A VIEW FROM LONDON, ENGLAND

The articles in this issue of *DATA BASE* were chosen by Anthony G. Hopwood, who is a professor of accounting and financial reporting at the London Graduate School of Business Studies. The articles contain important ideas, Professor Hopwood wrote, of significance to all interested in information systems, be they practitioners or academics.

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ORGANIZATIONAL LEARNING AND MANAGEMENT INFORMATION SYSTEMS

By Chris Argyris

In a recent review of the literature on management information system (MIS) implementation, I found the major theme to be unmet expectations and disappointments, especially when MIS technology was used to deal with the more complex and ill-structured problems faced by organizations. The author's explanations for the implementation gap could be broken down into eight different categories:

(1) MIS were not well understood by line management, (2) top line management was not involved in persuading and selling the use of MIS to the users in the organization, (3) MIS were not as foolproof as they could be, (4) MIS were technically too complex and too costly to create and utilize, (5) MIS specialists and line managers did not understand each other's job requirements, perspectives and pressures, (6) MIS ignored line managers' cognitive styles, (7) the implementation of MIS was too narrowly conceived and (8) MIS were not humanized adequately.

The purpose of this paper is to suggest that there are other and perhaps deeper reasons for the implementation gap. If the reasons are valid, then the explanations above

would provide solutions that contain inner contradictions and counter-productive consequences.

To get at the inner contradictions, we must view MIS as part of a more general problem of organizational learning. An organization may be said to learn to the extent that it identifies and corrects errors. This requirement, in turn, implies that learning also requires the capacity to know when it is unable to identify and correct errors. There are two types of learning that are important. They are single- and double-loop learning.

When a thermostat turns the heat on or off, it is acting in keeping with the program of orders given to it to keep the room temperature, let us say, at 68°. This is single-loop learning, because the underlying program is not questioned. The overwhelming amount of learning done in an organization is single-loop because it is designed to identify and correct errors so the job gets done and the action remains within stated policy guidelines. The massive technology of management information systems, quality control systems and audits of the quality control systems is designed for single-loop learning.

The trouble arises when the technology is not effective and when the underlying objectives and policies must be questioned. Let us examine the first case. A budgetary control system is designed to increase the likelihood that certain objectives will be met. If the objectives are not met, but the causes can be corrected without questioning the original objectives around which it was designed or without questioning the competence and loyalty of those using it, then the error will, in all likelihood, be corrected.

However, if the underlying objectives require reexamination or if someone or some department is going to get in trouble, it will be much more difficult to identify and to correct the errors. The former case is the equivalent of the thermostat following its program and orders. The latter is the equivalent of the thermostat questioning its order; that is what is meant by double-loop learning.

Most organizations, often without realizing it, create systems of learning that suppress double-loop inquiry and make it very difficult for even a well-designed information system to be effective. Take the case of the top management of a large newspaper. Their relationships at work were primarily competitive and win-lose; however, the majority insisted that what they needed to become more effective was a clear organizational structure and a tighter financial information system. With these in place, they argued, the win-lose competitive dynamics would be reduced or neutralized.

I doubted this would occur. The top management insisted and I helped them to obtain the appropriate technical advice. One year later, after a new structure and a new financial information system were in place, certain errors did disappear. The more difficult ones, however, were now camouflaged within the new financial system. The top managers who were most vociferous against working on the win-lose dynamics now admitted that the new financial systems did not reduce the former; indeed, they made it less likely that they could be dealt with since they were intertwined in and camouflaged by the new system (Argyris, 1974).

The trend to build quality-control checks to tighten things up also fails for another reason. The quality-control activities are housed in little organizations. Soon they, too, have their quality-control problems and they, too, use the same management theory to correct their errors. At best they are also only partially successful. The depth of their ineffectiveness is kept as covered as possible because how can a unit monitor other units when it is having the same difficulties?

If any of these factors are to be corrected, they require double-loop learning. Yet the basic concepts used to design and manage organizations and the types of capabilities that people bring to work regarding dealing with double-loop problems make it unlikely that double-loop learning will occur.

Organizations require, as a minimum, employees who have the skills to produce a product or a service. How do people acquire and use skills? A skill to perform some action is acquired by remembering and using the answer to previously solved problems and remembering and avoiding the traps previously fallen into (Sussman, 1973, p. 178). Developing skills for even simple activities such as riding a bicycle is an extremely complex process for the human mind.

The human capacity for information processing is quite limited in comparison to the demands of the environment in which it is embedded (Simon, 1968). Human beings may be said to have learned a skill when the use of the program necessary to perform the requisite actions is so much under their control that the control over the performance of the skill does not have to be conscious and explicit. This frees the individuals to use their finite information-processing capacity for other kinds of problem solving.

But to use these skills effectively, the programs must be "ruthlessly generalized and stored" (Sussman, 1973, pp. 178–179). Thus the workers not only make their skill-programs tacit, but once they do, they must make them rigid and not easily alterable. Only when errors are made will the programs become explicit, but then their rigidity must also be dealt with if corrections are to be made.

Managers are therefore faced with the task of monitoring employee actions that are guided by programs that are hidden from the actor, yet ruthlessly generalized and held tenaciously. The manager is held responsible for the workers' performances, yet neither he nor the workers have direct access to the programs that produce the performance. Moreover, if correction is necessary, the manager will en-

counter employees who will tend to hold onto their programs tenaciously. The manager is in the predicament of being held responsible for errors, yet he (and the workers) may have great difficulty in discovering and correcting errors.

This uncertainty created by the nature of human information-processing capacity is cumulated and expanded because the managers are also finite information-processing systems. They, too, must manage by making their programs tacit and then holding them ruthlessly. Even with the capacity to make programs tacit, there is a limit to how much information they can cope with. Hence there is a need for managers to monitor managers.

Although managerial control is necessarily incomplete and problematic, managerial responsibility for results is not. Managers must find ways to reduce the probability and cost of error. One strategy to minimize the cost of errors is to simplify jobs as much as possible. If a tacit and rigid program has to be surfaced to be corrected, it should be one that is as simple as possible.

The second strategy is to define production or work standards plus tolerances for errors related to achieving the standards. If performance exceeds the tolerances, then corrective managerial action will be taken. This strategy is called management by exception. At the core of this strategy is the creation of gaps of knowledge about employee performance coupled with a continual sampling for errors.

Implicit in the effectiveness of management by exception is that managers must have valid information only when workers deviate from standards. But since managers are finite and since they are monitoring the work of many human information processors, the data that they obtain about the performance of their subordinates must be comprehensive yet manageable. To be both, information must necessarily be abstract. The information cannot take into account the unique aspects of each situation because it would be too complex to use to manage.

So now we have workers with tacit programs ruthlessly generalized that are difficult to control directly, managed by superiors who use information that is abstracted from the unique situation for which they are held responsible. The superiors, in turn, create tacit programs that are also ruthlessly held. They, in turn, must be managed, and the problems of tacitness, incompleteness and abstractness become replicated.

The managers who are most distant from the local level are held most responsible for what happens at that level. To manage effectively, they too must design gaps in their knowledge yet be held responsible for these very gaps. Hence the need to assure themselves that they can institute programs to detect and correct error; hence the increasing power as distance from the local point increases. We now have the beginnings of the pyramidal structure with the top-down unilateral control feature.

The pyramidal structure creates a continuum of information systems ranging from local (immediate to the activity of producing the service or product) to distant from that point. These information systems are designed to be, in effect, programs to detect and correct errors. But assuring themselves that they have the prerogative to create programs to detect and correct errors is one thing; to assure that errors will be detected and corrected is another. The information system designed to detect and correct has in it properties that inhibit its effectiveness.

Why is this so? The characteristics of local MIS include (1) concrete descriptions of the unique situations, (2) representations of the actual processes whether they are rare or repeatable, (3) connection of the performance to the processes in the situation, (4) implicitly rational logic, in that the rules for defining categories, for making inferences, for confirming or disconfirming evaluations are private and (5) tacit knowledge and tacit processes.

Such MIS may be effective for local immediate management, but they also are (1) uneconomic for generalizations from one setting to many settings, (2) unusable by others than their creator (because they are not easily scalable, convertable, comparable and trend producing), (3) uninformative about the general characteristics of settings and (4) unvalidatable by objective knowledge and objective procedures that go beyond the capacity of any given individual.

These limitations are in the very areas where top management especially requires valid information to identify important overall errors and to design and execute new actions. Therefore, for the top to manage competently, it cannot depend directly upon the MIS used at the local levels. Moreover, since the local MIS tend to be private, intuitive, subjective, ungeneralizable, uncomparable and nontrend-setting, if the top based its MIS on these characteristics, it would find it difficult to manage employees in a just manner.

For members of top management to manage through the use of information, they require MIS that (1) contain abstract, quantitative descriptions of key performance indicators, (2) represent stable variance, (3) represent the results or the outputs of complex processes and not the processes themselves, (4) contain explicitly rational logic in that they attempt to satisfy the logical systematic rules for defining categories, making inferences and confirming or disconfirming evaluations publicly and (5) exclude as much as possible tacit knowledge and tacit processes.

Information systems with these properties tend to be (1) economic for generalization from one setting to many settings, (2) usable by others than their creators, (3) informative about the general characteristics of a setting and (4) validatable by objective knowledge and objective processes

Distant MIS Induces Individuals	*Local MIS Induces Individuals*
To think abstractly and rationally.	To think concretely and intuitively.
To conceptualize stable variance and general overall conditions and trends.	To conceptualize variable processes and specific conditions.
To distance self from processes that produce results and focus primarily upon the results or the performance.	To become close to the processes that produce results and focus on them as much as on the results.
To identify errors that are exceptional.	To identify errors and correct them before they become exceptional.
To infer causality from information lacking specifity of causal processes or mechanics.	To infer causality from information rich with situational causality related to specific mechanisms.

Table 1

that go beyond the information processing capacities of any given individual.

The characteristics of distant and local MIS emphasize different ways of thinking, different ways of dealing with people, different concepts of dealing with causality and, above all, different conceptions of how order is defined and managed. Some of these differences are illustrated in Table 1.

The distant MIS will tend to reward abstract conceptualization, impartiality, publicly verifiable rationality, distancing from individual cases and inferring personal responsibility from abstract data and overall trends. The local MIS will tend to reward concrete thinking, intuition, privately verifiable rationality, closeness to the individual case and inferring personal responsibility from concrete specific processes.

People who live over periods of time in either of these worlds may come to hold different conceptions of the meanings of responsibility, competence, causality and the requirements for effective order. Human beings' sense of justice may be a function of their concepts of responsibility, competence and the requirements for effective order.

For example, we may learn by observing the operations of our courts that justice requires that all parties have equal access to the same information and an equal opportunity to confirm or disconfirm it. Yet top managers have access to different information than the locals; the locals rarely have the opportunity to confront the information used by the top; and if the locals were to have such an opportunity, it is questionable whether they would have the information-processing competences required to deal with it effectively. Justice also requires that errors be directly and unambiguously coupled to individuals' actions (the smoking gun). Yet, the top MIS do not attend to such rules of evidence.

The sheer information-processing requirements and the costs that would be necessary to assure minimal misunderstanding and injustice may be so high that such assurances would not be possible. Employees who are responsible and loyal understand these constraints, but, in doing so, place themselves in a dilemma.

If they accept the high probability of injustice as necessary, then they have acted to legitimize injustice. If they do not accept the necessity of injustice, they would be seen as disloyal. Those at the upper levels may find it necessary to defend themselves from the dilemma of having to be unjust to make the organization effective. How do people deal with the dilemma of being exposed to necessary and self-legitimated injustice? Some possible adaptive activities at the lower levels may be:

- They may consider the basis for and the meaning of justice to be embedded in the nature of their type of MIS. But such an action leaves them open to potential conflict with the top because, as we have suggested above, each MIS implies a different conception of order.
- They may reduce their risks by withholding information or sending doctored information upward.
- They may reduce the tension of living in a world of unpredictable and uncontrollable injustice by withdrawing their energies and commitments and, hence, feeling less of a sense of personal responsibility.

Reactions such as these reduce the probability that the top will get the information it needs and the commitment it desires to manage effectively. This may lead the top to strive to make the MIS more complete and detailed, more tamper-proof and more oriented toward unilateral control over others. These reactions will probably require, in turn, a reduction of the gaps permitted by the top and an increase in the frequency of its interventions into the lower levels.

To compound the top's problems is the previously stated possibility that its members may be forced to be unjust even

when they do not wish to be. They may react to this possibility by developing attitudes and values such as that they must be tough because, as one president said to the writer, "Five percent of the people work, 10 percent think they work and 85 percent would rather die than work." Another set of attitudes usually developed is that lower-level managers and employees can be trusted only to the extent that they can be monitored.

These attitudes and values, combined with the top management's reactions described above, may lead to at least three counterproductive tendencies:

- The lower-level managers may become more fearful, take less risks and increase their defensive protective activities.
- The actions may deepen the degree of penetration management must take into the local MIS. This can lead to confusion because the properties of the top MIS are incongruent with the properties of the local MIS.
- The action may increase the probability that the subordinates will attempt to turn the top MIS into a way of getting even with or generating some control over the top. For example, air traffic controllers can "strike" simply by following the defined procedures rigorously.

To summarize: To manage through the use of information, it becomes necessary for the top to manage with incomplete information. Management by optimal gaps may be a critical characteristic of effective management. The gaps are managed by making the lower levels responsible for them and by the top intervening when standards are not met. If such management is to be effective, each level must use an MIS that has significantly different properties from the other.

This leads to different conceptions of responsibility, competence and order which, in turn, may influence each group's view of justice. Each group protects itself against being accused of being unjust by creating protective activities that reinforce the factors that cause the problem in the first place.

If that above is true, then organizations seem to have the capacity to learn primarily those lessons that are self-scaling because they maintain the status quo. It is therefore important to examine organizational learning more closely.

Organizations learn through individuals acting as agents for them. The individuals' learning activities, in turn, are facilitated or inhibited by an ecological system of factors that may be called an organizational learning system.

Figure 1 represents a model of the learning system that, to date, mirrors the conditions in all the organizations that we have studied (Argyris & Schon, 1976). The model begins with inputs of information. The substance of the information is relevant; it may vary from inaccessible to accessible, ambiguous to unambiguous, vague to clear, inconsistent to consistent and incongruent to congruent.

When such information interacts with individuals utilizing Model I theories-in-use, a primary inhibiting loop for learning is created because the tendency of these individuals will be to reinforce whatever degree of inaccessibility, ambiguity, vagueness and inconsistency that exists in the information. By inhibiting loop, I mean simply that the consequences of the interaction between columns 1 and 3 in Figure 1 are loops that tend to maintain and reinforce the original conditions that produce error. Feedback is positive in that it reinforces the original qualities of the information; it is not corrective. (Feedback is represented by arrows that return to a previous condition.)

What is a Model I theory-in-use? People design and guide their behavior by the use of theories of action that they hold in their heads. Espoused theories of action are the theories that people report are governing their actions. Theories-in-use are the theories of action that actually govern their actions. Most people studied so far manifest theories-in-use that are remarkably similar. This makes it possible to describe them in the form of a model which may be identified as Model I.

Model I theories-in-use are theories of top-down, unilateral control of others for the actors to win, not to lose, and to control the environment in which they exist to be effective. But it can be shown that Model I theories-in-use lead to effective problem solving primarily for issues that do not require that the underlying assumptions of Model I theories-in-use be questioned (single-loop learning). Model I theories-in-use do not make it possible for people to have problem-solving skills that question the governing values of their theory-in-use (double-loop learing) (Argyris & Schon, 1974).

Back to our model of organizational learning. I am asserting that people studied so far manifest similar theories-in-use which are oriented toward unilateral control and lead to single-loop learning. There are four consequences of the above (column 5). People tend to be unaware of their impact upon error discovery and correction. If A makes an error and others tend to hide the impact it has on them, then A will not be aware of the impact. A second result of primary inhibiting loops is that people tend to be unaware that they are unable to discover-invent-produce genuinely corrective solutions to problems. A third result is defensive group dynamics (little additivity in problem solving, low openness and trust and high conformity and covering up of threatening issues). A fourth result is inter-group dynamics that are also counter-productive.

These four results create secondary inhibiting loops. They are called secondary inhibiting loops because they

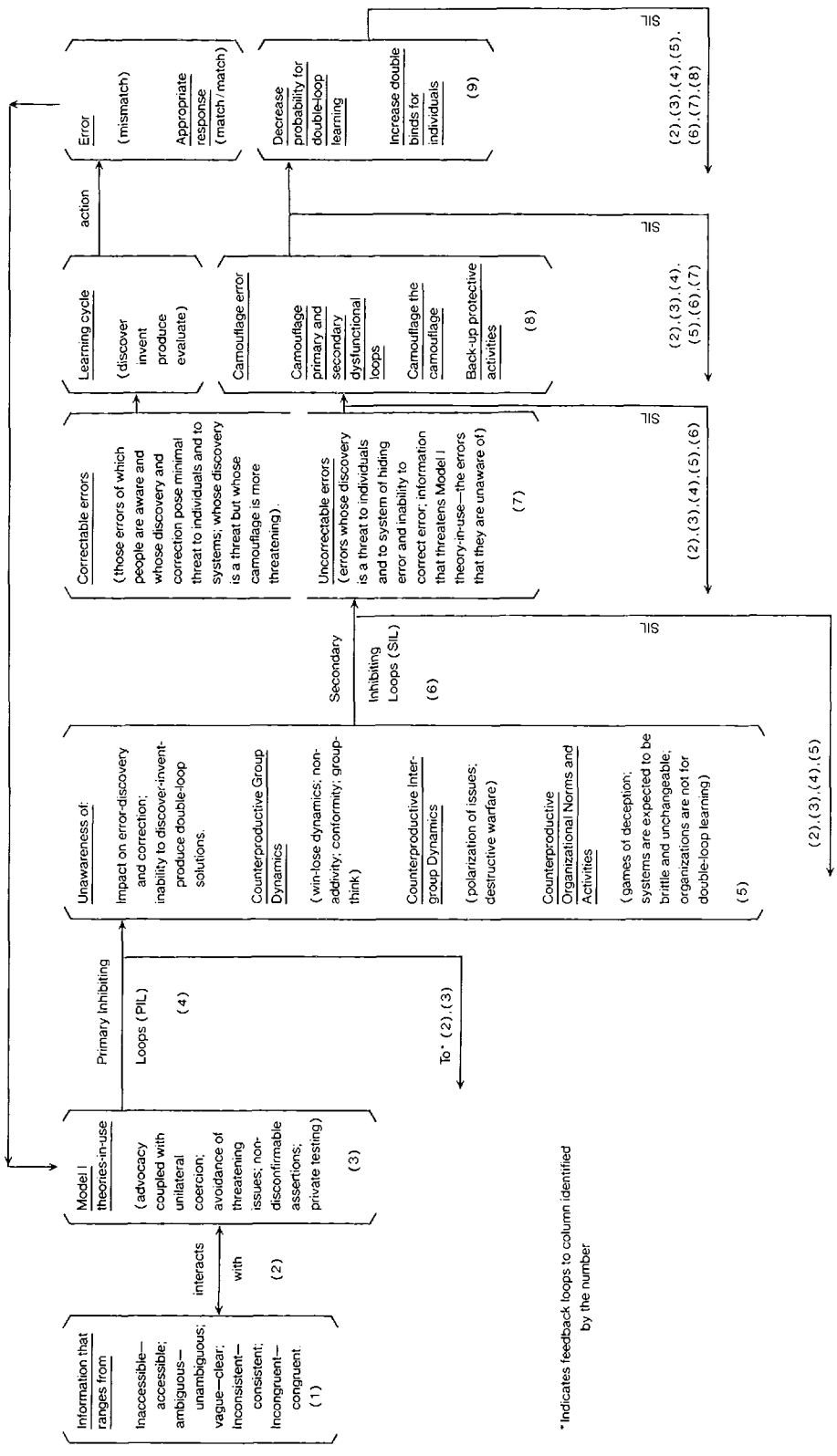

Figure 1. Organizational learning systems that inhibit error detection and correction.

arise out of interaction with the primary inhibiting loops. Secondary inhibiting loops also feed back to reinforce the primary inhibiting loops and the previous conditions that predispose error (columns 2, 3, 4 and 5).

What kinds of errors tend to be correctable and uncorrectable under these conditions? Errors that tend to be correctable (see top of column 7) include those: (1) whose existence is known and available to the relevant actors, (2) whose discovery and correction pose a minimal threat to the actors and (3) whose discovery and correction is threatening, but whose camouflage or noncorrection is more threatening. Errors that tend not to be correctable (see bottom of column 7) include (1) those whose discovery is a threat to the individual's system of hiding error and his or her inability to correct error, (2) errors that predispose primary inhibiting loops because they are threatening Model I values (win-don't lose, suppress feelings and so on), and (3) errors whose correction violates organizational norms.

The errors that tend to be uncorrectable are camouflaged, the primary and secondary inhibiting loops associated with them are camouflaged and the camouflage is camouflaged with the development of protective activities such as "j.i.c. files" (just in case the superiors ask) (8). Again, the conditions described in columns 7 and 8 feed back to reinforce the previous conditions.

The conditions described in column 8 also tend to increase the predisposition of competitive win-lose games, deception, not taking risks, the potency of the attribution that the participants will make to the effect that their organizations are brittle and unchangeable and the potency of their expectation that organizations are not for double-loop learning (9). These conditions feed back to reinforce the previous error-producing conditions and simultaneously tend to reduce the probability that the organization will effectively examine the processes of how it examines and evaluates its performance. And again, this feeds back to reinforce the previous conditions.

Every time the previous conditions are reinforced, the consequences that follow are also reinforced. Hence, we have a system that is not very likely to learn except when dealing with those problems that are correctable (top of column 7). The participants will tend to experience double binds. If they follow the requirements of the system, little learning will occur about issues which question the underlying objectives and policies. If they consider changing the system, they will tend to take on a task which they consider foolhardy and dangerous to their survival.

Let us reexamine the recommendations found in the literature to make the implementation of MIS more effective.

Recommendation 1. Make MIS more understandable to the executive. In the literature, the meaning of "more understandable" ranged from packaging in readable form (that is, an emphasis upon cosmetics) to an emphasis upon making explicit and clear the underlying assumption of the MIS. These suggestions would appear to make sense.

However, they may imply some unanticipated consequences. For example, as the underlying assumptions are made clear, as the impact of MIS is made explicit and as its potential for managing behavior becomes clear, the users of the MIS (especially at the lower levels) will also realize the potential of MIS to reduce their space of free movement, to increase psychological failure and to reduce their feelings of being essential to the organization.

Given the Model I theories-in-use and the defensive behavioral world, these consequences will not tend to be discussed. To do so would run the risk of being seen as a deviant or a trouble-maker. Moreover, if these indiscussables were brought up, the risk of bringing up the games of deception and camouflage would also be increased greatly. Bureaucracies have ways of punishing people who are responsible for such consequences and who are inept enough to make them public.

Recommendation 2. More involvement by management so that it can persuade others to value and use MIS. Again, such a recommendation appears to make sense, especially to a war-weary, exhausted MIS specialist. But there are unanticipated consequences. The predominant philosophy of management (in public and private sectors) is one that may be described briefly as unilaterally controlling others to get them to do what the organization requires, while at the same time controlling possible confrontations of management authority (Argyris, 1970; Haire, Ghiselle and Porter, 1966; Likert, 1967).

It is this theory of persuasion and management that reinforces Model I theories-in-use. Model I theories-in-use in turn produce primary inhibiting loops. Hence, the recommendation could increase the potency and scope of the very factors that make effective implementation of MIS more difficult.

Recommendation 3. Make MIS as foolproof as possible. The emphasis of this recommendation is upon better ways of detecting error and the potential for error while simultaneously reducing the flexibility at the local level to edit, forgive and correct errors privately. This recommendation tends to appeal to top-line management because it responds to one of its greatest anxieties, namely, its concern over control. As one may hear at the management levels, "Nothing gets done unless I check on it," "People respect what you inspect" and "Management must be on top of things."

There are several unanticipated consequences that may occur if this recommendation is implemented. An MIS that aspires to be foolproof also indicates lack of trust on the part of the user and sanctions unilateral control by the top. These messages will be heard clearly by subordinates. In the world that we have just described, subordinates' reac-

tions will tend to be continuously to make management's assertion that they must be monitoring and controlling a self-fulfilling prophecy. The employees may also reduce their sense of responsibility for monitoring and tend to produce at the safest minimum level. There are cases on record where employees have watched an MIS produce errors; they have permitted the errors to get into the management process, and they have watched while the financial and human costs escalated.

Recommendation 4. Simplify the models and the data needed to make them work so costs are reduced and usability may be increased. Serious MIS specialists recommend less elegant models and a reduction of statistical information required to speed up the construction and to increase the use of the model (Wagner, 1972). Again, this recommendation appears to be useful. However, our perspective alerts us to the possibility that such simplifications may leave untouched the problems described above.

Recommendation 5. Better education of line and staff (especially staff) to make each more sensitive to the other's problems. Education is a laudatory response. But in none of the discussions could one find any awareness of the primary inhibiting loops with which people are programmed. These loops do not impair the staff from hearing, let us say, about the pressures upon line management. Indeed, I found that staff specialists understood these pressures and sympathized with the line managers (Argyris, 1971). But they also felt that some of these pressures were self-inflicted, that their MIS might help to reduce them and that they, too, were under pressure, especially pressure created by line managers. Moreover, MIS specialists tended to be unaware when they were making their line managers defensive. There were many cases observed where the MIS individual was making things worse by utilizing a strategy that he had hoped would make things better. The phenomenon of unawareness was equally valid for line managers.

Recent research suggests that even if people became aware of the "other's" views, if they became aware of new behavioral alternatives, if they accepted these alternative behaviors and even if they learned them well, they still would *not* be able to use them in everyday life. The unfreezing of the old and the development of new values and skills is very difficult (Argyris, 1976). Moreover, changing the learning system outlined in Figure 1 is far from easy.

Recommendation 6. Design MIS to take into account the cognitive styles of line executives. This recommendation is just beginning to appear in the literature. However, our model raises the possibility that the dysfunctional loops may so reinforce each other that the impact of the styles of thinking may be swamped by the dysfunctional loops. Keen (1975), one of the researchers who has studied cognitive style, has recently raised the question of the potency of this factor under the conditions described above.

Recommendation 7. The introduction of MIS should be seen as part of a total organizational development program. This recommendation, especially emphasized by Keen (1975) and Ginzberg (1975), comes closest to grappling with the problems of overcoming the negative effects of the learning systems described in Figure 1. However, we may say that based upon other studies of organizational development programs, very few focus on individual theories-in-use and the learning system. At best, they focus on altering attitudes and behavior. But altering these two factors without altering theories-in-use and the learning system runs the risk that the organizational changes will become gimmicks and therefore not particularly credible in the eyes of others (Argyris, 1971).

None of the recommendations deals with the fact that there are inner contradictions embedded in organizations that cannot be eliminated because they are inherent in the use of information to manage organizations and in the limited capacities of individuals for information processing. Managers are rarely effective in dealing with paradoxes or dilemmas because, being programmed with Model I theories-in-use, they believe that the effective way to deal with them is to eliminate them or to choose one side of a dilemma.

If my analysis is correct, the paradoxes are not eliminateable, and dilemmas based on inner contradictions do not become resolved by choosing one horn or another.

It is not possible to close the article with recommendations that would overcome the problems that have been presented, because to my knowledge, the research needed to provide viable recommendations has not been carried out. I recommend, therefore, an alliance among line executives, MIS professionals and behavioral scientists to conduct research on how to develop MIS that are more effectively implementable.

I have attempted elsewhere to indicate one type of research program that may be useful (Argyris, 1976b). Emphasis is placed upon detailed case studies that are informed by theory (so that generalization is possible) and are coupled with attempts to redesign the MIS so that they are used more effectively. The attempts to produce a more effective MIS would not only be of value to the practitioner, but they could provide the basis for testing theories on organizational learning such as utilized in this paper.

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