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A Clinical Approach to the Implementation of OR/MS/MIS Projects

by

Peter G.W. Keen

Sloan School of Management
April 1975 WP#780-75

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Introduction

In the past few years there has been a rapid acceleration in the study of the implementation of computer-based decision aids. Most of this research is centered around two basic questions:

1. What are the key variables - organizational, individual, and technical - relevant to the implementation process?
2. What are the common patterns in either successful or unsuccessful implementation efforts?

The research is generally exploratory; much of it is data-gathering rather than theory-building or theory-testing and involves surveying large samples of projects in various organizations or industries through structured interviews and questionnaires. The results are sifted to identify clusters of variables - 'factors' - that are interrelated and that correlate with some measure of implementation success, such as user satisfaction. This sifting is generally atheoretical and aims, in fact, at inducting a base for theory.[1]

In assessing the value of such research on implementation, and in drawing conclusions from it, it is essential to stress how recent the topic is, even though it is also increasing in visibility and frequency of reference (to the extent that 'Implementation' seems to be taking over from 'Design' in the titles of journal articles). There is a Standard Paragraph that begins many discussions of implementation - including, of course, this one. It starts by pointing out that implementation is a very recent topic: Batchelor's bibliography of the OR/MS literature in 1965 did not even include the term in its index.[2] Radnor and Mylan's 1968 literature search found only 15 out of 750 articles focused on implementation.[3] Even more gloomily, Urban reports that only 3 percent of the 150 articles published in Management Science: Application between January 1971 and June 1973 represented implementation.[4]

The Standard Paragraph then moves on to point out that there is an implementation crisis, and that many more systems are built than are used. The 1960's version of the S.P. would cite Churchman's finding (1964) that in six years' issues of Operations Research Quarterly there was virtually no evidence that any of the models discussed were ever used.[5] The 1975 version could reinforce this from a variety of sources. Drake (1973), in surveying computer models for transportation planning, was able to identify expenditures of over a million dollars a year[6]; while some of the models were never completed and

sank after 'disagreement and disaster', the ones that were 'successfully' built seemed rarely, if at all, used by the decision makers for whom they were commissioned. The Standard Paragraph then closes by bemoaning our lack of empirical data and/or theory and promises to solve the world or tentatively explore it, depending on how good the researcher's own data has turned out to be.

The Standard Paragraph highlights our very defensive position on implementation. There is a crisis and we have little wisdom to offer. In parallel to this - perhaps even in reaction to it - there seems to be an increasing anti-academic bias among managers and practicioners who care about the Implementation Gap, with, in particular, an attack on schools of management for not providing the right training in the troops they send out onto the battlefield. An insightful illustration of this attack can be found in a panel discussion from the 1971 national TIMS meeting which later appeared under the title "Through a Glass Darkly" in Interfaces (August 1972).[7] It contains brief presentations by six practicioners, all of whom are well-known and active participants in MS and MIS societies and who, therefore, have been true believers in and missionaries for the Analytic Method. Their arguments are uniform in tone; the following extracts are representative of their discussion:

Table 1 Through a Glass Darkly

H. Halbrecht (Chairman Halbrecht Associates, management recruiting company with substantial experience in recruiting senior OR and MIS personnel)

"...the obvious fact that many people have not been willing to face (is) that the management science profession is in trouble. It is in substantial trouble and in many cases well-deserved trouble."

E.S. Savas (First Deputy City Administrator, Mayor's Office, New York City)

"How to Make OR Fail Without Really Trying"

"... We have been reluctant to hire people with Ph.D.'a in OR on the grounds that they have acquired 'a trained incapacity to think' (Herman Kahn), a rigidity brought on by some forms of higher education..."

G. Hoffman (Manager of Operations Research, Standard Oil of Indiana)

"The Missing 90% of Management Science"

"... The graduates of OR curricula are not adequately trained in OR. I now make a more damning assertion; usually these graduates are not educated at all."

H. Ayres (Vice-President for Operations Research, Morgan Guaranty)
"Skills for Effective Management Science"
"...We've really made very few job offers (to OR graduates). What stands out in my mind is that I don't think many of them realize what OR/MS really is. Who is to blame for this? Let's try blaming the academicians who train them these people. They do not train them in OR/MS; they train them in applied mathemtics and that's all."

Many of the panel's strictures may be less true now than in 1971; certainly most management schools are sensitive to the issues they raise and there has been a tremendous growth in applied research and training. None the less, the points have much force; they highlight the well-entrenched bias that has led to many, if not most OR/MS/MIS specialists defining their role in terms of technical and design skills, rather than as implementers. The panel's attack focuses on the lack among analytic specialists of:

1. an understanding of how decisions are really made
2. insight into and identification with managers
3. an ability to relate technique to context
4. a view of their role as supporting the management process

An obvious recent continuation of this theme is C. Jackson Grayson's criticism of the value of management science methods based on his experiences as chairman of the Federal Price Commission (Harvard Business Review, July 1973) "Management Science and Business Practice". Grayson, like the panel in "Through a Glass Darkly", is no ignorant outsider, but a veteran in teaching and supporting analytic skills. His article suggests the disillusion of a lost faith:

"Managers and management scientists are operating as two separate cultures, each with its own goals, languages and methods. Effective cooperation - and even communication - between the two is just about minimal.[8]"

Grayson's solution to the implementation problem is one that many other writers have suggested: training the manager and the management scientist towards a common middle ground, so that both have mutual understanding and shared skills. That solution may be very difficult to effect in that managers and specialists are generally unwilling, unable or too overburdened to spend time acquiring new skills that are of marginal value in their present jobs. More importantly, the main value of the specialist is his specialization. The methodological, rigorous analytic approach to problem-solving that is the idiosyncratic gift of the management scientist is fairly unusual; it is applicable in particular contexts only and represents an expertise that

is valuable mainly because of its specialized availability and applicability. In passing, it is worth noting that several researchers who have examined the 'cognitive styles' of managers and management scientists strongly imply that the scientist's skills presuppose a particular mode of thinking that is extremely hard to develop among many managers, whose equally distinctive abilities are built on an entirely different set of problem-solving strategies and habits.[9]

All the quotations cited above reinforce our defensive posture about both research on and practice in implementation. They clearly suggest that management scientists must develop a more effective role; of course, many counter-attacks reach a parallel conclusion that managers must develop new knowledge and be much more willing to take an active part in the implementation process. While this defensiveness and rather negative position is widespread, it represents a pessimism that is expressed rather than believed. When we stop to think about the general achievements of OR/MS/MIS there is ample reason for disillusion and yet, as a profession, management scientists and educators in analytic subject areas obviously feel that they are having a beneficial impact on organizational decision-making and that, on the whole, Progress is being made (though they will admit that perhaps, in the past, there was a tiny bit too much overselling). To a large extent, the emerging focus on implementation and the context of techniques, rather than on technique in itself, implies a welcome maturation within the management science field. Five years or so ago, the central issue was the development of relevant techniques; now those techniques are generally well-understood and there is a sufficient body of experience with them - negative as well as positive - to highlight issues beyond the design of models and systems. The strictures made by the panel of Through a Glass Darkly are justified but they provide a base for optimistic conclusions. They demand a refocussing of the role of the management scientist and in their very criticisms provide pointers as to what that role should be. The aim in the rest of this paper is to define that role, based both on conclusions that can be synthesized from the fragmented exploratory research of the past few years and on the equally fragmented beliefs and behaviors of effective implementers in organizations. The main intention in the illustrations made so far is to suggest that the central - and in many ways simple - aspect of that role is a clinical, diagnostic approach to implementation, the ability to assess the full organizational and management 'reality' and to adapt formal design

and technique to it. OR graduates, trained in a tradition that is explicitly rationalisitic, technical and normative, too often lack that ability, or perhaps simply lack an awareness of its relevance so that the ability remains dormant rather than absent. In some ways, redefining one's role from being a designer to becoming an implementer of models and systems will, in itself, make those latent abilities manifest.[10]

'actor' Research on Implementation

Having recommended this shift in perspective, we have, alas, very little conventional wisdom to pass on to the would-be implementer. At the start of this paper a deceptively simple question was posed:

"What are the factors that enhance the likelihood of successful implementation?"

A recent paper by Ginzberg[11] that surveys the efforts to answer this question finds astonishingly fragmented and even contradictory answers. The paper dissects 14 'Factor' studies, all of which are extensive, well-researched and insightful, so that Ginzberg is in no way jousting with straw men.[12] It identifies 140 distinct factors that are reported as having a significant influence on the likelihood of success in implementation: Of these only 15 (11%) appear in 3 or more of the 14 studies and 102 (73%) are reported in only one study. Table 2 shows the breakdown of the 140 factors:

Table 2 Breakdown of Factors Reported in 14 Studies (Ginzberg)

140	Total Factors	
102	(73%)	reported in 1 study only
23	(16%)	reported in 2 studies
12	(09%)	reported in 3 studies
2		" " 4 studies
1		" " 5 studies

Factors reported in 4 studies:

a) "well-defined, measureable objectives"
b) "complexity of techniques and models"

Factor reported in 5 studies:

c) "top management support"

Only three factors appear to have any broad empirical support. In some cases factors found to correlate with particular patterns of success or failure

in implementation are hard to interpret. For example, Hervey [13] finds "well-defined, measureable objectives" to be of substantial impact while Dickson and Powers[14] report it as having no discernable influence using any of the four measures of "success" they employed. Smith et al[15] find a moderate effect and Carter et al[16], in a very ambitious study, find a very large impact. This lack of consensus is not at all unusual in an immature field of research (or in mature ones, as the recent history of economics indicates) but, of course, it hinders the development of prescriptive techniques. At best, our conventional wisdom about the factors affecting implementation success are those shown in Table 3 and even this is tentative.

Table 3 The Conventional Wisdom on Implementation

"top management support"
"a clear felt need by the client"
"an immediate, visible problem to work on"
"early commitment by the user and conscious staff involvement"
"a well-institutionalized OR/MS group."

Some of these may also be hygiene factors in Herzberg's sense of the term[17]; without top management support, for instance, a project faces major difficulties, but having that support may be of little direct help.

The factor research is less than the sum of its parts. While it has isolated at least some of the clusters of variables relevant to implementation, it has not shown their interrelations, has not provided the maps necessary for understanding the dynamics of the process. Too often, its findings are merely correlative. For example, the Northwestern School, under various permutations of Neal, Radnor, Rubinstein and colleagues[18], have provided in-depth longitudinal studies of the organizational correlates of successful OR/MS implementation; these have used large, heterogeneous samples over a long time period and are clearly among the most scrupulous, insightful and reliable empirical analyses so far available. This research has provided some especially valuable conclusions about the life cycle of OR/MS groups and their activities.[19] Even here, though, the studies generally allow only descriptive post hoc reconstructions with little development of prescriptive techniques in that they often focus on what are, at best, semi-controllable variables, such as the value to the OR/MS group of a formal charter. More

importantly, they identify associations without throwing much light on the causal dynamics of the underlying process. Bean, Neal, Radnor and Tansik (1973) surveyed 108 companies in 12 industry sectors, with 10 to 15 projects in each company.[20] They examine 30 factors, using two measures of "success":

1. the percentage of initiated projects that are actually completed
2. a subjective assessment by the head of the OR/MS activity of his group's overall success.

Of the thirty factors examined, about one-third have no apparent relation to either of the two measures of success. Table 4 summarizes the results:

Table 4 Bean et al Summary of Significant Factors

	Factors correlating with success measures		
	1 implementation rate	2 group head's overall assessment	3 both rate and overall assessment
Positive Correlation	10	10	7
Negative Correlation	4	2	0

The factors positively correlated with both measures of success are:

1. management support for the MS approach and the technical group
2. top management interest and involvement in projects
3. the proportion of the MS group leader's time spent on implementation
4. the level of the MS group leader within the organizational hierarchy
5. the formality of the MS group (including an organizational charter)
6. the size of the MS group in relation to the size of the organization
7. the availability of data and information relevant to the problem situation

One factor, "post-project evaluation audit" is positively correlated with the rate of project implementation, but not with overall perceived success. It is difficult to assign a meaning to this unless one examines the dynamics of the process it reflects; presumably the post-project audit relates back to other procedures in planning and/or project management that are the causal

influence. The problem this example illustrates is a common one in Factor research, a basically static analysis of a dynamic multidimensional process, a snapshot of attitudinal or structural variables at a particular point in time. The nature of the process is inducted by clustering and correlating those variables.[21]

The conclusion to be drawn from the Factor research as a whole is not so much that we have no basis for a conventional wisdom as that there are obviously few absolutes. The contradictions and lack of overlap Ginzberg found in the fourteen studies he assessed suggest that implementation is a contingent process. The panel of Through a Glass Darkly seem to feel this, too, in that they criticize management scientists for not adjusting to the particular demands of the manager's situation. The term 'contingency theory' is a major trend, even a fad, in behavioral areas of organizational research.[22] It neatly cuts through some Gordian knots by, for instance, conveniently accepting such contradictions as those in Ginzberg's survey as due to some 'background features' of the situation (this is Nadel's phrase in a discussion of some similar problems to the ones discussed here, in comparative research in political science[23]). Implementation is then viewed as a function of many forces, the strength of which varies according to context - that is, "it all depends". However, this contingency approach can raise more issues than it resolves, since of course the key problem is to identify just what it all depends on and how. This requires metatheory, a theory of contingency. Of course, it also implies that regardless of our ability to provide this meta-theory, the implementer can be effective only if he can map the contingencies of the situation, that indeed there are no absolutes to guide him and that his techniques must be tailored to his clinical assessment of their context.

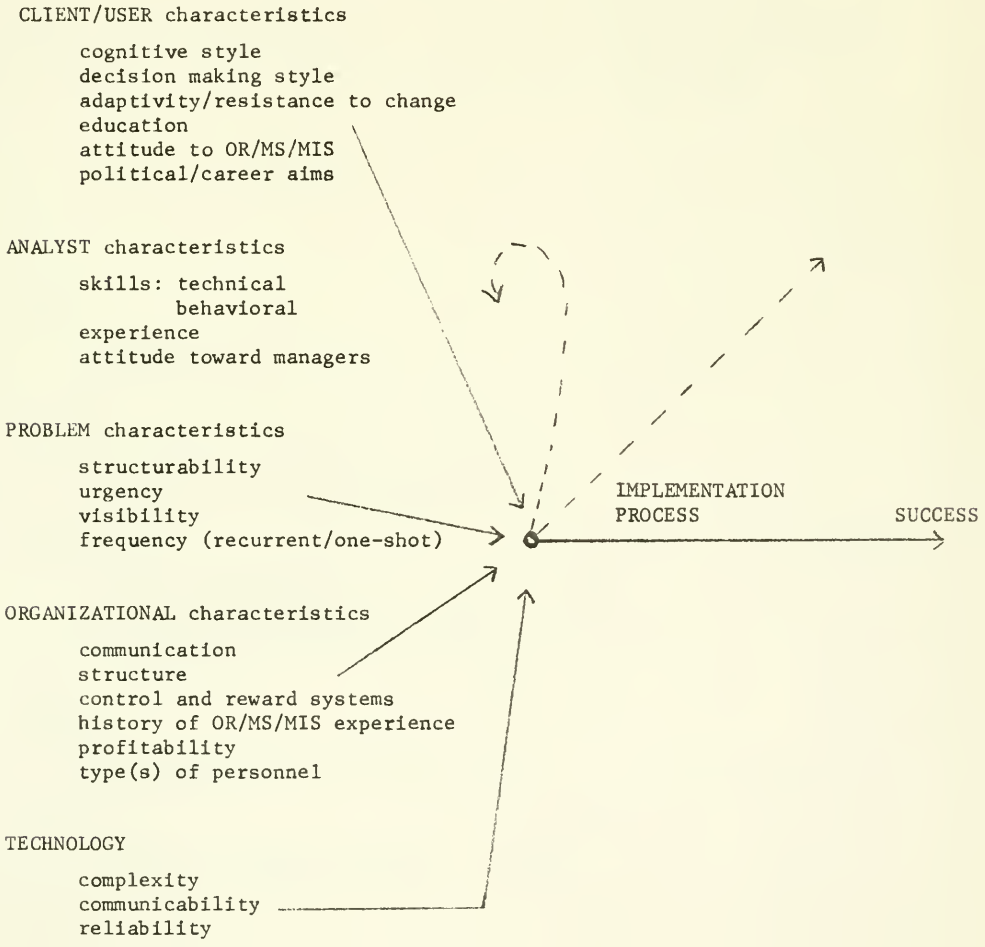
A Conceptual Map of the Implementation Process

A clinician needs a checklist of symptoms. The next section of this paper presents a simple conceptualization of the implementation process; this is not intended as a 'theory' of implementation but as an elementary and general map that can allow the implementer to diagnose and take action. The context of implementation is a complex fusion of contingent variables and a key step in managing the process is simply to identify the key issues and constraints and determine their relative influence.

Figure 1 represents the contingent variables in terms of a literal, Lewinian force field. [24] The uni-directional solid arrows represent 'forces'; for example, the characteristics of the problem, its structurability, urgency etc., exert a force that influences the direction of the implementation process. If one thinks of that outcome force as aiming towards a neon-lit gateway labelled "Success" then each force in the field can either divert the implementation process or help point towards success. (Or as the dotted lines show, toward disaster).

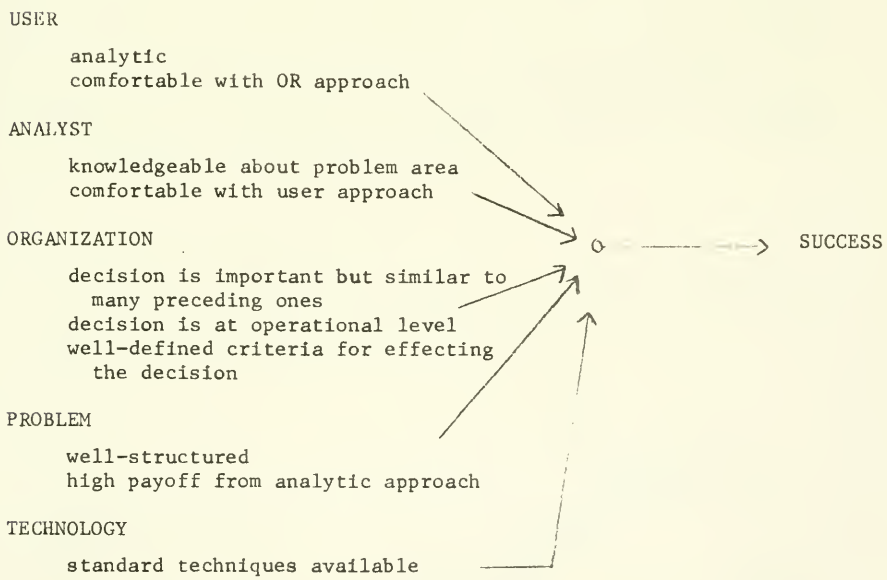
[Figure 1]

IMPLEMENTATION AS A FORCE FIELD



This schematization is obviously an oversimplification and, even on its own terms, is incomplete. In some sense it merely, like the factor research, clusters variables, adding in the notion of directional strength and influence. The key feature to be stressed, though, is that many of the potential forces are not acting in a particular context (while in others they may be of dominating impact). For example, Figure 2 (below) characterizes a hypothetical situation in which a chemicals company requires a one-shot production planning model for scheduling a new product. The problem is a complex one, involving a variety of constraints; the required data is, however, available and there seem to be a number of applicable standard optimization techniques. The OR/MS group is well-institutionalized, though the manager for whom the model is to be designed has had only intermittent contact with the group. He is an engineer with a fairly strong mathematical background. Finally, the problem has very few interdepartmental implications.

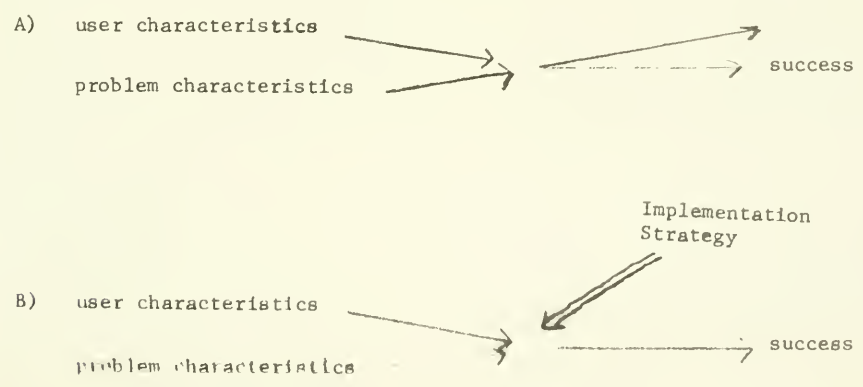
[Figure 2]



In this situation, the relevant variables combine to facilitate implementation. There are only a few forces (and virtually no organizational forces) each of which tends towards the right direction; for example, the manager's training and experience are compatible with the analytic approach and there are no pressures from organizational politics. The problem, too, is a textbook case, optimization of a well-defined, well structured production process.

If, however, the fiction is only slightly changed and we assume that the manager is hostile to OR/MS and a 'seat-of-the-pants-and-proud-of-it' type, then the outcome of the force field is very different and the implementation effort is very likely to be a failure. The mode of problem-solving implicit in an optimization model is alien to this manager; he is unconvinced of its value and validity, lacks the ability to critique it and is very probably personally threatened by it. If, but only if, the management scientist diagnoses this force field he can almost certainly adjust the forces through his own implementation strategy. He can, for example, spend substantial effort building a conceptual line of credit with the manager, starting from a very simple simulation model that the manager can explore to better define terms, constraints and alternatives; the manager can more easily validate the outputs of such a model and thus build trust and confidence in the management scientist as a basis for later accepting a more complex optimization model. In terms of the force field representation, the implementer's strategy involves strengthening or weakening existing forces or adding a new countering force; this adjustment is represented by Figure 3 (b).

Figure 3



A Clinical Strategy

Obviously, the schematization shown in Figure 3 does not define the exact nature of the implementer's strategy. It does, however, make clear the immense risk involved in not identifying relevant forces. A clinical diagnosis prior to any design of the model or system to be implemented will at least give the implementer a stronger hand to play. Clearly, even with such a diagnosis, there is always a chance that the user will still reject the result, whatever the implementer does. None the less, the implementer can at least develop a conscious strategy based on risk rather than on good faith and blithe ignorance of the hidden undercurrents of a situation. Implementation is too often the management of unanticipated consequences; in the situation outlined in Figure 3 above, the management scientist, if he designs his model without identifying and adjusting to the relevant contingencies, will later have to become a firefighter. Firefighting is expensive and generally ineffectual.

This redefinition of the implementer's role from designer to clinician and facilitator is really very simple. It may not require much new knowledge, merely a recognition and assimilation of relevant knowledge. For example, a number of researchers, including the author, have focused on the issues sketched out in the hypothetical situation in Figure 3, the impact of cognitive style on the willingness to adopt analytic methods:

> "...such aids (analytic models) must be designed to amplify the user's problem-solving strategies. Thus it seems that the central factor in determining whether a manager will use a model to reach a decision is the extent to which it 'fits' his style of thinking ...If the manager and the management scientist can recognize first that each has a different cognitive style, and thus a different way of solving the same problem, then their dialogue seems more likely to bear fruit." (McKenney and Keen)[25]

A difficulty with this claim, even if valid, is that cognitive style is only one of many interacting variables. It seems better to modify the argument and to speak of cognitive style as a potential constraint or facilitator in implementation; it is not always relevant to a particular situation, but the management scientist must diagnose when it is or is not relevant, if he is to manage the implementation process.

The technical and normative traditions of management science have often deliberately ignored this need. As Starr points out in "The Politics of Management Science", the analytic view of Truth is '0,1' while the manager's 'truth' always has a political context; he argues that the analyst must also be a 'political scientist' who includes managerial attitudes in his choice of a solution, an argument parallel to the one made here.[26] Starr's example is especially relevant in that some management scientists consciously choose to ignore political forces even though they are readily apparent. Gibson and Hammond provide a fairly typical example of this.[27] They describe a large-scale project in the corporate planning department of a large manufacturing company. Progress over the first three months was excellent and the staff viewed it as a very effective venture. It was, however, abruptly terminated.

The model built by the staff was technically well-designed and the logisitical problems were handled well. The economic issues involved were understood by both the design group and the planning staff. Moreover, the operational characteristics of the model were clearly suited to the planners and analysts who used its outputs in preparing their recommendations. Their report was skillfully presented and, indeed, very well-received by Mr. Cabot, the vice-president who had commissioned the model. Despite all this, the implementation effort had no impact on top management's decisions, except to raise their anger. Unfortunately, Mr. Cabot has aspirations for succeeding to the recently vacated presidency of the company and was using the modelling project, as the design team were almost gleefully aware, as a way to 'preempt other departments in the planning process and later to shine in front of the Board' by presenting the very impressive results of the modelling project. He was shot down and the corporate planning department bore the brunt of his dismay and top management's irritation.

The key symptom in this project, what Gibson and Hammond call the 'informal-social' contingencies, was known and ignored. The design group presumably had not thought through the direct relevance of such outside, non-technical forces for their own actions. The political dimension is not always relevant to an implementation effort; here it was, and the design team should have recognized it as being so. To explain the failure of the project as being due to non-rational 'politics' is not to excuse it. The lack of a clinical definition of their role led them into a venture they could not control and the outcome was once again one of unanticipated consequences.

Of course, political undercurrents in an organization are not easy to pick out at times. In particular, hidden agendas are intendedly secret. This fact, though, reinforces the need for a clinical perspective. Gibson points out in a study of a large-scale project in a bank that the analyst will generally be given an overrationalized explanation of organizational practices and that the researcher (implicitly, too, the practicioner) must consciously try to get beneath the surface.[28]

Implementation as the Management of Change

The arguments made so far justify a particular focus on implementation.

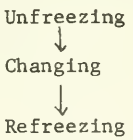
Obviously, however, a more detailed framework is needed to extend that focus to provide specific techniques for managing implementation. Perhaps, given the exploratory nature of research to date, it is premature to suggest any particular framework. None the less, from recent studies and from the less formalized perceptions of a number of experienced implementers, it does seem that viewing the implementation process in terms of a social change process provides a paradigm that is both conceptually rich and practical in its implications. That paradigm is especially consistent with the main theme of this paper in that it centers on the role of the change agent - the implementer - as a clinician, a 'process consultant' (in Schein's phrase)[29] and a facilitator.

We often fairly glibly talk about implementation as an organizational change process and the management scientist as a change agent, without pausing to examine the implications of interpreting that literally. There has been an immense variety of work throughout the social sciences on the dynamics of planned change and this work shows a remarkable unity, whether its specific topic is the training of Benedictine novices (Eriksen)[30], brainwashing of POW's in Korea (Schein)[31], organization change (Bennis)[32], or group dynamics (Cartwright)[33]. On the whole, planned change has ignored the technical and technological aspects of social change, but its insights still hold extremely well in the technical world of OR and MIS.

The most basic framework is Lewin's (expanded by Schein) which views change as a three-stage process:

Figure 4

The Lewin-Schein Model of Chnage



Each of these stages must be worked through if a change program is to be effective. Schein defines the stages:

> "1. Unfreezing: an alteration of the forces acting on the individual such that his stable equilibrium is disturbed sufficiently to motivate him and make him ready to change; this can be accomplished

> either by increasing the pressure to change or by reducing some of the threats or resistances to change....
>
> 2. Changing: the presentation of a direction of change and the actual process of learning new attitudes.....
>
> 3. Refreezing: the integration of the changed attitudes into the rest of the personality and/or into ongoing significant emotional relationships."[34]

Schein's description maps well onto OR/MS implementation ('implementation' here includes all three stages of course; the technical tradition that the "Through a Glass Darkly" panel complained of views the middle stage, 'Changing' or 'Action', as equivalent to implementation and the responsibility for the preceding and succeeding processes as being the organization's not the designer's). The Unfreezing stage perhaps explains much of our conventional wisdom. "Top management support", "a felt need by the client" and "an immediate, visible problem to work on" (See Table 3), factors that facilitate implementation, all relate to the need that there be motivation and momentum for change. Alter reports, in a detailed study of 56 computer systems and models, that systems that were 'sold' to the user by the technical group were rarely successful.[35] Change needs to be self-motivated and the client-system must take responsibility for and be committed to the change program (for a detailed discussion of this aspect of Unfreezing see Bennis[36]). "Resistance to change" reflects a lack of Unfreezing; such resistance is often assumed by the analyst who encounters it to be a pathological rejection of Truth, Beauty, and Integer Programming. The Lewin-Schein model highlights the fact that this resistance may be a reasonable response from a system in equilibrium that feels no motivation to adjust. The currency of management science is Change and analytic specialists often work from the viewpoint that change is generally desirable in itself. Since, however, change programs are almost certain to be ineffectual unless the Unfreezing stage has been worked through, the management scientist must take on as part of his function the creation of a climate for change. Sometimes this climate builds itself - an urgent problem involving substantial costs or profits can unfreeze a manager very quickly.

An unfrozen system will be homeostatic, trying to dampen change; once unfrozen, however, that system must change, must find a new equilibrium. By working to unfreeze an organization, the implementer can coopt its energy and momentum. In marketing terms, one cannot sell change but must make the consumer want to buy; the selling effort must focus on building a 'felt need' for which we happen to have the solution; the product itself should not even be mentioned until the consumer is Unfrozen.

The Refreezing stage explains many semi-successes in management science applications, projects which have an apparently successful outcome but which lose impetus and sink into oblivion when their sponsor or designer leaves the scene. The system in that situation is not self-sustaining but maintained by the enthusiasm and effort of a single individual. Change must be institutionalized by the building of a new and stable equilibrium that supports the change. Again, there are clear implications for the management scientist in building systems that are intended for more than one-shot use; he must make sure that the change is truly 'complete', that the system is embedded in the organization. This may require training, the assignment of a systems 'manager' within the user department or even new operating procedures. In particular, the change is not complete if the system is not consonant with the organization's control and reward systems. Alter reports that many of the systems he examined had difficulties obtaining the necessary input data if that data was not processed routinely by the department responsible.[37]

The dynamics of the Lewin-Schein model are complex and only casual illustrations have been given here. Sorensen and Zand used the model in a study of 280 management science projects.[38] Their results suggest that the framework has substantial explanatory power and that the Refreezing stage seems most critical in explaining implementation success.

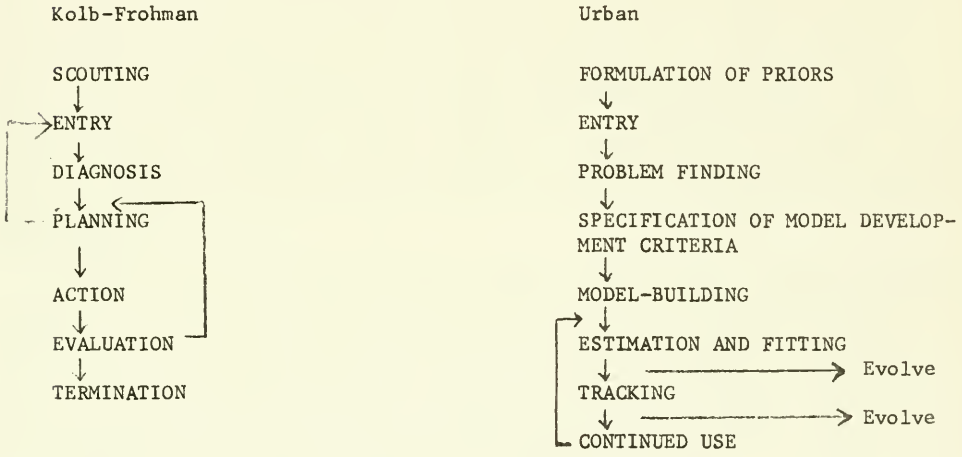
A Strategy for Managing Change

Regardless of its value as a basic paradigm, however, the raw Lewin-Schein model lacks detail. Kolb and Frohman's model of the consulting process in organizational development extends the frame to provide a rich normative base[39] (Organizational Development is to Planned Change what Management Science is to Operations Research). Urban used the

Kolb-Frohman model in his own implementation of marketing models; his paper "Building Models for Managers" (Interfaces 1974)[40] discusses it in substantial detail, relating it directly to the technical minutiae of a modelling project.

Like Lewin and Schein, Kolb and Frohman argue that effective organizational change involves working through a series of stages. The seven stages they define are presented in terms of the consultant's actions. Figure 5 shows the Kolb-Frohman model and Urban's reformulation of it in the context of implementing data-based marketing models.

[Figure 5]



'Action' of course is not implementation, anymore than getting a model up-and-running guarantees its use. The central Action stage must be preceded by the establishment of a contract for the venture (this is an elaboration of Unfreezing) and followed by Evaluation and Termination, where the system is linked into the ongoing organizational activities.

SCOUTING is the stage least directly relevant to implementation (though certainly relevant to consulting in the management science area). It involves matching the capabilities of the consultant with the needs of the client-organization; this implies avoiding what Heany has called "Have technique, will travel", in which every problem is solved by, say, linear programming.

ENTRY involves ensuring legitimacy for action: defining the problem-situation, the nature of a solution, criteria for evaluation and the allocation of responsibilities and resources, even if only at a general level. In arguing earlier that the management scientist should define his role as being essentially clinical and facilitative, many points were made that can be more explicitly captured in terms of this Entry stage. Entry requires subtle skills and in many instances far more time and effort than any other aspect of implementation (see Urban's case study: A Family Planning System which elaborates on the relative effort involved in Entry[41]). Far too often the analyst responds to the pressure for visible results and gets going on formalizing the model or system, leaving the 'people' issues to be sorted out later. However, most of the critical decisions are made at Entry, particularly in complex projects which involve an innovative system with many inputs, users and applications. Moreover, it is in Entry that the client's expectations are set; to some extent implementation <u>is</u> the management of expectations - many failures occur not because a 'good' model was not delivered, but because the 'right' one was not or because the user had excessively high expectations which led him to enthusiastically support the effort but which could never be met in practice.

Lucas provides an insightful case study of how the Entry stage should be managed. He describes a technically simple MIS built for the United Farm Workers Union (the simplicity of the system meant of course that Action was brief and easily handled)[42]. Lucas and his co-workers diagnosed the state of the client-system and found that the long-service older professional core of the UFW would need careful Unfreezing, that while they might not actively resist the change in operations and style implicit in the system, they were clearly not motivated to accept it. The MIS team arranged a retreat at which they presented a simple design plan with the statement that they would feel unhappy if at least half the plan were not rejected and redefined by the UFW personnel. In this way, the criticisms, restatements and definitions provided by the UFW group shifted the change program from being externally brought in, towards being self-motivated and under their control and initiation. As a tactic for unfreezing this approach seems generally valuable. Urban similarly designed a simple 'Mod 1' model for a family planning agency.[43] This model was overgeneral and incomplete; by getting the user group to determine whether the errors in output were due to faults in the model or to some aspect of the

wider environment that the user group had not identified, Urban threw the responsibility for developing a better model onto the users, committing and involving them.

Vertinsky, Barth et al[44] at the University of British Columbia have been directly involved in a number of implementations, working explicitly from this approach. They similarly stress the critical importance of Entry and Unfreezing. From these and similar studies it seems possible to specify the issues in Entry - and implicitly the responsibilities of the implementer: successful resolution of Entry requires:

1) a felt need:
   a. the implementer must make sure that the problem to be worked on is visible and seen as relevant
   b. he must make sure that the 'client' has a motive and commitment for action

2) a definition of goals in operational terms
   a. what are the criteria for 'success'?
   b. what are the priorities and tradeoffs?
   c. what 'key' indicators' can be used to measure progress and accomplishment?

3) a contract for change: a 'deal' between designer and client in which the following is established
   a. 'trust' - personal, professional or political
   b. mutual understanding (cf. Churchman and Scheinblatt)[45]
   c. mutual respect for each other's style, investment and needs
   d. realistic, mutual expectations

4) diagnosis and resolution of resistance to change by:
   a. including users as well as the client in implementation (Alloway makes the point that the designer often ignores the secondary users, groups who are indirectly but substantially affected by the system, by for example, being responsible for collecting particular input data)[46]
   b. recognizing that resistance is a signal to be responded to, not a pathology to be eliminated by fiat, power or endplays

5) initial allocation of resources and responsibilities
   a. meaningful user involvement
   b. the development of a team

This list is arid shorthand for a complex process (see Ginzberg [1975] and Urban for further discussions of Entry). It is worth mentioning in passing, that the characteristics and behavior necessary in the implementer for the Entry process to be successful correspond closely to Schein's definition of a 'process consultant' who must know "how to diagnose and establish helping relationships,"[47] who is an expert at getting a 'feel' for a situation, at the same time being able to get people working together and goals and procedures operationalized.

Entry also provides the bases for EVALUATION. In many projects no real definition of, or criteria for evaluating, success is ever made. The venture was justified on the basis of the standard polite fictions of saving $X on clerical personnel and increasing work load by Y%. The real impetus for the project may remain a hidden agenda: the sponsor's belief that the system will lead to 'better' decision-making. After the event, when the development costs and time are their customary large fraction over budget, it is too late to open up the hidden agenda and argue that the system is a 'success'. Evaluation of a completed project can really be made meaningful only by formalizing, before the system is even designed, a 'deal' or 'contract' which includes some definition for success; this would require specifying 'key indicators', variables that the consultant and client group agree can be used as surrogate measures for 'better decision-making'.[48] Evaluation cannot be a post facto audit . In an ongoing study, Ginzberg has identified a number of cases where even after the event, the designer and user had very different perceptions of the intent of the system and the degree to which it was successful[49]; 'success' is again contingent on intent and the responsibility of the management scientist is to ensure that there is a joint resolution of that contingency. Radnor, Tansik and Rubenstein, whose approach to implementation is much more analytic and technical than the one proposed here, argue in a similar direction[50]; they point to the relative difficulty of measuring the results of OR/MS activities and strongly suggest that the predesign stage (approximating Entry) is where the PEC, Project Evaluation Criteria, must be established. Only then can non-operational goals be formalized and any incongruence between the client and designer, in terms of goals and expectations, be resolved.

Determining the Criteria for 'Success'

A central issue in implementation research, hinted at earlier but not discussed directly, focuses on the question of what is success; Dickson and Powers use four measures, which have very low intercorrelations and their experience seems fairly typical[51]. There is a tendency to equate success with use, partly since terminal hours per month is an easily obtained metric. However, there are some instances where a successful implementation is one where the analyst helps a manager to understand his problem-environment better, to a degree that he may then say 'that's a lousy model' even if the model was built to his specifications. Management scientists too often think of a model or system as a product; 'success' then means providing the best product, sports coupe with all options , even where the manager really wants cheap, quickly-provided transportation. Of all the characteristics that seems to differentiate effective implementers from the OR graduates lambasted in the panel discussion quoted earlier, the distinction between a Service and a Product orientation seems most central.[52] Again, this conclusion needs to be modified in terms of diagnosis; there are occasions as in the hypothetical instance of a one-shot planning model discussed earlier (see Figure 2) where Entry is simple, the criteria for success easily identified and a Product definitely required. However, in the example following that one, where the user is assumed to be hostile to the analytic approach, a Product role on the part of the analyst virtually guarantees failure.

Huysmans provides a useful taxonomy of 'success'[53]; he defines three 'levels of adoption': (a fourth level has been added by this author to include the innovative interactive Decision Support Systems described by Scott Morton and Gerrity)[54];

1. does the model or system lead to management action (is it used?)
2. does it lead to management change (do management get new insights or information or adjust their decision process?)
3. does it lead to recurring use of the OR/MS approach?
4. does it lead to an extension or redefinition of the task it supports?

Only levels 1 and 2 can be evaluated in terms of the use of the system. Success is contingent and the technical features of the system will be very different depending on which level is assumed; that choice must be made before the system is designed. The analyst's own view of his role influences his ability to select a level that is congruent with the clients 'needs', the organization's current activities and capabilities, etc., etc - once again, the analyst himself must identify the et ceteras for this particular situation.

Underlying the recommendations made so far in this paper is a more fundamental issue. Every management scientist has an implicit model of the decision process that he uses; generally that model comes from the Rationalistic tradition that underpins the analytic disciplines. That tradition is normative, stressing logic and method. It is also axiomatic and most analysts ignore that fact. The axioms of one discipline may be the hypotheses of another; for example, the concept of utility, which is axiomatic to economics and decision theory, is a major hypothesis - not too well supported experimentally - in cognitive psychology. The point is critical; managementscientists have too often seen the analytic approach as the one Right Way and elevate the formalization and structuring of problems above the implementation of effective solutions as against 'correct' or 'optimal' ones. They tend to disdain the way in which managers operate and to lack even an understanding of what that way is. Few management scientists are at all familiar with descriptive theories of the decision process. For example, Lindblom's model of 'Muddling Through' in political science shows that in many instances margin-dependent choices rather than formal evaluation of outcomes can be a highly effective way of dealing with complex problems.[55] Lindblomian decision-makers examine only the alternatives that are close to their experience; they cannot assess the utility of pomegranates and oranges but can decide if they prefer three apples to the two oranges they have now. Management scientists operate from their implicit model of decision-making; it is a powerful one but it does not reflect the actual behavior of many of their clients who are often very effective decision-makers, particularly in their ability to deal with problems they do not consciously understand. The clinical facilitator, even when he aims at moving a manager towards the Rational ideal, will recognize where the manager starts from, understand the dynamics of his response and respect his abilities. Implementation must start from this understanding and the implementer must include in his body of knowledge descriptive as well as normative theories of the decision process. Minzberg, for example, shows that the manager lives in and prefers a world of 'Brevity, Fragmentation and Variety'[56]. Knowledge of this aspect of the management reality in itself enables the analyst to match his techniques to the context. Schein speaks of management as a process of influence[57]; his definition applies directly to implementation.

A role is mainly a set of expectations about how to behave. In general the expectations of the graduating OR or MIS specialist have been that his role is that of a technician and that any difficulties he encounters in getting managers to make use of the tools he provides comes from their inadequacies, not his. What has been presented in this paper is an outline for a more effective role. It really requires little new knowledge, only small adjustments of attitude which lead to large changes in outcome. The role of 'facilitator' and manager of change is in some ways an easier one than that of the much-beleagured, ever-struggling Expert in an alien land. This is not to argue against technical ability; indeed, the argument here takes technical skill as a given. However, techniques are means not ends and must be matched to context.

It is convenient, though an arbitrary dichotomy, in concluding this argument, to draw a distinction between Technician and Implementer.

	TECHNICIAN	IMPLEMENTER
Locus of effort	DESIGN	ENTRY/EVALUATION/ TERMINATION
Output	Product	SERVICE
Attitude towards Change Process	DIFFUSION OF INNOVATION	PROCESS CONSULTANT CHANGE AGENT
Main skill areas	KNOWLEDGE TECHNIQUES	DIAGNOSIS FACILITATION AND TECHNIQUES
Assumptions about the decision process	ANALYTIC PRESCRIPTIVE	DESCRIPTIVE
Slogan	"HAVE TECHNIQUE, WILL TRAVEL"	"IT ALL DEPENDS..."

The list above is largely self-explanatory. The technician's role is seen as one of isolation, strongly centered around expertise. His view of change as being a process of 'diffusion of innovation' is that of NASA; potential users are kept informed of new developments and techniques and it is assumed that they will recognize their value and adopt them. This is the approach that led from spaceship nosecones to Teflon frying pans but it does not get refrigerators into the hands of the eskimos who need them.

Implementation will never be easy. A complex model or system is an invention. It has never existed before and we have very few guidelines for building it. Now that the 'easy' triumphs have been accomplished - the automation of all the payrolls and accounts receivable in the world - future

innovations will almost certainly involve qualitative improvements in decision-making - better ways of doing the same jobs, and new jobs, too. In that situation, implementation will always involve a range of users over a long time-frame, will have many political and organizational impacts and require far more than technical skills in the analyst. This paper began by quoting pessimistic figures and pessimistic managers. There really is no need for pessimism. We have substantial insight into managing change in organizations, the technology of models and computer systems no longer seems to be the critical limiting factor and we have a new generation of specialists entering the Real World who understand the technology but are concerned with its wider applications. The key point in the argument here is to suggest that the major constraint on implementation is the analyst's view of his role. If he can recognize that implementation is not the same as design and that he has a responsibility to create the climate for change and to institutionalize the change he introduces, then he can be immensely effective with little adjustment other than patience, humility, and common sense (these are admittedly virtues the **average** manager does not associate with his OR whizkids). The leverage in implementation is the implementer himself and his control and influence are basically determined by his own assessment of the role he should play.

REFERENCES

1. See Keen, P.G.W., "Towards a Behavioral Methodology for the Study of OR/MS Implementation", Sloan Working Paper, MIT, 1974

2. Batchelor, J.H., Operations Research: An Annotated Bibliography, St. Louis Press, 1959

3. Radnor, M. and Mylan, quoted by Urban (see Ref. 4)

4. Urban, G.L., "Building Models for Decision Makers", Interfaces, vol. 4, No. 3, May 1974

5. Churchman, C.W., "Managerial Acceptance of Scientific Recommendations" California Management Review, 1967

6. Drake, J.W., The Administration of Transportation Modelling Projects, Lexington, MA.: Heath, 1973

7. Halbrecht, H. (Chairman), "Through a Glass Darkly", Interfaces, Vol. 2, No. 4, August 1972

8. Grayson, C. and Jackson, "Management Science and Business Practice", Harvard Business Review, July 1973

9. See, e.g., McKenney, J.L. and P.G.W. Keen, "How Managers Minds Work", Harvard Business Review, May 1974 and Keen, P.G.W., "Cognitive Style and the Problem Solving Process: An Experiment", Sloan Working Paper, MIT, 1974

10. An excellent study of the way in which a young analyst learnt to adjust his abilities can be found in "Bud Mathaisal", Case Clearing House, No. 9-371-252, 1970 (Written by J.S. Hammond)

11. Ginzberg, M.J., "A Critical Survey of Implementation Research", CISR Working Paper, MIT, 1975

12. The fourteen studies surveyed in Ginzberg's paper are:

Bean, A.S., R.D. Neal, M. Radnor, and D.A. Tansik (1973), "Structural and Behavioral Correlates of the Implementation of Formal OR/MS Projects: Success and Failure in U.S. Business Organizations", paper presented to the Conference on the Implementation of OR/MS Models, U. Pittsburgh

Carter, D.M., H.L. Gibson, and R.A. Rademacher (1973), "A Study of Critical Factors in Management Information Systems for U.S. Air Force", Colorado State University

Dickson, G.W., and R.F. Powers (1971), "MIS Project Management: Myths, Opinions, and Reality", University of Minnesota

Drake, J.W., (1973), The Administration of Transportation Modeling Projects, D.C. Heath, Lexington, MA

Evan, W.M., and G. Black (1967), "Innovation in Business Organizations: Some Factors Associated with Success or Failure of Staff Proposals", J. Bus. 40, pp. 5;9-530

Gibson, C.F., (1973), "A Methodology for Implementation Research", paper presented to the Conference on the Implementation of OR/MS Models, U/ Pittsburgh

Harvey, A., (1970), "Factors Making for Implementation Success and Failure", Mgt. Sci. 16 #6, pp. B312-B321

Lucas, H.C., (1973), "Behavioral Factors in System Implementation", Research Paper #188, Graduate School of Business, Stanford U.

Manley, J.H., (1973), "Implementation Attitudes: A Model and a Measurement Methodology", paper presented to the Conference on the Implementation of OR/MS Models, U. Pittsburgh

McKinsey & Co., (1968), Unlocking the Computer's Profit Potential

Rubenstein, A.H., M. Radnor, N.R. Baker, D.R. Heiman, and J.B. McColly (1967), "Some Organizational Factors Related to the Effectiveness of Management Science Groups in Industry", Mgt. Sci. 13 #8, pp. B508-B518

Schultz, R.L., and D.P. Slevin (1973), "Implementation and Organizational Validity: An Empirical Investigation", Paper #436, Krannert Graduate School of Industrial Administration, Purdue U.

Smith, R.D., J. R. Brown, R.H. Culhan, and R.D. Amspoker, (1973), "Operations Research Effectiveness: An Empirical Study of Fourteen Project Groups", Paper presented to the Conference on the Implementation of OR/MS Models, U. Pittsburgh

Vertinsky, I., (1972), "OR/MS Implementation in Valle, Columbia, S.A.: A Profile of a Developing Region", Mgt. Sci. 18 #6, pp. B314-B327

13. Harvey, A. (See Ref. 12 above)

14. Dickson and Powers (See 12 above)

15. Smith (See 12 above)

16. Carter (See 12 above)

17. Herzberg, F., "One More Time: How Do You Motivate Employees?", Harvard Business Review, Jan.-Feb. 1968. In studying motivation of workers, identifies hygiene factors (e.g. in salary) as those that are reported as being important only as dissatisfiers, having no positive motivational impact. While the concept of hygiene factors is useful, Herzbergs methodology and specific findings have been widely criticized.

18. See, in particular, Rubenstein, A.H. et al, "Some Organizational Factors Relating to the Effectiveness of Management Science Groups in Industry", Operations Research, Vol. 13, 1967, pp. B508-B518

19. Neal, R.D., and M. Radnor, "Relation Between Formal Procedures for Pursuing OR/MS Activities and OR/MS Group Success", Operations Research, Vol. 21, No. 2, March 1973, pp. 451-474

20. Bean et al, op.cit. (Ref. 12)

21. See Keen, P.G.W., "Towards a Behavioral Methodology.." (See Ref. 1) for a discussion of some statistical and methodological problems with this approach

22. The most influential contingency theory in management research is Lawrence, P.A., and J.W. Lorsch Organization and Environment, Harvard Business School, Division of Research, 1968

23. Quoted in Holt, R.T., and J.E. Turner, The Methodology of Comparative Research, New York, Free Press, 1970

24. See Lewin, K., Field Theory in the Social Sciences, New York: Harper, 1951. And also Keen, P.G.W., Implications of Cognitive Style for Individual Decision Making Chapter 3 - "Dimensions of the Decision Situation", Doctoral dissertation, Harvard Business School, 1973

25. McKenney and Keen, op.cit. (Ref. 9 above)

26. Starr, M.K., "The Politics of Management Science", Interfaces, vol. 1, June 1971, pp. 31-37

27. Gibson, C.F., and J.S. Hammond, "Contrasting Approaches for Facilitating the Implementation of Management Science", paper presented to National TIMS/ORSA meeting, Boston, April 1974

28. Gibson, C.F., "A Methodology for Implementation Research", unpublished paper, Harvard Business School, 1973

29. Schein, E.H., Process Consultation: Its Role in Organization Development, Addison-Wesley, 1969

30. Eriksen, E., Young Man Luther, New York, Norton, 1958

31. Schein, E.H., op.cit.

32. Bennis, W., "Theory and Method in Applying Behavioral Science to Planned Organizational Change: Applied Behavioral Science", Vol. 1, No. 4, 1965, p. 337-360

33. Cartwright, "Achieving Change in People: Some Applications of Group Dynamics Theory", Human Relations, Vol. 4, 1951, p. 381-392

34. Schein, E.H., op.cit.

35. Alter, S., An Exploratory Study of Decision Support Systems, Ph.D. dissertation in progress, Sloan School, MIT, 1975

36. Bennis, W., op.cit.

37. Alter, S., op.cit.

38. Sorensen, R.E., and D.E. Zand, "Improving the Implementation of OR/MS Models by Applying the Lewin/Schein Theory of Change", paper presented at U.of Pittsburgh conference on Implementation, Nov. 1973

39. Kolb, D.A., and A.L. Frohman, "An Organization Development Approach to Consulting", Sloan Management Review, Vol. 12, Fall 1970

40. Urban, G.L., op.cit.

41. Urban, G.L., "A Model for the Management of a Family Planning System", Operations Research, April 1974

42. Lucas, H.C., "Behavioral Factors in Systems Implementation", Stanford Graduate School of Business Research paper 188, Nov. 1973

43. Urban, G.L., op.cit.

44. Vertinsky, I., R.T. Barth, and V.T. Mitchell, "A Study of OR/MS Implementation as a Social Change Process", paper presented at U. of Pittsburgh conference on Implementation, Nov. 1973

45. Churchman, C.W., and A.H. Scheinblatt, "The Research and the Manager: A Dialectic of Implementation", Management Science, Vol. 11, No. 4, Feb. 1965

46. Alloway, R., "Application of a Contingency Theory of Temporary Management Systems to the Creation of Computer-based Systems", paper presented at Sloan Center for Information Systems Research conference on Implementation, April 1975

47. Schein, E.H., op.cit.

48. See Keen, P.G.W., "Computer-based Decision Aids: The Evaluation Problem", Sloan Management Review , Spring 1975 (forthcoming)

49. Ginzberg, M.J., "Managing the Implementation Process", Ph.D. dissertation in progress, Sloan School of Management, MIT, 1975

50. Radnor, M., D.A. Tansik, and A.H. Rubenstein, "Integration and Utilization of Management Science Activities in Organizations", Operations Research, Vol. 18, No. 6, pp. 967-991

51. Dickson, G., and R. Powers, op.cit. (Ref. 12)

52. See Keen, P.G.W., "Towards a Behavioral Methodology..", op.cit.

53. Huysmans, J.B.H., "Operations Research Implementation and the Practice of Management", paper presented at U. of Pittsburgh conference on Implementation, Nov. 1973

54. See Morton, M.S.S., Management Decision Systems, Harvard Business School, Division of Research, 1971, and T.P. Gerrity

55. Lindblom, C.E., "The Science of Muddling Through", Public Administration Review, Vol. 19, Spring 1959

56. Minzberg, H., The Nature of Managerial Work, Harper and Row, N.Y., 1973.

57. Schein, E.H., "Management Development as a Process of Influence", Industrial Management Review, Vol. II, May 1961