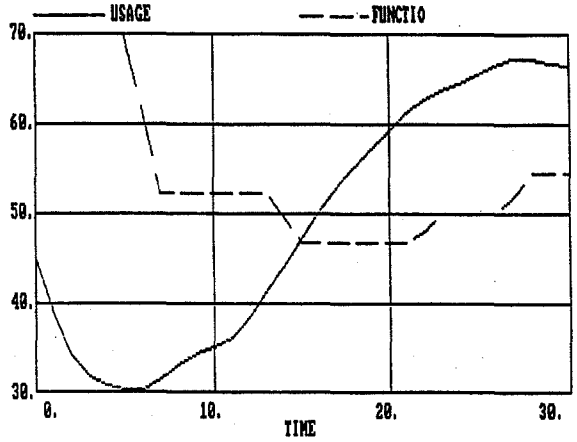


FIGURE 4
MODEL OUTPUT FOR USAGE AND FUNCTION

Figure 4 shows that at first USAGE dropped drastically, due to the fact that the first users were those who had been actively involved in the design and development of the MIS and had realistic expectations. The additional users had not been so involved and thus were more affected by ICLIMAT. As they joined the process, therefore, total USAGE fell. Management responded by lowering the initially planned scope, and by raising investments in inducements, technology, and training resources. These steps reversed the negative trend, so that after 30 two-week periods USAGE reached 67% (implying of course, that 33% of those who were designated to use the MIS had not yet done so after more than a year).

Conclusion. This study was designed to develop and test a realistic model of the process of introducing MIS into an organization. Findings indicate a good fit of model behavior to the empirical data. Our tentative conclusion is that the process is a special case of directed organizational change, and therefore basically an inter-disciplinary one. However, this conclusion is still tentative because more research is needed to apply both theory and model to other organizations undergoing the same process.

References

Alter, S. 1980. *Decision Support Systems: Current Practice and Continuing Challenges.* Reading, MA: Addison-Wesley.

Bostrom, R.P., and Heinen, S.J. 1977. "MIS Problems and Failures: A Socio-Technical Perspective." *MIS Quarterly* (Sept):17-32.

Carnall, C.A. 1986. "Managing Strategic Change: An Integrated Approach." *Long Range Planning:* 105-115.

Daft, R.L. 1986. *Organization Theory and Design.* St.Paul, MN: West.

Galbraith, J.R. 1977. *Organization Design.* Reading, MA: Addison-Wesley.

Gladden, G.R. 1982. "Stop the life-cycle, I want to get off." *ACM SIGSOFT Engineering Notes* 7(2):35-39.

Guthrie, A. 1974. "Attitudes of User-Managers Towards Management Information Systems." *Management Informatics,* 3(5):221-232.

Kling, R. 1980. "Social Analyses of Computing: Theoretical Perspectives in Recent Empirical Research." *ACM Computer Surveys* 12(1), March.

Lucas, H.C. 1975. *Why Information Systems Fail.* New York: Columbia University Press.

Lyytinen, K. 1987. "Different Perspectives on Information Systems: Problem and Solutions." *ACM Computer Surveys* (March).

Manna Z., and Waldinger, R. 1978. "The Logic of Computer Programming." *IEEE Transactions on Software Engineering* SE-4:199-229.

Mumford, E., Hirschheim, R.A., Fitzgerald, G., and Wood-Harper, A.T. (Eds). 1985. *Research Methods in Information Systems.* Amsterdam: North-Holland.

Nadler, D.A. 1981. "Managing Organizational Change: An Integrative Perspective." *J. of Applied Behavioral Science:*191-211.

Samuel Y., and Jacobsen, C. 1989. "Planned Organizational Change: Theory, Model, and Data." In *Computer-Based Management of Complex Systems.* P. Milling and E. Zahn (eds.). Berlin: Springer.

Schneidewind, N.F., and Hoffman, H.M. 1979. "An Experiment in Software Error Data Collection and Analysis." *IEEE Transactions on Software Engineering* SE-5:276-286.

Tichy, N.M. 1983. *Managing Strategic Change: Technical, Political, and Cultural Dynamics.* New York: Wiley.

Turner, J.A. 1982. "Observations on the Use of Behavioral Models in Information Systems Research and Practice." *Information Management* 5(3): 207-213.