A PROCESS APPROACH TO MANAGEMENT SCIENCE IMPLEMENTATION

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ABSTRACT

Implementing computer systems and models is perhaps the major obstacle to increased use of management science; our ability to develop technically elegant and sophisticated systems far surpasses our ability to provide managers with useful, workable solutions. Over the past decade, a number of researchers have addressed this issue, using, almost invariably, a research approach we will call the factor paradigm. The question asked is normally some variant of "what factors are related to implementation success?" The answers discovered, while appearing voluminous, are not very convincing. Beyond establishing the importance of management support and of user involvement to implementation outcomes, little else of general usefulness has emerged from this line of research.

Three key shortcomings of the factor model as a research paradigm help explain the seemingly scant results it has produced. First, it has little theoretical base. Combining this with a nearly endless supply of potentially relevant factors results in studies which cover only a small portion of the total territory, and which fail to build on past research. Next, the factor approach takes a static view of an inherently dynamic phenomenon. And, finally, the approach is oriented towards measuring factors rather than towards developing the tools with which management could guide and control the implementation process.

An alternative view of implementation, based on the Lewin/Schein theory of change, is presented. This view suggests that management science implementation is really a special case of the more general phenomenon of organization change; hence, studying it from the organization development/planned change perspective makes considerable sense. It is shown that the three problems which plague the factor paradigm are addressed by this model, and that it can serve both as a framework for research and as the basis for needed management tools.

Some initial steps towards developing an organization development model as a research paradigm and guide to managerial action are proposed. Hypotheses concerning the relationships between the stages of the process and an expanded view of implementation success are presented, and expected differences between decision support system implementations and more conventional MS and MIS implementations are noted. These hypotheses were tested in a study of a small sample of real implementation efforts. Responses to questionnaires distributed to both users and designers were used to reconstruct a view of the implementation process a project had followed.

The results of this study suggest that:

1. the interactions between users and designers (the implementation process) differed between projects regarded as successful by the users and those they considered unsuccessful;

2. the aspects (stages) of the process which are most critical to outcomes vary across projects of different types; and

3. designers in projects which the users considered unsuccessful differ markedly from the users in their assessments of both process and outcomes.

Some implications of these results for managers, consultants, and researchers are considered.

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I.1. Is There an Implementation Problem?

> "Operations research (OR) successes are abundant. OR has been applied successfully to important management decisions such as refining scheduling (linear programming), planning large projects (CPM/PERT), and making investment decisions (risk analysis). The effectiveness of OR solutions and their superiority to more traditional approaches have been shown repeatedly." (Huysmans, 1973, p. 1)

> "But the fact remains that only a small fraction of management science 'results' are being used." (Grayson, 1973, p. 43)

These two statements demonstrate the plight facing the management sciences today. On the one hand, we have been able to score some impressive victories; and, our technical achievements in model building and computer systems design are considerable. Yet, "in spite of the many success stories, the lasting impact of OR on management decisions is still in doubt." (Huysmans, 1973, p. 1)

Perhaps this problem is best exemplified by C. Jackson Grayson's experience as Chairman of the Price Commission. Though trained as a management scientist and having done research in the MS area, when put in a top management position he made no explicit use of any MS tool. If even those of us with sufficient training in the management sciences fail to use them when given the opportunity, what can we expect from managers without this training?

This view, that indeed we have an implementation problem is not peculiar to Grayson. Many authors have stated that MS is not used as extensively as we might hope (see for example, Dearden & Lastavica, 1970, or Hall, 1973). Perhaps the most distressing aspect of this problem is the dearth of reported applications of MS in real-life settings. Urban reports that:

> "In the period January 1971 to June 1973 Management Science: Application contained over 150 articles, but less than 3 percent represented implementation in an organization (used more than once) and only 15 percent more were applied even once in a real decision situation." (Urban, 1974a, p. 1)

While Urban's figures may be quite shocking, they do not seem to be out of line. Another study of OR groups in both government and industry shows that 86% of the groups in each sector report experiencing some implementation problems (Radnor et al., 1970). And, while it would be nice to lay the blame for such problems on technical inadequacy of the systems involved, the evidence strongly suggests that this is not the case. Ackoff reviewed forty eight projects he had participated in during the 1950's and reported that though none were technical failures, a number were implementation failures -- i.e., there was a partial or complete failure to implement the findings (Ackoff, 1960). Hammond suggests that much the same situation exists today (Hammond, 1973). It appears that we have a real problem; our ability to provide managers with systems they will find useful and will adopt has not kept pace with our growing technical capacity.

We can look at this implementation problem from two perspectives; that of the manager or management scientist involved in a project, and that of the researcher interested in understanding the problem. From the practitioner's viewpoint one thing is immediately apparent: implementations do fail completely on occasion and frequently run into some sort of difficulty. What, then, can the practitioner (be he manager or management scientist) do about this? What tools are available to aid him? There is a sizable literature on the topic of implementation, but few clear actions which can be taken emerge from this literature (we state this without proof for now, but will discuss it more fully in a later section of this chapter and in the next). The tools available to the manager are primarily various project control techniques. These may be useful for a certain level of planning and for tracking progress against this plan. But, they can only indicate that something has gone awry and caused the schedule to slip; they cannot identify the cause of the problem or what should be done to rectify it.

From the researcher's vantage point the view is somewhat different. The most striking aspect is that until quite recently there was little or no research on implementation; in fact, the word implementation itself seldom found its way into the literature. The concern of most management scientists (and we include information system specialists in this class) was with the <u>design</u> of systems.

The only discussions of implementation in the literature were found in the writings of a few 'wise men' who tried to draw generalizations out of their experiences; actual research on implementation was not considered a valid line of inquiry for the management scientist. The situation has now changed. In the past five years or so a considerable body of research on implementation has developed. We will review this literature in detail in the next chapter. For now we will simply state that the research results do not present us with a clear picture of the problem, but rather suggest that implementation is a complex process affected by a multiplicity of factors.

While the manifestation of the problem is different for practitioner and researcher, the problem itself is essentially the same: we do not yet have a good understanding of implementation. The remainder of this chapter will examine certain dimensions of the problem and a portion of the literature addressed to it.

I.2. Key Dimensions of the Problem.

I.2.1. Defining implementation.

The term implementation has different meanings for different people. Traditionally, implementation has been viewed as that part of the system development cycle beginning <u>after</u> the system or model has been designed and built, and ending as soon as outputs are produced. We believe, and will develop our reasoning later in this thesis, that such a definition is far too narrow. In this work, implementation is taken to refer to the entire complex of steps, beginning with the identification of a business problem (or opportunity) potentially amenable to a MS solution, and ending when active consideration of solutions to this problem (including installing, testing, and refining any systems designed to address it) ceases.

An implementation failure, then, may be any problem resulting in a failure to utilize the system designed as a solution to this business problem; or, more importantly, any problem which causes the user to be dissatisfied with the solution (even though he may be using it). This definition eliminates the rather arbitrary and artificial distinctions among design, development, technical, and implementation failures. All are implementation failures, and, as we will point out later in our discussion, have their roots in the handling of the implementation process.

I.2.2. Types of technology.

The term Management Science covers a very wide range of techniques. We will focus, in this thesis, on only a subset of this total range. To begin with, we will be concerned only with computer based applications. Clearly, such a restriction is not very exclusive, as most real world problems management scientists address are too large to tackle without some use of a computer. More importantly, however, we lose little in terms of understanding implementation through this exclusion; the problems attendant to computer-based applications include all those of non-computerized systems plus certain others.[1]

For our purposes it is useful to divide computer-based management science into three groups: conventional management information systems, one-shot decision models, and decision support systems. The first category, conventional MIS, includes those systems performing largely clerical functions -- systems which provide managers (or clerks) with data or routine reports, but which do not impact the manager's decision process in any real way (e.g., payroll systems or systems for transaction processing). Frequently, a new system in this category will simply replace some previously existing system (manual or computerized), and will do little more than change the means by which the data is processed, not the actual data available to the user. It is expected that systems in this category would be used regularly over a relatively long period (e.g., 2-5 years, which is long by computer application standards).

The one-shot decision model covers a large portion of those

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[1]Mumford (1969) helps us understand this; "The film 2001 ... must bring home to many people the fact that computers are projected as becoming both all-powerful and psychotic, a not very reassuring prospect. The systems analyst must therefore be aware that in giving people information about computers he is starting from a negative and not a neutral position ... " (p. 12).

applications traditionally considered to be MS or OR. This category includes all situations in which a major (in terms of cost or value) non-recurring decision has to be made, and a computer-based model is developed to aid in this decision. The model may be either a simulation or an optimization; it may be a model developed specifically for that situation or an instantiation of a general model. What is important from our point of view is that the decision be a non-recurring one (at least as far as the role incumbent making the decision is concerned), and that a computerized model be developed to aid in making this particular decision.

Our third class of MS application, decision support systems (DSS), requires some explanation. This type of system was first singled out and discussed by Scott Morton (1967, 1971), and its implications elaborated on by Gorry & Scott Morton (1971).[2] The DSS contains elements of both of our first two classes of MS applications. Like the one-shot decision model, a computerized model (or perhaps a data retrieval system) is designed to aid a manager (or staff specialist) in a decision making task. However, while the one-shot model is aimed at the non-recurring decision, the DSS focuses on the more regularly addressed problems in the manager's task repertoire. Thus, like the conventional MIS, the DSS is

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[2]Scott Morton originally called these systems Management Decision Systems, the term Decision Support System not appearing until the Gorry & Scott Morton article.

expected to have an extended lifetime; but, very unlike the conventional MIS, it provides the user with information, analytic capabilities, or perhaps simply speed of access to data which he did not previously have.

This combination of characteristics results in a system having considerably different requirements than either of the other two classes. The problems to which DSSs are applicable are primarily those for which we do not have well articulated decision models; those which Gorry & Scott Morton describe as unstructured or partially unstructured, or which Simon (1960) has termed non-programmed, These decisions cannot be relegated to a machine, as human skills (e.g., judgement or complex pattern recognition) are needed. However, a machine can aid (or support) the human decision maker in his task. It is this notion of 'sharing' an ongoing operating decision between man and machine which distinguishes the DSS from other MS applications, and results in different implementation considerations for this class of systems. We will discuss this issue more thoroughly in Chapter V.

The definitions of these three classes of applications are not completely clear; the boundaries are fuzzy, and it is not even certain that the groups as defined collectively exhaust the universe of computerized management science. The lack of definitional clarity is due, at least in part, to the fact that these groupings have emerged only recently. We are concerned with these three groups because we believe each one has slightly different implications for implementation. Part of the work of this research will be the development of certain operational means for distinguishing among these three classes. We will return to these issues in later chapters.

I.2.3. Defining the success of an implementation effort.

> "Here an unsuccessful case is taken to be <u>one in which there was partial or complete failure to implement findings</u>. The degree of unsuccessfulness depends on the completeness of this failure." (Ackoff, 1960, p. 260).

Definitions of implementation success similar to Ackoff's have been by far the most common way of conceptualizing the issue of success; and, this remains the case today (see Lucas, 1973, or Rockart, 1973, for example). To assess the merit of this view we must ask what assumptions underlie it and whether these assumptions are justified. Perhaps the most critical assumption concerns the product-service issue (see Keen & McKenney, 1973). If a MS effort is viewed as an attempt to provide a manager with a specific, tangible output (a product), then considering success to be obtained only when this product is accepted and used may make sense. However, we contend that implementing <u>a particular</u> model or specific results is rarely an appropriate goal for a MS project. Rather, concern should be focused on helping the client to better understand his environment and enabling him to deal with it more effectively -- that is, providing the client with a useful and important service. In this case, the implementation of specific models or findings is not an appropriate criterion for success; achieving agreed upon goals, developing client skills, and increasing client understanding are what we should be striving for.

Closely allied to the product-service question is that of the roles for manager and management scientist. The traditional view of success is based on an implicit assumption that the latter's job is to solve the problem or develop a system which will solve it, while the former simply accepts or rejects that solution, and then either implements it or does not. Such a view, which Churchman & Schainblatt (1965) have called the 'separate function position', is largely in line with the product notion of implementation. A service orientation, however, requires a different view, one in which manager and management scientist share responsibilities for all aspects of the project; a position much closer to what Churchman & Schainblatt have termed 'mutual understanding'.

While it is true that the bulk of the literature still accepts (implicitly or explicitly) the traditional (product) view of success, a number of authors have begun suggesting other views which are, in our opinion, more appropriate. In most cases this revised view is based on the notion that implementation is largely a question of social change (see Munson & Hancock, 1972, for example); and, when one adopts this view, a considerably broader definition of what constitutes a successful outcome is required. An important part of this view is the recognition that implementation is not unidimensional, and neither are its outcomes. Vertinsky & Barth (1972) suggest "that in the area of managerial innovation and implementation that the intangible innovations are possible the more important ones." (p. 164) Clearly, such a statement cannot be reconciled with a product view of implementation. The effort, then, has been to develop models of implementation which do justice to this multidimensionality. Chapter III reviews some of the work in this area.

In sum, the view of success most prevalent in the implementation literature is not appropriate for a major portion of MS implementation efforts. This is particularly true in the case of DSSs, where the problem of multiple dimensions reaches its peak. Given our revised view of this issue, we prefer to talk about an <u>implementation effort</u> rather than an implementation; the emphasis being shifted from the product to the client/consultant interactions which surround it. This switch in emphasis, while possibly appearing minor, is quite important. Consider the following example.

> A medium sized manufacturing company has just purchased a small facility in an allied line of business. The manager in the parent firm charged with responsibility for this facility is worried by its current operating results, and calls in a management scientist to help him build a model of the facility's operations. The model, he believes, will help him to manage the new acquisition better. The manager and management scientist begin discussing the problem; the latter furiously taking notes on everything the former is

> telling him. Later in the day when the management scientist is trying to organize all that he has been told into a unified model, he discovers a curious situation: on a few seemingly minor points, the manager has given him conflicting information. When he discusses this with the manager, they both see immediately that these conflicts were the cause of the manager's concern. Once he resolves these, the operating results for the new facility make sense, and neither party sees any reason to continue with the model building effort.

Should such a case be considered a success or a failure? Certainly from the product viewpoint it is a failure; the manager decided not to use the model that he had asked for. From another angle, however, this case was a smashing success. The manager was less concerned with having a model than he was with being able to manage the facility. The process of building the model showed him that he was operating under certain false assumptions; correcting these was all that was needed to enable him to manage the facility adequately.

I.3. A Review of the Normative Literature.

The literature on implementation can fruitfully be divided into two major groups: the empirical literatue, which we will begin discussing in the next chapter, and the normative literature, to which we will attend in this section. The normative literature consists primarily of the reflections of people having some degree of experience in the field. Their writing typically identifies one or more problems which led to implementation difficulties in specific situations they were involved in, and offers some solutions designed to counter these problems. This, it is assumed, will assure them (and us) of success in future ventures. We will attempt in this section to review this literature: the problems presented, the solutions suggested, and the picture we are left with in aggregate.

We begin by comparing the suggestions of two major figures in this field -- Ackoff and Argyris. We choose to start with these authors for two reasons. First, both have been and remain influential figures in the management area. Second, and more important, Ackoff and Argyris represent extremes of position; the former representing what has been the mainstream MS approach to the problem of implementation, and the latter the extreme of the counterattack to this approach.

Ackoff, in his article "Unsuccessful Case Studies and Why" (Ackoff, 1960), suggests three specific conditions which led to a failure to implement the results of MS studies:

1. personnel with interest in the project and sufficient power to do anything about it left or were transferred;
2. sponsorship of the project was not at a high enough level to enable implementation of changes which crossed departmental lines; and
3. ambitious staff personnel wanting to 'earn points' with management obstructed implementation of study results.[3]

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[3]We note that these studies were being carried out by outsiders, members of the OR group at the Case Institute.

These three specific conditions boil down to one issue which Ackoff is raising: The management scientist did not have sufficient power to implement his findings. In a later article dealing with the development of information systems (Ackoff, 1967), five assumptions assumed to be both erroneous and held by most MIS designers are presented. The primary issue raised in this case is a mismatch between the solution and the problem.

Given these two major problems which he believes lead to implementation difficulties, what solutions does Ackoff suggest? In the first case, that of insufficient power, five specific solutions are suggested, all of which aim to develop formal bases of power for the management scientist. In the case of problem/solution mismatch, the suggested answer is a highly rationalized system development process; identifying the set of decisions which the organization should be making, optimally grouping these decisions, and parceling them out in the manner which minimizes necessary role interactions and information sharing.

At a certain level each of Ackoff's suggested solutions addresses the problem for which it was designed. Let us turn for a moment, however, to the work of another well known name in this field, Chris Argyris. He argues (Argyris, 1971) that work specialization and rationalization, the chain of command, and unity of direction are perceived by many managers (and other organizational actors) as threatening. Such perceived threats engender emotional responses which are resistant to innovations. Thus, Argyris sees the threat of a change from the existing, relatively comfortable, situation as the major cause of implementation difficulty. And, what is it that creates this threatening situation? -- exactly the types of highly rationalized and power based action which Ackoff suggests as the solution to implementation problems. Thus, Argyris argues that the solution to our implementation problems lies in changing the basic win-lose dynamic that normally exists in an organization; and, the way to do this is by developing interpersonal competence in both managers and management scientists.

Clearly, these prescriptions for change present us with a problem: if we follow Ackoff's advice we are likely to run head on into Argyris' problem; and, accepting Argyris' proposed solution does nothing to attack Ackoff's problem. What is the solution to this dilemma? Does the literature provide us with enough evidence to come down on the side of one or the other of these two scholars? Let us start by considering the solutions proposed by some other well known figures. Wagner (1971) suggests that many of our implementation difficulties could be lessened by certain changes in OR/MS education. Techniques should not be taught in a vacuum, but rather with an appreciation for their real life applicability, the problems of (and means for) collecting the necessary data, and the needs of the human decision makers who must use them. In other words, OR education should strive to produce more professionals and fewer technicians. This basic theme, education as a solution to implementation problems, can be found elsewhere in the literature. Woolsey (1972) suggests that considerably more practical experience is needed as part of the management scientist's training. In fact, he argues that the OR/MS expert without sufficient practical experience should gain this experience by offering his services at no fee if necessary, a solution directly counter to one of Ackoff's 'rules' for developing sufficient power. Grayson (1973) proposes an education and training solution to the implementation problem which is basically an amalgam of Wagner's and Woolsey's suggestions. Another argument for education as the solution cames from Heany (1972), but he contends that it is primarily the manager, not the management scientist, who has been short changed in the education department.

A solution which implicitly covers both sides of this education question is offered by Churchman & Schainblatt (1965). They suggest that the real answer lies in the manager and management scientist operating on the basis of 'mutual understanding', each participant moving towards the other's position by gaining a purposive understanding of his goals, methods, etc. While suggesting that this approach is the necessary one, the authors also point out that it is threatening to both parties; however, they make no concrete suggestions for dealing with this threat.

A different, yet allied, solution is offered by Starr (1971), who suggests that the model builder must operate as a sort of political scientist, providing scientific analyses that reflect political realities. Doing this requires an understanding by the management scientist of the political world in which the manager operates, and this implies an enlargement of MS education. We should note that this solution corresponds to Churchman & Schainblatt's 'persuasion' position, one they find less satisfactory than 'mutual understanding'. A solution similar in structure but different in content is offered by Mumford (1969). She, too sees expansion of the management scientist's perceptions as critical, but would not limit this growth simply to an understanding of politics. Rather, an expanded role perception, one not limited to the purely technical, is suggested. Such a role definition would, in turn, allow growth in understanding on both the manager's and the management scientist's parts. Thus, her position eventually comes close to Churchman & Schainblatt's, though it moves one-sidedly in that direction.

The six authors just reviewed all have some educational component in their solution to implementation difficulties. Other authors of equal stature and experience suggest approaches not based on education. Little (1969) proposes a set of criteria for good, usable models that he terms a 'decision calculus'. Hall's (1973) solution to the implementation problem (at least for models to support top level managers) comes in two parts. The first -- building models which are simple in structure, deterministic, and personalized -- is close to Little's solution. The second part of Hall's approach is to do research into the decision making and strategy formulation processes of top level managers in vivo, with an eye towards improving these processes through the development of models useful to the managers.

We have now reviewed the suggestions of eight relatively well known authors in an attempt to find out who was right, Ackoff or Argyris. While we do find some common threads in their solution approaches, the approaches suggested do differ. What is more, not one of these scholars recommends either Ackoff's or Argyris' solution to the implementation problem. True, we have not exhausted the field, but adding more opinions will not settle this issue. (A more complete cataloging of the normative literature is provided in Appendix I.)

Why do we find so many diverse, and sometimes contradictory, solutions to the implementation question? A part of the answer can be found if we go back through our list of experts and ask what each of them sees as the problem. We pointed out at the start of this section than Ackoff and Argyris did not agree on its definition. Ackoff argued for two major problems: management scientists lack sufficient power to implement his solutions, and they have failed to build systems which meet the real problem (due to their using a design procedure based on false assumptions). Argyris, on the other hand, argued that emotional behavior resulting from the perceived threat of change was the real problem. When we add in the other authors, three additional general problem areas emerge, making our full list the following:

1. mismatch between problem and solution;
2. failure to deal properly with power;
3. threat due to the uncertainties of change;
4. failure to handle the manager/management scientist interface adequately;
5. poor criteria for problem selection and solution evaluation; and
6. environmental factors which affect the ease or difficulty of implementation.

Within each of these groups there are a number of variations, but by and large all the problems mentioned do fall into one of these six classes.

Why, we might ask, do so many different definitions of the problem arise? To answer this we must reflect on how the authors of this normative literature arrived at their conclusions. Largely, these people have looked back on their experiences in specific implementation situations. Thus, their definitions of the problem are often based on particular individual experiences, not in any sense on scientific inquiry into the nature of the problem. In one respect their definitions of the problem are correct; what they report likely was the problem in the case (or cases) they are thinking about. But, as we have already suggested, implementation is a multidimensional affair, and what appears to be the trouble in one setting will not likely be the case when we move to a different group of people, working on a different system, for a different client.

When we turn to the suggested remedies, we can see how our troubles are compounded. The solution proposed is typically the author's assessment of what should have been done differently in the situation he was considering. Thus, the solutions are developed to fit the particular problem. And, what is worse, in a number of cases the solution proposed is to do the opposite of that which the author believes got the project into trouble. Relying on solutions derived in this manner as the general answer to implementation problems is bound to lead to further failures.

The picture which seems to emerge from a review of the normative literature is that implementation is a very complex and messy issue. There are no absolutes, and answers derived from one (or even a few) specific instances are likely to be wrong when applied to other situations. This is particularly so when the answers are based solely on what was wrong with a project, as is the case with most of the normative literature. We must conclude, unfortunately, that 'wise men' with some practical experience are never going to provide us with the solution to the implementation problem. What appears to be needed is a carefully conducted, scientific inquiry into the problem. Such an inquiry should draw on the experiences in many projects, and should examine successful ones as well as failures.

I.4. A Brief Guide for Readers.

In this chapter we have outlined broadly the bounds of the problem being considered, and have reviewed the 'traditional approach' to discusssions of implementation in the MS literature. A dominant empirical approach to implementation research has developed over the past few years, and we will look at this in the next chapter (the reader who is not particularly interested in the details of research efforts in this tradition might read only the first and last sections of the chapter).

In chapters 3 and 4 we will begin looking at an alternative approach to implementation research, the approach which underlies our research. Chapter 5 presents the broad issues for research in this alternative perspective, and discusses the operationalization of some key concepts. In chapter 6, we present the hypotheses to be tested in this study, and outline the methods used in conducting this research.

An analysis of the data collected is presented in chapters 7 and 8. Finally, chapter 9 presents a summary of results and discusses their implications for researchers and practitioners.

II. A Critical Look at Empirical Research on Implementation.

II.1. Introduction.

Research on implementation in the past decade has been guided almost exclusively by a single paradigm, the factor model. This research generally starts with a group of variables or sets of variables potentially relevant to implementation outcomes, and attempts to determine the relative importance of these variables or sets of variables to these outcomes (we use the term factor to refer to either a single variable or a cluster of variables, as both tacks can found in existing factor research). The basis for deciding which variables to include in a factor study is complex, as there are a large number of candidates. Two major approaches to the selection of factors for studying can be found in the literature: the inductive approach, which starts with a source of data (e.g., case observations) and extracts those factors appearing to be important; and, the deductive approach, which selects factors for study before data collection on the basis of past research, literature review, expert opinion, etc. Certain other variations in research approach can be observed within the factor paradigm -- focusing on one particular type of factor vs. looking at a range of factors, examining a single project in depth vs. surveying multiple projects and organizations -- but in all cases the underlying question is, what factors are associated with implementation success.

Given the quantity of effort put into this single research paradigm, we might expect to find some definitive answers to the implementation problem emerging. And, a glance at the literature would suggest that this might be the case; we all know that top management support and user involvement are critical to successful implementations. But, beyond this, what do we know about implementation; and, how sure are we that this type of management support and user involvement is important? Or, more critically, when are these factors important?

In this chapter we will review a number of these factor research efforts. We will consider the studies both individually and as a group, assessing both the substantive and methodological contributions of this research paradigm. On the basis of our findings in reviewing this research, we will draw some conclusions about the most profitable avenues for further research on implementation.

II.2. Research Efforts Reviewed.

II.2.1. Bases for selection.

Research on implementation is a relatively recent phenomenon in the MS world. Throughout the 1950's and much of the 1960's the focus was on design. It is only in the past ten years that implementation has emerged as a legitimate area for MS research. The relative youth of this area makes our search for studies of implementation somewhat easier, but also limits the number which can be found. We considered three principal sources. Two journals, Operations Research and Management Science (and, more recently, Interfaces) are the source of much of the implementation literature. Scanning the indices of these journals from 1965 forward led to a number of articles. The third source was "The Conference on the Implementation of OR/MS Models" held at the University of Pittsburgh in November, 1973. A number of the papers presented at this conference are included in our sample. The reference lists of articles and papers from these three principal sources led to some additional material. Thus, the material considered for inclusion in this study should provide a reasonable representation of the published and generally available research on implementation in the past ten years.[1]

We stated in the previous chapter that the literature on implementation can be divided into several groups. We are looking here at only one subset of this literature. First, we are focusing only on the empirical research on implementation which seeks to find the determinants of implementation outcomes. Thus, we eliminate the normative literature -- descriptions of specific situations or problems and prescriptions for action -- and some research which deals with implementation in the abstract. Also eliminated were survey papers discussing the current state of affairs in the implementation of specific types of models (e.g., those articles discussing the characteristics of R&D project selection models in use),

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[1] In a number of cases references were made to unpublished masters or doctoral theses. We did not normally follow these leads, though in a number of cases, subsequently published articles which we did review, presented the empirical work of the thesis.

and empirical research which was essentially descriptive in nature (e.g., that asking what changes have taken place over the past ten years in techniques employed). Next, the research which is concerned with implementation outcomes can be divided into two basic groups. The first takes specific factors (most notably, cognitive style) and explores in depth the relationship of these factors to outcomes. The other approach asks a much more general question: What factors (or variables) affect the outcomes of implementation? It is only with this last category that we are concerned here. There are two key reasons for this focus:

1. this approach, the 'factor study' attempts to look at the full range and complexity of implementation, and
2. the factor study has become the dominant approach to research on implementation.

We believe we have found most of the published work in this area, and the studies included in our sample are representative of factor research on implementation generally. In fact, we only excluded a research report from the sample when it appeared that the author(s) reported on the same data in more than one article.

We can begin to gauge the adequacy of our coverage of implementation research by looking at the studies included in terms of three critical characteristics:

1. the settings included,

2. the measurement methodologies employed, and

3. the dependent variables chosen.

Turning first to the settings included in the studies, we find a wide range of coverage -- a substantial number of public and private organizations, a variety of organization sizes, a number of cultures (U.S., Europe, and Latin America), and a variety of project types. While no single study covers the entire range, taken as a whole they seem to provide an adequate representation of the non-military settings in which OR/MS activity is taking place.

In considering the measurement methodology employed, two issues are of relevance. First, what variables were selected for measurement and what was the basis for their selection? And, second, how were they actually measured? Keen (1974a) suggests that factor studies typically measure those variables which are most readily measurable, with little regard for theoretical considerations in the selection of these variables. The fourteen studies included in our sample identify approximately 140 different factors, covering a wide range of the variables potentially affecting implementation outcomes. We shall show later, however, that the distribution of research effort among these factors is far from balanced. The bases on which these factors were selected for study is not immediately apparent; few authors state explicitly why they have chosen the factors they have, and in at least six of the fourteen studies the factors examined were abstracted from the data (normally interview or case observation based) after it was collected. We will return to this question in a later section, but for now we can state that there are no immediate grounds for dismissing Keen's conjecture. Turning to the question of measurement itself, we find a variety of techniques employed, ranging from introspection, through case observation, to administration of questionnaires and the examination of company records. Thus, on the issue of the completeness of coverage of measurement methodology in our sample of studies, we can conclude that the range has been adequately covered.

The third characteristic to be considered is that of the dependent variable selected and the basis for its measurement. The fourteen studies show considerable variety on this dimension, including both 'hard' -- e.g., percent of projects implemented, specific types of system usage -- and 'soft' -- e.g., perceived project usefulness, rank ordering of perceived achievement in computer use -- measures of outcome. We will review these measures in more detail when we look at the individual studies.

The next section reviews briefly the fourteen studies we have included in our sample. We will look at the issues of setting and methodology, plus certain key points brought out by these studies. Consideration of actual results will be left to a later section.

II.2.2. Highlights of the fourteen studies.

1. McKinsey & Co. (1968): "Unlocking the Computer's Profit Potential"

While actually conducted later than some of the other studies in the sample, this work is conceptually first, as it is largely an update of an earlier McKinsey study (Garrity, 1963). The focus of this study was on those factors which differentiated more successful computer users from their less successful counterparts. The sample included thirty six companies in thirteen industries, covering a wide range of sizes, and located in both the U.S. and Europe. Success was measured by judgementally ranking the 36 companies on their overall achievement with computers, and then comparing the first 18 companies with the last 18. Factors considered in this study were derived inductively, on the basis of their apparent importance to the organization's computer success, from extensive interviews with both staff and line executives. The McKinsey studies are notable both for being early in the history of studying implementation and for their best known results, the importance of top management support of and operating management involvement in the application development process.

2. Evan & Black (1967): "Innovation in Business Organizations: Some Factors Associated with Success or Failure of Staff Proposals"

Evan and Black focus on innovation, "the implementation of new procedures or ideas" (p. 519), and attempt to determine what factors affect the likelihood that an innovative proposal submitted by staff to line management will be implemented. The sample considered in this study included 52 respondents in a smaller number of companies. The respondents were either staff personnel or line managers, and each reported on one successful and one unsuccessful proposal for innovation (success being defined as the proposal's being "largely accepted and implemented by management"). Data were collected with self-reporting questionnaires asking closed-ended questions about eleven pre-selected factors. The data were then analyzed using stepwise discriminant analysis to select those factors (from among the eleven) which best separated successful from unsuccessful proposals. Seven of the eleven factors were thus found to be significant at the .05 level, though the authors claim to see no a priori reason why these should be any more important than the other four.[2]

3. Rubenstein et al. (1967): "Some Organizational Factors Related to the Effectiveness of Management Science Groups in Industry"

The third study considered is reported in Rubenstein et al. (1967). While we have included only the results discussed in this

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[2]We offer the suggestion that some of these factors were not adequately tested, because the specific items in the questionnaire are not adequate indicators of what they purport to measure. For example, 'decision-making centralization' is measured with a single question, "To what extent is the company centralized or decentralized?" answered on a five-point scale. Centralization is a rather complex phenomenon, and there is no reason to believe that this simple question tells us anything about the degree of <u>decision making</u> centralization.

single paper, they are representative of other work reported by these authors (e.g., Radnor et al., 1968 & 1970). This work is concerned with finding the "necessary and sufficient conditions which permit the integration, acceptance, and growth of [innovative] activities", particularly OR/MS, in organizations; that is, the factors contributing to greater use of OR/MS. To operationalize this concept the authors examine the extent to which proposals and programs of the organizations's OR/MS activity were being implemented. The factors considered in this study were those appearing important to the authors after some preliminary exploration. Factors were assessed through interviews of personnel in 66 companies who had been involved in the cases studied. It is interesting to note that these authors are among the first researchers to suggest the potential impact of contingencies; in particular, they argue for the importance of the organization's stage in the life cycle of OR/MS activity as a conditioning variable.

4. Harvey (1970): "Factors Making for Implementation Success and Failure"

Harvey's study differs from the others in our sample in a number of respects. First, his research approach is one of group introspection to explain past successes and failures. Second, and more important from our point of view, it occurred because the auther felt that the literature tended to rely too much on a single explanation -- management support and participation -- for the success or failure of OR/MS implementations, and that other factors of at least equal importance should be explored. Thus, the sample analyzed in this study consisted of 31 former clients of the author's consulting firm; this, he claims, may have biased the results, as all of these companies "were looking for state-of-the-art solutions to problems ..." (p. B313). The factors considered were those that the author and his colleagues believed had been generally important in helping them to convince clients to implement the results of projects. After the consultants agreed on a list of factors, each of them ranked each of the thirty one clients on all of the factors. The dependent variable was the degree to which the client had accepted and implemented the consultant's recommendations. All eleven factors correlated highly with success. This is, perhaps not too surprising, as the method of generating factors to be tested had eliminated those factors which they felt had been relevant in only one or two special situations. We also should note that the factors which Harvey initially argued should not be the sole explanations of success -- i.e., management support and involvement -- are not considered at all in this study.

5. Dickson & Powers (1971): "MIS Project Management: Myths, Opinions, and Reality"

Dickson and Powers focused their attention on the "organizational and procedural factors" correlating with success in a certain class of MIS projects. The study included two projects in each of ten organizations in the Minneapolis/St. Paul area. The factors studied were selected in a relatively complex fashion. First, a moderately long list of potential factors (approximately 35) was generated by the authors and their students. This list was then submitted to a large panel of DP professionals (SMIS members) for their ratings of factor importance. Their responses (approx. 140 returned questionnaires) were used to compute average factor 'importance scores' and to develop clusters of factors (using factor analysis). A subset of these items, spanning the range of the a priori 'importance scores' and covering all factor clusters, was selected for use in this study. Additional items were included where data collection would be easy. Collecting data for the study was accomplished by extensive interviewing of management and technical personnel in each of the ten firms. Four separate indicators of success were employed as dependent variables -- actual vs. estimated development time, actual development cost vs. budget, user satisfaction, and the impact of the project on computer operations. One of the more interesting findings of this study was the total lack of correlation among these four measures.

6. Vertinsky (1972): "OR/MS Implementation in Valle, Colombia, S.A.: A Profile of a Developing Region"

This study widens considerably the coverage of settings in our sample, as it looks at OR/MS activities in Colombia, South America. The author is concerned chiefly with the correlates of implementation and diffusion of OR/MS in developing regions. Selection of factors for this study was based both on induction (those factors appearing important in an earlier study) and on deduction (factors which theoretically should be important in a developing country). Factor measurement was accomplished through a mixture of interviews and questionnaires, the respondents being Presidents or General Managers of the companies under study. The dependent variable in this study appears to be the researcher's assessment of factor impact on the OR/MS diffusion and implementation processes.

7. Drake (1973): The Administration of Transportation Modeling Projects

Drake's work focuses on a specific type of project, the application of OR/MS to transportation system modeling efforts. He surveyed a large number of such projects (approx. 50, with 25 in considerable detail) based in both the U.S. and Europe, and having both private and governmental clients. The factors considered were designed to test a series of hypotheses proposed by the author (the basis for selecting these particular hypotheses appears to be Drake's own work experience). Data were collected through a detailed questionnaire administered by the researcher, and this data was supplemented by his field observations. Drake's intention was to obtain responses from both the model builder and the decision maker (model user), though in a number of cases he was able to speak only to the user. The dependent variable chosen was the decision maker's assessment of the project's usefulness. This focus on the user's view of an implementation effort is both rare and quite important; much of the literature is based on the technician's view of the project, which can be quite different from that of the user (see Dickson & Powers for a discussion of designer/user differences in perception).

8. Lucas (1973): "Behavioral Factors in System Implementation"

Lucas' study differs from most of the others we will consider. He looks at a single sales information system having numerous potential users (salesmen) in a single company, and attempts to find those factors which help differentiate users from non-users. Lucas makes the argument that for purposes of implementation a M.I.S. is equivalent to any other MS/OR project; at a minimum, an information system is a simple model, and frequently information systems contain relatively sophisticated models. This argument, which we largely accept, should explain our rationale for including this (as well as some other) studies in our sample. Lucas presents a simple descriptive model of factor clusters purported to explain system use, and from this model derives a number of factors to be tested. Factors as well as dependent variables were measured with questionnaires and by examining company records. Indices of six specific types of system usage served as the dependent variables, and factor importance was assessed using stepwise multiple regression to develop usage 'prediction' equations. All factors were found to be significant in at least one such equation, but the particular factors included varied across equations; those dealing with attitudes towards and perceptions of the computer system showed a relatively consistent positive relationship with usage, with the results for environmental and personal factors being considerably weaker and less consistent.

9. Manley (1973): "Implementation Attitudes: A Model and a Measurement Methodology"

Manley's work differs in a number of respects from all of the other studies in our sample. First, it focuses neither on the model builder nor the model user, but on the 'client', defined as a person impacted by the proposed innovation but having no de jure authority to decide whether to accept and use it or not. The clients in this case were teachers in a public school system presented with a proposal for "optimizing the computation of the supplemental pay for extra-curricular activities." The second major difference was in the dependent variable, an index predicting the level of client group support of or resistance to the proposed project. This index was derived from the interaction of the clients' assessment of the relative importance of five external factors and their "attitude orientations" toward these factors. The external factors considered were arrived at by boiling down a list of factors culled from the literature to five generic factors. The measurement of these factors represents the third, and probably the most, unique aspect of this study. While being conducted in a real organization with respondents who believed the proposal to be genuine, the study was in fact a controlled experiment; factors were varied systematically by giving different respondents different versions of the proposal. In the experiment Manley tested two of the five external factors -- management support for the project and the amount of the client's time required for implementation -- and found both to result in significant differences in the client's 'attitude orientations'.

10. Gibson (1973): "A Methodology for Implementation Research"

Gibson offers the only example of a single case study that we have included in our sample. His research was conducted in a New England bank, and was concerned with an effort to implement a translator model which would interface with a regional economic model being developed concurrently. The factors considered in this research were arrived at inductively, being those issues which seemed to have important impacts on the progress of this implementation. Thus, selection of factors was tied directly to the dependent variable. We should note, however, that there was a fairly long history of 'action research' by Gibson and his colleagues at this site, adding credibility to the importance of these factors in this setting. 'Measuring' factors was accomplished primarily through unstructured, periodic interviews with key personnel, but supplemented with questionnaires to explore certain issues which arose. This is the only study in our sample where the researchers acted as participant observers and actually attempted to influence the implementation process.

Including Gibson's study in our review of factor research might seem inappropriate, but we have done so for two reasons -- first, the results of the study are couched to an extent in terms of factors; and, his work presents one extreme in methodology for studying implementation, thus adding to the range of our sample. In fairness to the reader we must admit that this is not really a 'factor study'. And, in fairness to Gibson we must point out that this work does not suffer from a number of methodological problems which plague factor research and which we will discuss later in this paper. Indeed, Gibson is one of a very few researchers in this area sensitive to methodological issues.

11. Smith et al. (1973): "Operations Research Effectiveness: An Empirical Study of Fourteen Project Groups"

Our next study also took place in a single organization, but it looked at fourteen separate projects within this organization. Smith et al. attempted to find the factors which contributed to the effectiveness of project teams consisting of user, systems, and OR personnel. The factors considered included a number of predefined items -- e.g., user demographics -- plus those factors reported by team members to have been important contributors to or detractors from their effort. Factors were measured using a questionnaire administered by the researchers. Two dependent variables were employed. For testing the predefined factors, the average group effectiveness rating as reported by the team members served as the dependent variable, while for the elicited factors, the relative importance rating given that factor by the respondents was used.

12. Carter et al. (1973): "A Study of Critical Factors in Management Information Systems for U.S. Air Force"

The research of Carter et al. is presented to us at a somewhat earlier stage than the other studies we have considered. The long term goals of this research are the identification of those factors critical to MIS implementation success, the development of instruments to measure the status of these factors, and, eventually, the development of a model for predicting implementation success. The phase I results presented relate primarily to the first of these three goals. An initial set of interviews with systems and general management professionals was used to generate a series of reconstructed implementation case histories. The researchers 'content analyzed' these interviews to abstract a list of critical factors. A subset of this list was tested in a national survey, in which respondents were asked to rank the relative importance of the fourteen factors presented. Thus, at this stage of the research, the average ranking (in terms of its overall importance) received by a factor serves as the dependent variable. We should note that this project is considerably more sophisticated, both in terms of scope and method, than much of the other factor research; the full project involves several recursive steps over a period of a few years.

13. Bean et al. (1973): "Structural and Behavioral Correlates of the Implementation of Formal OR/MS Projects: Success and Failure in U.S. Business Organizations"

This is the most ambitious study (at least in terms of sample size) included in our sample. It was aimed primarily at the structural and organizational factors affecting implementation. One hundred and eight companies covering 12 industry sectors were explored, and approximately 10-15 projects in each company were included in the sample. Factors were preselected on the basis of having been important in the earlier studies by these researchers (see Rubenstein et al., reviewed in this chapter), and were measured through structured interviews with the head of the OR/MS activity in each company. Two dependent variables were considered; the percentage of projects worked on which were successfully implemented, and the OR/MS activity manager's overall assessment of his group's success (an index composed of a number of his responses). One particularly important finding of this study is the effect of the OR/MS activity's 'stage in the life cycle' on both which factors are important and the overall level of OR/MS success.

14. Schultz & Slevin (1973): "Implementation and Organizational Validity: An Empirical Investigation"

The final study in our sample is a report of Schultz and Slevin's efforts to develop an easily usable instrument for studying implementation. The authors contend that the relative lack of research on implementation is due, at least in part, to a lack of research tools; hence their effort to develop a tool that would be generally applicable for such research. The instrument and this study focus on individual attitudes as they relate to a particular model and its implementation. An extensive list of potential variables was assembled from the literature, and a pilot version of the questionnaire was administered to a class of M.B.A. students. The responses were factor analyzed, and a modified questionnaire, based on these extracted factors was used in the field test. This latter test involved 94 sales and marketing personnel in a single company, responding to questions concerning a specific model under development for their department. Questionnaire items were of two types -- semantic differential concept factors and specific items in a Likert-type format. Five of these latter items, dealing with expectations for the model's use and worth, served as dependent variables.

This section has reviewed the issues of setting, methodology, and dependent variable in the fourteen studies that comprise our sample of factor research. Table 1 provides a summary of this material. As can be seen, the studies cover a wide range. Beyond the questions of setting and method, the issue of focus has been raised. Some studies were concerned with the factors affecting specific implementations, others focused on factors influencing OR/MS group effectiveness, while still others examined the issues of growth and diffusion of the OR/MS approach.

Table 1: Methodological Highlights of the Fourteen Studies

	Setting	Factor Selection	Measurement of Factors	Dependent Variable Employed	Notes
1. McKinsey & Co. (1968)	U.S. & Europe, 13 industries, 36 companies	Inductive	extensive interviews of staff & line executives	subjective ranking of overall computer achievement	importance of management support and involvement first shown
2. Evan & Black (1967)	104 projects, technical & non-technical in U.S. cos.	Deductive	self administered questionnaire	proposal largely implemented by line management	discriminant analysis of difference between successful and unsuccessful proposals for innovation
3. Rubenstein et al. (1967)	U.S. industrial organizations (66 companies)	Inductive, from their earlier exploration	in depth interviews	estimate of extent to which OR/MS proposals and programs were implemented	focus on factors affecting OR/MS group effectiveness and growth
4. Harvey (1970)	31 clients of author's consulting firm	Inductive, based on experience in projects	ranking of companies by consultants	acceptance and implementation of consultants' recommendations	grounded in belief that management support and participation were not only important factors
5. Dickson & Powers (1971)	10 cos. in Minneapolis/ St. Paul area	Deductive, common sense plus experts	interviews of major project participants	time, cost, user satisfaction, and impact on computer operations	very low correlations among the four measures of the dependent variable
6. Vertinsky (1972)	45 companies in Colombia, S.A.	Mixed -- case based + theory	interviews & questionnaire to Pres. or General Mgr.	researcher's assessment of factor importance	implementation and diffusion in a developing region

Table 1: Methodological Highlights of the Fourteen Studies (continued)

	Setting	Factor Selection	Measurement of Factors	Dependent Variable Employed	Notes
7. Drake (1973)	transportation modeling, US & Europe, public and private	Deductive -- past experience	researcher administered questionnaire + observations	decision maker's assessment of project usefulness	explicit focus on decision maker's view of project
8. Lucas (1973)	1 system in 1 co. with many users	Deductive -- simple model	questionnaires & company records	indices of specific types of system usage	argument for equivalence of MS & MIS from implementation view
9. Manley (1973)	teachers in a public school system	Deductive -- large lit. rev.	experimental variation	prediction of client group support or resistance	interaction of external factors and client attitudes
10. Gibson (1973)	single case in N.E. bank	Inductive	unstructured interview + questionnaire	propensity to implement; attitudes favorable to usage	participant observation; longitudinal case study
11. Smith et al. (1973)	14 project grps. in 1 mfg. co.	Mixed	interview administration of quest'aire	avg. effectiveness ratings given teams by members	focus on groups incl. user, OR, & systems personnel
12. Carter et al. (1973)	nationwide expert panel	Inductive - content analysis	questionnaire	ranking given to each factor	phase I of multi-phased study
13. Bean et al. (1973)	10-15 projects in each of 108 companies	Deductive	structured interview w/ OR manager	rate of implem'n; OR mgr's perception of success	modifying effect of stage in life cycle of OR/MS activity
14. Schultz & Slevin (1973)	potential users of 1 model in 1 org.	Mixed	questionnaire Likert & semantic differ'l	5 items on expectations for model usage & worth	attempt to develop a generally usable instrument

All of these are legitimate areas for implementation research; all are representative of some part of the factor research that has been conducted. Thus, all were included in this review. In the next section we turn to the results of these studies.

II.3. Results of the Factor Studies.

II.3.1. A structure of implementation factors.

The fourteen studies we have reviewed present us with 140 separate, identifiable factors which are listed in Appendix II. Considering all of these factors on an individual basis would be both time consuming and dull. Thus, we need some sort of structure within which to organize these factors. In reviewing the literature and in attempting to think about the various possible influences on implementation outcomes, we have found ten major clusters of variables. They are:

1. Symptoms, actions, and specific behaviors -- identifiable actions taken by the user, designer, or management which either affect or are in some way symptomatic of the implementation effort;
2. Internal ecology -- characteristics of the organization, its structure, and the people who comprise it;
3. Model characteristics -- characteristics of the physical and conceptual solutions to the problem;
4. Problem characteristics -- the nature of the problem and its criticality to the organization;

5. Extra-organizational environment -- characteristics of the external environment facing the organization;
6. Implementation process characteristics -- methods used to move through the stages of system development, communication patterns, role structures, etc.;
7. Perceptions -- perceptions of tasks, goals, and the impact of the proposed solution held by those involved in or affected by the implementation effort;
8. Expressed attitudes -- attitudes of involved and effected personnel towards technology, the problem, and one another;
9. Underlying attitudes and motives -- more basic outlooks and desires of involved and effected personnel; and
10. Organization history -- past actions of the organization which can impact its current ability to deal with innovation.

Each of these major clusters has been divided into sub-clusters based on the particular factors explored in the fourteen studies of our sample (see Appendix II). We make no claim for the completeness of the sub-clusters; these are based solely on the 140 identified factors. We do suggest, however, that the ten major groups cover the range of potential factors adequately.

Defining clear-cut and exhaustive categories for the factors affecting implementation is not a simple task. Though set up as separate groups, there are places where one class will fade into another. Class 1 -- Symptoms, actions, and specific behaviors -- and class 6 -- Implementation process characteristics -- present (theoretically) such a situation. At some point of specificity a generic behavior (class 6) becomes a specific action (class 1); the dividing line is, of necessity arbitrary. However, defining boundaries for these classes will make analysis of the factor study results much easier and more useful.

II.3.2. Summary of results.

Appendix II presents a matrix of the 140 factors, grouped in accord with the structure we have presented above, showing the results of the fourteen studies we have considered. Perhaps the most strikind characteristic of this matrix is its sparseness. Fully 102 (73%) of the factors are reported in only on of the fourteen studies. An additional 23 (16%) are reported in two studies, and 12 (9%) in three. Of the remaining three factors, two -- "well defined measurable objectives" and "complexity of techniques and models" -- are considered in four of the research efforts reviewed, and the final one -- "management support" -- sees daylight five times. Thus, from the start we must realize that we are not looking at issues widely tested in a variety of settings.

This general lack of overlap among the factors studied is quite surprising, and makes summarizing the overall results rather difficult. The results of the factor research seem to indicate consistently that management support of the technical group is related to better outcomes. Beyond this, numerous factors affect implementation; but, for most of them the evidence is too scant to draw any conclusions, and for some there is conflict among the findings of the various studies.

One might argue that we have created an artificially low degree of overlap among factors by failing to combine factors which 'really' are addressing the same issues, though they have different titles. For some of the factor sub-clusters we can group individual factors together without doing any apparent injustice. When we do this, we find one cluster, 'Management Support & Involvement (I.A in Appendix II), which shows relatively consistent (and positive) relationships to the outcome variables, but the remaining clusters demonstrate inconsistent results.

It is important to ask why we are finding differences in the relationships of factors to outcomes, both at the single factor level and at the factor cluster level. A partial explanation can be found in the difference in dependent variables among the studies. This can be seen most clearly in the results of the Dickson & Powers and Bean et al. studies. In both of these efforts multiple dependent variables were employed -- four in the former and two in the latter -- and the authors report the correlations of each dependent variable with the factors. Thirty percent (12 out of 40) of the factors reported in the Bean et al. study show different results depending on which dependent variable -- percent of initiated projects actually implemented or overall rating of the OR/MS group's success -- is used. Of course, the differences for any given factor are only between significance in one direction and no significant relationship. However, in the Dickson and Powers study the picture is somewhat more depressing; no factor significantly related (at the 10% level) to more than one of the dependent variables affects all of the dependent variables it is significantly related to in the same direction.

While the differences in dependent variables employed provide a fairly convincing explanation for the apparent contradictions among certain of the results, there are other potential explanations which we should explore. One such possibility is a lack of validity in the factor measures; i.e., the 'instruments' used do not measure what they purport to. The results reported in the fourteen studies do not give us much opportunity to test this hypothesis, but there is one indication that this might be the case. Schultz & Slevin use a combination of semantic differential and Likert-type questions in their work, and for a few factors these two measures overlap. For one, "expected changes in the communication system and interpersonal relations", the relationship to the dependent variable differs for the two measures, the semantic differential scale having a significant positive relationship to all five elements of the dependent variable, and the Likert factor not being significantly related to any of these five elements (all tests at the .05 level). If we look at the correlation between the two independent variables we find it to be -.12. This low reliability certainly should lead us to question just what it is that is being measured, and suggests that the validity of the instruments being used in this research is somewhat suspect.[3] This problem becomes particularly acute when we consider that many studies rely on the researcher's observation for 'factor measurement', and that there is little evidence to suggest that any instrument was ever used more than once.

The third potential explanation is the issue of contingency, or lack of comparable conditions. Implicit in most factor research is the assumption that factors are universal -- management involvement is always good, or the OR group's selecting the projects to be worked on is always bad.[4] We contend that this is an unwarranted assumption, that the impact of a given factor will vary from situation to situation.

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[3]Keen (1974a) takes a closer look at the instruments used in factor studies and the question of their validity.

[4]It is true that not all factor research is presented in this fashion; most notably, the Northwestern group (Rubenstein, Radnor, etc.) has done some contingency analysis of their data. However, most factor researchers present their results with no mention of setting or possible contingencies.

Bean et al. present some evidence which supports this position. They analyze their data both in aggregate and broken down to control for the stage in the life cycle of the organization's OR/MS activity, and find differences in the factors which are significant across the stages. This is only one of many possible contingencies, but it points up the need to identify relevant contingencies before accepting the results of a given study.

Finally, in considering explanations for particular results, we should not ignore the possibility of spurious correlation or non-correlation. Turning again to Bean et al., we observe a most unusual finding: the performance of post implementation evaluations is significantly positively related to the percent of initiated projects which are implemented, but is unrelated to the overall rating of the OR/MS group's success. It is indeed difficult to imagine why performing post project audits should affect the rate at which projects are accepted. At best we might believe that such an administrative procedure is related to other organizational practices which in turn impact implementation rate, but accepting this result as it stands requires just too great a leap of faith.

We can draw certain conclusions from our brief look at the factor study results. Though many factors have been studied there are few general guidelines emerging from this line of research. In part this is due to a lack of replication of tests, and in part to the fact that little of what has been reported prior to a given study seems to find its way into the design of that study. This is further compounded by the use of different instruments and dependent variables in each study, and by a failure to identify the contingencies that are important in any given situation. The factor studies have confirmed the prevailing view that management support is an important contributor to implementation success, and they have shown us the tremendous variety of factors which can impact implementation outcomes. But, this line of research has not developed a cohesive picture of the implementation phenomenon for us; and, we suggest that, continued in this same fashion, it is never likely to produce more than the fragmented type of findings it has generated so far (see Keen, 1974a, for further comments on this issue).

II.4. A Deeper Look at the Factor Paradigm.

II.4.1. Relationships among the factors.

In the previous section we presented ten groups into which we classed the 140 factors. Now we will explore these classes more carefully, attempting to uncover relationships which exist among them. We can think about factors as being arrayed along a dimension of visibility or accessibility to the outside observer. At one extreme are those factors which are totally overt, accessible to even the casual observer; and, at the other extreme, those which are almost completely hidden, inaccessible to all but those with considerable knowledge of that particular organization, its operations, and its background. We suggest that the ten factor classes presented earlier form, roughly, such a continuum, and can be divided into a few groups. At the overt extreme are the first two classes -- symptoms, actions, and specific behaviors, and characteristics of the internal organizational ecology; the factors in these two groups being relatively easy to observe in most organizations. At the opposite extreme are categories IX and X -- underlying attitudes and motivations, and aspects of the organization's history. Clearly, these factors are largely hidden from all but the most persistent and resourceful observers. In between are categories III through VIII. These might be divided into two or three groups, but it is not critical to do so for our purposes. We have arranged them in an order we believe approximates the degree to which they are hidden from the outsider -- model characteristics being most overt and expressed attitudes most covert.

Keeping this overt-hidden dimension in mind, let us look at the factors from another angle. Implementation is a process of change. As a process, it accepts certain inputs and produces certain outputs. The critical output of such a change process is the desired change; in the case of MS implementation, the model or system <u>and</u> the requisite changes in behavior to operate with the new system. The inputs to the process include the attitudes and actions of the individuals involved, their perceptions, the problem they are addressing and the technology they attack it with, and the environment in which they are operating. In other words, many of the factors mentioned in the factor studies are inputs to the implementation process. Others, particularly those listed under classes I (symptoms, actions, and specific behaviors) and

Table 2

Distribution of Research Effort by Factor Class*

	McKinsey & Co.	Evan & Black	Rubenstein et al.	Harvey	Dickson & Powers	Vertinsky	Drake	Lucas	Manley	Gibson	Smith et al.	Carter et al.	Bean et al.	Schultz & Slevin	Overall Proportion
Symptom & Actions	.75	.09	.42	.27	.31	.10	.13	-	.10	-	.18	.38	.37	.13	(45) .23
Internal Ecology	.25	.55	.42	.20	.56	.20	.33	.67	-	.22	.36	.15	.57	.07	(69) .35
Model Chars.	-	.09	-	.07	.06	-	.20	-	.10	-	-	.08	-	.07	(9) .05
Problem Chars.	-	.09	-	.13	-	-	-	-	.20	.11	.07	-	.03	.13	(11) .06
Extra-Org'l Environ.	-	.09	-	-	-	.30	-	-	-	.22	-	-	-	-	(6) .03
Implement. Process	-	-	-	-	.06	-	.27	-	-	-	.29	.08	-	-	(14) .07
Perceptions	-	-	.08	.13	-	-	-	.33	.10	.11	.07	-	-	.40	(16) .08
Attitudes	-	-	.08	.07	-	-	.07	-	-	.11	.04	.23	-	.20	(11) .06
Motives	-	.09	-	.13	-	.40	-	-	.50	.11	-	.08	-	-	(14) .07
History	-	-	-	-	-	-	-	-	-	.11	-	-	.03	-	(2) .01
Proportion of Total	(4) .02	(11) .06	(12) .06	(15) .08	(16) .08	(10) .05	(15) .08	(9) .05	(10) .05	(9) .05	(28) .14	(13) .07	(30) .15	(15) .08	(197) 1.0

*By research effort we mean the inclusion of a factor in a study, or to be more presise, the <u>reporting</u> of a factor in the write-up of a study. Thus, the numbers in the body of this table are the percentages of the factors in the particular study (column) falling into that class (row). The final column presents these same percentage for the fourteen studies taken as a group, and the final row shows the proportion of factor observations attributable to each study. The paranthesized

Table 2 (continued)

numbers in the final row and column represent, respectively, the number of factors included in the study, and the number of observations (i.e., inclusions in a study) of the factors in that class.

VI (implementation process characteristics) are an indication of the process that is taking place; they are symptoms of the on-going process. We should note that neither of these types of factors truly represents the actual process of change. On the one hand we have the 'fuel' for the process; on the other, certain side effects of its occurring. But, the former group does not represent the cause of change, nor the latter its output.

Returning now to our overt-hidden dimension, we can see how the factors fit together. At the overt extreme of the spectrum we have the bulk of the symptoms of change plus one type of input to the process. The remainder of the inputs are arrayed along the scale towards the hidden end.

When we look again at the fourteen studies we find a disproportionate amount of research effort going into the overt end of the scale (Table 2). The first two factor classes represent a total of 58% of the factor observations (23% and 35% respectively). None of the remaining eight classes received more than 8% of the total factor observations. Looking at the studies individually we see that all fourteen consider some factors from one of the two first groups. In addition, in all but three of the studies the class receiving the most attention was one of the first two. No other factor class comes near these first two in terms of attention received.

We have no a priori reason to believe that overt behaviors or internal organizational ecology are more important than other factors in determining implementation outcomes. In fact, a case can be made which suggests just the opposite; attitudes, perceptions, motives, and organizational history may well be the underlying causes of some of the more overt factors, specific actions and behaviors or the structuring of the internal organization, for example. However, the more overt the factor, the easier it is for a researcher to measure it. Having little or no theory to guide them in their selection of factors, researchers have chosen those factors which were most readily accessible.

II.5. Summary of Problems with the Factor Model.

Factor studies of implementation have given us some useful knowledge about implementation. They have shown that there are a myriad of factors which can, and at least sometimes do, affect the progress of an implementation effort. However, we contend that this approach has a number of flaws serious enough to cause us to doubt its further usefulness as a paradigm for research on implementation at this time.

The first of these problems stems from the almost limitless number of potentially relevant factors. The researcher, having only a limited amount of time, must of necessity limit his investigation to a small subset of these factors. In the absence of any well defined theory of implementation, the selection of factors for consideration is left largely to the individual researcher's biases; and as we have seen, the results of such studies can only give fragmented results, not the coherent, well integrated picture we need. The current state of 'theories of implementation' leads us into a similar problem. The theories which have been used in studying implementation (see, for example, Lucas' paper) fail to do justice to the complexity we know exists. Theory-based studies have focused on very limited pieces of the implementation problem, and have not attempted to link these pieces together. Again, we are left with fragments and no coherent picture.

The second major deficiency of the factor model as a research vehicle is its inherently static view of the world. Typically, factors are measured at a single point in time and the results are assumed to capture the essence of that implementation effort. If we review the factors listed in Appendix I, we find that all of them deal with either inputs to the implementation process or side effects of the process. None are truly concerned with the dynamics of the on-going process. Yet, implementation is a process, taking place over a considerable span of time, and any meaningful understanding of implementation must stem from a recognition of its inherently dynamic nature.

Our third complaint concerns the implicit assumption of many factor researchers that factors are absolutes -- a given condition is always good or always bad. A more realistic view is one which considers contingencies or factor interactions. The effect of a factor in a given situation depends greatly on the other factors present in that situation. There is no inherent reason why factor studies could not be designed in a manner which would allow some exploration of the contingency issue; indeed, some researchers have done a limited amount of this type of analysis. True, the research design would have to be more complex, and larger sample sizes would likely be needed. A start in this direction would be to consider only one or two major contingencies; but, some theoretical base is needed to select the contingencies to be tested. We realize that taking this approach might increase the difficulty of doing implementation research; but, we cannot expect to progress beyond our current fragmented state until researchers recognize and deal with this issue.

The fourth, and final, fault we will raise is the failure to focus on the management of the implementation process. The concern has been with measuring, classifying conditions as favorable or unfavorable to implementation outcomes. What is worse, the variables considered have been primarily those over which we have little control (e.g., demographics, structure, environment, and existing attitudes and perceptions), at least in the short run. Practitioners are far less concerned with measuring the characteristics of their environment than they are with learning to operate effectively in that environment.

In sum, we can state four necessary characteristics of an improved methodology for implementation research. First, it should search for an appropriate theoretical base, and employ this theory as a guide to research. An atheoretical approach is, at best, an inefficient way to build up the knowledge and understanding we need in the implementation area. On the other hand, importing theories from other areas without regard to how well they 'fit' the problem at hand will not produce meaningful results. What is needed is a thorough look at what we do know about the nature of implementation, and then a careful selection of relevant theory.

Any theory we do select must do justice to the three other criteria we believe are needed in an implementation research methodology. It should focus on dynamics, the process aspects of implementation. Next, it must recognize the existence of contingencies and interactions among factors, and it should aim towards developing maps of the major and critical contingencies likely to arise in given situations. Finally, if it is to be of any real use, it must be oriented towards the management of the process, and must include appropriate control points for managers' and practitioners' use.[5]

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[5]See Keen (1974a) for a more thorough discussion of the desiderata of a methodology for implementation research.

Factor research has demonstrated to us the complexity of the problem we are addressing. We now need to consider other approaches which can lead us to an integrated 'map'. Once this coherent picture has been developed, factor research is likely to be useful once again, in studying the detailed pieces of the overall structure. But, first we need the structure.

III. An Alternative Perspective: Implementation as a Process of Change.

> "... paradigms provide scientists not only with a map but also with some of the directions essential for map-making. In learning a paradigm the scientist acquires theory, methods, and standards together, usually in an inextricable mixture. Therefore, when paradigms change, there are usually significant shifts in the criteria determining the legitimacy both of problems and of proposed solutions."
> (Kuhn, 1970, p. 109)

III.1. Reviewing Where We Stand.

In the preceding two chapters we have looked at the two major approaches which have been taken to the study of and writing about implementation.[1] Neither approach provides us with an adequate basis for understanding implementation.

The normative approach, the experience of practitioners, fails because the authors become mired in the failures they have experienced. Each individual describes what has gone wrong for him and prescribes ways to avoid those pitfalls. Reading any one article,

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[1]A third approach of some importance can be found in the literature; that which looks in depth at particular aspects of the implementation problem, and attempts to assess empirically the relevance of these aspects to implementation outcomes. In the past few years considerable attention has been devoted to the issue of the 'cognitive styles' of manager and management scientist (see, Huysmans, 1970, Doktor & Hamilton, 1973, Keen, 1973, Keen & McKenney, 1973, and Stabell, 1974). The goal of this research is considerably narrower than that which we have chosen. Thus, it

it all seems quite simple; but, taken as a group, the picture these authors present is really quite complex. The problems vary across situations, and the obvious solution to one problem may well be the cause of another. Thus, no general guidelines emerge.

The empirical approach, the factor study, also fails, largely because it ignores the clearest message emerging from the normative approach -- that implementation and its attendant difficulties are to a considerable extent situation dependent. Ignoring this fact leads these researchers to charge off looking for absolutes where none exist. The result is little comparabiltiy of results, low correlations, etc. Again we are left with little of general value.

Perhaps we have been unfairly critical of past attempts to look at the implementation problem. Indeed, it is a messy and complex issue, and one which has only recently begun to be examined in earnest. Both the normative literature and the factor studies have given us certain insights, and both represent reasonable efforts at initial exploration of the phenomenon of implementation.

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is only the impact of a very few variables on implementation outcomes which is explored. These factors are not examined in the broader context of all the factors which affect implementation. Because of this limited focus, this line of research, while good as far as it goes, is inadequate for our purposes -- developing a sufficient understanding of the nature and mechanisms of implementation to be able to effectively manage the process.

However, to move forward from this base, we suggest that a new approach is necessary.

What we appear to need is a research approach which focuses on the dynamics of implementation in a variety of settings, including both successful and unsuccessful attempts to introduce management science innovations. In reviewing the normative literature it became apparent that we could not learn much about implementation by focusing solely on failures. Similarly, we will not learn much about success if we have no examples of failure to compare our successes to. Focusing on dynamics is necessary because implementation is a process, and a process cannot be understood if we look only at an instantaneous picture.

The approach we take should also have a diagnostic orientation, attempting to establish the key variables of significance in a given situation, rather than assuming that context is irrelevant as has been the practice in most factor research. That implementation is complex and multi-dimensional can easily be seen in both the normative literature and the results of the factor researchers. Our approach should not sweep this fact under the rug, but should be fully cognizant of it and should do as much as is possible to sort out this complex picture.

Finally, the approach we take must be theory-based, but not theory constrained. In the previous chapter we saw that an atheoretical approach left us with no way to meaningfully direct our study. At the same time, attempts to employ tightly defined theories of behavior caused us to ignore much important evidence. Our understanding of implementation is not yet to the point where we can define tightly knit theories; yet, we need something to help us organize the mass of available data.

III.2. The Social Change Paradigm.

Recent literature, both empirical and theoretical, suggests that we can find a paradigm for viewing implementation which meets all of our requirements reasonably well. Doing this, however, requires that we make a basic shift away from our past atheoretical and structural views of implementation, and towards a process view. Banbury (1968) suggests that we consider OR/MS as a means for changing the way complex socio-technical systems (organizations) are managed. Implementation then becomes a process of social change, of planned change within an on-going organization.

We will show later that this view of implementation -- as a process of planned organizational change -- is theoretically justifiable. Right now we will suggest that this is quite a sensible, even a natural, way to think about implementation. Consider some types of implementation problems raised in the literature -- poor communications, emotional behavior, resistance to change, failure to deal properly with power. All of these are problems arising out of the social system, and are the types of issues addressed by planned change literature. There should be clear gains to us as management scientists in drawing from the research and practice in this area and applying it to our problems of changing organizations.

The theoretical base most frequently suggested (or implied) by those authors advocating a planned change approach is the Lewin/Schein theory of change. The essential characteristics of this approach are:

1. it sees implementation as a process, oriented towards institutionalizing a technical change in a complex organization;
2. it recognizes the situational nature (and dependency) of the process, and hence adopts a diagnostic approach;
3. it emphasizes the behaviors of client and designer as key variables for understanding the implementation process; and
4. it provides the context within which we can look at other research findings (e.g., the cognitive style research).

Before looking in detail at the Lewin/Schein theory, we will consider a few other models of social and organizational change, showing why they do or do not provide adequate bases for viewing implementation. Sashkin, Morris & Horst (1973) review five models of planned change, examining how each deals with questions of information generation, information flows, and the tasks and roles of consultants. Key characteristics of the five models are presented in Table 3.

The first two models presented in Table 3 -- the Research, Development and Diffusion Model and the Social Interaction and Diffusion Model -- fall short of our needs on a number of dimensions. First, both models are concerned only with information external to the client system, and the transmision of this information into that system. As we have previously shown, the processes internal to the client system are critical to understanding MS implementation; any model which ignores these processes is bound to be inadequate. Similarly, both models take a largely structural approach to the problem, focusing on the communication packaging or the identification of communication channels (e.g., gate keepers), rather than considering the <u>process</u> of communication. Finally, both models are oriented towards a consultant role, providing the client with access paths to external information sources. As such, they fail to provide us with a paradigm for research on the implementation process.

Table 3 : Key Characteristics of Five Social Change Models

Model	Focus	Major Questions Asked	Change Agent Roles	Relevant Information
Research, Development & Diffusion	Diffusion of innovation gained through R&D; rational research orientation; little user orientation	Identifying user population; selecting medium, method & timing for communication of innovation	Consultant	External
Social Interaction & Diffusion	Two-step flow of info: natural flow processes augmented by feeding data to opinion leaders	Identifying opinion leaders & gatekeepers; using gatekeepers to transfer info. change agent wants transferred	Consultant	External
Intervention Theory (Argyris)	Generation of problem relevant data; use of data to develop alternatives; communicate shared commitment to decisions	How can interventionist facilitate process without having a major influence on choices made?	Consultant Trainer Researcher - on effectiveness of training process	Internal
Planned Change (Lippit, Watson, & Westley)	Open sharing of all info. between client and change agent; info is useful only if it can be translated to action	Determining relevant data; gathering, presenting & helping client use data; assuring institutionalization of change	Consultant Trainer Researcher - on training, process of change & model	Internal & External
Action Research (Lewin)	Development of action research process within client system; iterative research, action, evaluation loop	Solving specific problem & developing general skills simultaneously; keeping loop going after immediate problem is solved	Consultant Trainer Researcher - on training, process of change & model	Internal & External

Intervention Theory, as developed by Argyris, addresses the questions of process and utilization of information internal to the client system which we raised as objections to the two diffusion models. However, on this last dimension it goes too far, considering internal information to be the only information relevant to change. Clearly, in the case of a MS intervention we must be concerned with external information, that of technical experts with knowledge relevant to the problem. Bringing this information into the client system is a crucial aspect of the MS intervention. In the area of change agent roles, the Intervention Theory model represents a marked improvement over the diffusion models. Three roles are recognized for the change agent (or interventionist):

1. Consultant -- linking the client system to relevant internal information;
2. Trainer -- helping the client system learn to process and use the information; and
3. Researcher -- generalizing the results of the first two roles and making this information available to others.

The definitions of these roles, however, are not broad enough to meet our needs. The Consultant role focuses solely on information internal to the client system; a position we already have suggested is inadequate. The definition suggested for the Researcher role, too, fails to go far enough to meet our needs.

Argyris' concern in research has been only with the effectiveness of the training process. Thus, the model itself, Intervention Theory, has not been studied and revised on the basis of experience. When transferring a model to a domain for which it was not specifically designed, studying the model itself and its functioning in that domain is critical; once again we are left without an adequate paradigm for MS implementation research.

The final two models presented in the table -- Planned Change and Action Research -- meet all of the objections we have raised. In fact, these two models are quite similar, and both derive from the Lewin/Schein theory of change. Elements of both of these models are included in our specific approach to the study of implementation, and we will look at these in greater detail in the next chapter.

III.3. Specifics of the Lewin/Schein Theory.

III.3.1. The theory.

Kurt Lewin stated that one critical problem in action research, research which has as a specific aim the changing of people's behavior, was "how to change group conduct so that it would not slide back to the old level within a short time" (1952, p.459).

He then suggested a sequence of three changes in the relevant 'force fields' which would accomplish this end. First, the initial equilibrium position must be disturbed (unfrozen) so that a change might occur. Next, a force sufficient to cause the desired change must be applied. And, finally, a new equilibrium of forces sufficient to maintain the changed situation must be established.

These three steps, Unfreezing, Changing, and Refreezing, constitute the essence of the Lewin/Schein theory of change. Schein (1961, 1972) has elaborated the theory by describing the mechanisms which can be used to effect the necessary changes in 'force fields', and has demonstrated how similar these mechanisms are across a wide range of attitude change situations (ranging from Communist Chinese brainwashing techniques to programs for management development).

Unfreezing is accomplished by two basic mechanisms -- (1) increasing the pressure to change through disconfirmation of existing behavior patterns, and (2) developing psychological safety, an atmosphere in which the individual feels he <u>can</u> try something new. Schein (1972) points out that "no matter how much pressure is put on a person or social system to change ..., no change will occur unless the members of the system feel it is safe to give up the old responses and learn something new." (p. 77)

Changing, the presentation of information necessary for change and the learning of new attitudes and behaviors, can be effected by either of two processes. The first, 'Identification', involves locating a single source of information and relying on it as a pattern for new behaviors. The second, 'Scanning', involves surveying the environment for the range of available information, and synthesizing an approach which fits the situation in which the change must take place. Identification has the advantage of being quicker and in some ways easier; however, it is also less stable, and the change in behavior may disappear when the role model (or information source) is no longer present (see Schein, 1972).

Refreezing entails the stabilization of the change and the integration of it into existing patterns and relationships. Refreezing, however, is not meant to imply stagnation. Indeed, the whole sequence of Unfreezing, Changing, and Refreezing is seen as an iterative process.

III.3.2. Applying the theory.

Lewin used the change model largely to describe his work in changing social attitudes and behaviors. Schein's use of the model has focused on attitude and perception change in a number of environments. Neither of these two scholars, however, has been concerned with change involving technology. The fact that a MS implementation effort has both a cognitive dimension (i.e., understanding the technology and its implications) and an interpersonal dimension (the individual and organizational issues surrounding the technical change) distinguishes it from the types of change efforts that these researchers have focused on.[2] We must, then, ask: is this model an appropriate framework within which to consider a technology-based change like MS implementation?

In the past few years, a number of researchers have commented on this issue. Banbury (1968), as we have already noted, views OR/MS as a means for changing organizational processes, and suggests that it is therefore very analagous to organization development (OD). Bennis (1965) carefully compares OR/MS with planned change, and concludes that even though the latter does not consider the technological dimension, they are quite similar on a number of important dimensions. Vertinsky et al. (1973) suggest that MS can be a significant source of social change

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[2]This lack of concern for any technological component is quite characteristic of the OD field generally. Bennis, in comparing planned change to OR makes the following statement:

> "Planned change is concerned with such problems as (1) the identification of mission and values, (2) collaboration and conflict, (3) control and leadership, (4) resistance and adaptation to change, (5) utilization of human resources, (6) communication, (7) management development." (1965, p. 65)

We note that all of the issues he raises relate to the interpersonal dimension of change; none to the technical.

in the organization, and that the most effective way to bring about this change is to imbed the OR/MS effort in a broader OD effort aimed at changing managerial attitudes and values. Finally, Gibson & Hammond (1974) contend that the critical issue in implementation is that of influencing the behaviors of individuals within the client system.

Each of the authors mentioned sees MS implementation as including a major attitude or behavior change component. While none directly suggest the Lewin/Schein model as an appropriate framework, all express views compatible with the model. Other researchers have been more specific in their consideration of the change aspects inherent in MS implementation. Munson & Hancock (1972) suggest that success in implementation can only be achieved by interfacing both technical and behavioral approaches to the problem. On the technical side they are concerned with the quality of the product (e.g., model, information system). But, they suggest that the framework underlying their view of implementation is one of "unfreezing, moving, and refreezing the task perceptions of individuals." (p. 258) Their implication is clear; the Lewin/Schein theory is an appropriate framework for considering implementation.

Beyond the largely speculative literature, one piece of empirical evidence is available. Sorenson & Zand (1973) have tested the Lewin/Schein theory in a questionnaire study of a large number of OR/MS projects (approximately 280). Their results indicate that high levels of activity conducive to unfreezing, changing, and refreezing, as reported by the management scientist, are associated with greater project success; and, the evidence they present suggests that the refreezing stage may well be the most critical stage in the process.

III.4. Summing Up: What We Have and What We Need.

The available evidence, both logical and empirical, suggests that the Lewin/Schein theory is a fruitful way to look at MS implementation. Indeed, it meets many of the objections raised in the previous chapters to other views of implementation. We have argued the need for theory. This approach is theory based; and, the theory is not overly restrictive, another characteristic we found to be necessary. The need for a situational approach, too, is met by the Lewin/Schein theory. Both Lewin (1948) and Schein (1969) emphasize the need for diagnosis, gaining an understanding of the particular setting in which you are operating. Further, this diagnosis aims at uncovering the more covert aspect of the organization and its functioning which we suggested were critical to the implementation process.

It would appear, therefore, that we have found a potentially fruitful approach. However, it does not go quite far enough. Bennis has argued that our theories of change are adequate as descriptive theories but not as normative ones; "They are suitable for observers of social change, not for practitioners. They are theories of change, and not of changing." (Bennis, 1965, p. 64, emphasis in the original) We must agree with this assessment. Sorenson & Zand present us with evidence suggesting that there is a relationship between process and outcome, but they do not present a picture which is sufficiently operational or detailed. We need more refined definitions of the behaviors which will lead to sufficient unfreezing, changing, and refreezing. We want a normative model which shows us the appropriate levers for steering a project to success.

In the next chapter we present such a model. It is essentially an elaboration of the Lewin/Schein theory of change, and should provide us with a basis both for further elaboration of the theory and for the development of a general implementation research methodology. We do not claim that this is the theory of implementation. Rather, it is a vehicle which should be useful for resolving the questions we have met up until now.

IV. Development of a Normative Implementation Model.

IV.1. Introduction.

Much of the needed elaboration of the Lewin/Schein theory can be found in two of the social change models introduced in the previous chapter -- the Planned Change and Action Research models. Both models are based on the Lewin/Schein theory, and in many respects the two models are quite similar. However, there are certain differences in focus between these two approaches which distinguish them from one another and make it important for us to consider each of these models.

Lippit, Watson, & Westley (1958) present the Planned Change model as a sequence of seven phases.[1] These authors examined the functioning of external change agents working with four types of client systems -- individuals, small groups, large organizations and

[1] The seven phases suggested are:
1) developing a need for change,
2) establishing a change relationship,
3) diagnosing the client system's problems,
4) examining alternative goals and actions,
5) conducting the actual change effort,
6) generalizing and stabilizing the change, and
7) achieving a terminal relationship.

communities -- and identified patterns of activities common to all of these relationships. They group these activities into seven stages which serve as an elaboration of the three stages of the basic Lewin/Schein theory. The importance of this model to us in our effort to develop an appropriate model of MS implementation is that it begins to define operationally the activities of and mechanisms necessary for Unfreezing, Changing, and Refreezing.

While the Planned Change model is important primarily for its descriptive elaboration, the Action Research model is relevant largely for the view of change agent roles which it presents. We should note that, in fact, each of these models addresses both of these aspects, but they differ in emphasis, and we are, therefore, able to profit from a somewhat eclectic approach. Like the basic change theory we are employing, Action Research is properly attributed (at least initially) to Lewin. The Action Research approach stresses two interacting and complementary aspects of the change agent's role (see Lewin, 1948, and Foster, 1972):

1. training of the client system to deal with its problems, and
2. studying the processes of change and intervention themselves.

Clearly, such an approach is highly appropriate in an area where there is as much to be learned about the process as is the case with MS implementation. Another aspect of the Action Research paradigm important in a methodology for studying implementation is its diagnostic orientation. Lewin (1947) suggests that field research in the action mode must include three basic steps:

1. a characterization of the initial situation,
2. occurence of some events designed to bring about change, and
3. a study of the end situation to determine the actual effect of interventions.

Gibson (1973) explores quite thoroughly the advantages and disadvantages of action research as a methodology for research on implementation. On the negative side he cites two problems, the difficulty of replicating results and the occassional conflicts which arise between the research role and the action role. On the positive side he suggests the approach has the basic strength of being congruent with the implementation process itself; that a longitudinal, case-based methodology is most appropriate for studying a complex, multi-variate, longitudinal process. Gibson also suggests other reasons for an action research approach. The state of implementation theory is still so primitive that we are likely to gain much from exploratory, case-based research which attempts to develop constructs and build towards a theory. Also, implementation is complex, and few generalizations are meaningful. Thus, it is necessary to carefully diagnose each specific situation before attempting to make changes. We note an important implication; the needs of the change agent (implementor) for diagnosis are exactly the same as those of the action researcher. Looking at these pros and cons in aggregate, it would appear that there is much to be gained by adopting the action research paradigm as a part of our approach to implementation research.

IV.2. The Kolb-Frohman Model.

IV.2.1. Stages in the model.

The Lippit, Watson & Westley Planned Change model is meant to be quite general, covering a great variety of both change agents and client systems. Kolb & Frohman (1970) present a change model based on the Planned Change approach, but tailored to the relationship of an external consultant and an organizational client system. This model, too, specifies seven phases, and the phases are based on the three steps in the Lewin/Schein theory. After discussing the details of this model, we will consider our reasons for choosing it as a model of MS implementation.

Figure 1 presents the Kolb-Frohman model graphically. For each stage, Kolb and Frohman have suggested certain important characteristics and types of activities. The first step in the process, Scouting, is largely a process of mutual 'sizing up.' The client is concerned with assessing the consultant's ability to provide the help needed by the client system, and the consultant is interested in learning about the nature of the client system, the problems facing that system, and the prospects for being able to make the necessary changes within the system. One critical outcome of this stage is the choice of an appropriate Entry point to the client

The Kolb-Frohman Model

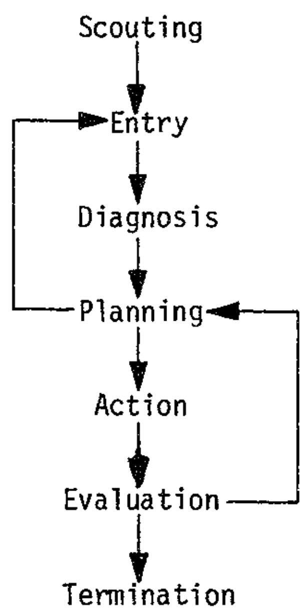

Figure 1.

system; that is, selection of people to work with in the client system who will both be interested in the change effort and have the necessary power and influence to make the desired changes.

Entry focuses on two major issues -- the negotiation of a contract between consultant and client, and the development of trust and trust-based power. The contract referred to is not simply a formal legal contract, but rather a more encompassing 'psychological contract' (see Schein, 1969). It covers each party's expectations, available resources and willingness to commit them, as well as their willingness to influence and be influenced by the other party. It also includes an initial statement of the problem and the goals and objectives to be achieved by addressing this problem. We must note that the 'contract' and relationship being developed at this stage are between individuals, the consultant and specific members of the client organization. Thus, if there is a subsequent change in actors, it becomes necessary to return to the Entry stage to renegotiate this contract.

The third phase in the process, Diagnosis, is concerned primarily with data gathering and revolves around four basic questions:

1. what is the client's felt problem (what is his model of the system, its problems, and its potentialities)?
2. what are the client's goals (desired end states, operationally defined)?
3. what resources does the client have for improving the situation? and
4. what resources does the consultant have?

Gathering the data necessary to answer these questions should be a _joint_ effort of client and consultant (this is one of the critical issues highlighted in Schein's process consultant view), and the output of this stage should be a full statement of the _apparent_ problems and the resources available for attacking these problems.

Once the needed diagnostic information has been gathered, the process moves on to the Planning stage. This begins with the definition of specific operational objectives to be achieved through change. These objectives will later be used as a basis for evaluation. The process then proceeds to seek alternative means for reaching these objectives. Each alternative must be evaluated to determine the resources required to put it into action, the organizational sub-system(s) it impacts (directly and indirectly), as well as the degree to which it meets the client system's requirements. If Planning is successful, the process can move into the Action stage; however, if new issues are raised (e.g., a requirement to include a previously uninvolved segment of the organization), it is necessary to cycle back to Entry and repeat the process.

In the Action phase, the alternative judged best during Planning is put into effect. If the preceding stages have been handled well, Action should not present any particular problems. When unanticipated consequences of the change effort do occur, dealing with them (e.g., by modifying the action plan) becomes a part of this phase.

Evaluation of the change effort follows Action. Evaluation focuses on the new situation and attempts to measure how well the objectives defined during the planning effort have been met. If goals have not been attained, the process should move back to Planning for another iteration through the steps.

If both client and consultant are satisfied with the outcome of their efforts, the process moves into the Termination stage. The conditions which must be satisfied before the client-consultant relationship is terminated should be agreed upon at Entry; typically they include meeting mutually agreed upon goals and improving the client system's problem solving ability (which may be quite difficult to assess). The decision to terminate should be a joint one, but there is an extra measure of responsibility on the management scientist to see that termination is neither too early (before the client system has had a chance to internalize the change) nor too late (after the client has become unduly dependent on the consultant's presence).

Kolb and Frohman make a number of very important points about the nature of the process which are congruent with Schein's process consultant view. First, they highlight the cooperative nature of the consulting effort. The client cannot expect the consultant to step in and carry the entire process off by himself; rather, it must be a joint effort of client and consultant throughout the seven phases. Next, they point out that the stages and the boundaries between them are only loosely defined, and that it is frequently necessary to iterate through some subset of phases a number of times. Finally, they suggest that this model be viewed as a normative model; that success of the entire effort requires successful negotiation of each of the phases, and that this must occur more or less in order. Each of these points is highly relevant to us in our concern for MS implementation, and we will discuss them in the next section.

IV.2.2. Reasons for selecting the Kolb-Frohman model.

Our choice of the Kolb-Frohman model of the consulting process as a basis for viewing MS implementation deserves some comment. A number of factors underlie this choice. Most basic among these is that the model derives from the theory we (and a number of other MS researchers) find most appropriate (the Lewin/Schein theory of change), it focuses on planned change in an <u>organizational setting</u>, and it comes at least as close as any other available model to operational specification of the process of changing. Consider for a moment the relationship between the Lewin/Schein theory and the Kolb-Frohman model. Unfreezing, the process of disequilibrating existing stable force fields, is dealt with by Kolb & Frohman in the Scouting and Entry stages; Changing, by the three middle stages -- Diagnosis, Planning and Action; and Refreezing, by the Evaluation and Termination stages. A direct mapping between these two schemes is thus possible, and the detail provided by the model brings the theory much closer to being directly applicable.

The three characteristics of the process which Kolb and Frohman highlight (and which we pointed out in the preceding section) are also important contributors to our selection. Consider, first, the issue of cooperation between client and consultant. Managers and management scientists have too often approached implementation as though cooperation were unnecessary. The result has been the 'separate functions' position described by Churchman and Schainblatt, and the outcome has been the frequent failures we have experienced. A model which stresses joint action as the correct approach is clearly appropriate to our needs.

The definition of just what constitutes 'implementation' is another key issue. The traditional MS view has been that implementation is that part of the development process starting once the system is designed and ending as soon as it produces usable outputs (in the case of a system designed for recurrent use) or once its recommendations are put into practice (in the case of systems designed for one time usage). Perhaps this view is appropriate if one holds a 'product' view of MS, but we cannot accept these boundaries as appropriate. Dickson & Powers (1971) present some interesting data on this issue. In their studies of MIS implementation, they find that technicians and users differ in their definitions of implementation; the former claiming it is the process of cutting a new system over to computer operations, and the latter arguing that it is the period of learning to operate with the new system _after_ cutover. Some management scientists have argued for broader boundaries to the implementation process. Roberts (1972) contends that model builders who want to be effective must adopt an 'implementation perspective' from the start of any project, and Starr (1965) suggests that "The problem of implementation begins with the first model-building decision." (p. B31) We believe that this expanded view of implementation boundaries is necessary. Accepting the Lewin/Schein theory implies such a view, and the Kolb-Frohman model provides a framework for examining the activities throughout the process.

Another critical point is the conception of the basic structure of the process -- linear vs. iterative or cyclic. The product view of MS development has fostered a linear, one pass approach. We suggest that this approach is inadequate for all but the most simple and well understood systems. As we move to more complex systems whose operation in the client's environment is difficult to predict entirely in advance, we _must_ adopt an iterative approach. On each cycle through the loop we can bring the system closer into line with the client's needs, but we need the feedback from our previous efforts in order to take the proper corrective action. The Kolb-Frohman model is more explicit in its recognition of this iterative character than most other change models, and, as we have seen, outlines a normative structure of process flow which includes the necessary iterations.[1]

The final characteristic of the model itself which led to our choosing it as the basis for viewing MS implementation is the contention that this is a normative model. Our goal has been to articulate a model which can serve both as a guide to action in implementation situations and as a paradigm for research on implementation. Meeting the first of these requirements demands that we have a normative model. As we pointed out earlier, Bennis argued (in 1965) that most available models of change are useful only for descriptive purposes; thus, finding a suitable normative model presents certain difficulties. Kolb and Frohman, both practicing consultants in the OD area, use their model to manage the change efforts they are involved in. They find the model rich enough to guide their actions, and we are inclined to accept it, at least tentatively, for the same purpose.

Beyond the characteristics of the Kolb-Frohman model itself, another factor contributed to our selection. Other researchers on implementation have used this model (or a variant of it) in their work. Lucas & Plimpton (1972) have used the model to describe

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[1] Beyond iterating to bring a complex system into line with previously defined client needs, there is also a question of system evolution -- refining the existing system to meet the changing needs of the client. The flow structure of the model is appropriate for this type of process iteration also.

their effort in a system development project with the United Farm Workers. They found that their progress mapped well onto the stages and loops outlined by Kolb and Frohman. Urban (1972) uses a slightly modified version of the Kolb-Frohman model to describe the process he finds appropriate for developing models to be used by management decision makers. While both Urban and Lucas & Plimpton use the model for descriptive purposes, Urban implies that it is also a normative approach and he has, in fact, followed this (or a very similar) process in a number of his model building efforts (see Urban & Karash, 1969, and Urban, 1974).[3]

In summary, the choice of the Kolb-Frohman model as the basis for studying and managing the MS implementation process was based on three major factors. First, its theoretical base (Lewin/Schein) is the one we believe is most appropriate. Next, it is perhaps the most fully developed and highly operational of the available models, and it makes some very important points about the nature of the process. And, finally, other researchers concerned with implementation have used it, and have demonstrated by their use that it can be a useful and practicable tool.

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[3]A report on the use of the Kolb-Frohman model purely as a normative tool can be found in Ginzberg et al., 1975.

IV.3. Elaboration of the Kolb-Frohman Model.

The model as presented by Kolb & Frohman goes a long way towards providing us with the model we need to guide our actions in both research on and practice in implementation. However, in certain respects the model as it stands is inadequate. First, the authors are in the mainstream of the OD tradition. As a result, the interventions which they are concerned with are seldom technological ones, and the model they articulate gives little consideration to issues of changing technology. This in no way presents us with a major problem; it simply requires that we add to the model an explicit recognition that we are concerned with a change process that is technology induced and has a major technological component.

There are a number of implications of this technological focus, stemming, for the most part, from the fact that technical knowledge must be injected into the client system. The technologies we deal with are not fully understood; thus, there is the potential for legitimate disagreement about the appropriate technology in a given situation. Beyond this there is uncertainty about the use of the technology and about the way it will fit into the client's operations. Taken together, these imply a greater degree of risk than is common to most OD interventions; there are certain issues which simply cannot be fully resolved. At the other extreme, the technological intervention requires a more rigid structuring of roles than is usual in the OD intervention. The focus is on importing technical expertise and knowledge from outside the client system, and this is the province of the designer or consultant. The OD practitioner more typically attempts to facilitate the use of knowledge and expertise internal to the client system, and, thus is able to function more nearly like a member of that system (see Schein, 1969). This difference in roles is legitimate, but must be accounted for in the model we adopt.

It is worth digressing for a moment to state that although we are looking at the implementation of technology (MS), the technical changes are by no means the only ones relevant in these situations. Leavitt (1964) has suggested that organizations can be viewed as composed of four basic elements -- task, people, structure, and technology. Most organizational problems can be attacked along more than one of these dimensions; however, changes on any one of the dimensions may require compensating changes along other dimensions. Thus, though the focus of a MS implementation effort is on changing the technology component, bringing it to a successful conclusion may well require changes to task, people, or structure. At the most trivial level a change to 'people', training in the use of the new technology, is always required. And, we will argue later that DSS implementation requires a change in task definitions if it is to be successful. We can now, hopefully, see that the more general organization change notions embodied in the Kolb-Frohman model are highly relevant to the issue of MS implementation.

Other than this focus which does not deal with technology, the only shortcoming we find in the model as it is presented is the degree to which the activities of each phase are specified. Kolb and Frohman define these activities rather loosely, claiming that it is not possible to reduce the consultant-client relationship to a set of mechanistic rules. We do not quarrel with this assertion, but we do contend that a more explicit definition of activities is possible; indeed, it is necessary if we are to use this model as our normative model of implementation. Thus, our effort has been directed towards refining the definitions of the model phases, delineating specific, concrete sets of issues which must be resolved at each stage if the overall process is to be successful.

Defining specific issues is our attempt to answer both shortcomings we find in the Kolb-Frohman model. A list of these issues organized by stages is presented in Appendix III. As most of the issues are raised in the literature, our effort was largely devoted to structuring and formalizing what others have already said. Through a series of iterations (involving this author, Peter Keen, and David Kolb) we developed the list presented in Appendix III. Since in most cases the issues included closely parallel the stage descriptions already presented, we will consider only certain highlights here.

One key issue at the Entry stage is the development of a clear statement of goals, objectives, and expectations. Huysmans (1973) has proposed that when dealing with changes in management technology (i.e., MS), a number of different degrees of acceptance and usage are possible, and he has developed a convenient conceptualization of this termed 'level of adoption.' This notion, that there is a range of possible levels of system acceptance and usage, is a very important one. It runs quite strongly counter to the usual practice of assuming that success can only be measured by system usage, by suggesting that it is logical to talk about outcomes only in relationship to goals. Thus, we see well designed systems that managers say are important to them, but which they never seem to use; or, on the other hand, systems with little conceptual or technical merit which are used extensively. We will discuss the particular 'levels' which have been suggested in later chapters. For now we should note that the issue of 'level of adoption' is probably unique to technological changes, and agreement on the desired level is an important part of the expectation setting process of Entry in cases of this sort of change.

A number of issues listed as parts of the Planning phase deserve explanation. First is the question of considering and choosing among alternative courses of action. Since we are dealing with technological changes, it is important that we assess the technical quality of any proposed solution -- is it technically sound? is it achievable given present technology and available skills? does it meet the requirements of the client system? But, beyond assessing the technical quality, we must also ask how the system will fit into the client organization; what are the secondary impacts of this change, and can the client system cope with them? Selecting the 'best' solution then becomes a process of trading off among competing requirements (see, for example, Munson & Hancock, 1972).

Once a single alternative has been selected, the specification of a plan of action is necessary. This plan should provide sufficient detail to guide the activity which follows, but it is important that the plan not be rigid. Changes involving very sophisticated technology-based systems (e.g., DSSs or advanced MISs affecting multiple organizational activities) are too complex to be thoroughly understood in advance. Unanticipated occurrences are likely no matter how careful the diagnostic and planning efforts were; hence, it is critical that the action plan be able to adapt as new information becomes available.

The final issue listed under Planning -- cycling back through the loop -- really represents the upper branch pictured in Figure 1. We include this as a Planning issue because it is at this stage that a decision to move on to Action or to refine the design and plan for action must be made. We consider it a failure of the Planning process if the move to Action is made before the issues of the first four phases have been resolved.

The Action phase is the one about which Kolb & Frohman have the least to say. Clearly, the main goal of this stage is to implement the alternative selected as 'best'. Achieving this end may require modification of the original plan in response to information gained during this phase. Dealing with the issues that arise, rather than ignoring them and hoping that it all works out in the end, is a requirement for successfully passing through the Action stage. The other major activity of this stage is training of members of the client system, both to produce the desired changes in the organization and to enable it to function in its new state.

At the Evaluation stage two types of assessment should be made -- of the change effort and of the evaluation process itself. Assessing the evaluation process is necessary to ensure that this process is handled effectively, that errors made in one implementation effort are not perpetuated. This aspect of evaluation has become more important as the systems we are implementing have become more sophisticated and their impacts more difficult to measure.

Evaluation of the system should be accomplished by applying previously defined measures to assess progress towards goals and objectives specified at Entry and Planning. The judgement to be made, however, is not simply one of success or failure. Rather, it should ask how complete has progress towards these goals been. If goals have been completely reached, the process should move into Termination; but, if not, a decision to evolve, to cycle through the Planning and Action stages again, should be taken. Thus, the lower loop in Figure 1, which closely parallels Lewin's planning-action-reconnaisance-evaluation loop for action research (see Lewin, 1948), is formalized as part of the Evaluation stage.

The only Termination issue which deserves special mention is that of implanting a capability to adapt in both the social and technological systems. MS systems are often developed for relatively fluid environments, and their continued use is critically dependent on an ability to adapt to changes in these environments. Developing this capacity and setting the mechanisms of evolution in motion is an important aspect of this final phase of the implementation process (see Urban, 1972, for a more detailed discussion of this evolutionary activity).

IV.4. Summary: Use of the Modified Model.

By specifying sets of issues to be dealt with at each stage, we have made the Kolb-Frohman model considerably more useful for our purposes. Our aim was to articulate a normative model of the implementation process, and our intention is to use the model just presented as this normative model. The implication of this is simple: we contend that success of an implementation effort requires successful resolution of the issues presented at each phase of the process. That is, the consultant and client must 'work through' each of these issues so that each understands the other's position and some mutually agreed upon direction of action emerges. Furthermore, the issues at each stage should be resolved before moving on to later stages. Of course, there will be some oscillation back and forth between stages, and some transitions -- between Planning and Action and between Evaluation and Termination -- are the truly critical ones.

Accepting this model as a normative model (this acceptance is tentative and is the issue addressed by the field study described in later chapters) gives us certain types of leverage which we have been seeking. On the research side it provides us with an alternative to the factor model as a paradigm for research. We have argued that the factor model falls short of being an adequate vehicle for research on a number of dimensions -- it is atheoretical, it generates a nearly endless list of 'critical variables', it ignores the dynamic nature of implementation, and it fails to recognize the issue of contingency or factor interactions. The Kolb-Frohman model as modified addresses each of these issues. First, it is theory-based, but only to a level commensurate with our current degree of understanding; thus, the theory does not constrain what we can observe. Next, the focus of this approach is on the dynamic aspect of implementation, the fact that it is a process. Replacing a nearly endless list of factors (140 identified just in the studies discussed in this thesis) is a fairly compact list of stages (7) and issues (30 divided among the 7 stages). In sharp contrast to the list of factors which we have seen expand with every new study considered, we contend that this list of thirty issues is complete.

The question of factor contingency is not addressed directly by the Kolb-Frohman model. It provides us with a view of process and states that all process steps are theoretically important in all situations. In a later chapter we will sketch out some hypotheses dealing with the relationship between certain factors and the process, arguing that the centrality of the various process phases will vary systematically with these factors (e.g., technology type). This raises the more general issue of the role of factors in our process view of implementation. By accepting a process model we do not mean to dismiss factors as unimportant. Rather, we suggest that a different view of the relationship between factors and outcomes is required. Figure 2 illustrates the difference in viewpoints embodied in these two paradigms. The factor model (Figure 2.a) implies that factors directly determine implementation outcomes. The process view (Figure 2.b), on the other hand, suggests that it is process which determines outcomes, but that factors have a significant effect on process.

Factors, Process, and Outcomes

2.a.: Factor Model View

2.b.: Process Model View

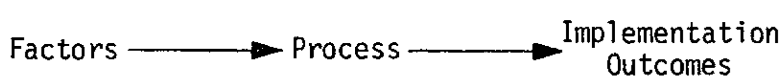

Figure 2.

Process, therefore, mediates between factors and outcomes. A concrete example should help to clarify this. The factor approach would suggest that the reporting level of the chief MS person in an organization could affect the success of MS projects. The process interpretation is that the chief MS person's reporting level may affect the ease with which certain process issues can be resolved; but, it is the resolution of these issues (e.g., developing a trust-based relationship), not the factor (reporting level) itself, which determines outcomes in a causal sense.

While all of the points raised on the research side suggest a relative advantage of a process focus over a factor focus, it is when we turn to the question of MS practice that this advantage is clearest. The factor approach deals largely with variables that are, in the short run at least, non-controllable -- organization structure, demographics of users and designers, characteristics of the environment. Even if this research were perfect in every other respect, it still would fail from the practitioner's point of view. It does not help him identify the leverage points accessible to him, nor does it prescribe courses of action which he can take to guide the project to a successful conclusion. The major controllable variable in an implementation effort is the implementor's behavior. The Kolb-Frohman model focuses squarely on this issue. Its normative stance makes specific suggestions to the practitioner for courses of action which should lead to success. The detailing of issues to be attended to makes these action recommendations reasonably concrete. And, the division of the process into stages, together with the definition of flow patterns and decision points to guide iteration, offer the manager definite control points at which he can assess progress and take corrective action if necessary. It is our contention that the definitions of stages and issues provided by the model can lead directly to the development of management tools (currently this is simply supposition and remains an issue for research).

The final point to be mentioned about the use of this model is its generality. We have already discussed the variety of MS technologies to which we find it applicable (see Chapter I). These, of course, should not be taken as the limit of the model's useful range. Our elaborations of the basic Kolb-Frohman model do not invalidate its usefulness as a paradigm for non-technology based change. Kolb has suggested (personal communication, October, 1974) that the issues listed in Appendix III are equally valid for the more usual OD change efforts, though some minor changes in emphasis may be necessary when the technology component is not a major consideration.

V. An Outline for Research

V.1. Key Issues and Questions for Research.

In the preceeding chapters we have developed an alternative conceptualization of the MS implementation process. We have suggested that this new model can serve us both as a paradigm for research and as a guide to action. At present, however, these assertations are highly conjectural, the evidence supporting them being quite sparse. We are left, therefore, with two major research questions -- that of the model's theoretical merit and that of its practical usefulness.

There are some fundamental differences between these two issues. In the first case, theoretical merit, our questions center on finding empirical support for the contention that we have articulated a normative model. That is, we would like to have evidence showing that achieving success in MS implementation efforts is strongly related to successful resolution of the issues presented at the various stages of the Kolb-Frohman model. In considering the model's usefulness in practice, our concern shifts to its ability to guide the on-going implementation effort -- to provide tools useful in situation diagnosis, and to suggest strategies and tactics which will move an implementation effort towards a successful conclusion.

Testing these two major questions requires two quite distinct approaches, but the payoff is likely to be greatest if we coordinate these efforts. Churchman & Emery (1966) have suggested that numerous approaches to studying organizations are available, each having some positive value, but each being incomplete. Thus, the results from a combination of two or more diverse approaches are likely to be more beneficial than those from any single approach. Other researchers have also pointed out the importance of taking multiple perspectives to the understanding of complex situations (e.g., Beckhard, 1973) and the development of any science-based field (Mitroff, 1972).

Our desire, therefore, is to sketch out a program of research which incorporates both of the issues, theory and practice, allowing each to benefit from the work addressed primarily towards the other. Clearly, some initial effort in operationalizing certain key concepts (e.g., DSS, Level of Adoption, Success/Failure, etc.) is needed as groundwork for both the theoretical and the practical sides. We address these issues later in this chapter.

Some initial steps towards testing the practical use of this model have already been taken. Lucas & Plimpton (1972) have shown that it has merit as a descriptive tool; that they could map their relationship with their client (the UFW) in a system development effort into this model, and that this exercise was useful in explaining the dynamics of that relationship. Ginzberg, Little & Smith (1975) used the basic Kolb-Frohman model as a diagnostic tool and guide to action in a real implementation situation, and report having some degree of success. The methodology used in both of these cases is that of action research or participant observation. The researcher in such situations is faced with two roles -- one, to take an active part in the implementation process, and the other, to study that process and add to the general knowledge about it. We find this approach to be a highly appropriate one. Gibson (1973) has used it quite successfully in his implementation research. And, he suggests that comparative, case-based action research is likely to be a very fruitful avenue towards the development of a practical theory of implementation.

The action research approach makes sense to us for a number of reasons. First, as we have pointed out, the context of an implementation effort is likely to have significant effects on its outcome. We do not as yet know, however, which of the many situational attributes have the greatest impact, nor what are their effects on the process. The diagnostic orientation of action research is perhaps the best way to ferret out the important aspects in each situation (Gibson, indeed, uncovered key political factors through this approach), and a comparison across a number of such cases should lead to a clearer understanding of these issues. The modified Kolb-Frohman model can point the researcher in certain potentially fruitful directions for his diagnosis. At the same time, the skilled diagnostician can find those areas where the model is weak, and this should lead to elaboration of the model. The process, of course, is iterative, and over time should lead to better tools for the practitioner.

In order for this iterative process to make sense and to provide useful tools, it must be based on a paradigm which is theoretically sound. If successful implementation efforts do not differ from unsuccessful efforts in terms of the process each has followed, it makes little sense to take a process model into the field and attempt to refine it on the basis of experience. Thus, an appropriate next step is to test the model with some field data. Such a test was conducted as part of this research and is discussed in the remainder of this thesis. We should note that field testing of the model should not be a one time effort. Rather, it should enter the action research loop suggested above. This implies that as modifications are made to the model on the basis of specific case experiences, the revised model should be tested using a broader data base. Following such a procedure, both theory and practice can be continually updated to reflect the best available information.

The empirical effort of this study addresses the merit of the Kolb-Frohman model as a normative model of the implementation process. A number of relationships were hypothesized and tested with data collected from a sample of implementation efforts in industrial, financial, and service organizations. The hypothesized relationships address two major issues:

1. the relationship between resolution of the issues presented by the process stages and success of the implementation effort, and
2. the differential requirements for resolution of process issues across technology types -- particularly between DSSs and the other two types of systems.

We begin our discussion of this field study in the next chapter, the remainder of this one being devoted to a clarification of some key terminology.

V.2. Operationalizing the Major Concepts.

A number of the terms we have used in discussing MS implementation are only loosely defined. Among these are the MS technologies we are talking about, the success or failure of a project, and the question of who are the users and designers of a system. Before we can do any testing of the proposed process model, of either its theoretical merit or its practical value, it is necessary to clarify what we mean by these terms. The more precise the definitions of terms, the more understandable and useful the results of our research will be.

The operationalization of concepts included in this research is both an important and a difficult aspect of the total effort. The concepts we are looking at -- e.g., success, process -- are difficult to pin down and measure; yet, we must measure them if we are to learn anything about them. The problem becomes tautological. In order to gather data about these concepts we must employ some paradigm to define measures of them; but, one purpose of this research is to find a paradigm useful for describing implementation, and to do this we must gather data. Thus, our operationalizations of concepts can only be first approximations. We will use them to gather data, and then use the data to refine the measures of these concepts.

It is important to recognize that the question of concept operationalization is one of the major research issues we are addressing. The value of this research effort does not, however, stand or fall on the goodness of these first approximations to measures of the concepts. Rather, it is determined by how well we use the resulting data to modify our measures and move towards a useful, realistic paradigm for implementation research.

V.2.1. Technology types.

In chapter I we introduced the three MS technology groups -- one-shot models, conventional information systems, and decision support systems -- we are particularly concerned with and defined, broadly, the distinguishing features of each class. It was also pointed out that the differences among these three technologies impose different demands on the implementation process. Thus, it becomes necessary for us to be able to determine the technology type involved in each implementation effort we study.

This task is more difficult than it may initially appear, particularly when it comes to differentiating DSSs from conventional information systems. The reason for the difficulty is largely the great range of capabilities to be found among systems (both DSS and conventional) currently in use in organizations. In the past, researchers concerned with DSSs have pointed out some of their hallmarks -- designed to <u>support</u> a manager's decision making, not replace it; dealing with unstructured or semi-structured tasks. But, these researchers have seldom been faced with having to identify a DSS in the field; their research almost invariably being focused on a single system with which they are familiar (frequently because they designed it). Thus, though we have general notions of what distinguishes a DSS from a conventional information system, no good operational measures to help us in this classification have been specified.

The typical solution to this classification problem has been to say "I can tell a DSS when I see one." Indeed, this is true of most researchers concerned with such systems, but it requires that the researcher spend considerable time studying the content and use of a system (see, for example, Alter, 1975). The DSS literature, however, provides us with a number of suggestions about the ways DSSs differ from conventional systems. From these suggestions we can develop a short series of questions which will enable us, generally, to distinguish among system types. We contend that DSSs are more likely to possess certain characteristics and less likely to possess others than are conventional information systems. We make the following assertions about the differences between these two classes of systems:

1. DSSs are likely to provide both data and analytic capabilities, while conventional systems are likely to provide

1. (continued) only data;
2. DSSs are not meant to be used by clerical personal, while conventional systems frequently are;
3. DSSs are likely to result in changes to <u>what</u> system users do (e.g., the types of analyses and decisions they make), while conventional systems are likely to impact only <u>how</u> people do their job (i.e., the procedures they follow);
4. DSSs are likely to provide capabilities which enable the user to perform new tasks, while conventional systems are not likely to provide such capabilities;
5. DSS operation is likely to be exclusively via on-line terminal, while conventional systems may be on-line, batch, or mixed;
6. interaction with a DSS is likely to be carried out by the information user, while conventional systems are likely to have an intermediary between system and user;
7. conventional systems are likely to deal with data on current or historical operations of the organization, while DSSs are likely to include environmental data and/or projections of future operations;
8. DSSs are likely to produce information only upon request, while conventional systems normally produce information

8. (continued) automatically; and
9. DSSs are likely to have analytic capabilities which go beyond data retrieval, report formating, and simple models (e.g., balance sheet or income statement production), which conventional systems are less likely to have.

Based upon these nine statements, we can get a rough measure of the degree to which a system looks like a DSS (the specific questions asked and the scoring algorithm are presented in Appendix IV), and thus are not forced to look in great detail at the specifics of each system. We realize that one could argue with all of the nine criteria we have suggested; for each one it is undoubtedly possible to find systems which present counterexamples. We contend, however, that in aggregate these criteria do a reasonable job of quickly differentiating those systems which clearly are DSSs from those which clearly are not (We will explore in Chapter 7 how well this method worked). There will be some systems in the middle, not falling neatly into either class because they possess characteristics of both. We will not worry about classifying these systems, as an attempt to do so by any method is likely to be quite arbitrary and subject to debate.

One potentially confusing point requires clarification. There is a tendency to assume that DSSs are inherently more complex than conventional information systems. From a technical point of view this is not the case. Many DSSs are technically quite simple (as an example, see the system described by Ginzberg, Little & Smith, 1975); that is, DSSs typically are smaller (in terms of lines of code and numbers of modules or users) and have fewer required interactions (internally and with the external world) than do conventional systems. Even the most complex DSSs (see Gerrity, 1970, for an example) are considerably less complex in a technical sense than are sophisticated conventional systems (e.g., SABRE, or the current generation of airline reservation systems). However, from the implementation perspective, DSSs are typically considerably more complex than other types of systems. This is true in the sense that the number of dimensions on which there is uncertainty -- e.g., task, usage, information, interpersonal, political, as well as technical -- is by far the largest in the case of the DSS. We state this without further explanation for now, but will return to it later in our discussion of the research hypotheses.

V.2.2. Users and designers.

In the preceeding chapters we have frequently focused on the relationship between the user and the designer of a system. We have used these terms rather loosely so far, and must now define them more precisely.

We will turn first to the question of the user (or client). A whole spectrum of system users can be defined: those who generate input data, those who enter this data, those who operate the system to produce the output, and those who use this output. We cannot deny the importance of any of these 'users' to the overall successful functioning of the system. However, our focus is on the use of MS to support the activities of management, most notably decision making. Thus, we are primarily concerned with the users on the output side of the system, particularly the user of the output information.

We will require two conditions to define this output user:

1. that he receives the output (conceptual, not necessarily the computer printout) of the system and in some way uses it, and
2. that he is aware of the system which produces the output.

The need for the first condition is obvious; we are looking for the information user because he plays a large (ideally, the major) role in defining what the system looks like and how it is used. The second condition is necessary because some users of a system's outputs may be so divorced from the system itself as to have virtually no impact of the implementation or operation of the system. An example should clarify this. A marketing manager may rely heavily on forecasts of demand in planning his product strategy, and these forecasts may be generated by some computer-based system. Consider two extreme modes in which he might operate. In the first, he would run over to his computer terminal each time he wanted a forecast, and would specify to the system just what he wanted. He would then receive a print-out which, hopefully, would satisfy his requirements. In this case, his actions are clearly relevant to the design and operation of the system.

Consider, now, the opposite extreme. Rather than turning to his terminal when he required a forecast, the manager could call the marketing research department and explain his needs to the research analyst. The analyst could then turn to the terminal, run the appropriate program, and receive the output. From this output he could abstract the necessary data, write a report, and send this report to the manager. Though the data he receives and the system which produces it are exactly the same in this case as they were in the prior one, the marketing manager's actions are not now directly relevant to the development or use of the system; while he is the information user, he is not the system user, and hence is not the client in the system development relationship. His interactions are solely with the research analyst, and it is likely that he does not care what tools the analyst uses, so long as the information he receives meets his needs. The analyst in this case is the relevant user or client as it is his preferences and actions which are of importance to system design, implementation, and use.[1] There is, of course, some middle ground where both the manager and the analyst

[1]There are likely some basic differences between staff and line users, and we should examine them separately. In the data we have collected, however, almost all system users are also the information users.

qualify as users in the sense we have defined the term.

The system designer (or consultant, as we will refer to him later) is the person responsible for the technical end of the system development. There are a number of pieces to this technical task -- e.g., system specification, programming, testing, etc. -- and the way they are divided up and assigned to people varies from project to project. In some projects part of the design task may fall on the user; but, in all but the smallest of projects, there is a non-user responsible for some portion of these tasks. From an implementation viewpoint we are concerned with the non-user technical person (or group) who is in most direct contact with the user, and we will call this person (or group) the designer or consultant. This implies that the function of the designer can vary from system to system. Indeed, this is true, but it is not of major concern to us; we are focusing on the nature of the relationship between user and designer, not its content. We must recognize that the content of this relationship, the way tasks are divided, might have an impact on its quality, but it is the effect of quality on implementation outcomes which we are addressing in this research.

Whatever the division of tasks, the consultant can be either internal (an employee of the same company as the user) or external (an employee of another organization). Again, this is not of direct concern to us, as we are focusing on the nature of the resulting relationship between client and consultant.

To summarize, we have now defined the terms user and designer. Given these definitions we should be able to look at an implementation effort and identify the key individuals on both the design and usage sides of the system. It is the relationship between these individuals which we want to examine in our research on the implementation process. For, as Bennis has stated, "Implementation is the problem and the relationship between researcher and user is its pivotal element." (Bennis, 1965a, p. B13).

V.2.3. The issue of success.

Success, the dependent variable in implementation research, is perhaps the most critical concept to be considered. The choice of measure for this concept can have a marked effect on the outcomes of the research. Recall our discussion of factor research. Many dependent variables were considered, and this accounted for a part of the lack of comparability of results. Researchers who used multiple dependent variables (e.g., Dickson & Powers, Bean et al.) found major differences in their results depending upon which measure was considered. Given this critical importance of the choice of a dependent variable to the research outcome, we want to be very careful in our choice of a measure. We want the measure chosen to reflect our view of success as closely as is possible.

We suggested that viewing implementation as an attempt to implant a specific product (model or information system) in an organization was seldom the appropriate perspective. Rather, implementation should be considered a process for taking the client from where he is to where he wants to be. If we adopt this view, then our measure of success must reflect the degree to which the process was able to move the client to his desired ending point. The mechanism we propose for this measurement is the concept of 'level of adoption.'

Huysmans (1973) proposed that there are three different levels of adoption which may be appropriate for MS implementation efforts. Keen (1974b) has suggested that a fourth level must be added to enable us to deal with the full range of requisite change when DSSs are included among the technologies considered. The four levels that these authors discuss are:

1. management action: does the system effectively solve the manager's problem, providing him with a solution he accepts?
2. management change: does the system provide the manager with a tool useful for developing answers to the problems he faces?
3. recurring use of the OR/MS approach: does the system lead the manager to rely more heavily on analytic aids

in his task performance? and

4. redefinition or extension of supported tasks: do the decisions the manager makes or the tasks he performs change as a result of having this system?

These four levels of adoption are posited to be hierarchical. Each higher level requires a greater degree of change than do the levels below it, and in most cases changes at one level imply that the lower level changes occurred also.

Conceptually, it is possible for any of these four levels of change to be the one desired for any given system (we will argue later that different types of technology require different levels of adoption). Success of the implementation effort can be measured by the match between desired level of adoption (LOA) and achieved LOA.

The question arises of when the desired and achieved LOAs should be measured. For achieved LOA, the answer is simple; this cannot be measured until after the system (or model) is installed or the project terminates. Desired LOA, however, could be measured at any of a number of points. At first one is tempted to argue that desired LOA should be measured at the outset of the project. But, consider carefully what we are trying to assess here. Essentially, we are asking how well an individual's goals or expectations were met by the project. Goals are subject to revision (upwards or downwards) during the life of a project (see Keen, 1974a, for a discussion of the movement of expectations over a project's lifetime). Thus, if we want to know how well an individual feels his goals were met, we ahould assess these goals at the end of the project.

Desired LOA, then, is rooted in the individual, reflecting his aspirations for the project, and can only be measured subjectively. Achieved LOA could, theoretically, be measured more objectively. the way in which a system is used could be observed, and this observation could be translated into one of the four levels of adoption outlined above. System usage, however, need not be the same for all users. Thus, achieved LOA would have to be measured separately for each user. Making the necessary observations would not be a simple task; even for a single user it would require a long period of observation, both before and after the system was developed, to assess how (and if) that user changed as a result of having that system. Thus, for our study, each respondent reports his own perceptions of both LOA goal and achievement.

Given the possibility for differences among project participant, whose LOA is the appropriate one to use in measuring project success? Ignoring for now the problem of improper aspirations (we will discuss this in the next chapter), we must consider the user(s)'s LOA as more appropriate than the designer's as an indicator of project success, since it is the user whose problems the implementation effort should be designed to address. This discussion implies that different users of the same system might have conflicting views of its success. Indeed, this occurs in some of the projects we have studied, and we will discuss this issue more thoroughly in subsequent chapters.

Consider an example where user and designer have conflicting expectations. The designer, head of OR at a large financial institution, proposed to the management of that institution that he develop a model for analyzing the profitability of various types of customers. This model would have implications for a large group of senior managers, since it would change considerably the way they look at their customers. The model was developed with management's approval and support, was used for a short while, and then put aside. Virtually all of the senior managers say this project was very important to them, and while none make explicit use of the model anymore, they all 'think like the model' when looking at customers. The designer, while recognizing the implicit use of the model in the manager's changed way of thinking, is frustrated by the lack of any explicit model use. What we see is a difference in desired LOA between the designer and the user group; the latter wanting level 2 adoption, change in their thinking through the use of a new conceptual tool, and the former hoping for level 3 adoption, recurrent use of the physical tool (computer-based model) which he had built. The users' LOA goal was met; thus, they view the project as a success. The designer's goal was not met, and he sees the project as somewhat of a failure.

Resolving this difference of opinion is not possible from the participants' point of view, but from ours as external observers it is. The users' aspirations for this project were met, and in that sense, at least, it is a success. In a more global sense, we might call this effort a failure if the users' aspirations had been inappropriately low. We have no evidence that this is the case; the designer, in fact, does not argue that the existing pattern of implicit model use is wrong, only that he would like to see explicit use. Indeed, this likely reflects a failure by the designer to work through the Entry stage adequately and come to an agreement with the users as to just what the project's goals were. The conclusion we draw from this example is that it is primarily the match between the user's desired and achieved LOA that determines the success of an implementation effort.

V.2.4. Success vs. completion.

The concepts of success and failure do not by themselves do justice to the model of implementation that we have been building. We have stressed that implementation is dynamic, that it is a process of change. Our outcome measures should reflect this fact. Success and failure imply a rather static and final assessment of a project. Thus, we add to our picture of outcomes the notion of 'incompletion.'

Many projects will, at some time during their life, appear to be failures. Often the character of the project outcomes can be changed by devoting further effort to the project. The Kolb-Frohman model includes a loop from Evaluation back to Planning. An implementation effort which has not reached its goals may follow this path in an attempt to reach a more successful conclusion. In this sense, then, an apparent implementation failure may really be a project which is still incomplete.

This issue of a time dimension applies also to another phenomenon we may observe. A project which succeeds in meeting its original goals may alter the environment in which it is placed to such an extent as to necessitate a change in goals and further action (see Ginzberg, Little & Smith, 1975, for a description of just such a project). Such a project, while successful, is still incomplete. Evolutionary iteration through the implementation process is needed to complete the changes.

The purpose of this short section has been to point out that implementation outcomes have a time dimension. Whether a project looks successful or not depends on when we measure this attribute. Apparently unsuccessful projects *may* later become successful ones; and, successful implementation does not necessarily mean that change can cease.

VI. Research Hypotheses and Methods.

VI.1. Overview.

This chapter introduces a field study designed to assess the applicability of the modified Kolb-Frohman model as a description of the implementation process and its relationship to outcomes. The basic approach taken in this study was the sampling of a small number of MS implementation efforts, using questionnaires distributed to both the consultant (designer) and the client (user or intended user). Responses to these questionnaires were used to reconstruct the implementation process followed in each project, and to test certain hypotheses about the relationships among process, technology, and outcomes.

The use of a questionnaire-based methodology to study process requires some comment. Clearly, a more thorough picture of a process can be developed if it is observed directly in real-time, and observation is the general approach to implementation research suggested by some researchers (e.g., Gibson). Indeed, we have recommended observation (action research) as part of our approach to implementation research. Observation, however, is a tremendously time consuming process. Even the basic questions about the relationship between implementation process and implementation outcomes are yet to be answered. Collecting real-time observations on a large enough sample to be able to address these questions would require numerous person-years of effort. Clearly, an alternative strategy which might provide some basis for evaluating the approach advocated here is preferable.

Thus, we must ask whether the questionnaire-based approach represents a viable alternative to observation? Can we obtain an adequate representation of an implementation process using questionnaires to reconstruct that process? This question should be asked in two parts. First, can we ask the appropriate questions to tap into this process? And, if we can ask the right questions, can we expect to receive answers which are indicative of what actually happened? Considering first the questions to be asked, we suggest that the process issues previously discussed (and detailed in Appendix III) are the elements of process we are concerned with. Knowing how each of these issues was resolved in a given situation should provide us with a picture of the process which took place. We can develop a series of questions which addresses this set of issues, and we will discuss the development of these questions later in this chapter.

Next, consider the answers we are likely to receive. Using a questionnaire to gather retrospective data does introduce some sources of error -- e.g., misinterpretation of questions, bias in responses, rationalization, and forgetting. We can try to minimize the impact of these problems through careful design of the questionnaire and selection of the projects to be studied, and through motivating the participants to respond to the questionnaire as carefully and as faithfully as possible.

Berleson and Steiner (1964) discuss a number of research findings on human memory which are relevant to us in designing the questionnaire and selecting projects for the study. First, much "forgotten" material can be recaptured with appropriate cues; aided recall will turn up much more material than will unaided recall. Thus, by asking direct, relatively specific questions we are likely to obtain a more accurate picture than we would with more general questions. Second, recent events and isolated events are better remembered than events which are long past or which are surrounded by similar occurences. This suggests that we would do best to look at projects which are relatively recent and represent major efforts.

There is some evidence which suggests that managers' perceptions of their environments are reasonably accurate. Morse (1970) used both objective and subjective measures of organizational characteristics, and found these to be largely congruent, even in those cases where the characteristics reflected an unfavorable condition. Von Hippel (1973) has used retrospective data to explore new product innovation. While finding some inconsistencies in the data (e.g., between respondents), he did find the approach useful, at least for the early stages of research in that area. Thus, there is reason to believe that the respondents to our questionnaires are at least <u>able</u> to provide reasonably accurate data.

Beyond careful questionnaire development and project selection, we hope to be able to motivate careful and accurate responses by demonstrating to each participant the potential value of this research to him and to his organization. To this end, a description of the research and its goals was distributed to each participating organization before questionnaires were distributed. Only those organizations agreeing that this research was potentially valuable to them participated in the project.

We conclude on this issue, that while we cannot eliminate all measurement problems, we are at least likely to be able to gather data adequate for exploring the major process issues. We can minimize the problems by careful design of the questionnaire, and we can get a feeling for the magnitude of the residual problem by careful analysis of the data gathered.

The remainder of this chapter describes the hypotheses to be tested and outlines the study itself -- development and testing of instruments, the research plan, and selection of research sites.

VI.2. Research Hypotheses.

The major hypothesis to be investigated in this study is:

H1: The difference between successful and unsuccessful implementation efforts can be explained by the handling of the implementation <u>process</u>.

By 'handling of the process' we mean working through and resolving the issues presented at each stage. Thus, we would expect to find a greater degree of resolution of these issues in successful implementations. As we have already spent many pages developing the argument for this hypothesis, we will not repeat it here. We will look in more detail at this hypothesis (as well as the others) in a later section of this cahpter.

H1 suggests certain broad requirements for success without regard to factors other than the process. The other major hypotheses suggest necessary differences in the process across technology types.

> H2: Success in a DSS implementation effort requires a higher LOA goal than does success in a conventional information system or one-shot modeling project.

Each of these types of technology has a minimum level of change needed for success. For one-shot modeling projects it is level 1 in the Huysmans/Keen scheme ("management action"). The project should provide the user with a solution which he can act on; neither adoption of a new tool for recurrent use nor change in the types of decisions made by the user is required in this case.

Conventional information systems require a somewhat greater degree of change than do one-shot models. These systems attempt to provide a tool useful to the manager in performing existing tasks. Typically they represent a new mechanism for providing the user with the same data he has been using. No change is required in the user's view of his job or in the decisions he makes, nor is a shift towards more use of MS techniques demanded. Thus, conventional information systems require adoption at level 2 ("management change").[1]

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[1]This is actually an oversimplification. "Conventional" information systems range widely in characteristics, from the quite simple

DSSs, in order to be successful, require substantially greater change than either of the other two classes. These systems are designed for use in relatively unstructured situations, they frequently provide the user with information or capabilities he previously did not have, and there often are multiple possible ways to use them. This implies a need to adopt at both level 3 ("recurring use of the MS approach") and level 4 ("redefinition of tasks"). The former, level 3, is necessary because of the multiplicity of potential uses for such systems and the lack of precise definitions of all these uses in advance of implementation due to the unstructured nature of the situation. It is only through a willingness to experiment with the system that the most meaningful use of it can be found. The need for level 4 adoption is almost tautological, as the purpose of a DSS is normally to provide the user with task relevant capabilities he previously did not have.

The LOAs outlined above represent the minimum LOA goals consitent with the type of system being developed. If the aspiration level is lower than that suggested, the necessary degree of change has not been recognized, and the prospects for successful installation of that system are low.[2] LOA goals higher than those suggested are completely possible. The client in a one-shot modeling project may view this effort as the first step in a move towards a more formal approach to

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and straight forward to the very complex (this, in the organizational sense we discussed earlier). As these systems become more complex, the degree of change necessary increases; we will consider this range and its implications as we examine specific systems included in this study.

[2]The overall implementation effort may be successful by the

management, and may, therefore, hold a level 3 LOA goal. Successful use of this model will still require only level 1 LOA achievement, but the client may be dissatisfied with the project as a whole if he does not reach level 3. In summary, H2 suggests only the minimum LOA goal necessary, and implies that systems cannot be successful unless the user holds this minimum goal.

The last of our major hypotheses deals with differences due to technology type at one specific stage of the implementation process, Entry.

H3: The number of dimensions requiring resolution at the Entry stage increases with system complexity.

H3 can best be explained by looking at the Entry issues likely to be relevant for each type of technology. For this analysis we divide the conventional information system class into two sub-classes. The least complex systems, those conventional information systems wholly contained within one primary task group (e.g., payroll, accounts receivable), are essentially unidimensional. The primary issue presented by these systems is technical, providing a tool which processes the data correctly and produces the required output. No changes in task definition or task relationships are necessary, since the system follows existing organizational lines. As a result, efforts to implement these systems may well be successes even if little

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definition we gave earlier (i.e., matching of the user's LOA goal and LOA achieved), but the system adopted will function only at a level consistent with the achieved LOA.

attention is paid to the Entry issues.

The next class up in terms of complexity is the one-shot model. Besides the purely technical dimension, these systems present the issues of an individual's understanding the system and accepting it as useful . The cognitive issue, understanding the nature of the modeling approach, is important here because these models represent a considerable degree of abstraction from the reality the manager typically deals with (conventional information systems, on the other hand, are usually a part of the manager's reality). Thus, care must be taken to assure that the abstractions embodied in the model are both meaningful and sensible to the user. Model acceptance at the Entry stage concerns the issue of developing 'felt need' and commitment. Unlike the case with many conventional information systems which are the sole source of clearly necessary outputs (e.g., pay checks), the client in the one-shot modeling effort can choose to ignore the system. Gaining commitment and developing a felt need at this early stage are, hence, more directly relevant to the success of these projects.

At the next step up the complexity ladder are those conventional information systems which encompass a number of organizational activities. As an example, consider a sophisticated bill of materials system which might be used by the the engineering, production, marketing (for bidding), finance, and accounting departments. The technical, cognitive, and acceptance issues are all present here. But, we have now expanded the number of actors involved, and this introduces a variety of new issues. Multiple task perspectives must be considered, implying a much greater need for communication and coordination. The situation becomes more complicated as a variety of organizational issues -- historical and political -- come into play. Thus, the need to attend to all of the Entry issues -- goals, objectives, commitment, influence, team formation -- is very real for these systems.

The DSS, as we have argued, is the most complex system type from the implementation perspective. Not only are all of the issues of sophisticated conventional systems involved, but there is also the question of bringing about a change in the client's view, often a sizable change. This can only serve to reinforce the need to attend to the Entry issues, particularly those of commitment, influence, and felt need for change.

The implication of the differences just described is that while the Entry issues are important for all systems, they become more salient as system complexity increases. Thus, more complex systems are likely to require considerably more attention to these issues than are less complex systems, and the resolution of these issues is likely to become more difficult as system complexity increases. A degree of attention to these issues that is adequate for successful implementation of a simple system will not be so for a complex system.

In summary, we have proposed three major hypotheses. The first presents the major contention of this thesis, that the outcome of an implementation effort is determined by the implementation <u>process</u>

followed. The other two hypotheses modify this initial statement by suggesting some specific variations to the process required for different technology types. After looking at the research plan, sites, and instruments, we will look again at these hypotheses, suggesting the specific results (in terms of measurements taken) expected.

VI.3. Research Plan.

The data gathering portion of this research can be divided into two phases -- screening and survey. The screening phase serves two purposes, locating projects suitable for inclusion in the sample and gathering some background information on those projects selected. The Screening Questionnaire (see Appendix IV) was used for this portion of the data collection. Typically, this was completed by the system designer/consultant.

Project selection was, of necessity, somewhat fortuitous. The organizations approached for participation in this project were selected on the basis of one or both of the following criteria:

1. an informal affiliation with the Sloan School (e.g., employing Sloan School alumni), or
2. an expressed interest in research in the general areas of management science or management information systems.

Not all organizations approached had projects suitable for inclusion in this study. Three principal criteria were used to screen out unacceptable projects. First, projects which were not computer-based were eliminated from the sample (we discussed the reasons for this in Chapter I). Second, projects for which the user and designer (as defined earlier) were the same person or for which the user was not available to respond to a questionnaire were eliminated. We have already pointed to the importance of the user's perspective for defining project outcomes, hence the need for the second half of this restriction. The need for the first half should be obvious; much of the 'process' is embodied in the user/designer relationship, and these issues disappear if user and designer are the same person. Finally, project timing was used as a screening criteria. We indicated earlier that recently completed projects (i.e., no more than a couple years old) were preferable to projects which had been completed long ago. In addition, we wanted projects which had been completed, or if still active, had gone through the Action and Evaluation stages at least once. Projects which were still in earlier stages could not provide us with any measure of outcomes, and thus would not be useful in testing our hypotheses about process.

In all, sixteen organizations were approached. Two were eliminated because they had no projects which passed the screening criteria (above); two refused to participate; and, one agreed to participate but was subsequently unable to do so because of pressing problems within the organization. The eleven organizations which did participate provided data on 34 projects (the number of projects from each organization varying between 1 and 9).

The data collected at the Screening stage provided certain background information on the projects -- size, timetable, purpose, participants -- and enabled us to place it (tentatively) on a two dimensional grid of technology type and project success. As both of these dimensions are relevant to the hypotheses being tested, our hope was to get fairly even coverage along both dimensions. Technology type was assessed with the questions in section II of the Screening Questionnaire (see Chapter V and Appendix IV for descriptions), and an initial tentative assessment of success was made with the questions in section III. Placement on the success dimension at this point was made only as a gross check on the characteristics of the sample, so that efforts to find additional projects could be directed towards the sparser areas.

The second phase of the study, Survey, represents the bulk of the data gathering activity. For each project selected at the Screening stage, questionnaires were distributed to both user and designer personnel. For most projects this meant one user and one designer, though for some projects where it was not possible to find a single key user or key designer, multiple questionnaires were distributed. The two questionnaires were identical in terms of questions asked (see Appendix V), but differed in phrasing in order to match the perspective of the respondent. For example, question 29 on the user questionnaire states, "Our people were just too busy to participate much in problem diagnosis," while the corresponding question on the consultant version is stated, "Client personnel were just too busy to participate much in problem diagnosis." In this manner, we were able to obtain both the client's and the consultant's perceptions of the same aspects of the implementation process.

The data collected at this phase were used to reconstruct the implementation process from each party's viewpoint. The questionnaires ask a few background question -- about the respondent, his involvement with the project, his experience with this type of project, and his work environment -- and then present a series of 81 descriptive statements about implementation. These statements were derived from the list of stages and issues in the Kolb-Frohman model (see Appendix III); some statements represent favorable resolution of the issues, and some unfavorable. The respondent was asked to indicate for each statement whether it was characteristic of, uncharacteristic of, or not applicable to the specific project. From these responses, scores for each of the seven process stages and for the dependent variable, success, were calculated. Development and scoring of the instrument are discussed in the next section of this chapter.

VI.4. The Survey Questionnaire.

VI.4.1. Development and testing.

Considerable effort was put into the development and testing of the Survey questionnaires (consultant and client versions). The first step was the formalizing of the 'implementation issues' discussed earlier and listed in Appendix III. Developing this list of issues began with a careful reading of the relevant literature (in particular, Kolb & Frohman, 1970, Lippit, Watson & Westley, 1958, Lucas & Plimpton, 1972, and Schein, 1969). All issues suggested by these sources as issues requiring resolution were put on a master list. We should note that this literature is often rather vague, discussing issues only at a rather general level. Indeed, Kolb has suggested (personal communication) that our efforts have made his model far more specific and operational than he ever intended to himself, but that he does find this useful. Thus, our master list required some refinement to make the issues sufficiently specific. David Kolb, Peter Keen, and this writer discussed this list, modified it, and finally agreed that the list included here (Appendix III) is a fair and accurate representation of the issues suggested and implied by the literature.

Once agreement on these issues had been reached, we developed lists of statements which described conditions congruent with resolution (or non-resolution) of the various implementation issues. A panel of people familiar with the Kolb-Frohman model and the Lewin/Schein theory (David Kolb and four doctoral candidates in the OD area) were given a randomized list of 101 statements and the list of issues and stages. They were asked to indicate to which stage each item related, and whether agreement with that statement indicated favorable resolution of that issue or lack of resolution. Before asking the raters to score these items, we developed our own a priori item assignments (stage and direction). Items for which at least four of the raters (one of whom had to be Kolb) agreed with our assignment were assumed to be properly assigned. The reamaining items were discussed with the raters, and were either modified so that the raters could agree on their placement (both stage and direction), or dropped if agreement could not be reached. Agreement was finally reached on the list of 81 statements included in the questionnaires appearing in Appendix V. This list is reasonably well balanced. It includes at least one item for every issue, and, in those cases where the issue was too complex to be adequately assessed with a single item, it includes two. In addition, it has roughly equal numbers of statements favorable to and unfavorable to the resolution of issues within each stage. We tried throughout the questionnaire to make the item phrasing as value-free as possible.

When agreement on items was reached with the expert panel, the statements were assembled into questionnaires. Three forms were constructed -- ordered (in terms of model stages) client and consultant versions, and a randomized client version. These questionnaires, together with a brief case description of an implementation situation, were distributed to a group of masters students enrolled in a course in research methodology and measurement. Each student received only one version of the questionnaire, and each member of the class was asked to read the case and respond to the questionnaire as if he had been a participant in the project described. This exercise was to serve as a pretest for the questionnaire, and we hoped it would answer two important questions:

1. was the instrument reliable -- i.e., given the same data to work from, would individuals give the same responses? and,
2. would responses differ in any systematic way across the three questionnaire forms?

The latter question was important for two reasons. First, though we made every effort to assure the comparability of statements in the client and consultant versions, it was conceivable that some items would be interpreted differently in their two forms. Second, our own feeling was that the ordered version was easier to use and would make more sense to the reader that the randomized version. However, we wanted to be sure that presenting these statements in a logical order would not invite indiscriminate responses.

The number of questionnaires completed and returned (8) was, unfortunately, too small to allow conclusive testing of all of our questions. However, useful information was gained. As in the final questionnaires, each statement in these questionnaires could be described as characteristic, very characteristic, uncharacteristic, very uncharacteristic, or not applicable (e.g., not enough information). The case description provided enough information for definite responses to 55 of the 81 statements in the questionnaires (that is, the information provided was adequate for determining whether the statement was characteristic of the case or not). Among the eight respondents there was substantial agreement (no more than two persons selecting the opposite side of the neutral position) on 43 of the 55 statements. The number of questionnaires returned was too small to do much comparison between versions, but we found no evidence of systematic differences.

The responses to the questionnaires suggest that the instrument has at least some degree of reliability. The respondents' comments helped answer our other questions. There was agreement that the randomized version was both difficult and annoying to complete. On the other side, a number of respondents suggested that having the statements ordered in some logical sequence caused them to think more carefully about the issues than they would have for isolated questions. The final questionnaires are, thus, ordered in terms of stages. Other comments offered by the class resulted in minor changes aimed at making the questionnaire easier for the respondent to use and less ambiguous than it had been (i.e., certain terms which seemed to be confusing were defined at the beginning of the questionnaire).

VI.4.2. Scoring the responses.

The purpose of the Survey Questionnaires is to gatner data sufficient for reconstructing the implementation process followed during a project. These data can then be used to test the hypotheses outlined earlier. Our model of the implementation process is organized around the concept of stages, and our hypotheses deal with these stages rather than with the individual issues. Thus, the questionnaire responses must be aggregated by stages before data analysis can begin.

The basic approach taken in scoring the questionnaires is to calculate a score for each of the seven process stages which reflects the degree to which the issues at that stage were favorably resolved. Responses were given on a five point scale, allowing two degrees of either agreement or disagreement with the statement as descriptive of the project, and one neutral point (the statement was neither characteristic nor uncharacteristic of the project, or it was not applicable to the project). Responses to the individual items were scored on a five point, zero centered scale (i.e., -2 to +2), with the neutral responses being scored as zero. A response of "Characteristic" ("Very Characteristic") was scored as 1 (2) if agreement with the statement indicated resolution of the issue, and as -1 (-2) if agreement indicated lack of resolution. Responses of "Uncharacteristic" and "Very Uncharacteristic" were handled similarly but with opposite signs.[3]

For each project we would like to be able to calculate a score for each stage which represents the degree to which the issues

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[3]The questionnaires and an indication of the direction of each item (favorable or unfavorable) are included in Appendixes V and VI.

underlying that stage were successfully addressed. When we look at the data, however, we find that the inter-item correlations within the stages are, in a number of cases, quite low (Appendix VII includes tables of these correlations). We should ask, then, under what circumstances would we expect to find high correlations between the items, and under what circumstances would we not? If each stage represented a single, unitary action, or some set of actions which logically had to be performed together, we would expect, at least in the case of successful projects, to find high intercorrelations of the items making up that stage. But, the stages of the Kolb-Frohman model are not uni-dimensional. There is a great diversity of activities within each stage. Consider even the relatively simple Diagnosis stage. It includes:

1. the consultant's attempting to understand the problem from the user's point of view,
2. the user's taking an active role in the diagnostic data gathering,
3. defining the problem and its organizational interdependencies, and
4. predicting the impact of the solution on the client <u>and</u> on other parts of the organization.

There is no inherent reason to expect these actions to occur in concert. No one of them logically implies the others. They are defined as a stage, however, because each represents a type of activity which the OD approach to change implies should be a part of the problem diagnosis effort. We have looked only at Diagnosis; similar statements could, however, be made about the other six stages as well. Given this situation, it is not surprising to find low inter-item correlations.

Though the individual items need not vary together, the OD tradition defines them as logically belonging together. Furthermore, it suggests that the consequences of ignoring (or failing to resolve) the issues of Diagnosis, for instance, will differ from those of ignoring the Action issues. Thus, we would like some measure of a project's overall success in negotiating each stage; how well did it resolve the issues which should be attended to at that stage? The method we have chosen for this calculation is to sum the number of issues reported as having been favorably resolved at a stage, and subtract from this the number of issues reported as being unfavorably resolved. We must recognize that given the low inter-item correlations, such scores provide us with only a gross measure of what occurred at the stage. The same numerical score can arise from quite different combinations of responses, so we cannot conclude anything about which issues were resolved (or not resolved) on the basis of the overall score for the stage.

We caution the reader not to consider the stage score as anything more than a gross indicator of the respondent's perceptions of the general level of success in resolving the issues which should be resolved at that stage.

Our basic unit of analysis for examining the data should be the project. But, the question arises; in terms of respondents, how do we define a project? We can calculate stage scores for each user and each consultant involved in a project. In the simple case of one user and one consultant, the project can be defined quite simply as the responses of these two individuals.

When we begin to look at projects with more than one user or more than one designer responding, the question of defining project boundaries is not so simple. Our measures of both the independent (implementation process) and dependent (outcome) variables reflect largely the _repondent's_ perceptions of these aspects of the project. We suggested earlier that much of the implementation process is embodied in the individual relationships of consultant and client. Thus, when there are multiple participants on one or the other side of a project, we cannot necessarily expect their perceptions of process to be congruent; each has been involved in a unique client-consultant relationship.[4] Similarly, the assessment of project outcomes can vary from user to user, depending upon how well the project met the individual's needs. It would make little sense to aggregate respondents in an attempt to obtain some overall score for the project. It is more logical to examine the relationship between process and outcome for each user involved in a project. Thus, for projects with multiple user respondents we will examine separately the responses of each user, keeping in mind, of course, that they represent different views of the same project.

VI.4.3. The dependent variable.

The discussion so far has focused on scoring the degree to which the implementation process was handled in accord with the prescriptions of the Kolb-Frohman model. These scores are our measures of the independent variables in this study. As explained earlier, we take as the primary dependent variable, success, as measured by the match

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[4]Our data include a number of projects with multiple user respondents but none with multiple designers. Thus, we address our comments primarily to the former situation.

between the user's LOA goal and LOA achieved. Operationally, we use nine of the 81 statements in the questionnaire to measure this variable. Items 7-11 are used to assess LOA goal and items 71-74, the LOA achieved. There are direct correspondences between questions 7 and 71, 8 and 72, and 9 and 73. These items measure the goal and achievement of levels 1, 2, and 3 -- action, change, and recurring use -- respectively. Level 4, task redefinition or extension, is handled in a slightly more complex fashion. Both items 10 and 11 address aspects of this issue from the goal side, and a positive response to either is taken to indicate a level 4 LOA goal. Item 74 addresses the question of level 4 LOA achievement.[5]

Success has been defined as the matching of LOA achievement to LOA goal. We suggested that these levels form a hierarchy, and that it is the highest aspired to level of adoption which with we are primarily concerned. Thus, we define success by the closeness of the match between the highest LOA goal and the highest LOA achieved. Specifically,

$$\text{Success Level} = 1 + \frac{\text{Highest LOA Achieved} - \text{Highest LOA Goal}}{\text{MAX (1, Highest LOA Goal)}} .$$

[5]With the benefit of hindsight we can see that our testing of level 4 adoption is not ideal. The item is phrased as, "The decisions I make have changed as a result of having this system." Our intent was to find out if the nature of decisions made -- e.g., variables considered -- had changed. Unfortunately, the statement could be interpreted as referring to the outcomes of decisons.

This score can range between 0 and 5. A score of 1.0 would indicate a perfect match between aspirations and achievements; scores above 1.0 indicate achievement in excess of goals; and, scores less than 1.0 indicate a failure to achieve the level aspired to.

There is another posible measure of success included in the data collected. Item 69 in the Survey Questionnaires ("All in all, I am quite happy with the outcome of this project.") is a gross measure of overall satisfaction with the project. We would expect this item to correlate well with our other measure of success, and, if problems develop with using the LOA measure, we could use this as a substitute measure of success. We discuss these measures in the next chapter.

VI.5. Some Expected Relationships.

Having discussed both the major research hypotheses and the measurement of dependent and independent variables, we can look now in some detail at the relationships we would expect to find. Recall that H1 stated that success in an implementation effort should be related to good resolution of the process issues. Thus, we would expect high scores for the process stages to be associated with high levels of success. Does this imply that less successful projects must exhibit lower process scores across all stages? Our answer must be no. The Kolb-Frohman model suggests that <u>all</u> stages should be dealt with to insure success; thus, the failure to handle and one stage adequately could, theoretically, lead to diminished success.

We suggest, however, that certain stages are likely to be far more critical than others in determining project success. These stages are Entry, Diagnosis, and Termination. Consider first Termination. It is at this stage that institutionalization of the system must take place. This means not only assuring that the system is integrated into the users' current task behavior, but also assuring that the system and the users can evolve into new behavior patterns together. Failing to handle this stage properly is liable to result in a system which is soon put aside; either because the user never really accepted the system as 'his', or because the environment changed and he could not make the system keep pace with that change. In either case the end result will be dissatisfaction, low success.

Entry is another of the stages we believe to be critical. It is at this stage that the felt need for the change effort, commitment to it, and expectations for it is developed. It is also at this point that the relevant personnel to effect that change are gathered to form a team. Failure at this stage is likely to result in lack of commitment to the change effort, improper expectations for the change, or the development of a team not capable of implementing the change. The likely outcomes are user dissatisfaction and resistance, though they may not show up until near the end of the project.

Consider now the Diagnosis phase. It is at this point that the problem to be solved is defined. Failing to resolve the issues at this stage implies that the problem solved may not be the right one from the user's perspective. No matter how good the solution, we could not expect the users to be particularly enthusiastic about it if it was addressed to a problem they did not see as their own. The likely outcome is an elegant system which is never used.

We can contrast this failure in Diagnosis to a failure in the Planning-Action-Evaluation loop. Assume that we are successful in our diagnostic effort but that we fail somewhere in the three stages which follow. What is the likely outcome? Most probable is that we develop a system which is not the best possible system for that situation. But, if good diagnosis got us to focus on the right problem, it is likely that the system developed will be in some measure useful to the users. We will argue, in fact, that when dealing with technology based changes, these three process stages will relate much more to the system's technical quality than to user satisfaction with it. Users quite often are not in a position to assess technical quality; thus, its impact on their satisfaction may well be minimized.

We have discussed the importance of all stages but one, Scouting. Though not included among the stages we previously suggested as critical to success, Scouting should, in theory, be on this list of critical stages. Our sample of projects, however, likely has a systematic bias against projects with truly bad Scouting efforts. Such a project would likely die long before it reached the Action phase. Our selection criteria requiring that the project had gone through the Action stage would therefore tend to eliminate projects with very poorly handled Scouting. Thus, while we believe that Scouting is an important stage and should theoretically relate strongly to user satisfaction, we would not expect to find such a relationship in our data.

We have looked at the stages individually and suggested that three are particularly likely to be related to the success or failure of the projects in our sample. We should note, however, that there can be interactions among the stages which could modify the observable results. A poor job at Entry or Diagnosis, for example, could be compensated for by a more thorough Planning effort; issues from the earlier stages found to be unresolved could be addressed at this later stage. Since many of the items in our questionnaires include some indication of the relative timing of events, issues which are resolved at a later than normal stage would likely not show up in the score for the stage to which they would ordinarily belong. Due to some similarity of issues in the Entry, Diagnosis, and Planning stages, the late resolutions could affect the score for the later stage.

For one stage, Termination, there clearly is no later stage at which errors can be remedied. We would thus expect to find the strongest association between Termination and success. Entry, Diagnosis, and possibly Planning should also be related to success, though we would expect these associations to be weaker than that for Termination.

The reasoning behind H2 (the requirement for different minimum LOA goals for projects of differing complexity) has already been rather fully explored. To test this hypothesis we will look within each complexity group (dividing the projects into complexity groups is discussed in section 2 of the next chapter) at the highest level LOA goal specified by each respondent. We would expect to find considerably lower success rates (measured by overall project satisfaction) among those projects not having a LOA goal at least as high as the minimum appropriate for projects of that complexity. A weaker test of this hypothesis, but one which still could give us some useful information, would be to compare the average maximum LOA goal level across complexity groups. We would expect to find this average increasing as system complexity increases.

H3 states that the number of dimensions requiring resolution at Entry increases with system complexity. In terms of our study, this means that we would expect to find higher Entry scores (on average) among successful DSSs (and other complex systems) than we would among successful systems of lesser complexity. Put another way, an Entry score that would be adequate for success in a simple system might not be so for a complex system.

While H3 considers differences across technologies only at the Entry stage, one might expect to find such differences for other stages too. Diagnosis, the problem defining stage, is likely to become more difficult as system complexity rises, and we would expect to find a relationship here similar to that suggested for Entry. Our priors for this are somewhat lower than those for the relationship at the Entry stage, however. Planning, Action, and Evaluation have been suggested as the 'technical loop' in the process. Since the technical dimension is more salient in less complex systems (often being the dominant issue), we might expect to find higher Planning, Action, and Evaluation scores among simpler systems, both generally and if we control on success.

Finally, let us consider the Termination stage. We have stated that the continued use of any system (and hence, satisfaction with it) requires a well handled Termination stage. Some systems, however, have 'built-in' mechanisms which tend to assure their continued use. Conventional information systems normally provide some sort of output without which the organization simply could not function. DSSs, on the other hand, provide a 'product' only loosely connected to the organization's previous mode of operation. Thus, we would expect the conventional system to be to an extent 'self-institutionalizing', while the DSS requires a conscious effort to achieve institutionalization. As a result, we well may find a stronger relationship between Termination and success for DSSs than for other system types (particularly conventional information systems).

To summarize, we have now presented three major hypotheses concerning the relationahips among implementation process, implementation outcomes, and technology types. Specific relationships relating to these hypotheses have been outlined in terms of the specific measurements made in this study. In the next chapter we will begin to look at the data to determine the degree to which our hypothesized relationships do, in fact, exist.

VII. Analysis of the Field Data.

In this chapter we begin to look at the data collected in our field study. After describing the sample of projects obtained, we will discuss the division of the sample into groups which are internally more homogeneous than is the sample as a whole. We then move on to an examination of our major hypotheses. In the next chapter we will look at some of the data in greater detail, but in a more qualitative fashion than in this chapter. Then, in the final chapter, we will consider the implications of our findings for managers, consultants, and researchers.

VII.1. A Description of the Sample.

Data were collected for 34 projects in eleven organizations. Twenty seven of the projects provided complete data -- user(s) and designer Survey questionnaires, and Screening questionnaire -- and can be used in all phases of the analysis. One project could not be used at all, as no Screening questionnaire had been returned, and the project could not be classified as to complexity (discussed in the following section of this chapter). Two of the remaining six projects were missing only the consultant responses to the Survey questionnaire, and could be used for all aspects of the analysis except where user and consultant responses were compared. The remaining four projects were missing the user responses, and are used only in the discussion of segmenting the sample into homogeneous sub-groups (see next section).

The twenty-nine projects (27 with full data plus 2 with consultant missing) remaining come from 11 organizations in the following industries:

Industry	No. of Orgs.	No. of Projects
Banking & Financial Services	2	4 (1,3)
Broadcasting	1	3
Hospital	1	1
Retail Sales	1	4
Consumer Non-Durable	1	2
Nuclear Fuel Fabrication	1	1
Office Equipment (Mfg. & Sales)	1	9
Manufacturing (Electronics)	2	4 (1,3)
Industrial Chemicals	1	1

The projects range in age. One took place in 1968, and one other in the period 1969-1971; all others fall in the 1972-1975 time frame. Project size ranges widely; the smallest project reports involving 3 people, taking 2 months elapsed time, and costing $1500; the largest, requiring 30 months to complete and costing $15,000,000 (total number of participants not specified). Most projects lie closer to the small end, however, costing $10,000 - $100,000, involving 5 - 10 people, and taking 6 - 15 months to complete.

For the majority of projects we have twc respondents -- one user and one designer. This is adequate in most cases. There is usually one prime designer for each system who has the major interactions with the user(s); the majority of those involved on the technical side interface with this person rather than directly with the client. On the user side we are interested only in the users of the system's output, and among these our primary concern is with managerial users. Even on projects with large numbers of users, there are typically only a few managerial users. In four projects where multiple users (or classes of users) were identified, we obtained responses from more than one user (2 from three of the projects and 7 from the other). In all other cases, the user who responded to the questionnaire indicated that he was the principal user of the system. We expect process to be related to outcome at the individual level; that is, the individual's perceptions of the process should relate to the outcomes he reports in the manner suggested in the discussion of our major hypotheses. Different users involved in the same project could (and as we will see, sometimes do) differ in their assessments of both the process and the outcome dimensions. Differences on the outcome dimension likely reflect differences in the degree to which the project met the individuals' needs. Such differences could arise from the designer's being more concerned with the needs of one group of users than with those of another group (a process difference). If these differences in outcome are systematically linked to differences in process which are in accord with our hypothesized relationships, it only serves to underscore a point made earlier, that the implementation relationship must be between individuals (see Stabell, 1974, 1974a, for further discussion of the issue of individual differences among information system users). Thus, sampling only a part of the user population for a given system may not tell us the whole story about that system, but it does not harm our investigation of the implementation process.

VII.2. Segmenting the Sample.

The projects we are dealing with vary widely in organizational complexity, and our theory suggests that the process is likely to differ for projects of differing complexities. Thus, the data are likely to be analyzed most meaningfully if they are first divided into a number of relatively homogeneous subsets. Once subsets are defined, patterns of responses within groups and differences in the patterns across groups can be examined. We begin, then, by attempting to divide the projects into groups which are, internally, of similar complexity, and therefore relatively homogeneous from an implementation standpoint. If these groups seem to make sense, we can then further divide each one by type of respondent (user or designer) and by the dependent variable (success or failure). The resulting groups and sub-groups will be, we hope, sufficiently similar (internally) to allow meaningful analysis.

VII.2.1. Complexity groups.

Three technology types were discussed in Chapter 5 -- one-shot models, conventional information systems, and decision support systems -- and a sequence of questions to be used in differentiating among these technologies was discussed in that chapter and in Appendix IV. In the sample of projects collected only one met the criteria for one-shot models, and the data on this project were incomplete (there was no user respondent). Thus, the sample of projects to be analyzed includes no one-shot models.

When we apply the complexity scale to the remaining projects we find that they span almost the entire range of the scale. The possible range runs from 0 (least complex) to 9 (most complex), and the projects included in this study have scores ranging from 1 to 8. We suggested (in Chapter V) that systems falling at the low end of the scale would be the most conventional, and hence simple from an organizational/ implementation standpoint; those falling at the high end would typically be DSSs; and those falling in the middle would likely possess characteristics of both conventional systems and DSSs.

Our sample of projects divides into three roughly equal sized subsets if we group together those projects having scores of 1 to 3, 4 to 5, and 6 to 8. Looking at the nature of the projects falling into each of these groups can give us some feel for the adequacy of this subsetting for developing relatively homogeneous groups.

The low complexity group (scores 1 to 3) contains nine projects.[1]

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[1]All projects for which the complexity data was available are included in the discussion in this section. Some of these projects are not included in the later analysis due to a lack of user responses, and hence no measure of the dependent variable.

Seven of these projects fall within the general functions of accounting and business reporting. These projects are:

1. the accounting system for the trust accounts managed by a large bank;
2. a hospital outpatient billing system;
3. the billing system of a large manufacturing company which operates primarily on a rental basis;
4. a system to calculate salesmen's commissions for a large manufacturing company;
5. a system to produce taxable wage reports for a division of a large manufacturing company;
6. a system to collect and report daily operating data from the branch offices of a large manufacturing company; and
7. a system to collect and report data on equipment on rental within sales territories.

All of these projects represent fairly conventional data processing applications, all are limited to basically one function falling within a single functional area of the organization, and all but the last two (#'s 6 and 7) are strictly batch processing systems (the last two are remote batch systems, with data being transmitted from a number of locations to a central processing facility, and reports being transmitted back).

The other two systems in this low complexity group are:

1. an inventory control system for a single component of a very complex product; and

2. a system which automates production of the operating schedule for a commercial broadcast facility.

While not as conventional as the other seven systems, these two are relatively simple in an organizational sense. Both are basically single function systems and span only a small part of the organization space. The inventory control system is strictly a batch processing system, while the broadcast schedule system operates in both remote batch and on-line modes.

Characterizing all systems in this group as low in complexity seems quite reasonable. Beyond the characteristics already mentioned, all of these systems are limited to data collection and reporting of historical data (with the exception of the inventory control system which does some statistical analysis of the data). None of these systems include projective models. The systems do differ in size, number of users, etc., and we will discuss these differences in a later section.

The middle complexity group (scores of 4 or 5) includes twelve systems. Four of the systems are essentially data retrieval systems -- one in an investment services organization, one in a commercial bank, one in a large manufacturing firm, and one in a commercial broadcasting facility. Each of these systems serves multiple purposes, providing the user primarily with data needed for specific recurring decisions. All four systems operate on-line; all work with historical data and include no models for projecting future operations of the organization or conditions of the environment.

A second group of three systems can be described as multi-function operational systems:

1. a bill of materials processor/inventory control/requirements planning system in an electronic equipment manufacturing firm;
2. a comprehensive profit sharing plan system, which includes investment performance tracking; and
3. a stock option record keeping and data analysis system.

Each of these systems serves multiple functions, but the functions served all fall within a fairly narrow span of the organization (e.g., in production <u>or</u> accounting, but not both). All three systems deal primarily with historical data, and the models included (if any) are fairly straight forward (e.g., parts explosions). All of these systems operate in batch processing mode.

Another project included in this middle complexity group is an indirect expense reporting system for a division of a large manufacturing organization. This system is in many respects similar to the three just described; but, while those three serve multiple functions within a small part of the organization, this system performs a single function (indirect expense reporting) for multiple clients in a variety of positions (both different functional areas and different hierarchical levels). Like the three systems previously described, this system operates in batch mode, deals largely with historical data, and includes only very simple models.

The four remaining systems in this group are all to some degree model based. They are:

1. a beef inventory tracking and forecasting system for a supermarket chain;
2. a heuristic model for a manufacturing machine set-up problem; and
3. two relatively large business simulation models.

Of these four systems, the first operates on-line and the other three in batch mode. All aim primarily to provide data necessary for specific, normally recurring decisions, and all include models which attempt to project future operations (and, in the case of the beef inventory system, future environments).

Clearly, these twelve systems are more complex than the nine included in the low complexity group. They derive this added complexity from a number of sources -- multiple functions, multiple users, and the inclusion of projective models. For the most part, however, each system includes only one of these characteristics. Hence, the complexity of each is increased only along a single dimension. It is not until we consider the next group, high complexity, that we find systems which encompass a number of these characteristics.

Eleven systems are included in the high complexity group. Some general characteristics of this groups are:

1. all but one of the systems operate on-line;
2. all but one of the systems were intended for managerial users only;

3. all of the systems include some type of model or modeling capability, and in most cases they incorporate multiple models and capabilities;
4. nine of the systems are concerned with projections of the future -- either of future environments, future company operations, or both;
5. eight of these systems were designed to provide the user with <u>general</u> support for his tasks, rather than being aimed at specific decisions; and
6. eight were meant to introduce major changes in the way users did their jobs.

The eleven systems included in this group are:

1. a system for statistical analysis and projection of work measurement data in a supermarket chain;
2. a mathematical model for short range (12 months) sales forecasting of a frequently purchased consumer product;
3. a model based system (including optimization and sensitivity testing routines) for short and long term inventory evaluation, allocation, and planning, and for short term shipping scheduling in a large manufacturing firm;
4. a system to provide access to data, models, and general analytic support to portfolio managers in the trust department of a large bank;
5. a model used to project the sales volume of proposed new

supermarket locations;

6. a system which integrates the outputs of a number of organizational functions and allows projections of the budget for a large manufacturing company;
7. an extremely detailed accountability inventory system serving three client groups (Accountability, Material Control, and Production Control) in a complex and expensive fabrication process;
8. a system for budget preparation and simulation serving buyers and store managers in a chain of discount department stores;
9. a model and statistical routines used to predict the market success of new frequently purchased consumer products;
10. a model based system for the development and analysis of sales proposals for a commercial broadcast facility; and
11. a model based system for use by regional representatives of an equipment manufacturing company in analyzing customer needs.

The difference between these eleven systems and those classified as of intermediate complexity is more of degree than of kind. Each system in the middle group is complicated on one dimension -- inclusion of models, focus on the future rather than the past, serving multiple users, serving multiple functions. Most systems in the high complexity group incorporates <u>at least two</u> of these dimensions; the result, we believe, is that these systems are significantly more complex to

Characteristics of the Systems Studied

Project	On-Line	Multi Function	Multi User Areas	Clerical Users	Mgt. Users	Projective Models	Statistics, Optimizations
Low Complexity							
1. Bank Trust Acctg.				X	X		
2. Hospital Billing				X			
3. Rental Billing				X			
4. Sales Commission				X	X		
5. Taxable Wages				X			
6. Branch Operating Data				X	X		
7. Rental Eqpt. Reports					X		
8. 1-Component Inventory Control				X	X		X
9. Broadcast Schedule	X				X		
Medium Complexity							
1. Investment Data Retrieval	X	X			X		
2. Bank Data Retrieval	X	X		X	X		
3. Mfg. Data Retrieval	X	X			X		
4. Broadcast Data Retrieval	X	X		X	X		
5. BOMPS/IC/RP		X		X	X	X	X
6. Profit Sharing		X		X	X	X	
7. Stock Option		X		X	X	X	
8. Indirect Expense			X	X	X		
9. Beef Inventory	X			X	X	X	
10. Machine Set-Up				X	X		X
11. Simulation I					X	X	
12. Simulation II					X	X	

Table 4.

Characteristics of the Systems Studied (Cont.)

Project	On-Line	Multi Function	Multi User Areas	Clerical Users	Mgt. Users	Projective Models	Statistics, Optimizations
High Complexity							
1. Work Measurement	X				X	X	X
2. Short Range Forecasting	X				X	X	
3. Inventory & Shipping	X	X	X		X	X	X
4. Portfolio Mgt.	X	X			X	X	
5. Supermarket Sales	X				X	X	X
6. Budget Projection		X			X	X	
7. Accountability Inventory	X	X	X	X	X		X
8. Budget Preparation & Simulation	X	X	X		X	X	
9. New Product Model	X				X	X	X
10. Broadcast Sales	X				X	X	X
11. Customer Needs Analysis	X				X		X

Table 4.

implement than those in the other two groups.

Our measure of complexity appears to do a good job of dividing systems into groups which are relatively homogeneous within, and which differ substantially from one another. Table 4 summarizes these differences, indicating the key characteristics of each system. Beyond the differences described above, there are differences in project size, number of users, etc. both within and between groups. After looking at the dependent variable, success, we will turn to a discussion of these differences.

VII.2.2. Success and failure.

Ideally, our measure of project success should be the matching of the user's LOA achievement with his LOA goal (see Chapter 5 for a full discussion). As we mentioned in Chapter 6, however, our measure of achievement is somewhat suspect because of poorly chosen wording for one of the items. In addition, we suggested that different technologies require different LOA goals; and, unless the goal specified is appropriate to the technology, we would not necessarily expect the LOA matching criterion to be a good measure of success (e.g., achieving only an inappropriately low goal would not ensure success, nor would failing to achieve an inappropriately high goal necessarily indicate failure).

Considering the three technology groupings discussed in the preceding section, we would expect the appropriate LOA goals to be 2, 2 or 3, and 3 or 4 for the low, medium, and high complexity groups respectively. We find in the data, however, a strong tendency to specify level 4 regardless of complexity level, ranging from 65% of the respondents in the low complexity group to 78% in the high group. In all three groups there is a greater tendency for consultants than for users to specify a level 4 goal, but even so, fully 56% of the low complexity users specify a LOA goal at level 4.

We suggested in Chapter VI that we have another measure of success available. Item 69 in the Survey Questionnaire asks for an overall assessment of satisfaction with the project. The user's response to this question should provide a reasonable measure of project success, defined as meeting the user's needs. We can look at the relationship between these two measures, overall satisfaction and the matching of LOA achievement to goals. Both variables can be dichotomized to yield "successful" and "unsuccessful" scores. For the LOA measure we define as "successful" any respondent whose highest achieved LOA equals or exceeds his highest level LOA goal. For overall satisfaction we define success as a positive response to item 69; neutral and negative responses are counted as unsuccessful. Figure 3 presents the results separately for users and designers.

It is evident from the figure that there is a fairly strong correspondence between the two measures of project success for both users and consultants. (We note that designers are less likely to see a project as unsuccessful along either dimension than are users. We will look more carefully at designer-user differences later in this

Correlation of Overall Satisfaction with LOA Goal Achievement

Users

Overall Satisfaction	LOA Unsuccessful	LOA Successful
Unsuccessful	8	3
Successful	7	19

γ = .76 (Fisher exact probability = .025)

Designers

Overall Satisfaction	LOA Unsuccessful	LOA Successful
Unsuccessful	3	1
Successful	3	20

γ = .90 (Fisher exact probability = .013)

Figure 3.

chapter.) In fact, if we look at the seven users who report being successful on the overall satisfaction basis but unsuccessful on the

LOA basis, we find that each one reports having achieved an LOA level at least equal to the minimum we suggested above as being appropriate to the level of complexity of the group in which that project falls.

In Figure 4 we present the relationships between consultant and user for each of the potential dependent variables. We see that the agreement between users and consultants on either measure is considerably smaller than that between the two measures for either group. In fact, for the LOA measure, the relationship between users and consultants is negative.

Figure 5 presents the relationships between the two traits (LOA and overall satisfaction) when measured by different 'methods' (users or designers). As can be seen, the relationship between user satisfaction and designer LOA is positive, though not highly significant, while that between user LOA and designer satisfaction is negative (though, again, not significantly so).

Finally, Figure 6 summarizes these relationships in a multitrait-multimethod matrix (see Campbell & Fiske, 1959). The fact that the highest correlations are found where the two traits are measured by the same method (i.e., type of respondent), suggests that both measures reflect, to some degree, a general, retrospective evaluation of the project by the individual respondent. The satisfaction measure, however, shows some weak evidence of both convergent validity ($\gamma = .52$ but $p = .30$, not significant at conventional levels) and discriminant validity (the correlation between the two methods

Correlations of Users and Designers on the Dependent Variables

Overall Satisfaction

		Designers: Unsuccessful	Designers: Successful
Users	Unsuccessful	2	6
	Successful	2	19

γ = .52 (Fisher exact probability = .30)

LOA

		Designers: Unsuccessful	Designers: Successful
Users	Unsuccessful	2	8
	Successful	5	14

γ = -.18 (Fisher exact probability = .5414)

Figure 4.

Heterotrait - Heteromethod Correlations

		Designer LOA: Unsuccessful	Designer LOA: Successful
User Overall Satisfaction	Unsuccessful	3	4
	Successful	5	17

γ= .44 (Fisher exact probability = .28)

		User LOA: Unsuccessful	User LOA: Successful
Designer Overall Satisfaction	Unsuccessful	1	3
	Successful	9	16

γ= -.26 (Fisher exact probability = .57)

Figure 5.

Dependent Variable Correlations -- Summary
(Gamma)

		User Satis.	User LOA	Designer Satis.	Designer LOA
User	Satis.	---			
	LOA	.76 (.025)*	---		
Designer	Satis.	.52 (.30)	-.26 (.57)	---	
	LOA	.44 (.28)	-.18 (.54)	.90 (.013)	---

*Fisher exact probability

Figure 6.

for this trait being higher than those for different traits being measured by different methods). The LOA measure gives no indication of either convergent or discriminant validity. Thus, the overall satisfaction measure appears to be a better measure of project outcomes.

For the remainder of our analysis we will accept the user's overall satisfaction score as the primary indicator of a project's success. In two instances we have classified a project as unsuccessful on a basis other than this measure. One is the hospital outpatient billing system in the low complexity group. Though both the LOA and the overall satisfaction measures would indicate success, the user's written comments on the questionnaire suggest otherwise. He states:

> "System people made study of problem, then designed system without complete approval of user. Management refused to accept a delay in starting for proper testing. Initial problems are still being resolved two years after start of system.
>
> System was to be complete on-line 24 hour coverage. There still is no on-line input or correction capability -- still using batch system.
>
> The system has shown that it was better than the old way. There has been financial gain, but the system could have been better if there was more 'user' participation. This was impossible at that time." (emphasis added)

It appears that this respondent has mixed feelings about the system. It has proved worthwhile from a financial perspective; but, in terms of his general satisfaction with the project outcomes, his comments seem to indicate a considerable degree of dissatisfaction. And, from this point of view, we are justified in calling the project a failure.

The other project we have classified as unsuccessful without an unfavorable response to the overall satisfaction question is the broadcast facility sales analysis system from the high complexity group. The user in this case failed to respond to 26 of the 81 items in the Survey Questionnaire; item 69 was among these unanswered items, as were the LOA achievement questions. The user included the following comment on his questionnaire:

> "Sorry that I couldn't complete the questionnaire. Many questions did not apply since our system has not been fully implemented."

This comment is quite interesting when we consider that the designer indicated on the Screening Questionnaire that implementation ended three months before the user filled out his questionnaire. Given this information we must conclude that the user is not satisfied with the project as it stands, and we will classify it as a failure.

With the exception of the projects just mentioned, all classifications of success or failure were based on the users response to item 69 (overall satisfaction). This gives rise to an interesting situation. In two projects where we had more than one user respondent, there was a disagreement among the users as to whether the project was a success or not. Clearly, it would make little sense to average the responses of users with such diverse opinions; hence, we treat each user individually, defining a 'sub-project' for each, whose success or failure is determined solely by the individual user's responses.

VII.2.3. Success and failure within complexity groups.

Among the thirty two projects described above, we have user responses for twenty nine (we lose one in the low complexity group and two in the middle complexity group). Of these twenty nine, ten are considered failures by at least one user. Broken down by groups this becomes two, three, and five projects for the low, medium, and high complexity groups, respectively. We notice immediately that the probability of a project's failing increases as it organizational complexity increases (we stress again that organizational complexity and technical complexity bear no necessary relationship to one another).

Most of the remainder of this thesis will explore differences in the implementation process between successes and failures and across complexity groups. For now, however, we will look at some other characteristics (structural) of these projects, looking for possible alternative explanations of success and failure.

We will consider two basic hypotheses about the relationship of project 'structure' to project outcomes. The first is that older projects are more likely to fail than are more recent projects. The reason for this would be that our ability to build successful systems has improved with time and experience. Looking at the years in which projects took place, we find no apparent pattern; successes and failures are distributed over both recent and older projects, and the distribution of project ages is similar across complexity groups.

The second structural hypothesis suggests that more complex projects (this time, complex in terms of 'project mechanics' rather than the organizational <u>or</u> technical complexity of the system) are more apt to fail than are simple projects. Surprisingly, there is little research data reported in the literature which bears on this hypothesis, though Drake (1973) does report that project size and length (elapsed time) are negatively related to success. We collected data on three measures of project 'mechanical complexity':

1. the size of the project (budget, personnel, elapsed time),
2. the number of users (one, few, or many) for whom the system was intended, and
3. whether the designer was an insider (same company as the user) or an outsider (different company or different division of a decentralized, multi-divisional company) -- we assume that the mechanics of running the project become more difficult in the latter case.

Table 5 tells the story for two of these variables -- project size and number of intended users. Two trends are clearly apparent. First, Distribution of Projects by Size and Number of Users

		COMPLEXITY											
		LOW				MEDIUM				HIGH			
		No. of Users				No. of Users				No. of Users			
SIZE**		One	Few	Many		One	Few	Many		One	Few	Many	
Small	# Suc.	0	1	0	1	1	1	0	3	2	2	0	5
	# Fail.	0	0	0		0	1	0		0	1	0	
Med.	# Suc.	0	0	3	4	1	1	2	6	0	1.5*	1	5
	# Fail.	0	0	1		0	1	1		0	.5	2	
Large	# Suc.	0	0	2	3	0	0	1	1	0	0	.5	1
	# Fail.	0	0	1		0	0	0		0	0	.5	
		0	1	7		2	4	4		2	5	4	

**Small projects typically had budgets under $50,000 and involved only 2-3 participants; Medium projects had budgets of less than $1,000,000 and usually involved 5-10 participants; Large projects had budgets of $1,000,000 or more.

*A half project is used to indicate those situations where users disagreed on the project's success or failure.

Table 5.

these two dimensions, project size and number of users, are positively correlated. Second, there is a strong tendency for less complex projects to be larger and to involve more users. In terms of the dependent variable, however, there is little apparent pattern. There is a slight tendency in the high complexity group for failure rate to increase as project size increases, but the numbers involved are too small for us to put much credence in the generality of this trend.

Distribution of External and Internal Consultants

	Complexity Group					
	Low		Medium		High	
	Int.	Ext.	Int.	Ext.	Int.	Ext.
Success	6	0	3	4	5.5*	1.5
Failure	2	0	2	1	1.5	2.5

*Half projects indicate situations where multiple user respondents who disagreed on the project's outcome were included in the sample.

Table 6.

When we look at the use of internal vs. external consultants, the hint of a pattern emerges (see Table 6). Nine of the 29 projects involved external designers (in three cases this was in conjunction with an internal consultant). The use of external consultants was split evenly between the middle and high complexity groups, with none in the low complexity group. The rate of failure among these nine projects was somewhat higher than among the projects generally: of 21 projects in the middle and high groups, 8 are counted among the failures, and 4 of these involved external consultants. Thus, it appears that the use of an external consultant may in some way be related to project failure. And, the problem is worst in the high complexity group, where three of four projects using external consultants are among the failures. We have identified what appears to be the symptom of a problem. We do not yet know what the real problem is. One possibility is that resolution of process issues is more difficult when an outsider is involved.

We have now briefly explored the relationships between some structural variables and project outcomes. Two relationships emerged:

1. the failure rate increases as the organizational/implementation complexity of the project increases, and
2. the failure rate is higher among projects using external consultants than it is for projects using internal consultants only.

We should note also that these two relationships are correlated with one another. None of this is in any way damaging to our process view of implementation success. Indeed, these may be factors that affect the ease with which the proper process can be successfully followed. The remainder of our analysis will focus on the process itself, and its relationships to outcomes.

VII.3. User and Consultant Responses -- A First Look.

We have already noted that there is some disagreement between users and consultants in their assessment of project outcomes. Using either measure of the dependent variable we find that consultants are less likely to judge a project as unsatisfactory than are users. We will consider the implications of this shortly; but, first we should ask whether this lack of congruence is limited to the assessment of outcomes or whether it extends also to perceptions of the implementation process.

For each project we can obtain a gross measure of user-consultant congruence.[2] Congruence scores can then be grouped by project complexity and by success or failure within complexity groups. Table 7 shows the average of these scores by group. For one project in the high complexity group, the Portfolio Management (PM) system, we have responses from seven users, three of whom saw the project as successful. As this is the only project for which we have more than two user respondents, we have shown the results for the high complexity group

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[2]The measure employed was Goodman and Kruskal's Gamma (see, Goodman & Kruskal, 1954). Gamma was calculated for each user-consultant pair within the project (in most cases this was one pair), by cross-tabulating the 71 questionnaire items (each measured on a 3-point scale) which are not part of either measure of the dependent variable. The number of item pairs on which user and designer responses were similarly ordered (e.g., user's response higher than designer's response in both cases) and dissimilarly ordered was then calculated. Gamma can be interpreted as how much more probable is it to get similar rather than dissimilar orderings of designer and user responses when two items are picked at random.

Average User-Consultant Congruence Scores

Project Complexity	Average Gamma	Average for Successes No.	Average for Successes Gamma	Average for Failures No.	Average for Failures Gamma
Low	.57	6	.64	2	.39
Medium	.58	7	.68	3	.33
High - Total	.43	9	.51	7	.33
- w/out PM sys.	.44	6	.46	3	.41
- PM system	.41	3	.60	4	.27

Table 7.

in aggregate and with this project broken out separately.

It is apparent from Table 7 that there is considerably greater congruence between users and consultants in the cases where the user felt the project was successful. We also note that congruence tends to decrease as project complexity increases.[3] This latter result is not particularly surprising; the issues to be resolved become more numerous and more difficult as project complexity increases.

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[3]Two points about the numbers underlying the averages in the table should be made. First, the two failures in the low complexity group are markedly different; one having a gamma of .02, the other's being .75. This second project looks much like the successes in other respects also, and we will consider it more carefully in subsequent sections. Second, among the non-PM system high complexity projects, one of the successes is quite atypical; the consultant calims this project is a failure, and the gamma for user-consultant congruence equals -.11. Eliminating this project from the successes would raise gamma for successful projects to .58 for the total group and to .57 for the group with the PM system excluded.

It is the first result, the markedly lower agreement between user and consultant perceptions of the process itself in the case of unsuccessful projects, which requires our attention. Recall that the OD approach to implementation stresses the need for joint effort, for the consultant to understand the user's perspective on the problem. These low congruence scores for unsuccessful projects are, then, in one sense not surprising. They suggest a gross mishandling of the process, a failure by the consultant to learn what the user is about. Indeed, when we look at the individual responses we find that the consultants typically feel that the process was better handled than do the users.

One might be tempted to argue that since we are basing our assessment of success or failure on the user's reported satisfaction, the apparent results are due to a general negativism in the user's responses. However, for two of the projects both user and consultant report dissatisfaction. And, the same pattern of low congruence (gammas of .29 and .37) with the consultant reporting better handling of the process exists here as does in those cases where only the user reports being unhappy with project outcomes.

There are some very important implications of these results, both for the practice of and for research on implementation. First, recall that in many studies of implementation it has been the consultant who defined projects as successful or unsuccessful. Our results strongly suggest that consultants often cannot recognize that a project is not meeting the user's needs, and should be termed a failure. We must, therefore, question the meaningfulness of the results of research which has allowed the consultant to define the dependent variable. At best, such research can tell us something about how consultants view success and failure. This, however, should not be (and has not been stated as) the goal of implementation research. Our aim is to learn how to make implementations succeed, and this implies a need for the user's perspective on outcomes.

Turning to the question of implementation practice, we find a number of implications arising from these results. The first, and perhaps clearest, is the need for the user (or someone who clearly has a user perspective) to manage the relationship between user and consultant. Our data indicate that a project can go on for quite sometime, and can even terminate, with the consultant never realizing that the user is dissatisfied. Recall that all projects included in this study went through all phases of development at least once, and that all of the resulting systems are (or were) being used. Thus, none of these consultants ever received a completely unambiguous message of failure. Apparently, many consultants require such a message before they will assess a project as being a failure. It is apparent that these consultants are failing to take a user perspective; they operate in a product (technical expert) rather than a service (process consultant) mode. Without some active effort on the user side to alter the nature of the relationship, such implementation efforts are likely candidates for failure.

VII.4. Patterns of Success and Failure.

We explore in this section the first of our major hypotheses, that the difference between success and failure can be explained by the nature of the implementation process that a project has followed. Stage scores (see Chapter VI) were calculated for each of the participants in the projects studied.[4] Scores were normalized by dividing the score for each stage by the number of questionnaire items addressing that stage, and thus represent the percent of issues favorably resolved less the percent unfavorably resolved. The seven stage scores for a given respondent can be looked at as a profile of his perceptions of the project's progress through the implementation process. Our analysis in this section will focus on these profiles, particularly on the differences we find between successes and failures, between users and designers, and across complexity groups.

VII.4.1. Overall patterns for users and designers.

Figure 7 shows the median implementation profiles for successful and unsuccessful users and consultants by complexity group. It is readily apparent that in all three groups successful users report, on average, consistently higher process scores than do unsuccessful users.

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[4] In addition to the projects considered in the previous section, we include now two projects for which we have user respondents but no consultant respondents. These two projects come from the same company, and both are in the high complexity group; one is a failure, the other is a success.

The differences between the successful and unsuccessful users varies considerably across stages within complexity groups, and the stages displaying the largest differences vary from group to group. Recall that these scores represent the difference between the percentages of favorably and unfavorably resolved issues. In Figure 8, profiles displaying favorably and unfavorably resolved issues separately indicate that for most stages successful users do both more right and less wrong than their unsuccessful counterparts; and, this tendency is strongest at those stages showing the greatest differences in Figures 7 a, c, and e. Thus, it appears that there are differences in process between successful and unsuccessful users in all three complexity groups (we will test their statistical significance later in this chapter). We will explore these differences in greater detail after considering the overall patterns shown by the consultants.

Unlike the users, consultants do not show any clear patterns of differences between successes and failures. In all three complexity groups, unsuccessful consultants report higher average scores than successful consultants at some process stages. For both the low and medium complexity groups, the profiles of successful and unsuccessful consultants are exceedingly similar. We can test for differences between successes and failures on a stage by stage basis using the Mann-Whitney U statistic.[5] Doing so we find that we cannot reject the null hypothesis (no difference between the distributions of scores for successes and failures) for any stage in either the low or medium

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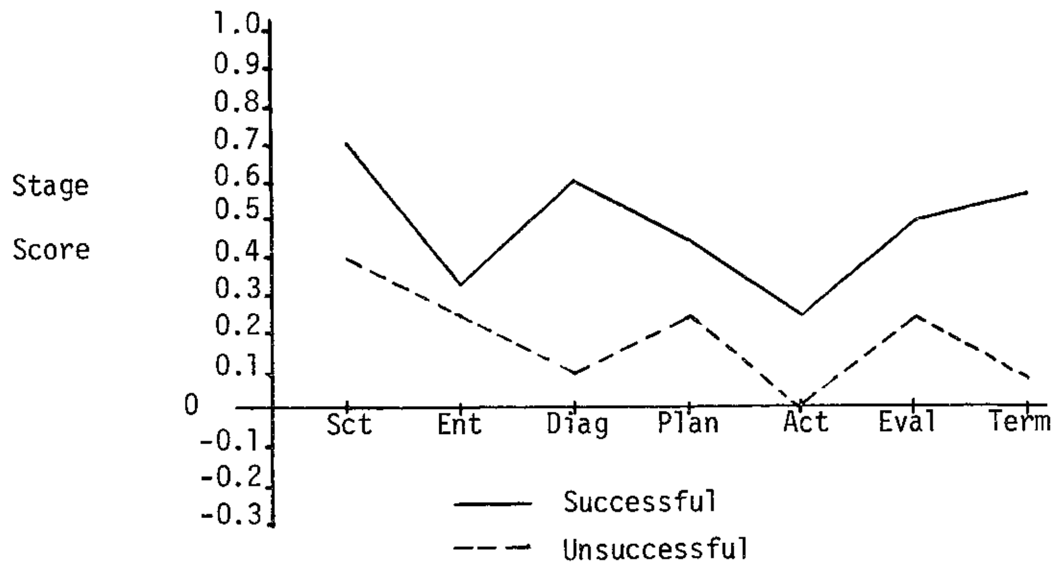
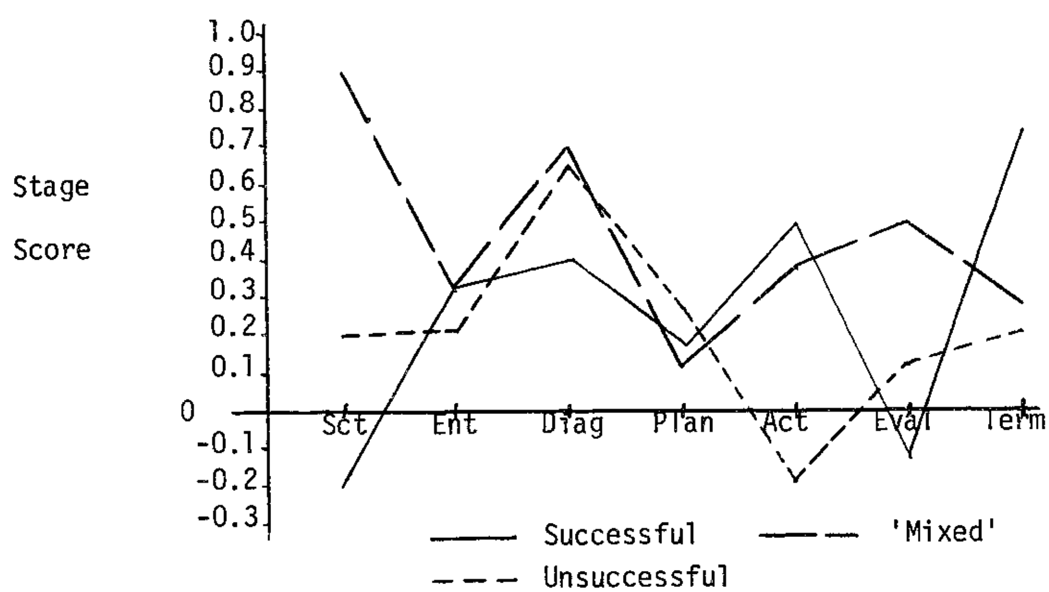
[5]See Siegel, 1956.

Median Implementation Profiles



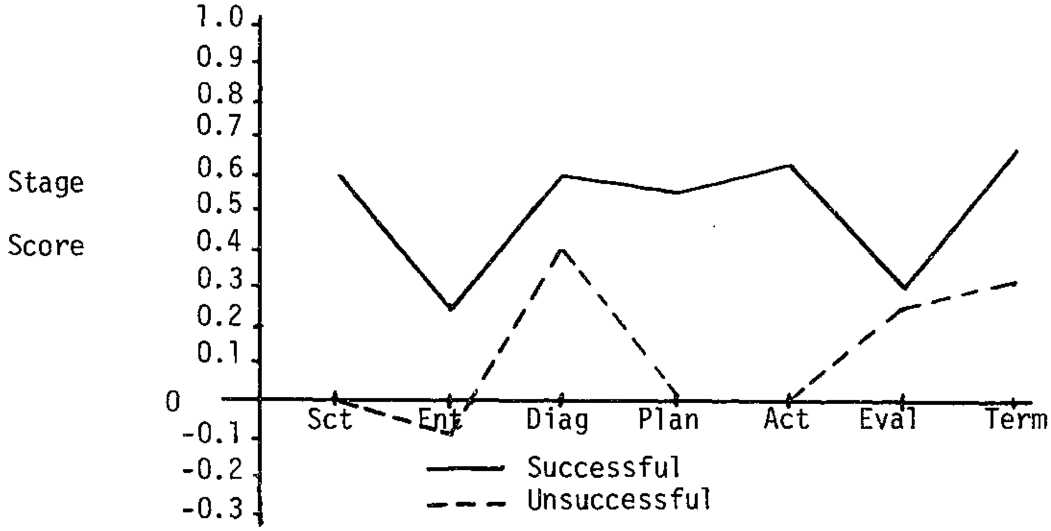
7.a. High Complexity Users



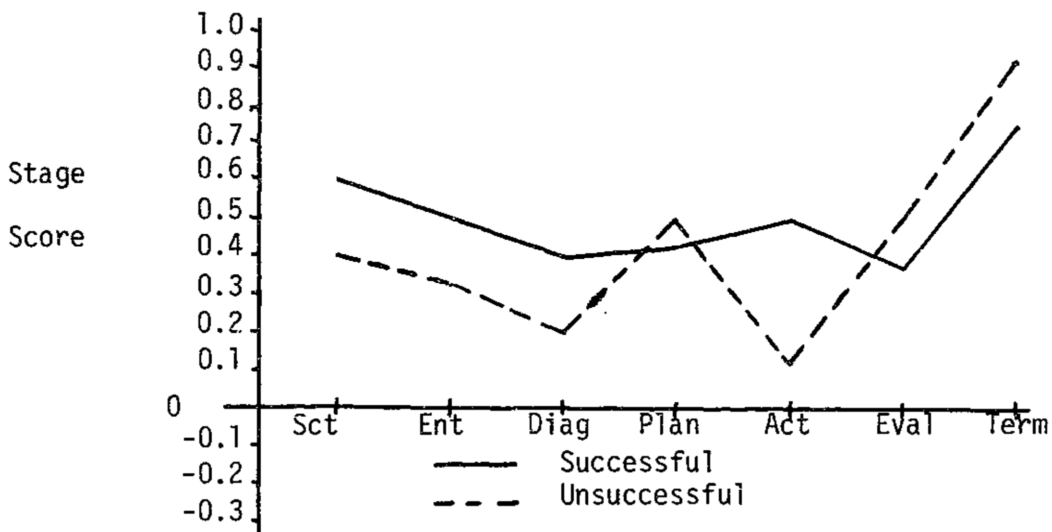
7.b. High Complexity Consultants

Figure 7.

Median Implementation Profiles (Cont.)



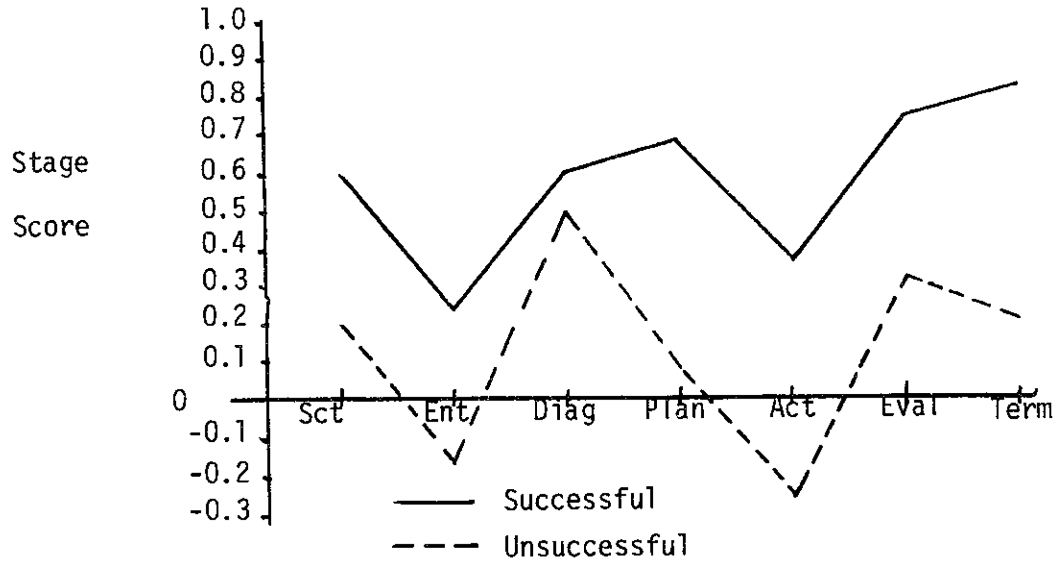
7.c. Medium Complexity Users



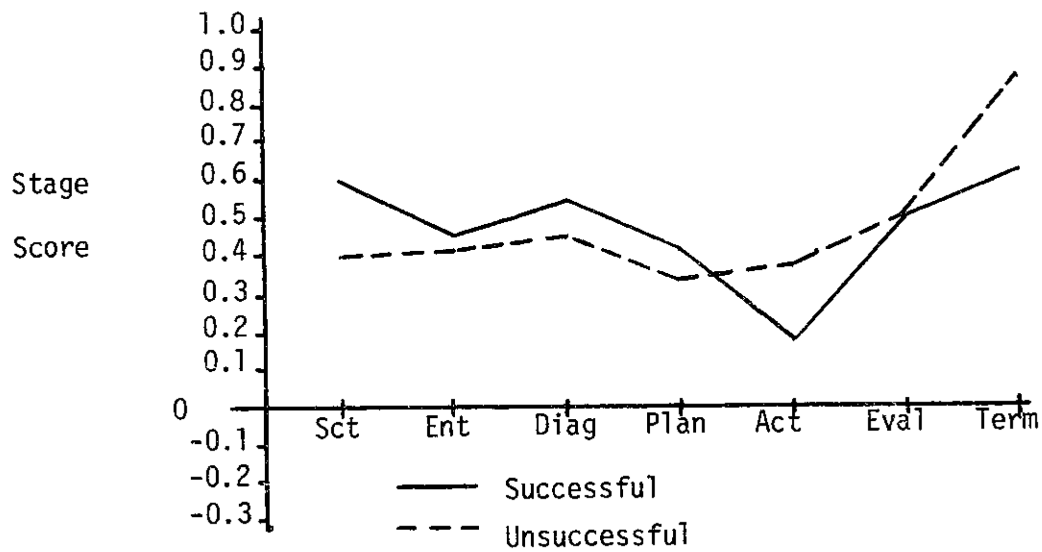
7.d Medium Complexity Consultants

Figure 7 (Cont.).

Median Implementation Profiles (Cont.)



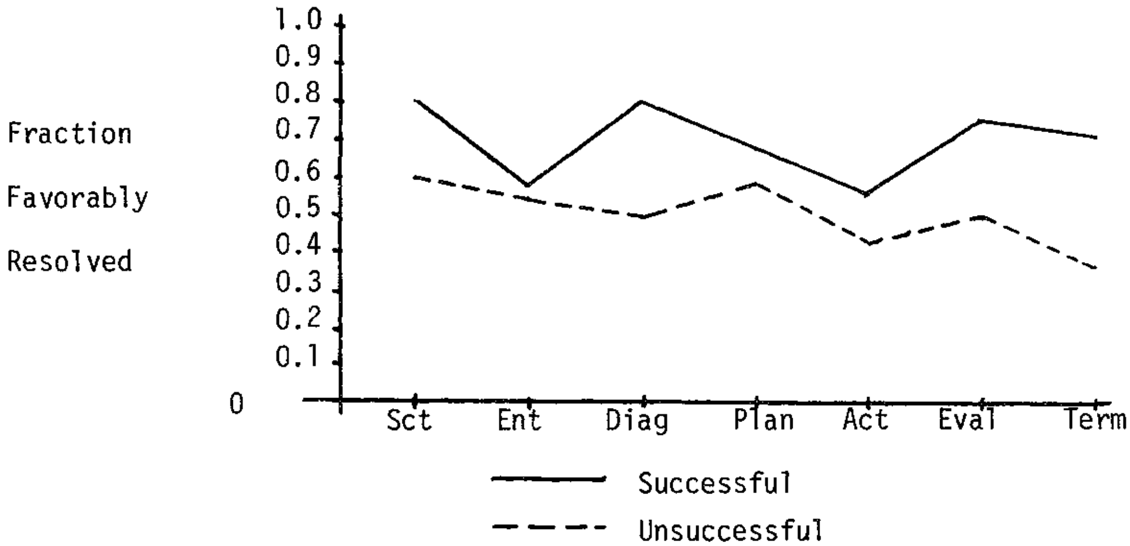
7.e. Low Complexity Users



7.f. Low Complexity Consultants

Figure 7 (Cont.).

User Median Profiles -- Favorable and Unfavorable Issue Resolution



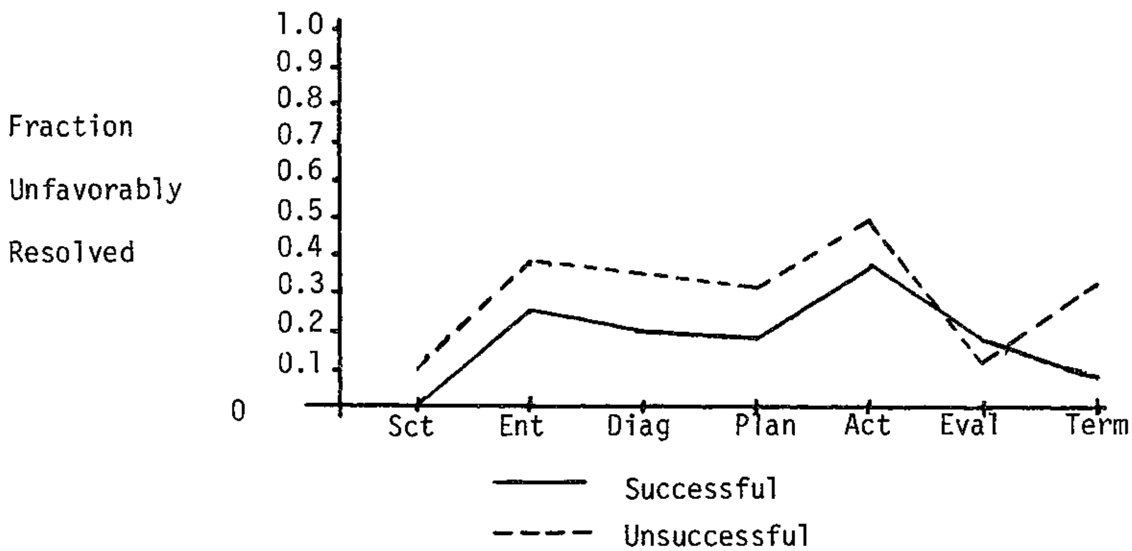
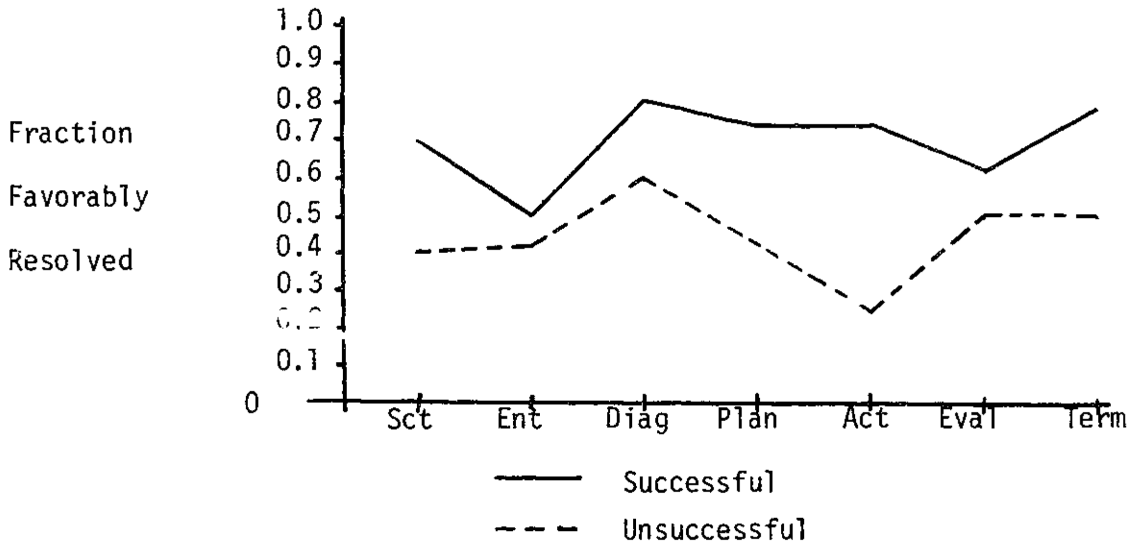


Figure 8.a. High Complexity Users.

User Median Profiles -- Favorable and Unfavorable Issue Resolution (Cont.)



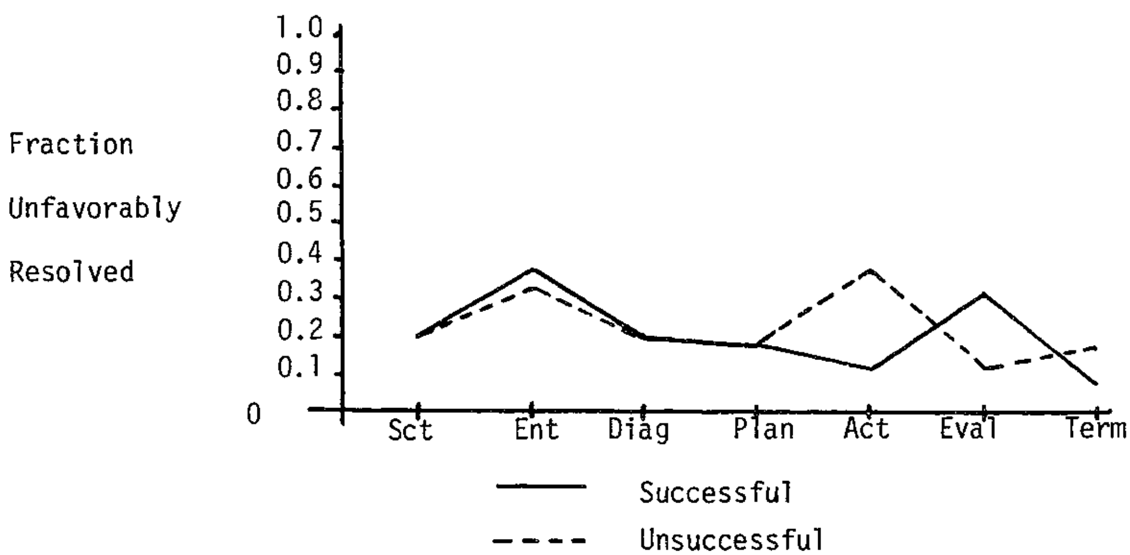
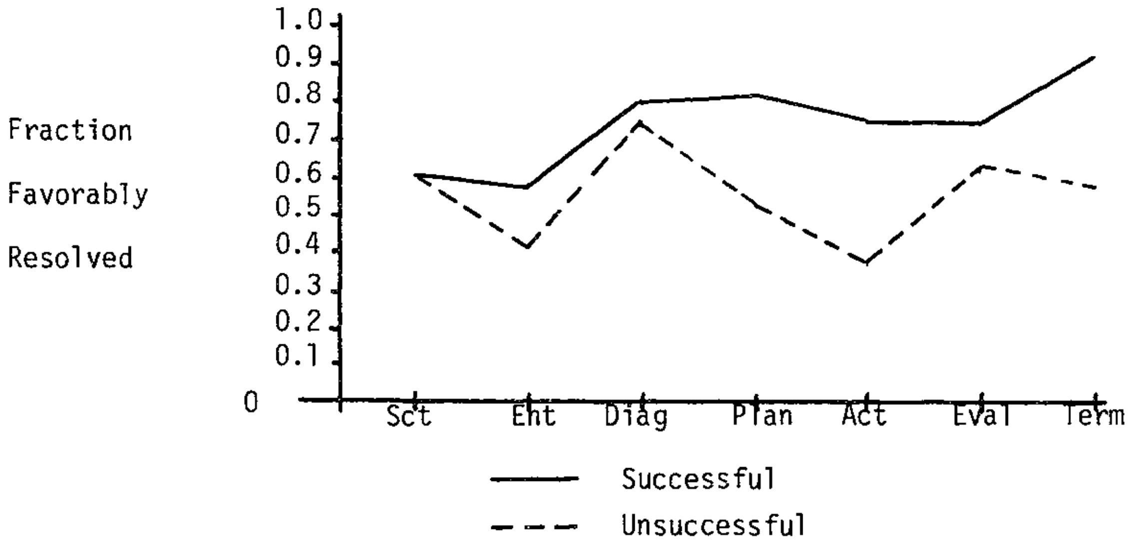


Figure 8.b. Medium Complexity Users.

User Median Profiles -- Favorable and Unfavorable Issue Resolution (Cont.)



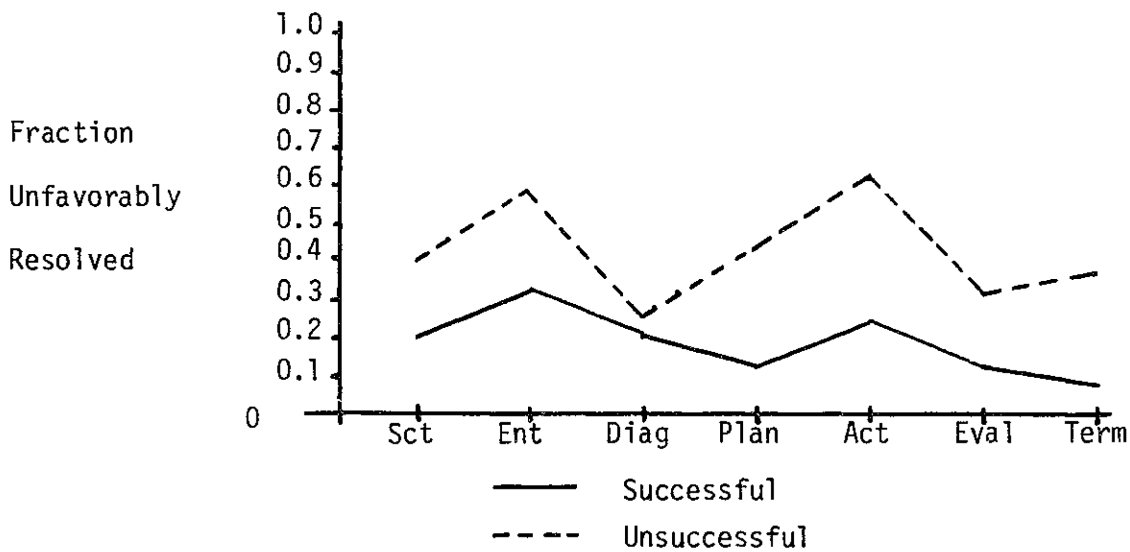


Figure 8.c. Low Complexity Users.

group. The smallest probability of the same underlying distribution having generated both the success and the failure scores is .286 (two-tailed test) in the case of Termination for the low complexity consultants, with failures scoring <u>higher</u> than successes.

Consultants in the high complexity group have been divided into three sub-groups. Besides the successful and unsuccessful categories found in other groups, we include here a 'mixed' category for the consultants from those projects which some users defined as successful and others as unsuccessful. The profiles for the consultants in this high complexity group do not exhibit the degree of similarity present in the other two groups. Comparing the successful consultants with each of the other two sub-groups (failure and mixed) we find that for some stages the null hypothesis (no difference between the two groups) can be rejected for one or the other of the sub-groups. The table below summarizes these differences.

Probability* that Successful Consultants (N=5) Do Not Equal:

	Failures (N=2)		'Mixeds' (N=2)	
	Prob.	Direction	Prob.	Direction
Scouting	NS	F > S	.094	M > S
Diagnosis	.094	F > S	NS	M > S
Action	.19	S > F	NS	S > M
Termination	.19	S > F	.094	S > M

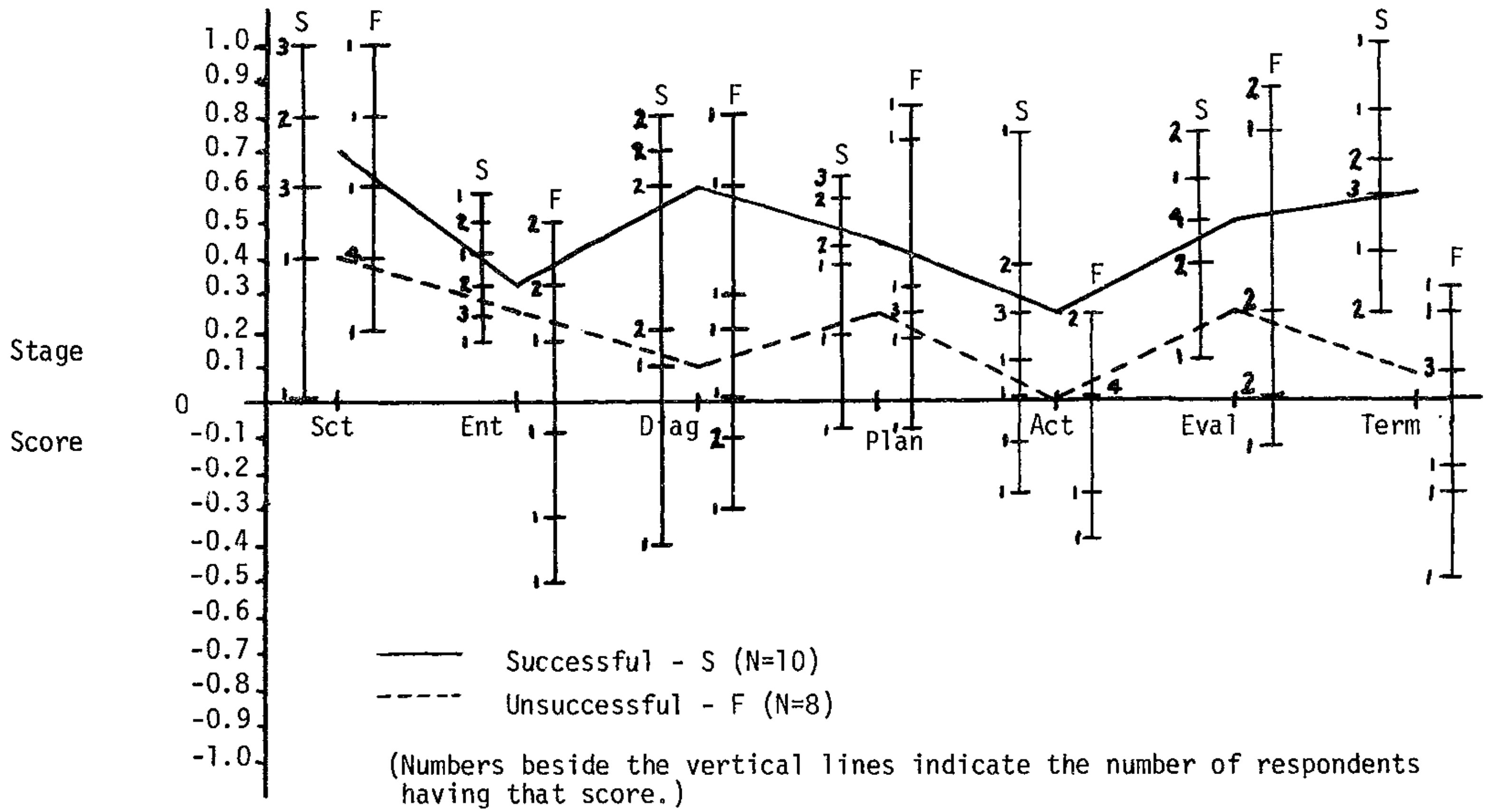
(*Two-tailed Mann-Whitney U test)

We note that the direction of these differences varies from case to case, the successes rating significantly lower at one stage when compared to each of the other groups.

To summarize our results for the consultants, we find no differences between successes and failures in the two lower complexity groups. We find some differences in the high complexity group, but they are not all in the direction suggested by the theory. These results help to explain our findings in the previous section, the discussion of user-designer congruence. While users in all three complexity groups show marked differences in the assessment of process between successes and failures, consultants show few, if any, differences. And, where there are differences among the consultants, they are about equally likely to be in the same or the opposite direction as the corresponding differences among users. Consultants, it seems, are unable to distinguish a project that is in trouble from one that is not.

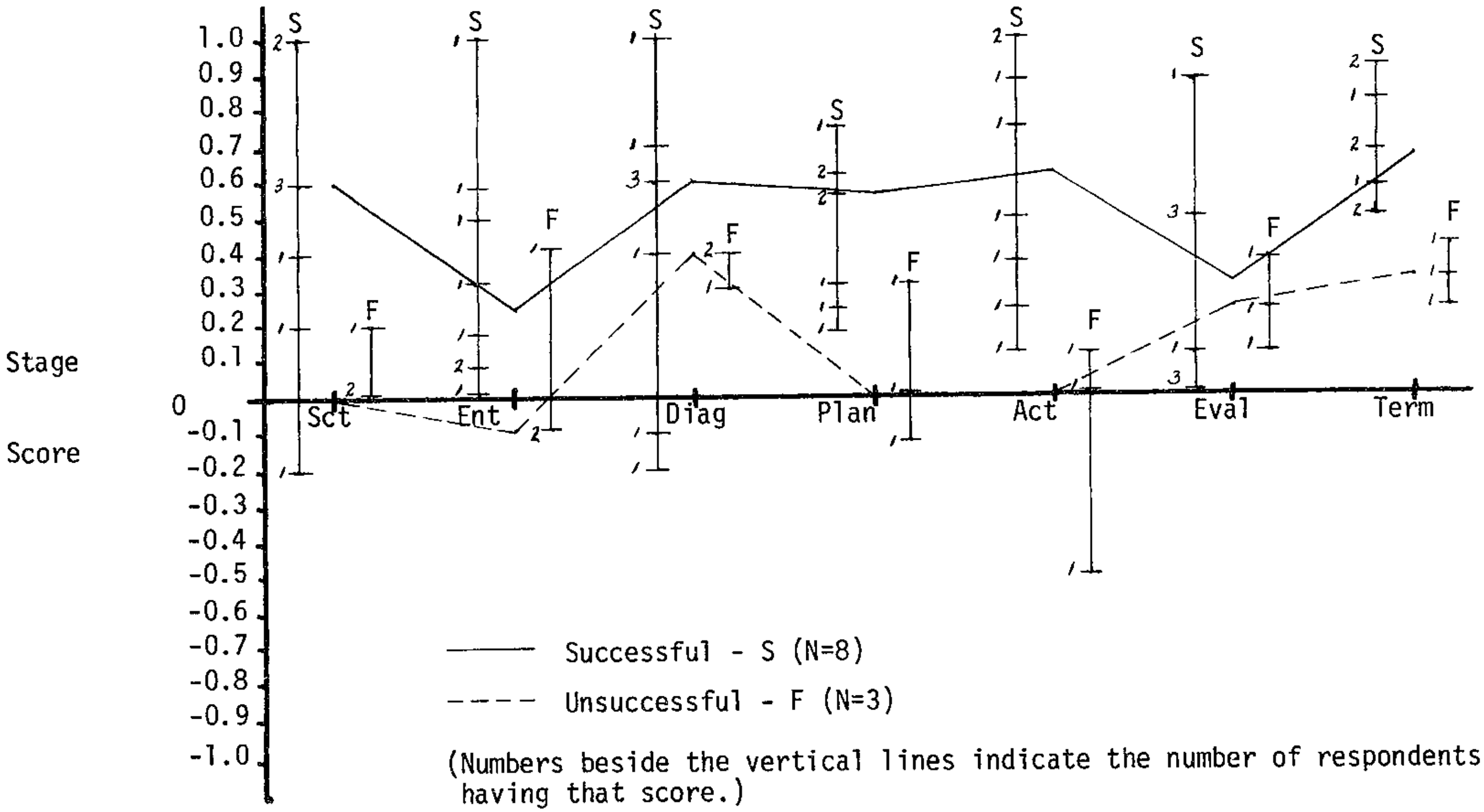
VII.4.2. User success-failure differences by stage.

Successful users have, on average, higher stage scores than do unsuccessful users. Our hypotheses suggest, however, that these differences are not all equally important. We will explore in this section the differences existing at each stage for each of the three complexity groups. Figures 9, 10, and 11 show the median success and failure profiles for the users in each complexity group, as well as the range of scores displayed by successful and unsuccessful users at each stage. We begin our analysis by comparing the scores of successes and failures in each complexity group at each of the seven stages. We employ the Mann-Whitney U statistic to test the hypothesis



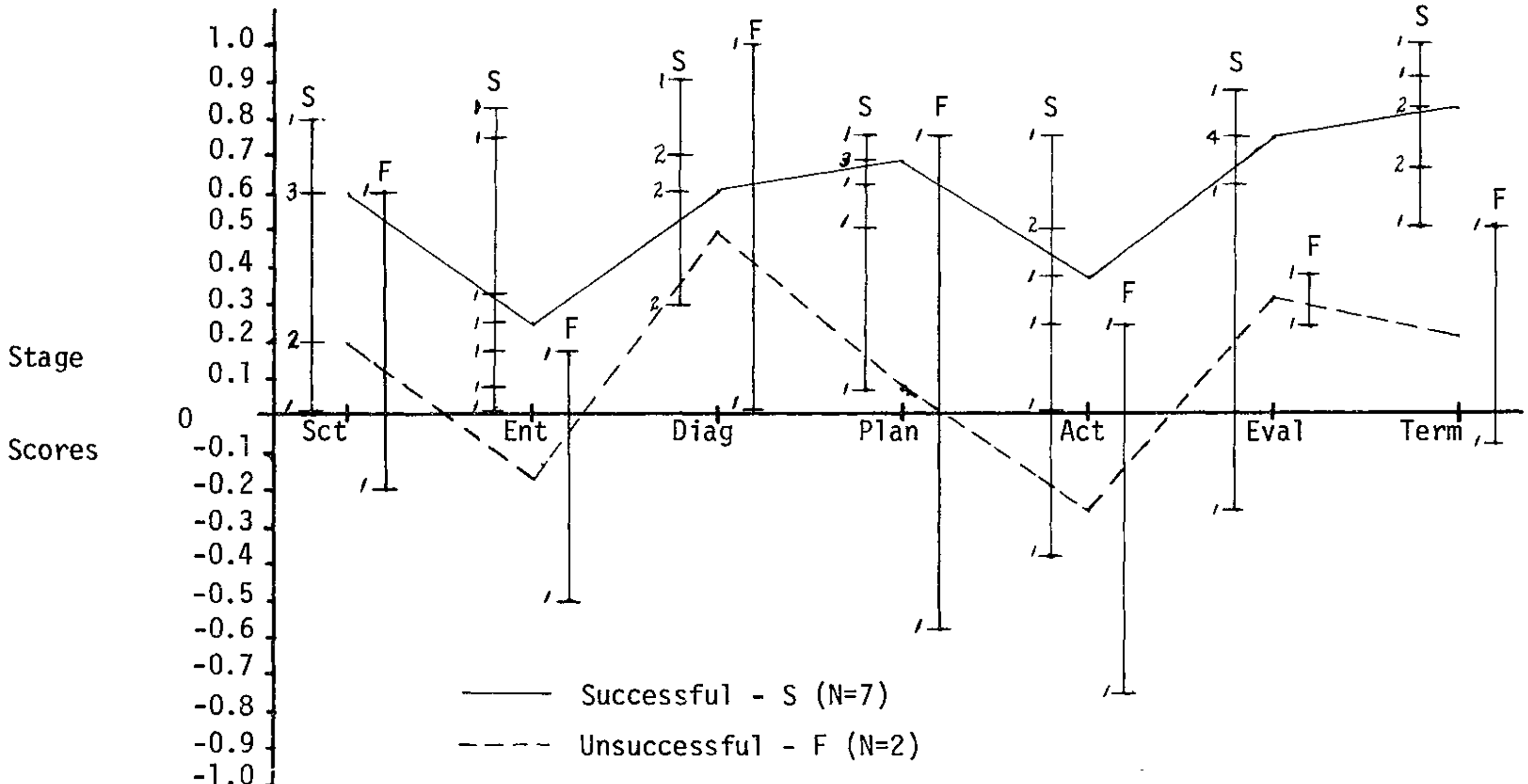
High Complexity Users -- Stage Score Ranges and Medians

Figure 9.



Medium Complexity Users -- Stage Score Ranges and Medians

Figure 10.



(Numbers beside the vertical lines indicate the number of respondents having that score.)

Low Complexity Users -- Stage Score Ranges and Medians

Figure 11.

that there are no differences between the distributions generating the observed success and failure scores.[6] Table 8 shows the results of this test.

Probabilities[a] That Successful and Unsuccessful Responses Were Generated from the Same Distribution -- Mann-Whitney U Test

Stage	High Complexity	Medium Complexity	Low Complexity
Scouting	< .0918[b]	< .067	NS
Entry	NS	< .097	NS
Diagnosis	< .0918[b]	NS	NS
Planning	NS	< .042	NS
Action	< .0505[b]	< .012	NS
Evaluation	NS	NS	NS
Termination	< .001	= .006	< .056

[a]One tailed tests; probabilities greater than .10 indicated by NS.

[b]Calculated by the Normal approximation to U.

Table 8.

One stage, Termination, shows a significant difference between successes and failures in each complexity group. Moreover, as we hypothesized in the previous chapter, the relationship between Termination and success is at least as strong as that between any other stage and success for each of the three groups (see Table 9). We note that among all of the users, there is only one unsuccessful user who reports a

[6]We examine, here, only the stage by stage differences. Statistical analysis of the full profiles (see Morrison, 1967) is not possible due to the limited sample sizes.

Correlations* of User Stage Scores with Overall Satisfaction

	Complexity Group		
Stage	High	Medium	Low
Scouting	.43	.74	.46
Entry	.38	.58	.69
Diagnosis	.41	.46	0
Planning	.29	.83	.08
Action	.54	1.00	.69
Evaluation	.23	.04	.71
Termination	.95	1.00	1.00

*Goodman & Kruskal's Gamma.

Table 9.

Termination score higher than that of the lowest scoring successful user in his complexity group. No other stage comes close to this degree of differentiation between successful and unsuccessful users.

A number of other stages do exhibit some degree of differentiation in the medium and high complexity groups;[7] but, we note that in all cases except for Action in the medium complexity group, some of the failures rank higher than a number of the successes. This result is consistent with the hypothesis we advanced earlier. A project need not

[7]The very small number of low complexity failures (N=2), together with the fact that one of them ranks well into the range of the successes on five of the seven stages, makes it difficult to draw any conclusions about these projects. We will, however, look at these two projects in a qualitative sense in the next chapter.

do poorly at all phases in order to fail. There seem to be multiple approaches to failure. In order to explore these alternative paths, we must consider the relationships between the stages; the ranges of scores that we have been looking at show us only the ranges covered by all projects in a group, not the relative positioning of a given project at each of the stages.

Since Termination appears to have such a dominating effect on project outcome, we need to in some way control for this relationship if we wish to examine the relationships (if any) between the other stages and success. Given the very small sample sizes we are dealing with, we can do little more than look at the relationships between Termination and each of the other stages. Table 10 presents the rank order correlations between Termination and each other stage for the six user sub-groups.

Looking first at the high complexity successes, we find a fairly strong negative relationship between Diagnosis and Termination, and low positive correlations between Termination and the other five stages (being lowest at Planning and Entry). Looking at the failures in this group, we find a high positive relationship between Diagnosis and Termination, and a moderate (but not significant) negative correlation between Termination and Entry. We also note a very strong positive association between Termination and Action in this group, which suggests that a poor 'installation' phase is not the cause of the problem. These relationships suggest certain patterns for these high

User Inter-Stage Correlations*

Termination with:	Complexity Group: High Success (N=10)	High Failure (N=8)	Medium Success (N=8)	Medium Failure (N=3)	Low Success (N=7)	Low Failure (N=2)
Scouting	.297	.381	-.167	.875	.893++	1.000
Entry	.285	-.476	-.208	.875	.446	1.000
Diagnosis	-.609+	.673+	.256	.875	-.295	1.000
Planning	.139	-.143	-.452	1.000	-.268	1.000
Action	.364	.851++	.506	-.500	.268	1.000
Evaluation	.442	.494	.208	.500	-.018	-1.000

*Spearman's Rho (see Seigel, 1956)

+Significant at .05 (1-tailed test).

++Significant at .01 (1-tailed test).

Table 10.

complexity users. First, the successes who score low on Termination (i.e., those who look the most like failures on this dimension) tend to have done well at Diagnosis and have not necessarily done poorly at Entry or Planning. Failures with high Termination scores, on the other hand, tend to have low Entry scores (indeed, the two failures with the highest Termination stage scores have two of the three lowest Entry scores in the high complexity group). Thus, there is the suggestion that for high complexity projects, the early stages of Entry and Diagnosis have a greater impact on project outcomes than do the other stages (with the exception, of course, of Termination).

Turning to the medium complexity group, we see a different pattern. Among the successes, low Termination scores tend to be associated with low Action scores, but with high Planning (and to a lesser extent, Entry) scores. There are too few failures in this group (N=3) for us to say much about them, but we should note that for all stages except Action, there is a relatively high positive association with Termination. Thus, again there is some hint that the pre-Action phases may be of importance in determining project outcomes; but, for this middle complexity group, the emphasis seems to shift to the project Planning stage, and there is some suggestion that poor resolution of the Action issues may lead to project failure.

The pattern displayed by the low complexity successes (we will ignore the failures for now, as there are only two of them) is difficult to interpret. We find a very high positive association between Termination and Scouting, a moderate positive correlation between Termination and Entry, and relatively low correlations (one positive, three negative) between Termination and the other four stages. There is no evidence here to suggest that some other stage has an important impact when Termination is poorly handled.

No absolute conclusions can be drawn from this data, but the hint of some patterns emerges. Remember, first, that none of the successes have low Termination scores in relation to those of the failures. Thus, the successes we have been calling low on Termination are only so in comparison to other successes. We have seen that, in the medium and high complexity groups, successes with low Termination scores tend to score quite high at some pre-Action stage. Further, there is the hint that for systems of the highest complexity, it is the earlier stages of Entry and Diagnosis which are relatively more important, while for systems of moderate complexity, Planning may be the critical issue. Note that while this lends some slight support to our arguments for H1 (that Termination would be the most critical stage, followed by Entry, and possibly Diagnosis and Planning), it is not what one might expect on the basis of the stage by stage relationships shown in Table 9. That table shows that after Termination the stage most strongly related to success in both the high and medium complexity groups is Action. Yet, there is no consistent pattern of high Action scores among those successes relatively low on Termination.

Thus, the evidence seems to suggest that there are two patterns which can lead to success. One is to do an average job in the early stages (Entry-Diagnosis-Planning), but to make up for it with a very strong Termination effort. And, the other is to be strong in the early stages, but only average in Termination. That it is not adequate to be strong in the early stages but then very weak in Termination is suggested by one high complexity user who ranks very high at Entry, Diagnosis, and Planning, but very low from then on, and reports being dissatisfied with the outcome.

VII.4.3. Success patterns across complexity groups.

We have been exploring H1, the overall relationship of process to outcome. H3 suggests that there should be certain systematic differences in the relative importance of stages across complexity groups. Figure 12 displays the median process profiles for successful users in each of the three groups. H3 states that successful high complexity users should, on average, have higher Entry scores than successful users in the other two groups. The figure shows that the median Entry score is slightly higher for the high complexity group -- .333 for the high group vs. .250 for the medium and low groups -- but the differences are not significant (Mann-Whitney U tests).

A look at the range of Entry scores may give us some insight into what might be happening. The lowest score among the successful high complexity users is higher than the three lowest and two lowest scores among the medium and low complexity successes, respectively. The highest Entry scores in the latter two groups -- one in the medium and two in the low -- are higher than the highest score in the former group. The range of Entry scores for successful users in the three complexity groups is summarized below:

	Complexity Group		
	Low	Medium	High
Low score	0	0	.167
High score	.833	1.000	.583

A possible explanation for these results is that, indeed, higher Entry scores (reflecting more thorough attention to the Entry issues) are required for success in these more complex systems, but the added complexity of the issues involved makes these higher scores more difficult to attain. Two of the three failures in this group having Entry scores below that of the lowest successful user, have Termination scores within the range of the successful high complexity users. While none of this is evidence of a need to better attend to the issues of Entry in high complexity projects, it is all consistent with such a situation.

It was suggested that higher Diagnosis scores might also be expected among the high complexity successes. Figure 12, however, shows the median scores to be identical for the three groups (.600). We should recall, though, that successful users in the high complexity group showed a strong negative relationship between Diagnosis and Termination, and unsuccessful users a strong positive relationship. And, this pattern was not seen in either of the other two complexity groups. Thus, while we do not find higher Diagnosis scores in the high complexity group, we do find the suggestion of this stage's being more important in this group than it is in the others.

Next, we suggested that the greater salience of the technical

Successful Users -- Median Process Profiles

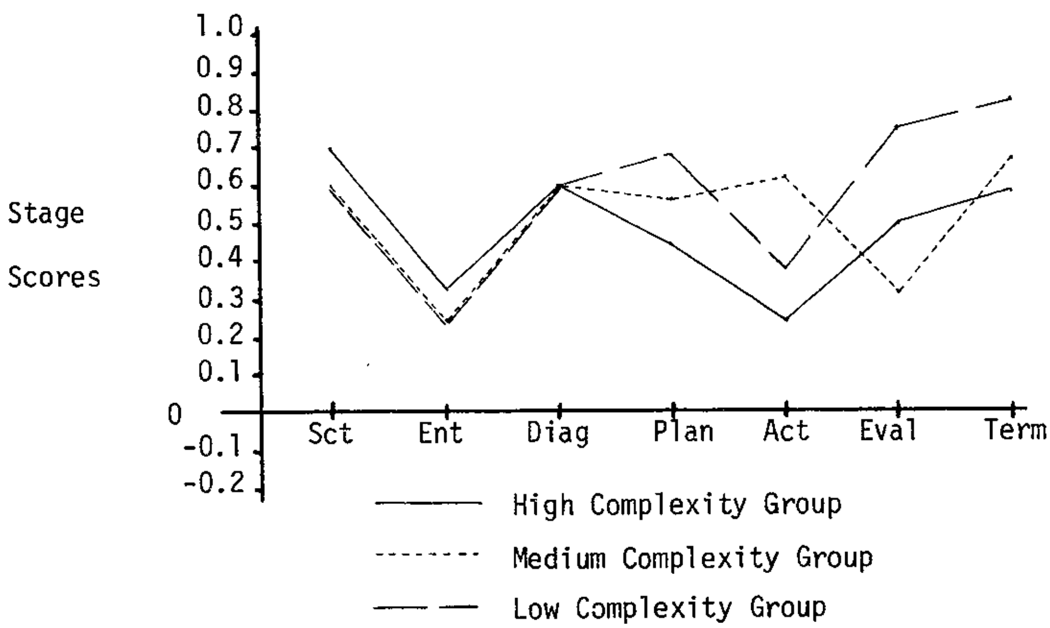


Figure 12.

dimension for less complex systems might result in higher scores on Planning, Action, and Evaluation for these systems. Indeed, such a pattern is to be found. The high complexity successes are, on average, the lowest of the three groups on the first two of these stages, and are considerably lower than the low complexity group at the Evaluation stage. What is more, the scores of successes and failures within the high complexity group are very similar for two of these stages -- Planning and Evaluation -- the differences being generally more marked in the lower complexity groups.

Finally, when we come to Termination, we find an inverse relationship between complexity and the median score for the successes. This relationship suggests that institutionalizing the change becomes more difficult as system complexity increases. Such a situation does make sense, and may be a partial explanation for the higher rate of low Termination scores (and failures) in the high complexity group.

VII.5. User-Consultant Differences by Stage.

In section 3 of this chapter we saw that users and consultants differed markedly in their perceptions of the implementation process in the case of projects defined as failures by the user. We have just seen that certain stages appear to bear more on the success of a project than do others, and that these stages may vary with project complexity. We now turn to an examination of the differences in user-consultant perceptions by stage. Table 11 and Figure 13 show the average congruence (Gamma) between users and designers, broken down by stage and complexity group, and within groups by success or failure.

Average User-Designer Congruence by Stage

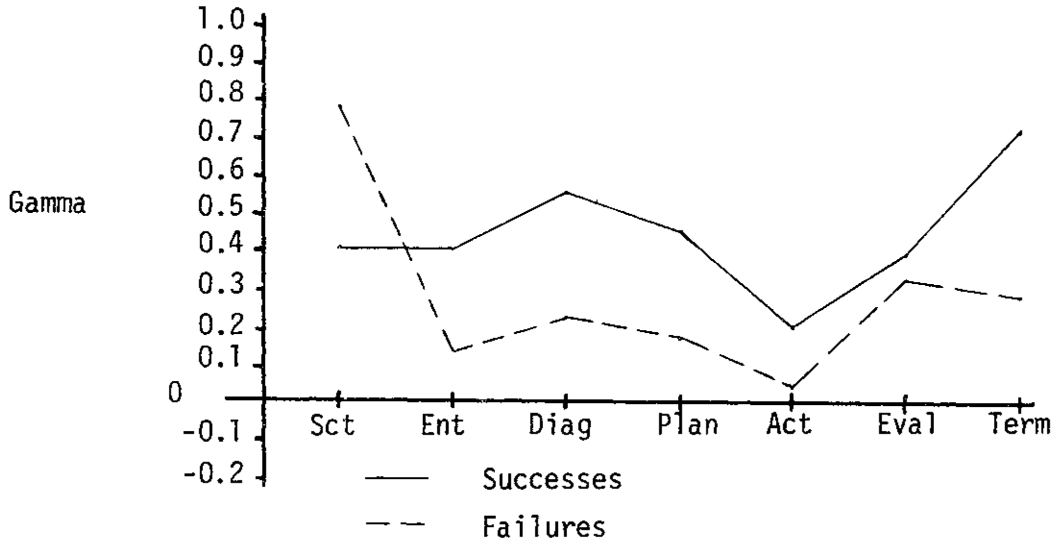
	Complexity Group					
	High		Medium		Low	
Stage	S	F	S	F	S	F
Scouting	.41	.79	.88	-.28	.48	-.67
Entry	.41	.14	.70	.22	.34	.18
Diagnosis	.57	.23	.82	.44	.75	.33
Planning	.47	.18	.48	.18	.76	.85
Action	.20	.04	.49	.11	.59	.43
Evaluation	.40	.34	.86	.31	.85	1.00
Termination	.73	.29	.76	.88	.72	.05
Overall*	.51	.33	.68	.33	.64	.39

(*From Table 7)

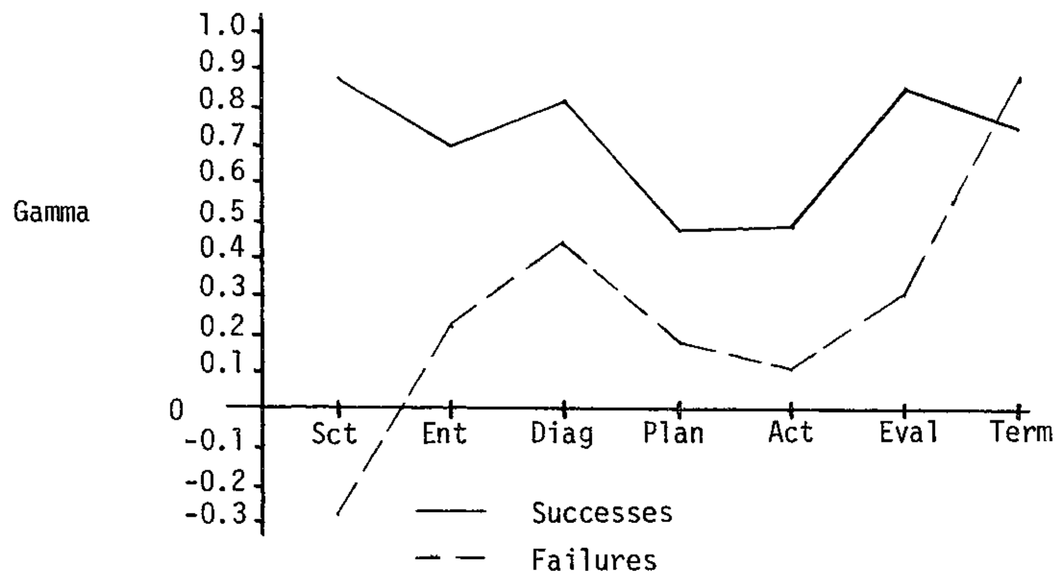
Table 11.

In the high complexity group we find the largest differences between successes and failures at Termination, followed by the pre-Action stages. We note that the failures show greater agreement than the successes at Scouting; this is likely due to the very low Scouting scores reported by successful consultants in this group (we reiterate our warning that we have probably biased the sample against truly bad Scouting efforts). This pattern of differences lends some support to our earlier contention that the key issues for this type of system are in the pre-Action stages rather than in

Average User-Designer Congruence by Stage



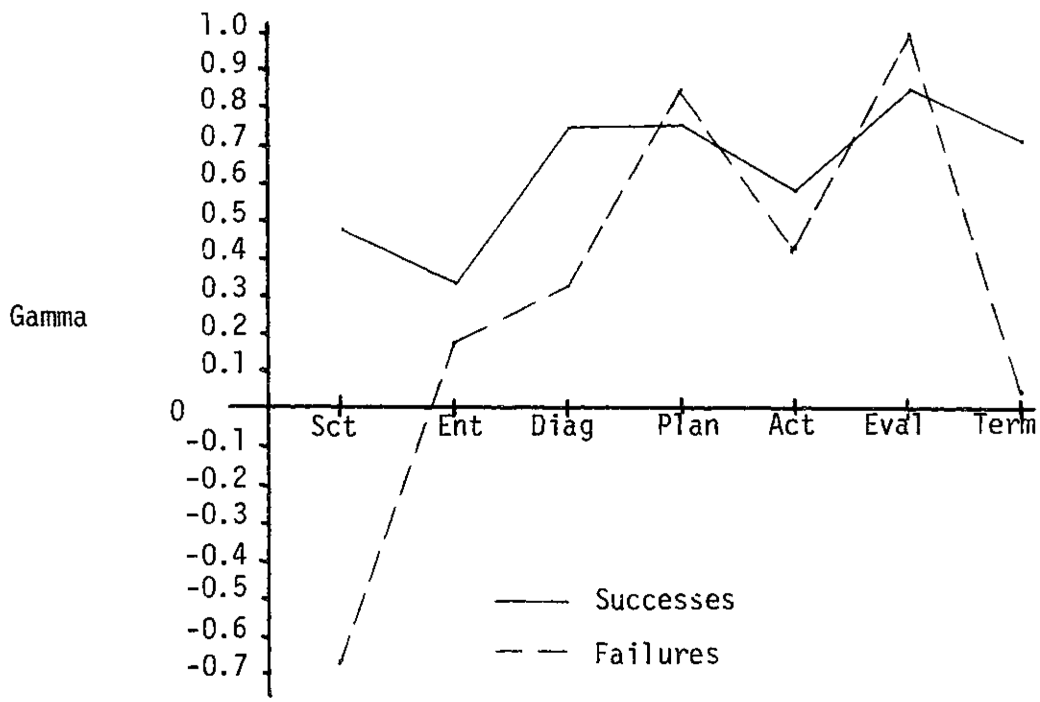
13.a. High Complexity Group.



13.b. Medium Complexity Group.

Figure 13.

Average User-Designer Congruence by Stage (Cont.)



13.c. Low Complexity Group.

Figure 13 (Cont.).

the 'technical loop', and suggests that it is the consultant's failure to understand the user at these early stages which sends a project down the road to failure.

The middle complexity group shows sizable differences at all stages except Termination, where the failures are more congruent than the successes. This strange reversal appears to be explained by the consistently low Termination scores of unsuccessful users and high scores for unsuccessful consultants in this group, coupled with the relatively unrestrictive definition of perfect association inherent in gamma (i.e., if the consultant's response is always at least as large as the user's, gamma will be quite large). We note that the technical activities are sources of disagreement in the failing projects in this group. unlike the case in the high complexity group. Again, this fits with our suggestion that the technical dimension should be more relevant in this group than in the higher complexity group.

Anything we say about the low complexity group must be tempered by the fact that it includes only two failures, and that these display very different profiles from one another. These two projects show similar patterns on four stages -- Scouting, Planning, Evaluation, and Termination. Considering these four stages, the failures show markedly lower user-designer agreement than do the successes on Scouting and Termination, but slightly better agreement on Planning and Evaluation. These latter two results are surprising, as we would expect greater disagreement at the technical stages in these low complexity projects.

In summary, the evidence tends to support the notion that some stages are more critical to project success than others, and that in the case of failure, the greatest differences in perception between user and designer are likely to be at these key stages. In addition, we find support for the relative unimportance of the primarily technical aspects of implementation in the case of DSSs and other projects of high organizational complexity.

VII.6. Level of Adoption and Success.

H2 suggests that success in implementing complex systems requires a higher LOA goal (and achievement) than is the case for less complex systems. We have already pointed out that we have some problems with our measures of LOA; the goal questions do not seem to discriminate as well as we would like, and at least one of the achievement questions (level 4) can easily be misinterpreted. The test of H2 cannot, then, be as clean as we would like, but perhaps it can give us some information.

In all three groups we find that a majority of users specify a level 4 goal. Table 12.a displays the mean and median LOA goal levels, and Table 12.b the achieved LOA levels, for successful and unsuccessful users in each complexity group. We note that successful users in the high complexity group report higher goals and achievements

User LOA Scores

12.a. LOA Goal

	Complexity Group					
	High		Medium		Low	
	Success (N=10)	Failure (N=8)	Success (N=8)	Failure (N=3)	Success (N=7)	Failure (N=3)
Mean	3.80	3.50	3.38	3.67	2.71	4.00
Median	4.00	4.00	4.00	4.00	3.00	4.00
Significance*	NS		.10		NS	

12.b. LOA Achieved

	Complexity Group					
	High		Medium		Low	
	Success (N=10)	Failure (N=8)	Success (N=8)	Failure (N=3)	Success (N=7)	Failure (N=2)
Mean	3.60	1.00	3.38	3.67	3.00	4.00
Median	4.00	1.00	4.00	4.00	3.00	4.00
Significance*	.001		.10		NS	

*Mann-Whitney U Test.

Table 12.

than do successes in the other two groups, but only the difference between the goals of high and low complexity users is significant at the .10 level (one-tailed Mann-Whitney U test). We also see in the high complexity group, a slight tendency for the successes to hold higher (but not significantly so) goals than do the failures. But, the reported achievement levels of the successes are very much higher than those of the failures. In the other two groups, the failures are higher than the successes on both goal and achievement levels, and these differences are significant in the medium complexity group. What is more, we note that the failures in the two lower groups report higher achievement levels than do the successes in the high group.

Perhaps the questionnaire items describing the LOA levels were not meaningful to users in the lower two groups. We have already suggested that level 2 (or possibly 3 in the middle group) was the appropriate level for this type of project. It is possible that these users could not relate the degree of change needed to reach level 3 or 4 (greater use of analytic aids in their decision making, or a change in the issues considered and decisions made) to their own experiences, and interpreted these items as describing some lesser degree of change than was intended, while users involved in high complexity projects were better able to relate these items to their experience. In any case, the data does lend support to the contention that a high LOA, both goal and achievement, is necessary for success in implementing DSSs and other high complexity systems.

VII.7. Summary.

The data we have collected are reasonably supportive of the major hypotheses of this thesis. First, there are systematic differences evident between the process scores of successful and unsuccessful implementation efforts. Most notable among these is the very strong difference in Termination stage scores. It appears that a poor job at this stage almost assures user dissatisfaction. The evidence for differences at other stages is less striking, and the stages which seem most important vary with project complexity. Some attention to the Entry and Diagnosis issues appears important, at least in the highest complexity group, and a failure to do a good job at these stages requires a very strong Termination effort if the project is to be successful.

A fairly clear difference in the importance of the technical dimension across complexity groups emerges from the data. The Planning, Action, and Evaluation stages seem to have less bearing on the success of high complexity projects than they do on projects of lower complexity. In the next chapter we will explore in more detail some differences between groups of projects on these (as well as other) stages. The evidence regarding Entry is less clear cut, though one plausible interpretation is that this stage is both more salient and more difficult to address effectively in projects of higher complexity.

On the question of LOA, the data tend to support the contention that organizationally complex systems require both high goal and achievement levels to be successful; it is not clear from the data, however, whether these levels can be lower for success in less complex systems. Indeed, no successful system in the high complexity group had either goal or achievement levels below 3, recurring use of the management science approach to problem solving. This has important implications for both consultants (who must recognize what 'ball game' they are in and the different demands of different games) and users (who must understand how much they will need to change if the project is to be satisfactory to them), which we will discuss in the final chapter of this thesis.

Finally, one very important, though unexpected, finding emerged from the data. Consultants in unsuccessful projects typically fail to recognize that their project is in trouble. What is more, they give markedly different reports of the implementation process itself than do the users. The implications of this situation are most important. We mentioned them in section 3 of this chapter, and will return to them in the final chapter.

VIII. Further Exploration of the Data.

The results just presented provide us with a general picture of the differences between successes and failures within complexity groups, and of the differences across systems which vary in complexity. We attempt, in this chapter to add to our understanding of these results by exploring, in a more qualitative fashion, certain aspects of the data. First, we will look at the individual questionnaire items which make up the stages, to see if the issues within a stage appear to differ in relative importance across complexity groups. Next, we will look at specific projects in an attempt to understand why they exhibit the patterns they do.

VIII.1. Differences at the Item Level.

Table 13 summarizes by stage the differences at the item level between successful and unsuccessful users in each of the three complexity groups. The entries in the table indicate the number (and fraction) of items at each stage for which the median response of the successful users is <u>strictly</u> <u>greater</u>[1] than the median response of the unsuccessful users (this is based on the full five-point response scale; tables of

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[1]Table 13 indicates only the number of items on which the median for the successess was higher than that for the failures. The two groups are tied on a number of items, and there is no stage for any of the three groups where the number of items on which the failures <u>exceed</u> the successes is as large as the number on which the successes exceed the failures.

medians and means by item can be found in Appendix VII).

Item Differences by Stage (Users)

Stage	# of items	Number of items where median success response exceeds median failure response — Complexity Group: High	Medium	Low
Scouting	5	4 (.800)	3 (.600)	2 (.400)
Entry	12	5 (.417)	7 (.583)	8 (.667)
Diagnosis	10	6 (.600)	6 (.600)	5 (.500)
Planning	16	6 (.375)	12 (.750)	12 (.750)
Action	8	3 (.375)	6 (.750)	7 (.875)
Evaluation	8	5 (.625)	4 (.500)	5 (.625)
Termination	12	10 (.833)	6 (.500)	11 (.917)
Total	71	39 (.549)	44 (.620)	50 (.704)

Table 13.

It is apparent from the table that while successes report better resolution of a majority of the issues raised, they by no means do so for all issues. We note, also, that the variation across the stages is considerable, and the patterns differ across the three groups of systems. Both of these tendencies are important. We would expect to find successes scoring at least as high as failures on half of the items if there were no relationship between process and outcome. But, were the successes to score higher on almost all items, we would have reason to suspect that the stages we have defined are not meaningful, and that all we are finding is some general retrospective evaluation of a project. That we find considerable variation in the degree to which the successes score higher than the stages at the different stages, suggests that these stages may indeed represent meaningful constructs. Looking at the patterns across complexity groups, the most striking difference is at the Planning and Action stages. In the high complexity group, these stages show the smallest differences between the successes and the failures. In the two lower complexity groups, however, Planning and Action are two of the stages at which successes are most differentiated from failures. This result is in accord with our contention that the technical dimension is less important in high complexity systems than in systems of lower complexity.

To further explore differences across complexity groups, we will look at the specific items which differentiate most clearly between successes and failures in each of the three groups. If our hypotheses about the differences implied by systems of differing complexity are correct, we would expect to find that the items which best differentiate successes from failures vary across groups. In particular, we would expect the high complexity successes to score higher than the failures on more of the Entry and Diagnosis items than would be the case in the other two groups.

At the Planning and Termination stages, we would expect the <u>particular items</u> which differentiate successes from failures to vary across groups. A number of the Planning issues deal with the mechanics of planning (e.g., defining operational objective and evaluation criteria, specifying a plan, setting priorities). We have suggested that the technical dimension is <u>relatively</u> unimportant in determining the outcomes of high complexity projects. Thus, we would not expect these technical issues to differentiate successes from failures in the high complexity group, while they are likely to do so in the lower two groups.

At Termination, six items address the general question of how well the system has been institutionalized. Two of these (numbers 65 & 68 in the Survey questionnaires -- see Appendix V) focus on the individual's adjustment to the demands of the system, while the other four (#s 66, 67, 78, & 81) focus on how well the system 'fits' the organization's exisiting practices. The greater degree of change demanded by high complexity systems implies that the former issue (individual adjustment) should be relevant to success in these systems, while it would not be relevant in less complex systems. In other words, we would expect to find that successful users in the high complexity group had recognized the need to adjust to a new mode of operation and had done so, while their unsuccessful counterparts had been unable to make this adjustment. Since systems of lesser complexity normally do not demand this degree of change, the adjustment dimension should not be relevant to success in these groups. The issue of 'fit' to organizational practices should be important for all types of systems.

In the discussion that follows we will focus on those questionnaire items for which there is a significant difference between the distributions of successes and failures in a given complexity group (Mann-Whitney U statistic significant at least at the .10 level for high and medium complexity systems, and at .111 for low complexity systems; the values of U for all items are shown in Appendix VII).

At Scouting, we find distinct differences on three items (#s 3, 4, & 5) in the middle complexity group, with successes higher than failures on each. These items deal with the issue of defining project needs and selecting a consultant who can meet these needs. In each of the other two groups, successes are significantly higher than failures on only one of these items (#3 in the high group and #4 in the low). The pattern is not clear, but it appears that at least some failures can trace their difficulties back to the Scouting stage.

We suggested that at the Entry and Diagnosis phases, successes in the high complexity group should score higher than failures on more items than would be the case in the other two groups. The evidence we find, however, is weak. Three Entry items (#s 13, 20, & 21) distinguish successes from failures in the high complexity group. There are no such items in the middle group, but in the low complexity group, successes also score higher than failures on three items (#s 15, 19, & 21). At Diagnosis, two items differentiate successes from failures in each group. In the low complexity group, the failures score higher on both (#s 25 & 28); in the middle group, successes are higher on both (#s 29 & 30); and, in the high group, successes are high on one item (#32) and low on the other (#31).

Thus, in terms of the number of items on which there are differences, there is little support here for our suggestion of the greater salience of Entry and Diagnosis in high complexity implementation efforts. There is, however, an interesting difference across the groups in the content of the items on which successes and failures diverge. In the high complexity group, three of the four items on which successes scored higher deal with the issues of gaining wide involvement in the project (#20), discussing goals at the start of the project (#13), and assessing the way the system would impact the organization (#32). There were no differences on these issues in the middle group, and in the low group, it is the failures who spent more time in diagnosis (#28) and considered the broader impacts of the system (#25). Thus, there is the suggestion that the issues of gaining wide involvement and developing a good understanding of the problem are either more important or more difficult to resolve in high complexity projects than in projects of lesser complexity.

Eight of the Planning items (#s 34, 35, 42, 43, 44, 45, 46 & 47) deal with the mechanical issues of specifying detailed objectives and a plan for action, developing evaluation criteria, and setting priorities. We have suggested that these items would not differentiate successes from failures in the high complexity group, while they might do so in the other two groups. Our expectations are partially borne out. In the high complexity group, successes are significantly higher than failures on one of these items (#45), while in the medium complexity group, successes are higher on four (#s 42, 43, 44 & 46). However, in the low complexity group, none of these items differentiates successes from failures. The evidence is not compelling, but once again it suggests the relatively lower salience of the 'technical' issues in implementing DSSs.

One interesting result we do observe in the Planning data is that in both the high and medium complexity groups, failures score considerably higher than successes on an item which concerns 'cycling' through the Entry, Diagnosis, and Planning stages (#48). Theoretically, this cycling is supposed to ensure the match between the solution and the problem, and is therefore an important aspect of a well handled development process. Apparently, in at least the two more complex groups, this cycling is often symptomatic of a project in trouble.

At the Action stage we find a most interesting pattern. In both the low and high complexity groups, two items (#s 49 & 50) differentiate successes from failures. These two items deal with the quality of the implemented system, and successes in both groups report that this quality was higher. In the middle group, neither of these items is significant, but three others are (with successes higher on each of them). One (#54) concerns user training, but the other two

(#s 51 & 56) concern the handling of a changing situation, recognizing and dealing with the organizational disruption caused by the implementation. In successful medium complexity projects this is done well, while in low and high complexity projects it is not (successes in these groups score lower on these items than do successes in the middle group). The likely explanation is that systems at either extreme of the complexity scale are considerably less disruptive than those systems falling in the middle. For the low complexity systems this is because they are straight forward and perform tasks that are well understood; i.e., they automate existing functions. High complexity systems, on the other hand, are too far removed from the locus of organizational activity to create any significant disruption. Thus, it is only for those systems in the middle that this issue is particularly relevant.

We can turn, now, to Evaluation. In each group, successes report doing a better job of evaluation (#57) and of following it up with needed changes (#62) than do failures. Perhaps the most interesting result at this stage, however, is that failures in two of the groups (high and low) score higher than successes on an item (#58) dealing with the degree to which they would plan more carefully for the Evaluation stage were they to do this project over again. Apparently, unsatisfied users ascribe at least part of their problem to a failure to properly plan for (a Planning issue) and execute project evaluation.

Finally, we come to Termination. In both the middle and low complexity groups, successes rank higher than failures on three items. Two of these (#s 66 & 78) are among the four mentioned earlier that concern the 'fit' of the system to the organization's practices. The third item differentiating successes from failures is different in these two groups; in the middle group it is the realization of expected benefits (#70), and in the low, a clear understanding of who is responsible for system maintenance (#79).

In the high complexity group, successes score significantly higher than failures on nine of the twelve Termination items. Among these are the item dealing with the realization of expected benefits (#70), all four items dealing with system 'fit' to the organization (#s 66, 67, 78 & 81), and two items concerning the quality (#76) and ease (#80) of the transfer of system 'ownership' and responsibility from the consultant to the client. The last two items are those which address the issue of individual adjustment to the system (#s 65 & 68).

Thus, our expectations for this stage are borne out rather strongly. It is only in the case of the highest complexity systems that the issue of individual adjustment to the system's demands differentiates successes from failures. In lower complexity systems, little (if any) change in task view is demanded; thus, the adjustment dimension is not relevant. But, in the case of DSSs and other organizationally complex systems, a change in task view or task definition is often the name of the game, and the individual who does not recognize this or refuses to make that change is likely to be dissatisfied with the outcome.

We have now considered all seven stages of the implementation process. The results support some of our expectations, but fail to do so for others. Our contention that the interpersonal and organizational issues of Entry and Diagnosis would be more critical to success in projects of higher complexity receives only the weakest of support when we look at individual items withing the stages. In terms of the number of items on which successes and failures differed, there was little difference across complexity groups. A difference was noted, however, in the particular issues on which successes and failures diverged; and, we saw that while successes in the high complexity group reported better resolution of goals and consideration of the system's implications, it was the failures who scored higher in these areas in the low complexity group. The evidence for the relative unimportance of the technical issues in high complexity projects is considerably stronger. At both the Planning and Action phases we find these issues differentiating successes from failures in the middle group, but not in the high group. Finally, the evidence strongly suggests that the handling of the Termination stage is critical to the outcome of high complexity projects. The fact that these projects do not typically fall in the mainstream of the organization's activities, makes it imperative that a strong, active Termination effort be made if the system is to be integrated into that organization's functioning.

VIII.2. A Look at Some Specific Projects.

Our final look at the data will be at a much more disaggregated level than we have considered until now. To round out our understanding, we will look briefly at a small number of cases which help illustrate some key points. Hopefully, these brief caselets will further demonstrate the richness to be found in the process view of implementation.

VIII.2.1. Preordained failure.

We have mentioned a number of times that one of the failures in the low complexity group looks much like a success on most stages. The system is a sales commission accounting system for a large office equipment manufacturing firm, and one would expect it to be fairly straight forward implementation effort (particularly in a company having as much D.P. experience as this one does). Yet, the project failed, the user being quite dissatisfied.

When we look at the user's responses we find something very interesting. In Scouting, though time was spent in looking for an appropriate consultant, selection of the consultant did not go well. Also, while many of the Entry issues are reported to have been successfully resolved, those dealing with team formation and leadership sharing were not. On most other stages, this project looks like a success, and the user even reports that expected benefits were realized.

The problem, therefore, seems to be at the Scouting and/or Entry stages. And, the user provides us with comments that explain the situation. In response to the questions about selection of the consultant the user says:

> "Selection of the consultant was not controlled by the client. The systems group selected the analysts without client's approval.
>
> "If client had the option, different consultants would have been selected.
>
> "We had no choice [on selection of the consultant]."

Though Scouting had been carried out by the user group, they were not allowed to choose their preferred consultant. As a result, though client and consultant could agree on goals, objectives, etc., no satisfactory working team could be formed; and, though the rest of the process was reasonably well handled, the user views the project as a failure. This is probably the most extreme Scouting-Entry failure we have in our sample, and it serves well to point out the problems this can cause even in a relatively straight forward project.

VIII.2.2. Multi-user systems.

A number of the systems included in this study were developed for use by more than one person. For four of these systems we have responses from more than one user, and in the case of two of these the users disagree on the question of success. That is, at least one user in each of these cases says the implementation effort was successful, while at least one other says it was not.

By looking at the differences between those users who find a single system satisfactory and those who do not, perhaps we can obtain some better insights into the requirements for success in implementation. Both systems on which users disagree are in the high complexity group.

We will turn first to the accountability inventory system in a nuclear fuel fabrication company. There were essentially three distinct constituencies (or client groups) for this system -- Accountability, Production Control, and Inventory Control -- and our user respondents are the primary users in the first two of these constituencies. The initial purpose of this project was to automate an existing, largely manual, accountability system. The comments of the Production Control (PC) user and the system designer suggest, however, that this aim was soon changed. The PC user describes his getting involved with the project as follows:

> "[The system designer] and myself proposed a system similar to the one being implemented. The idea was a result of the use of a special program written by [the system designer] for a specific QC problem." (emphasis added)

And the designer claims that his involvement arose when:

> "The Production Control Supervisor and myself were talking about some of his problems and ... "

Thus, there was a shift of focus (as evidenced by these comments, plus those of the D.P. manager in an interview) from the original plan to develop an automated accountability inventory system to an effort to develop a sophisticated production control system. What was the cause of this shift, and what were its consequences? Understanding the cause of this change is simple. The accountability system originally planned was a relatively straight forward, unexciting system. The possibility of grafting on-line production control/material control capabilities onto this base was just too enticing to pass up. It did not take long, however, for the add-on to become the major focus while the 'core system' was forgotten.

Given this background we would expect to find the PC user relatively satisfied with the project, while the accountability user is less so. Furthermore, we would expect to find major differences in process perceptions between these two users at the very beginning of the project -- i.e., at Scouting or Entry. Indeed, we find such differences. The original, but dissatisfied, user reports an active effort to find the right consultant, but dissatisfaction with the match of the consultant to his needs. The PC user reports just the opposite pattern at Scouting; he fell into the project without any active searching, but the fit between problem and consultant was good. Similarly, while the original client reports very poor resolution of all Entry issues except that of focusing on projects with long-term benefits, the PC user reports just the opposite pattern. He does not see the project as aimed at his long-term needs, but does report favorable resolution of almost all the other issues presented by the Entry stage. At the subsequent stages the two users are in relatively good agreement, except for Diagnosis which the satisfied user reports as having been poorly resolved.

The example above is a relatively simple one, but it serves to illustrate how a project can be both a success and a failure simultaneously. We turn now to a slightly more complex example, a system to support portfolio managers (PM) in a bank trust department. The system was intended for use by a large group (circa 40) of PMs in three divisions of the department. Divisions are differentiated by the type of customer they handle; customer size, investment goals, and sophistication vary considerably across divisions. The system was designed by a committee including the consultant plus a few PMs from each division. The responses we have obtained come from seven users, five of whom were on this design committee. Among the five on the committee, two claim the project was successful and three claim it failed. Of the two not on this committee, one is satisfied with the outcome and one is not. We will use these users' responses plus notes from interviews with some of them in an attempt to learn how these differing perceptions arose.

Consider first two users from a division having customers with aggressive investment goals. Both served on the design committee, but one sees the project as a success while the other sees it as a failure. Both report that all Scouting issues were well addressed. But, when we come to Entry, they differ. The success finds fault with two Entry issues -- establishing committment and forming a team. The failure, on the other hand, finds a lack of agreement on goals and a failure to gain adequate involvement, as well as some problems with team formation. These differences at Entry are consistent with what we have already seen is the overall pattern for successes and failures in this high complexity group. Agreement on project goals and having true participation of client personnel may well be the critical Entry issues for systems of this type.

The other major differences between these two users are at Diagnosis -- where the dissatisfied user sees a complete failure to assess the system's impact on the organization -- and at Planning -- where he believes there was a failure to develop an understanding of the system. Other than these, the two users look much the same until we reach Termination. While these two users have the same overall Termination score (.250), its composition shows an important difference. The satisfied user reports that the system does not fit well with the old way of doing things, while the dissatisfied user reports that he has not adjusted to the new system. In a sense, this difference tells it all. It is generally agreed (by the consultant and management, at least) that this system was meant to introduce a major change in the way things are done in this department. The successful user recognized this and made the necessary changes. The unsuccessful user did not understand this -- he felt that there was disagreement on goals and that the system's impact was not understood -- and he failed to adapt to the demands of the change.

The other five users are from a division having less agressive, and generally smaller, accounts. Considering first the two users who were not on the design committee, we find a pattern similar to the one just discussed. The unhappy user reports a number of problems at Entry -- including the lack of agreement on goals -- and a failure to adequately define the problem or understand the system at Diagnosis and Planning. He comments, in fact, that the project's "aim has not been well articulated or widely explored." Finally, he has not adjusted to the new system, and responds to the question of whether a return to the old way of doing things would be difficult by saying "Most emphatically not!" Once again, the pattern displayed shows the dissatisfied user's problem beginning with a lack of agreement on goals at Entry, and ending with a failure to change to a new (required) mode of operation. The satisfied user, like the one discussed above, does not report these types of problems, and has, in fact, adapted.

Finally, we have three remaining users who were all members of the design committee. The successful user among these three looks much like the other successful users from this project -- good Scouting, Entry, Diagnosis, and Termination, with a strong indication that he has changed to meet the demands of the new system. Though he is satisfied with the project, his comments suggest some reasons for the dissatisfaction we have observed among other users. In particular, he suggests that the 'old way' was adequate for most PM's needs, and that it is not clear that the added sophistication of the new system is necessary. This is likely the reason for the lack of agreement on goals expressed by other users. They never saw a need for major change; hence, they could not agree with the consultant's (and other PMs') definition of goals.

The two remaining dissatisfied users differ considerably from one another. The first is somewhat similar to those already discussed. Though he does not report problems at Entry, he does report major problems at Diagnosis (particularly in defining the problem to be solved) and at Termination, again being unable (or unwilling) to adapt to the new system. The final dissatisfied user looks much like the successful ones. He does report, however, strong reservations about the consultant's understanding of the users and their needs (items 23, 26, 28 & 30), and shows lower adaptation to the new system than do the successes (though his score is considerably higher than those of the other failures). His comments, however, explain his position.

The one function of the system which he deemed to be most valuable had not yet been implemented -- it was more complex, both to develop and to use, than the other parts of the system, and hence its installation had been put off (for more than a year beyond the date at which it was originally to have been operational). Thus, this user was dissatisfied because his expectations for the system's capabilities had been violated. In terms of the process, this problem manifests itself as a failure in Diagnosis -- the designer's failure to understand the user's needs well enough to recognize that for some users it was only these more advanced capabilities that were desired, and that without these capabilities, this part of his constituency would find the system more or less useless.

VIII.2.3. Summary.

The reasons for discussing these few specific systems in some detail are two. First, by tying process scores to specific contexts and comments we hopefully make our arguments more concrete and understandable. Second, the particular systems we have looked at in this section make some important points. In the first instance, that of the sales commission accounting system, we find that doing almost everything right could not make up for the participants' (user and consultant) inability to 'get together' at Scouting and Entry. This reinforces our contention that these preliminary stages, the negotiation of a satisfactory psychological contract, are crucial to the eventual outcomes of a project.

The other two systems we have looked at make a key point about the nature of that psychological contract, and more generally, about implementation. The process is very definitely centered around individuals. Each person involved in a project has his own set of needs, expectations, etc. Failing to deal with these issues <u>on an individual level</u> means risking failure; the designer may meet the needs of part of his constituency while failing to meet those of another part. We reiterate, the contract must be between individuals, and the chances of success are significantly diminished when this fact is not recognized and dealt with.

IX. Summing Up.

Our primary aims in conducting this research have been to define implementation as a process, to develop descriptive insights into this process, and to point the way towards some normative techniques for conducting it. Our hope is that this work will both increase the general understanding of implementation -- the issues involved, the connections between process and outcomes -- and enable us to practice MS implementation more effectively. Specific hypotheses and results have been discussed in the preceeding three chapters. Here we will briefly summarize these results and discuss some of their implications for researchers, practitioners, and managers.

IX.1. General Summary of Results.

The results of this research fall into three main categories -- the general importance of the implementation process in determining implementation outcomes, the differential demands placed on the process by different technologies, and the low degree of perceptual congruence between users and designers in projects where the users were dissatisfied with outcomes. Of these, the first two were expected, and are in accord with our hypotheses. The third result, however, was quite unexpected, and we shall turn to it first.

We have seen that consultants are much less likely to view a project as unsuccessful than are clients. We must remember that none of the projects we have been looking at are failures in the sense of not being used. All were installed and were used for some period (in fact, we know of only one system which was not being used at the time the data for this study were collected). Thus, the measure of project success is considerably more stringent than the simple criterion of system use. This measure, user satisfaction with project outcomes, is far more appropriate to the 'service' orientation which we have suggested is necessary for effective MS implementation than would be the system use criterion (which suggests a 'product' view of implementation). Apparently, however, many consultants do not operate in this service mode and are unable (or unwilling) to recognize when a client is dissatisfied with a project even though he is using the system.

This difference between client and consultant perceptions is not limited to outcomes. Looking at perceptions of the implementation process itself, we find substantially less agreement between users and designers in those cases where the user is not satisfied than we do in those cases where the user is satisfied. What is more, these differences tend to be largest at the process stages which appeared to be most critical for success in that type of project. Generally, while we find a number of differences between the process perceptions of satisfied and dissatisfied clients, we find far fewer differences between consultants involved in projects with satisfied users and those with dissatisfied users. Because of this inability, or unwillingness, of consultants to differentiate between successful and unsuccessful projects, the bulk of our analysis has focused on the clients only.

It is worth noting here a parallel between MS implementation and marketing. The client in an implementation effort is truly a buyer of a service; it is his needs which the consultant (or seller) is trying to meet (see Stabell, 1974a, for a more detailed discussion of this buyer-seller relationship). The client's perceptions, then, are the critical ones for understanding implementation. They will reflect the difference between a consultant who takes a 'sales' approach -- offering a product -- and one who takes a 'marketing' approach -- attempting to develop and meet a felt need. Many consultants in the MS area may not recognize the difference between these two approaches, so it is only through the user's perceptions that we can tap into this critical difference in process.

The primary hypothesis tested in this study was, essentially, that differences between successful and unsuccessful implementation efforts (as defined by the user's achievement of his goals for the project) could be accounted for by differences in the implementation processes followed by the projects. In other words, our contention was that the problem(s) which led to user dissatisfaction could be found in the nature of the implementation process; more specifically, it could be traced to a failure to adequately deal with and resolve certain issues which are implied by the Lewin/Schein theory of change. Two measures of project success were considered. The first quite literally attempted to map the users goals against his achievements, and measured success by the degree to which goals were achieved. The second measure is conceptually much simpler, asking the respondent only to rate his overall satisfaction with the project. This second measure proved to be somewhat more reliable (at least partially because of problems in the operationalization of the goal matching measure), and was used as the dependent variable in this study.

The data show that there are significant differences in the processes followed by successes and failures. Systems were divided into three groups based on their implied organizational complexity (which is not necessarily related to technical complexity), and in each of these groups, satisfied users reported significantly better Termination efforts than did dissatisfied users. That is, the transfer of responsibility for the system from consultant to client and the confirmation of necessary new behavior patterns was, in almost all cases, better handled in successful projects than in unsuccessful ones. It is true that in a number of cases the failure to adequately handle this Termination stage is likely to reflect problems which arose at earlier stages of the process and were carried through, unresolved, until the project ended. However, there are unsuccessful projects in our sample which give no indication of any problem until they reach this Termination (or institutionalization) stage. No other process stage was as strongly related to success as was Termination. This result is highly congruent with Sorenson and Zand's finding that the Refreezing stage was much more strongly related to outcomes than either of the other two stages in the Lewin/Schein theory of change. Indeed, this result adds emphasis to Dickson and Powers' contention that, to users, implementation is institutionalization, not the system installation phase which technicians tend to equate with it.

Other than Termination, no stage of the implementation cycle bears a clear and consistent relationship to outcomes. Other stages do exhibit significant differences between successes and failures in one or two of the three complexity groups, but many of these differences disappear when we take the project's Termination score into account. The limited data which are then available can do no more than suggest some patterns which lead to success or failure. The patterns which seem to emerge differ across complexity groups and are consistent with the view of implementation we have espoused in this thesis. Essentially, it appears that for systems of higher organizational complexity, the substantive issues of the Entry, Diagnosis, and Planning stages -- e.g., agreeing on goals and objectives, gaining wide involvement of organizational personnel, and developing a good understanding of both problem and solution -- are important contributors to the eventual outcomes of the project. The procedural and mechanical issues at the Planning, Action, and Evaluation stages seem to have less bearing on success in these higher complexity projects. In projects of lower complexity these substantive pre-Action issues may still be important, but they are relatively less important, as here the procedural/technical activities appear to be more directly related to project outcomes.

We can summarize the evidence we find in support of our contentions. In looking at the stages one at a time, the only clear difference was at Termination, where only three failures scored as high as the lowest scoring successes. There were no clear and consistent relationships between success and the scores on other stages we suggested as likely to be critical in determining success. When we considered the correlations between the Termination score and the scores for the other stages, however, some interesting patterns emerged. In the high complexity group we found that successes who did poorly on Termination had done very well at Diagnosis, while failures who did well on Termination had done quite poorly on Entry. In the middle group we found a similar pattern, but this time it involved the Planning and Action stages. These patterns suggested that there was some merit to our belief that organiztional/interpersonal issues would be most important in DSS implementations, while procedural/technical issues would be critical in implementing less complex systems. This latter suggestion was borne out well when we looked at the individual items on which successes and failures differed most.

We stress once more that the patterns we have described are merely suggestions. They are consistent with the 'theory of implementation' we view as most appropriate. We find some evidence in the data which suggests these patterns are present. This evidence varies in quality and weight, and more conclusive results would be desirable. The data, however, are too limited to provide these results.

IX.2. Methodological Issues -- A Review.

A number of methodological issues have been raised in our discussion, and a brief review of some of them seems worthwhile. Let us first consider some of the problems encountered because of our choice of methodology. As we discussed in Chapter 6, our research is retrospective; we ask respondents to report on events which transpired in the past. Perceptions of past events are subject to change over time and as a result of the individual's more recent experiences (e.g., use of the system about which he is reporting), and it is difficult to assess the extent to which such processes have colored the data which we have collected.

The other major problem which plagued this research is that of degrees of freedom. The stages of the implementation process are, by and large, a convenient way to summarize a moderately large number of issues which are part of the implementation situation. As we have seen, these issues need not vary in concert. Thus, the number of variables we really have to deal with is considerably larger than just the seven stages. With a limited sample size (as in this study) no conclusive results are possible. The best we can expect is to gain some gross insights into the relative importance of various issues.

We can compare this research to the factor studies. The two problems just mentioned -- the retrospective data and insufficient degrees of freedom -- are common to both designs. Factor researchers attempt to finesse the latter problem by considering only a small set of factors. However, as we discussed in Chapter 2, the choice of factors is often arbitrary, and we are unlikely to gain an understanding of the complexity of implementation by ignoring it. Thus, neither the factor approach nor the one taken here addresses these two problems effectively.

On a number of dimensions, however, this study has differed considerably from the factor studies. First, as mentioned before, our approach is grounded in theory, and the theory chosen does justice to the complexity we know exists. Next, we have tried to focus on dynamics, the key aspects of the implementation process, rather than on the context which surrounds this process. Thirdly, based on our theory, we have identified _a_ major contingency affecting implementation -- the implied organizational complexity of the project's technology -- and have explored some of the ramifications of differences along this dimension. Finally, this study differs from many past efforts in that we _predicted at the outset_ the major process variables which would affect implementation and the direction of this effect.

Clearly, there remain methodological problems with this approach; but, it has brought us one step closer to understanding a complex phenomenon, implementation.

IX.3. Implications for Research and Practice.

The interests of scholars and practitioners are very closely alligned in the area of MS implementation. Both need models which help them understand this phenomenon; the scholar, so that he can study it and refine this understanding; the practitioner, so that he can guide it to achieve the most desirable outcomes. Our purpose in this research has been to articulate and test one such model, a model of the implementation process. Our contention is that process provides a more meaningful framework for viewing a variety of implementation situations than do competing models, most notably the factor approach. Ultimately, we argue, this process view can provide us with considerably better action implications than can other approaches to implementation research. We have reviewed the evidence that was presented by this study; our purpose, now is to translate our results into implications for action for three interested parties -- researchers, consultants, and managers.

IX.3.1. Implications for researchers.

Probably the clearest message to implementation researchers arising from this study is the care which must be taken in defining the dependent variable. In reviewing the literature we saw that different definitions of the dependent variable led to different conclusions not only about which forces impact implementation outcomes, but even about the direction in which they affect these outcomes. The results of this study indicate that the individual's role is of prime importance in determining how he views outcomes; that we cannot expect consultants and users, or even all users, to be in agreement about the outcomes of all projects. Thus, who you ask is at least as important as what you ask. The obvious implication of this for researchers is that extreme care must be taken in both defining and measuring the dependent variable. The choice must be based on the objectives of the study, and we meed to be careful not to make unwarranted generalizations by assuming that the outcome variable measured will be highly correlated with other possible measures of outcome. To be more concrete, if we are concerned with the determinants of user satisfaction, we should ask <u>users</u> if <u>they</u> are satisfied. But, we should not assume that this measure necessarily reflects anything about the consultant's, or even user management's, satisfaction with project outcomes.

A similar warning can be voiced about independent variables. We have seen that in many cases clients and consultants differed markedly in their perceptions of the implementation process. The researcher must take care to assess the degree to which the variables he wishes to measure are subject to individual interpretation. Some variables -- e.g., demographics or structural characteristics of the organization -- are likely to be assigned similar values regardless of whom the respondent is. Others, however, like the more perceptually based variables used to assess process in this study, are subject to wide variation across respondents. In summary, for both independent and dependent variables, it is important to recognize that the individual respondent, his role and his perceptions, can have a marked effect on the measurements obtained.

In retrospect, it is clear that the questionnaire used in this study meant different things to different respondents. A few respondents seemed to have difficulty (as evidenced by question marks, a few comments, and neutral responses scattered through their questionnaires) in relating the general statements in the questionnaire to the specifics of their situations. Others were able to relate to these general statements, but felt it necessary to add explanatory comments and elaborations. At least one user found responding to the questionnaire an educative experience, and commented that his understanding of his situation was enhanced by the experience. In designing instruments and selecting respondents for this type of research it is important to keep these differences in mind; the trade-off, of course, is between the tailoring of the instrument to the situation and the range of situations to which it can be applied.

A second implication for researchers is the importance of contingency models in developing our understanding of implementation. Radnor and his colleagues have reported that an organization's stage in the 'OR/MS life cycle' affects which factors are most relevant to implementation outcomes. Our results indicate that the organizational complexity inherent in a specific system affects the relative importance of the various aspects of the implementation process. In organizationally simple systems, the technical dimension appears to be the dominant one; but, as systems become more complex, the non-technical dimensions become more salient, eventually overshadowing the technical. There are quite likely other important contingencies that have not yet been explored, and it is only by this type of 'map building' that we can develop a full understanding of implementation.

IX.3.2. Implications for consultants.

There are two basic messages for consultants to be found in this study. First is the fact that not all projects are alike.

Systems differ from one another in the degree of organizational/implementation complexity they imply. That is, implementation has numerous dimensions -- technical, cognitive, interpersonal, political. For some (low complexity) systems, the technical dimension is the dominant one. But, for other, more complex systems, additional dimensions become more salient, and may, in fact, overshadow the purely technical aspects. We saw this in the differences among our three groups of projects. For systems in the two lower complexity groups, there seemed to be a fairly strong connection between the handling of the technical aspects of the project and success; but, for the most complex systems, the non-technical dimensions appeared to be more important.

The implication of this difference is quite simple. Different projects require different types of skills, and the consultant must learn to recognize the skills needed in the particular situation. He must be skilled enough to vary his emphasis and apply those skills most appropriate to the circumstances he is facing; and, he should be honest enough to back away from those projects requiring skills he does not possess. We realize that this is a rather utopian prescription. Admitting to a lack of requisite skills is difficult enough when the skills in question are only technical ones; it is undoubtedly more difficult when the real issue may be interpersonal skills. But, difficult or not, the prescription is appropriate. Gorry and Scott Morton (1971) suggested that one very possibly needed different people to build DSSs than to build conventional information systems. Our data and these comments suggest that they well may have been right.

The second major point on which this study speaks to consultants is that of their relationship with their clients. There are several aspects to this. Perhaps the most important is how the consultant defines his role. He has a critical choice to make; he can act as a process consultant or he can act as a technician. Schein has suggested (personal communication) that this is the most important decision the consultant has to make in the course of a project; and, he must make it at the very start of that project. His decision at this point will impinge on every aspect of the project from start to finish. If he wishes to act as a technician, the likelihood of his truly understanding the user's needs, goals, and general perspective is severely diminished; and, with this, so are his chances of success! What is more, the more complex the project, the greater the damage. Success, particularly in high complexity projects, demands that the consultant understand the user. Achieving this understanding normally requires a conscious effort by the consultant, and this implies a need to behave as a process consultant, not a technician.

The other key aspect of the client-consultant relationship issue is that of defining who the client is (or clients are). Our data show clearly that not all users see a single project in the same way, that each has his own unique set of needs and desires.

This result points out the individual nature of implementation; it must be viewed as the relationships betweeen individuals. For the consultant this implies a need to identify all key actors in the client group, and to negotiate an appropriate contract with each of them. It is not enough to work with one user in a multi-user system, and assume that he can adequately represent the views of all others. True participation of all relevant users (and other affected personnel) is necessary. Clearly, this adds considerably to the consultant's work load, and in some cases may be infeasible. But, the consultant must recognize that by failing to deal with each person individually, he increases the probability.

We can summarize all of the implications for the consultant in one simple statement: He must learn to be a diagnostician. His role truly should be a 'clinical' role, as he must study each situation to learn what makes it unique, to ferret out the critical aspects in that setting (for further comments on the clinical nature of the consultant's role, see Keen, 1975).

IX.3.3. Implications for managers.

Finally, we turn to the user. What can he do to assure that he receives the most for his investment in system development? We can divide his actions into two groups -- those things he should do by himself and those things he should do in conjunction with the consultant.

We will consider first what he can do alone, as these are actually prerequisites to the other actions he can take. First, he, like the consultant, must recognize that projects differ from one another; that the demands placed on him and his organization will vary from project to project. A key aspect of this is the variation in the degree of change implied by different technologies. The potential system user must learn to understand both these differences and his own capacity for change. A user who is unwilling to consider new modes of problem solving is wasting his own (and the consultant's) time and money if he asks for a sophisticated, model-based, on-line DSS. He must take the time to think through both the demands for change implied by the system and the capacity for and willingness to change he (and his organization) possesses. If there is not a match between demands and capacity, the project should be abandoned, or at least carefully redefined.

Closely allied to this assessment of demands and capacity for change is another simple step the user can take; that of articulating carefully his goals and objectives for the project. This may seem to be a trivial suggestion. Nonetheless, it is an important one; for it is only by clarifying for himself exactly what he hopes to achieve that the user can judge whether the project has a realistic chance of reaching this goal.

A key aspect of both of these suggestions is that the user must realize that _he_ has a tremendous responsiblity for the progress of an implementation effort. Hiring a consultant in no way lessens these responsibilities. The *user* must be willing to make the project a joint effort if he wants it to succeed. He must recognize that his *time* and *commitment* are required whether or not a consultant is involved. If he is not willing to give this time and commitment, the project should be dropped.

The other implications for managers arising from this research concern their relationships with consultants. Three interrelated prescriptions seem warranted. First, the user must demand that the consultant have the skills necessary for the type of project they are considering. This implies that the user must understand the different demands of different project types, and must have some basis for judging the consultant's capabilities. Next, the user must demand that the designer behave as a process consultant; that he not view his role as one of simply injecting technical expertise, but rather one of working *with* the client organization to help it improve its functioning. Finally, in order to assure that these first two demands are being met, the user should periodically test the match of his perceptions with those of the consultant. Such an action should force the project to stay 'on course', and thus eliminate the type of situation we observed in our sample, having marked differences in perceptions about both process and outcomes.

IX.4. Conclusion.

We argued earlier in this thesis that one of the most serious defects in existing research on MS implemantation is that it fails to focus on the management of the process, that it has studied those aspects of the implementation situation over which we have the least control. Focusing on process, on the other hand, should lead to an understanding of implementation upon which we can act, since this understanding sould be in terms of those aspects of implementation over which we have the greatest control, our own behavior. We have now looked at data gathered from a small sample of projects, and have discussed some implications arising from this data. As we had hoped, the data bear not on structure or other non-controllables, but rather on the actions which users, designers, and researchers can take. The task now is to test these actions in practice, to determine whether they do lead to the outcomes that have been suggested here.

BIBLIOGRAPHY

Alter, Steven L. (1975): "A Study of Computer-Aided Decision Making in Organizations", Unpublished Ph.D. Thesis, M.I.T.

Ackoff, Russell L. (1960): "Unsuccessful Case Studies and Why", Operations Research 8, pp. 259-263.

_____ (1967): "Management Misinformation Systems", Management Science 14 #4, pp. B147-B156.

Argyris, C. (1971): "Management Information Systems: The Challenge to Rationality and Emotionality", Management Science 17 #6, pp. B275-B292.

Banbury, J. (1968): "Operational Research and Innovation in Management Methods", Operational Research Quarterly 19 #4, pp. 377-387.

Bean, Alden S., Rodney D. Neal, Michael Radnor & David 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, University of Pittsburgh.

Beckhard, Richard (1973): "Health Care Systems: Opportunities and Challenges", Sloan School of Management, M.I.T., Working Paper #672-73.

Bennis, Warren G. (1965): "Theory and Method in Applying Behavioral Science to Planned Organizational Change", JABS 1 #4, reprinted in Bennis, Benne & Chin (eds.), The Planning of Change, Holt, Rinehart & Winston, New York (1969).

_____ (1965a): "Commentary on 'The Researcher and the Manager: A Dialectic of Implementation'", Management Science 12 #2, pp. B13-B16.

Berelson, Bernard & Gary A. Steiner (1964): Human Behavior: An Inventory of Scientific Findings, Harcourt, Brace, & World, New York.

Brenizer, Ned W. (1973): "A Funny Thing Happened on the Way to Progress -- Resistance", Data Management 11 #4, pp. 20-22.

Campbell, Donald T. & Donald W. Fiske (1959): "Convergent and Discriminant Validation by the Multitrait-Multimethod Matrix", Psychological Bulletin 56 #2, pp. 81-105.

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

Churchman, C. West & F. E. Emery (1966): "On Various Approaches to the Study of Organizations", in Lawrence (ed.), Operational Research and the Social Sciences, Tavistock, London.

_____ & A. H. Schainblatt (1965): "The Researcher and the Manager: A Dialectic of Implementation", Management Science 11 #4, pp. B69-B87.

Dearden, John & John Lastavica (1970): "New Directions in Operations Research", Financial Executive XXXVIII #10, pp. 24-33.

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

Doktor, Robert H. & William F. Hamilton (1973): "Cognitive Style and the Acceptance of Management Science Recommendations", Management Science 19 #8, pp. 884-894.

Drake, John W. (1973): The Administration of Transportation Modeling Projects, D. C. Heath, Lexington, Mass.

Emery, James C. (1972): "Where do we stand in implementing information systems?", Proceedings SJCC 40, AFIPS Press, Montvale, New Jersey, pp. 1167-1171.

Evan, William M. (1965): "Commentary on 'The Researcher and the Manager: A Dialectic of Implementation'", Management Science 12 #2, pp. B17-B19.

_____ & Guy Black (1967): "Innovation in Business Organizations: Some Factors Associated with Success or Failure of Staff Proposals", Journal of Business 40, pp. 519-530.

Foster, Michael (1972): "An Introduction to the Theory and Practice of Action Research in Work Organizations", Human Relations 25 #6, pp. 529-556.

Garrity, John T. (1963): "Top Management and Computer Profits", Harvard Business Review 41 #4 (July-August), pp. 6-12.

Gerrity, Thomas P., Jr. (1970): "Design of Man-Machine Decision Systems", Unpublished Ph.D. Thesis, M.I.T.

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

_____ & John S. Hammond (1974): "Contrasting Approaches for Facilitating the Implementation of Management Science", presented to the Joint National Meeting of TIMS and ORSA, Boston.

Ginzberg, Michael J., John D. C. Little & C. Scudder Smith (1975): "An On-Line Budget Tracking System for Massachusetts", Sloan School of Management, M.I.T., Working Paper #763-75.

Goodman, Leo A. & William H. Kruskal (1954): "Measures of Association for Cross Classifications", Journal of the American Statistical Association 49, pp. 123-163.

Gorry, G. Anthony (1971): "The Development of Managerial Models", Sloan Management Review 12 #2, pp. 1-16.

_____ & Michael S. Scott Morton (1971): "A Framework for Management Information Systems", Sloan Management Review 13 #1, pp. 55-70.

Grayson, C. Jackson, Jr. (1973): "Management Science and Business Practice", Harvard Business Review (July-August), pp. 41-48.

Hall, William K. (1973): "Strategic Planning Models: Are Top Managers Really Finding Them Useful?", Journal of Business Policy 3 #2, pp. 33-42.

Hammond, John S. (1973): "The Roles of the Manager and Analyst in Successful Implementation", presented to the XX International Meeting of TIMS, Tel Aviv.

Harvey, Allan (1970): "Factors Making for Implementation Success and Failure", Management Science 16 #6, pp. B312-B321.

Hax, Arnoldo C. (1973): "An Analytic Approach for the Development of Customized Model Based Large Scale Logistics Systems", presented to the 44th National Meeting of the ORSA, San Diego.

Heany, Donald F. (1972): "Education -- The Critical Link in Getting Managers to Use Management Systems", Interfaces 2 #3, pp. 1-7.

Howard, Ronald A. (1968): "The Practicality Gap", Management Science 14 #7, pp. 503-507.

Huysmans, J. H. B. M. (1970): The Implementation of Operations Research, Wiley-Interscience, New York.

_____ (1973): "Opearations Research Implementation and the Practice of Management", presented to the Conference on the Implementation of OR/MS Models, University of Pittsburgh.

Keen, Peter G. W. (1973): "Cognitive Style and Individual Decision Making", Unpublished D.B.A. Thesis, Harvard Business School.

_____ (1974a): "Towards a Behavioral Methodology for the Study of OR/MS Implementation", Sloan School of Management, M.I.T., Working Paper #701-74.

_____ (1974b): "Computer-based Decision Aids: The Evaluation Problem", Sloan School of Management, M.I.T., Working Paper #738-74.

_____ (1975): "A Clinical Approach to Implementation", Sloan School of Management, M.I.T., Working Paper #780-75.

_____ & J. McKenney (1973): "The Implications of Cognitive Style for the Implementation of Analytic Models", presented to the Conference on the Implementation of OR/MS Models, University of Pittsburgh.

Kolb, David A. & Alan L. Frohman (1970): "An Organization Development Approach to Consulting", Sloan Management Review 12 #1, pp. 51-65.

Kuhn, Thomas S. (1970): The Structure of Scientific Revolutions, University of Chicago Press, Chicago.

Leavitt, Harold J. (1964): Managerial Psychology, University of Chicago Press, Chicago.

Lewin, Kurt (1947): "Fronteirs in Group Dynamics: II. Channels of Group Life; Social Planning and Action Research", Human Relations 1 #2, pp. 143-153.

_____ (1948): "Action Research and Minority Problems", in Resolving Social Conflicts: Selected Papers on Group Dynamics, Harper & Bros., New York.

_____ (1952): "Group Decision and Social Change", in Newcomb & Hartley (eds.), Readings in Social Psychology, Henry Holt & Co., New York.

Lippitt, Ronald, Jeanne Watson & Bruce Westley (1958): The Dynamics of Planned Change, Harcourt, Brace & World, New York.

Little, John D. C. (1969): "Models and Managers: The Concept of a Decision Calculus", Sloan School of Management, M.I.T., Working Paper #403-69.

Lucas, Henry C., Jr. (1973): "Behavioral Factors in System Implementation", Graduate School of Business, Stanford University, Research Paper #188.

_____ & Rodney B. Plimpton (1972): "Technological Consulting in a Grass Roots, Action Oriented Organization", Sloan Management Review 14 #1, pp. 17-36.

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

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

Miller, Richard D. (1974): "Multidimensional Processes of Implementing Computer Based Models", Unpublished D.B.A. Thesis, Harvard Business School.

Mitroff, Ian I. (1972): "The Mythology of Methodology: An Essay on the Nature of a Feeling Science", Theory and Decision 2 #3, pp. 274-290.

Morgan, Howard L. & John V. Soden (1973): "Understanding MIS Failures", Data Base 5 #2, 3, & 4, pp. 157-168.

Morrison, Donald F. (1967): Multivariate Statistical Methods, McGraw-Hill, New York.

Morse, J. J. (1970): "Organizational Characteristics and Individual Motivation", in Lorsch & Lawrence (eds.), Studies in Organization Design, Irwin, Homewood, Illinois.

Mumford, E. (1969): "Implementing EDP Systems -- A Sociological Perspective", The Computer Bulletin 13 #1, pp. 10-13.

Munson, Fred C. & Walton M. Hancock (1972): "Problems of Implementing Change in Two Hospital Settings", AIIE Transactions 4 #4, pp. 258-266.

O'Reilly, Francis J. (1967): "Why Operations Research Doesn't Always Work", Management Review 56 #4, pp. 53-56.

Radnor, Michael, Albert H. Rubenstein & Alden S. Bean (1968): "Integration and Utilization of Management Science Activities in Organizations", Operational Research Quarterly 19 #2, pp. 117-141.

_____, _____ & David A. Tansik (1970): "Implementation in Operations Research and R&D in Government and Business Organizations", Operations Research 18 #6, pp. 967-991.

Roberts, Edward B. (1972): "Strategies for Effective Implementation of Complex Corporate Models", presented to the International Symposium on Model- and Computer-based Corporate Planning, University of Cologne, Germany.

Rockart, J. F. (1973): "On the Implementation of Information Systems", presented to the Harvard Business School Conference on the Management of Technology in Health Organizations.

Rubenstein, Albert H., Michael Radnor, Norman R. Baker, David R. Heiman & John B. McColly (1967): "Some Organizational Factors Relating to the Effectiveness of Management Science Groups in Industry", Management Science 13 #8, pp. B508-B518.

Sashkin, Marshall, William C. Morris & Leslie Horst (1973): "A Comparison of Social and Organizational Change Models: Information Flow and Data Use Processes", Psychological Review 80 #6, pp. 510-526.

Schein, Edgar H. (1961): "Management Development as a Process of Influence", Industrial Management Review 2 #2.

_____ (1969): Process Consultation: Its Role in Organization Development, Addison-Wesley, Reading, Mass.

_____ (1972): Professional Education: Some New Directions, McGraw-Hill, New York.

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

Scott Morton, M. S. (1967): "Computer-Driven Visual Display Devices -- Their Impact on the Management Decision-Making Process", Unpublished D.B.A. Thesis, Harvard Business School.

Scott Morton, M. S. (1971): Management Decision Systems, Harvard University Graduate School of Business Administration, Boston.

Siegal, Sidney (1956): Nonparametric Statistics for the Behavioral Sciences, McGraw-Hill, New York.

Simon, H. A. (1960): The New Science of Management Decision, Harper & Row, New York.

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

Sorensen, Richard E. & Dale E. Zand (1973): "Improving the Implementation of OR/MS Models by Applying the Lewin-Schein Theory of Change", presented to the Conference on the Implementation of OR/MS Models, University of Pittsburgh.

Stabell, Charles B. (1974): "Individual Differences in Managerial Decision Making Processes: A Study of Conversational Computer System Usage", Unpublished Ph. D. Thesis, M.I.T.

_____ (1974a): "On the Development of Decision Support Systems As a Marketing Problem", Sloan School of Management, M.I.T., Working Paper #708-74 (also presented to the IFIP 1974 Conference, Stockholm, Sweden).

Starr, Martin K. (1965): "Commentary on 'The Researcher and the Manager: A Dialectic of Implementation'", Management Science 12 #2, pp. B30-B33.

_____ (1971): "The Politics of Management Science", Interfaces 1 #4, pp. 31-37.

Urban, Glen L. (1972): "An Emerging Process of Building Models for Management Decision Makers", Sloan School of Management, M.I.T., Working Paper #591-72.

_____ (1974): "A Model for Managing a Family-Planning System", Operations Research 22 #2, pp. 205-233.

_____ (1974): "Building Models for Decision Makers", Interfaces 4 #3, pp. 1-11.

_____ & Richard Karash (1969): "Evolutionary Modeling in the Analysis of New Products", Sloan School of Management, M.I.T., Working Paper #424-69.

Vertinsky, Ilan (1972): "OR/MS Implementation in Valle, Colombia, S.A.: A Profile of a Developing Region", Management Science 18 #6, pp. B314-B327.

_____ & Richard T. Barth (1972): "A Model of Diffusion and Implementation: An Exploratory Study of Managerial Innovation in Colombia", Socio-Economic Planning Sciences 6, pp. 153-171.

_____, _____ & Vance F. Mitchell (1973): "A Study of OR/MS Implementation as a Social Change Process", presented to the Conference on the Implementation of OR/MS Models, University of Pittsburgh.

Vollmer, Howard M. (1965): "Commentary on 'The Researcher and the Manager: A Dialectic of Implementation'", Management Science 12 #2, pp. B36-B39.

Von Hippel, Eric (1973): "An Exploratory Study of 'Corporate Venturing' -- A New-Product Innovation Strategy Used by Corporations", Unpublished Ph. D. Thesis, Carnegie-Mellon University.

Wagner, Harvey M. (1971): "The ABC's of OR", Operations Research 19, pp. 1259-1281.

Woolsey, R. E. D. (1972): "Operations Research and Management Science Today, or, Does an Education in Checkers Really Prepare One for a Life of Chess?", Operations Research 20 #3, pp. 728-737.

Appendix I: Implementation Problems and Solutions -- The Normative Approach

This appendix expands on material presented in Chapter I, listing the problems and solutions suggested by a large sample of authors from the normative implementation literature. This material is organized around six generic problem areas to be found in this literature and presented in Chapter I. For each of the six areas, the authors suggesting that area are listed along with the specific problems they discuss and the solutions they offer. We note that in some cases, the specific problems an author raises span several major groups, and no distinction is made among the solutions concerning which problem each is designed to attack.

I. Mismatch between problem and solution.

1. Ackoff (1967):
   Problem: Designers hold the following five faulty assumptions:
   a. managers lack relevant information (in fact, they have too much irrelevant information)
   b. managers know what information they need, and want it
   c. managers know how to use the right information if it is given to them
   d. better information results in better coordination and better decisions
   e. managers do not need to understand a system, just how to use it

   Solution: Rationalize the design process as follows:
   a. identify all decisions the organization should be making
   b. classify decisions by degree to which models for them are known and analyze their information requirements
   c. group decisions with overlapping information requirements and make them the responsibility of a single manager
   d. design data collection, storage and retrieval procedures for this set of decisions
   e. design procedures to monitor system operations and correct deficiencies

2. Dearden & Lastavica (1970):
Problem: Solutions are too different from management's view of the problem to be useful to them

Solution: Analysts should work in a decentralized fashion with managers and should be guided by four principles of operation
   a. know what the problem is and what questions should be answered -- these are not necessarily what the manager initially tells you they are
   b. formulate a decision model which answers the questions
   c. gather data selectively in accordance with the needs of the model
   d. pay heed to the principle of diminishing returns to information throughout the analysis

3. Emery (1972):
Problem: We tend to underestimate complexity and the difficulty of technical sophistication
We attend to the low level technical details of a system rather than the interface with the user

Solution: More planning, long-term organizational commitment , and exploitation of existing, well understood techniques

4. Gorry (1971):
Problem: We try to transfer techniques that were useful in solving structured operational control problems to other types of problems where they are not appropriate

Solution: Start with a simple model and work with the user for a few iterations to develop a useful (to him) model

5. Grayson (1973):
Problem: Management science solutions are too often over simplified, stripping away the difficult human and political problems

Solution: Suggests specific actions on two fronts:
   a. in operating organizations:
      1) management scientists should be 'sprinkled' throughout the organization and be part of operating teams, not isolated in a MS group
      2) managers should demand that management scientists implement their work
   b. in universities:
      1) students should work on real problems, and should have to pick the tools to fit the problem

2) students and faculty should tackle messy, real world problems, not ones santinized for presentation
3) managers and academics should be rotated into each other's environments for meaningful periods of time (e.g., 1 year)

6. Hall (1973):
Problem: Models are designed to support a theoretically normative process which does not fit the reality of most settings
We have poor understanding of causal connections between strategic decisions and future performance

Solution:
a. Build models which are:
   1) deterministic and relatively simple in structure
   2) information processing models, rather than models based on limited data and implied causal relationships
   3) individualistic models, enabling the manager to incorporate his own values
b. Do research into the processes of management, decision making, and strategy formulation

7. Hax (1973):
Problem: Circumstances and personnel change, making system obsolete

Solution: Build systems which can adapt

8. Little (1969):
Problem: Communication across the model/manager interface is almost nil because the model fails to meet the manager's needs

Solution: Build models which meet the following criteria for a 'decision calculus':
a. simple -- promote ease of understanding
b. robust -- foolish answers should be hard to get
c. easy to control -- you can get out the answers you want
d. adaptive -- in both parameters and structure
e. complete on important issues
f. easy to communicate with

9. Rockart (1973):
Problem: Abstraction of reality embodied in the model or system is not really the user's

Solution: Secure user participation in design to assure that the abstractions which underlie the system are truly his

10. Wagner (1971):
Problem: We tend too often to be technically elegant and innovative rather than simply useful
Operations researchers frequently misunderstand the real nature of daily operating problems

Solution: Change OR/MS education for those who want to be practitioners rather than technicians:
a. techniques should be taught with an appreciation for their real life applicability and the needs of the decision maker who will use them
b. more attention to teaching techniques for data collection and parameter estimation
c. train people to be professionals, not technicians

II. Failure to deal properly with power.

1. Ackoff (1960):
Problem:
a. Reorganization -- personnel with an interest in the project and sufficient power to do anything about it left or were transferred
b. Sponsorship of the project was not at a high enough level to enable implementation of findings
c. Ambitious staff personnel wanting to prove their value to management obstructed implementation

Solution: Develop formal bases of power by:
a. Never signing a contract you cannot break
b. Never reporting to anyone lower than the authority capable of forcing cooperation among all functions involved in the project
c. Never reporting to responsible authorities through intermediaries
d. Never failing to complain forcefully to management about undesirable research conditions
e. Never performing research for anyone at no cost to him

2. Evan (1965):
Problem: Manager/management scientist power differentials breed suspicion, distrust, and fear

Solution: No specific solutions suggested

3. Mumford (1969):
   Problem: Power is used by each group as the chief strategic element; each group attempts to force its will on other groups

   Solution: Employ strategies stressing participation, communication, education, and the organizational reward structure

III. Threat due to the uncertainty surrounding change.

1. Argyris (1971):
   Problem: Perceived threat due to change engenders emotional response on the part of managers; management scientists in turn react emotionally

   Solution: Develop interpersonal competence in both MS and line management groups

2. Mumford (1969):
   Problem: Uncertainty of the consequences of change in an otherwise stable system develops resistance to change

   Solution: (See II.3)

3. Radnor et al. (1970):
   Problem: Innovative OR/MS activity poses a threat to management; this is exacerbated by the fact that truly accepting the OR/MS approach implies a continuing process of change, and hence continued uncertainty

   Solution: No specific solutions suggested; point out that many variables affect outcomes, but that these vary from case to case

   NB: Data from a number of actual cases have been used to support their arguments.

4. Vertinsky, Barth & Mitchell (1973):
   Problem: Territorial threat (management scientists encroaching on the manager's domain) is a major reason for resistance

   Solution: Develop warm, trusting relationships between managers and management scientists in order to facilitate change in manager's attitudes and values

   NB: Results based, at least in part, on empirical data.

IV. Failure to deal adequately with the manager/management scientist interface.

1. Churchman & Schainblatt (1965):
   Problem: Managers & management scientists typically operate without appropriate understanding of the goals and methods of one another

   Solution: Adopt a position of 'mutual understanding' -- "On the side of management, it calls for an understanding of the politics of decision making, and on the side of science it calls for an understanding of the creative process." (p. B84)

2. Dearden & Lastavica (1970):
   Problem: Bifurcation of knowledge -- staff people know OR and line people know business

   Solution: (See I.2)

3. Evan (1965):
   Problem: Value & personality conflicts between manager and management scientist

   Solution: No specific solutions suggested

4. Grayson (1973):
   Problem: Educating people in the organization to reduce their resistance is too great a task
   Response time of management scientists is generally too long to be useful to managers

   Solution: (See I.5)

5. Hall (1973):
   Problem: Model development is done by management scientists in isolation from the actual strategy formulation processes

   Solution: (See I.6)

6. Hammond (1973):
   Problem: Improper expectations about the purposes of the analysis and about appropriate roles for each party
   Strong preconceptions by one or both parties about the problem nature or preferred alternatives

Sharply differentiated characteristics (knowledge, values, & preferred modes of action) between manager and management scientist

Solution: Management scientist should function as a decision prosthetic rather than a decision maker
Manager/scientist relationship should be process rather than product oriented

7. Hax (1973):
Problem: Failure of the parties involved to communicate with one another

Solution: (See I.7)

8. Heany (1972):
Problem: Too little attention has been paid to management education

Solution: Develop educational programs for managers which take maximum advantage of on-the-job situations
Distinguish between real education and simple orientation programs -- to understand MS/OR, managers need an integrated program, not just a series of discrete bundles of specialized knowledge

9. Howard (1968):
Problem: Ineffective communication between manager and management scientist due to differences in their backgrounds

Solution: Establishment of a new profession which could be based in both engineering and business, and would bridge the gap between manager and management scientist

10. Morgan & Soden (1973):
Problem: Style and capabilities of the top information systems executive result in failures of various types; the appropriate style for the IS chief differs across the stages of an organization's computer experience

Solution: Hire an IS executive having the right characteristics for the organization's stage of development at that time

11. Mumford (1969):
    Problem: Technical groups tend to define their roles too narrowly, ignoring all but the purely technical issues

    Solution: Adopt a broader definition of technical group role, including consideration of 'social constraints' to implementation, and consultation with and involvement of the user group in the development process

12. O'Reilly (1967):
    Problem: Inadequate instruction on the use and limitations of OR solutions given to management
    Solutions not framed in terms of operational systems and procedures that management can use

    Solution: Use of implementation teams and other similar devices to integrate operations researchers into management structure

13. Starr (1971):
    Problem: The model builder's scientific sub-culture which values curiosity and veracity and attempts to be objective, conflicts with the manager's political sub-culture

    Solution: The model builder must adopt the posture of a political scientist, allowing his scientific analyses to reflect political realities

14. Vertinsky, Barth & Mitchell (1973):
    Problem: Prevailing organizational value systems differ from that required for an OR/MS based management style

    Solution: (See III.4)

15. Vollmer (1965):
    Problem: Bureaucratization of organizations leads to a high degree of task specialization which is conducive to a 'separate functions' approach to implementation; other approaches have resulted from recent trends in management (i.e., the human relations school suggests the 'communication' approach, and the professionalization of science leads to 'persuasion'), but no major trends promote the 'mutual understanding' position

    Solution: Institutionalize the MS/OR approach to organizational problems as a means of achieving 'mutual understanding'

16. Woolsey (1972):
    Problem: Management scientists generally lack the necessary practical experience to be able to help managers with problems

    Solution: Changes on three fronts would increase the management scientist's practical base:
    - a. Professional societies:
      - 1) report more <u>real</u> applications with detailed accounts of their implementation issues
      - 2) license OR/MS people as 'fit to practice', not just able to do research
    - b. Educational institutions:
      - 1) require practical experience, especially at the thesis stage
      - 2) tie practical assignments into course work
      - 3) make it clear (through practical assignments) that it is important to understand how something really works before you attempt to optimize it
    - c. Individual:
      - 1) get practical experience; if necessary, at no fee

V. Poor criteria for problem selection and solution evaluation.

1. Brenizer (1973):
   Problem:
   - a. We have developed systems which we should not have because we:
     - 1) implemented what the equipment manufacturers suggested without seriously considering the organization's needs or appropriate directions
     - 2) went for the 'easy' application rather than the big payoff application
   - b. We have relied too heavily on payroll expense reduction as the primary measure for system justification

   Solution: Obtain user participation in system development
   Designers should do a better job of understanding user needs
   <u>Plan</u> for systems development and direction for expansion

2. Hall (1973):
   Problem: Designers assume planning models are being developed for reasons other than those held by managers

   Solution: (See I.6)

VI. Environmental factors affecting ease of implementation.

1. Grayson (1973):
   Problem: Time pressures are too great to use relatively time consuming MS tools
   Necessary data are not available

   Solution: (See I.5)

2. Vertinsky & Barth (1972):
   Problem: Four environmental factors affect the organization's readiness to take innovative action
   a. Government policies
   b. Market conditions
   c. Societal values
   d. Inter-organizational communication patterns for diffusion of new knowledge and techniques

   Solution: No solutions are suggested; of course, as these factors are largely beyond the manager's or management scientist's control, the key issue is knowledge of their existence and potential effects

Appendix II: Findings of the Factor Studies

Key

Since the studies vary in what they report, it is not possible to adopt a uniform coding for all of the study results. Thus, each of the studies is marked in the following table in the manner which fits it most logically.

Where applicable factors are coded as follows:

+ -- significant (by whatever test was used in the particular study) positive effect of the factor on the dependent variable

- -- significant negative effect of the factor on the dependent variable

0 -- no significant effect of the factor on the dependent variable found

Exceptions to the above scheme are:

1. Rubenstein et al. -- a ' x ' indicates those variables found to be favorable to implementation success.

2. Harvey -- a ' x ' indicates those factors suggested to be important.

3. Dickson & Powers -- factors marked with the direction (+ or -) for each of the dependent variables they were found to affect significantly (T -- time, B -- budget, U -- user satisfaction, C -- computer operations), or with a '0' if no dependent variable was found to be significantly affected.

4. Vertinsky -- a ' x ' indicates those factors found to be important.

5. Lucas -- a ' x ' indicates that the factor entered into at least one of the 'prediction equations' -- N.B. all factors tested entered into at least one equation.

6. Manley -- five external factors marked according to their relative importance as determined by the study (1 = most important); motivational factors (attitude orientations towards the external factors) marked with a ' x '.

7. Gibson -- a ' x ' indicates those variables emerging as important in the case studied.

8. Smith et al. -- quantitatively measured factors indicated with the standard +,-, or 0; qualitatively assessed factors marked for their <u>relative</u> (to one another) importance as determined in the study (H = high, M = medium, L = low).

9. Carter et al. -- ranking of the <u>relative</u> importance assigned the factors included in the nationwide study (H, M, or L).

10. Bean et al. -- marked as +,-, or 0 for each dependent variable separately: implementation rate/overall success.

11. Schultz & Slevin -- standard +,-, or 0 marking except in cases where the two ways of measuring a factor yielded different results; then marked as semantic differential finding/Likert factor finding.

    <u>N.B.</u> factors included in the table are the concepts used in the sematic differential instrument and the <u>derived</u> factors composed of aggregates of items from the Likert-type instrument.

Factor Cluster, sub-cluster & factor:	McKinsey & Co.	Evan & Black	Rubenstein et al.	Harvey	Dickson & Powers	Vertinsky	Drake	Lucas	Manley	Gibson	Smith et al.	Carter et al.	Bean et al.	Schultz & Slevin
I. SYMPTOMS, ACTIONS, & SPECIFIC BEHAVIORS														
A. MANAGEMENT SUPPORT & INVOLVEMENT														
1. Top management selects the projects													0/0	
2. Management supports MS approach and technical group			x						1		H		+/+	+
3. Top management is interested and involved in projects											L		+/+	
4. Operating management participation in projects					U+							M		
B. USER INVOLVEMENT														
5. Substantive communication between modeler and user		+					0							
6. Formalized user-OR liason role													0/0	
7. Client selects project													0/0	
8. Cooperation and participation of user personnel	+										M			+
C. SPECIFICATION OF OBJECTIVES														
9. Cost/benefit analysis performed												M	0/0	
10. Well defined, measurable system objectives				x	0						M	H		
11. Management's information needs are identified												H		
12. Organizational objectives identified, and projects relevant	+		x									M		
D. PROJECT ADMINISTRATION														
13. Formal project planning	+						0							
14. Use of documentation standards					T+									
15. Formalized project progress reporting					0									
16. Post project evaluation													+/0	
E. DISCRETION GIVEN TO OR GROUP														
17. Technical group generates project ideas					U-								0/-	
18. Technical group selects projects			x								L		0/-	
19. Freedom given group to gather data and implement results			x	x										
20. OR/MS group ability to influence organization			x											
F. OR/MS GROUP LEADER ACTIVITIES														
21. Orientation towards profession rather than towards organization													-/0	
22. Proportion of leader's time spent implementing													+/+	
G. MANAGEMENT ORIENTATION TO INNOVATION														
23. Management avoids being overcautious				x										
24. Management does not punish failure excessively				x										
25. Management displays confidence in interactive environments						x								

Factor Cluster, sub-cluster & factor:	McKinsey & Co.	Evan & Black	Rubenstein et al.	Harvey	Dickson & Powers	Vertinsky	Drake	Lucas	Manley	Gibson	Smith et al.	Carter et al.	Bean et al.	Schultz & Slevin
II. INTERNAL ECOLOGY														
A. FORMAL STRUCTURE														
1. Degree of bureaucratization							-							
2. Organization size (revenue, employees)		0											-/0	
3. Degree of centralization		0				x							0/+	
4. Functional location of OR/MS group			x										0/0	
5. Level in hierarchy of OR/MS group or group leader					T- C+								+/+	
6. Formality (including the OR/MS group's having a formal charter)		+											+/+	
B. OR/MS GROUP STRUCTURE														
7. Life cycle stage (age) of group			x										-/0	
8. Absolute size of group					*						0		0/0	
9. Relative (to size of organization) size of group													+/+	
10. Centralization of group & OR/MS activities					**						L		0/0	
11. Formality of group operations													0/+	
C. TECHNICAL COMPETENCE, SKILLS, & EXPERIENCE														
12. Modeler expertise in subject area							+							
13. Low turnover of project personnel					U+		+				L			
14. OR group involved in a mix of projects (various sizes & lengths)													0/0	
15. Variety of techniques employed													+/0	
16. Variety of functional areas as clients													+/0	
17. Technical competence of OR/MS group members			x								H M	M		
18. Project personnel have systems experience					0									
19. Staff professionalization (proportion)		+												
20. Frequency of innovative ideas		0												
D. OR/MS GROUP ORGANIZATIONAL & SOCIAL SKILLS														
21. Communication ability of design team												H		
22. OR member human relations skill											M			
23. Leadership skill in project group											L			
24. Organizational competence; ability to work with managers			x	x										+

* = T-; B-; U+

** = no variance found among projects sampled

Factor Cluster, sub-cluster & factor:	McKinsey & Co.	Evan & Black	Rubenstein et al.	Harvey	Dickson & Powers	Vertinsky	Drake	Lucas	Manley	Gibson	Smith et al.	Carter et al.	Bean et al.	Schultz & Slevin
II. INTERNAL ECOLOGY (continued)														
E. RESOURCES/SLACK														
25. Organizational profitability													0/+	
26. OR/MS group budget													-/0	
27. Availability of sufficient resources			x											
28. Hardware investment (relative to sales)					0									
F. OR-USER SIMILARITY AND CONTACT														
29. Proximity of decision makers to modelers; contact	+						0							
30. Similarity of decision maker and modeler backgrounds							+							
31. Project team includes both MIS and user personnel					0									
G. USER DEMOGRAPHICS														
32. Management experience with sophistacted techniques				x										
33. Management decision making fact-based, viewed as trade-offs				x										
34. Organizational cooptation of modernizing personnel						x								
35. Line management professionalization		-												
36. User load (e.g., number of accounts)								x						
37. User experience in job, position, territory								x						
38. User's past level of task performance								x						
39. User's age								x						
40. User's educational level								x						
41. User's 'decision style' -- attention to details								x						
H. OR/MS GROUP MEMBER DEMOGRAPHICS														
42. Age of leader and group members											0		0/0	
43. Group member years with the company					U+						0			
44. Formal educational level of personnel					T- C+						0		0/0	
I. SOCIAL SYSTEM														
45. Relative power of different organizational components										x				
46. Stability of social and decision-making structures										x				
III. MODEL CHARACTERISTICS														
A. TECHNIQUES EMPLOYED														
1. Complexity of techniques and models							?		5			L		+
2. Use of high level languages					T+		-							

Factor Cluster, sub-cluster & factor:	McKinsey & Co.	Evan & Black	Rubenstein et al.	Harvey	Dickson & Powers	Vertinsky	Drake	Lucas	Manley	Gibson	Smith et al.	Carter et al.	Bean et al.	Schultz & Slevin
III. MODEL CHARACTERISTICS (continued)														
B. MODEL COMPLETENESS/COMPREHENSIVENESS														
3. Inclusion of social and political considerations in model							-							
4. Proposal/solution quality		+												
5. Solution reflects sensitivity to motivations and priorities				x										
IV. CHARACTERISTICS OF THE PROBLEM														
A. URGENCY														
1. Urgency to company and to management		+							2					+
2. Importance of project to user											L			+
B. PROBLEM STRUCTURE AND NOVELTY														
3. Problem not easily addressed by conventional means				x										
4. Well defined scope -- neither too broad nor too narrow				x										
5. Availability of data and information											H		+/+	
6. Level of client involvement required for implementation									4					
7. Nature of the decision process employed for the problem -- rational vs. opportunistic										x				
V. EXTRA-ORGANIZATIONAL ENVIRONMENT														
A. COMPETITIVE ENVIRONMENT														
1. Market position & competitor's actions						x				x				
2. Strength of organization's competitive position		+												
B. GOVERNMENT														
3. Governmental activities and pressures						x				x				
C. TECHNOLOGY														
4. Type of product and technological environment						x								
VI. IMPLEMENTATION PROCESS CHARACTERISTICS														
A. TIME														
1. Size and length of project							-							
2. Adequate time frame allowed for system development												L		
B. ROLES														
3. Recognition of manager-analyst role differences							+							
4. Group responsibilities and goals well defined											H			
5. Separation of analyst & programmer roles					T+ U-									

Factor Cluster, sub-cluster & factor:	McKinsey & Co.	Evan & Black	Rubenstein et al.	Harvey	Dickson & Powers	Vertinsky	Drake	Lucas	Manley	Gibson	Smith et al.	Carter et al.	Bean et al.	Schultz & Slevin
VI. IMPLEMENTATION PROCESS CHARACTERISTICS (cont.)														
C. COMMUNICATION														
6. Methods used for, number of and use made of external communications											0			
7. Number of external contacts made by perceived project leader											+			
8. Communications, cooperation, and information received from user											M			
9. Time spent by project group in internal communication											0			
10. Internal contacts by group members with user representative											+			
11. Positive quality of internal communication (open, friendly, etc.)											H +			
12. Time spent in internal communication by perceived leader											-			
D. CONFLICT RESOLUTION														
13. Conflict resolution through confrontation							+							
E. EVOLUTION														
14. Evolutionary approach to modeling taken							+							
VII. PERCEPTIONS														
A. TASK PERCEPTIONS														
1. Perceived task sophistication											0			
2. MS team recognizes operational realities and potential difficulty				x										
3. Expected effect of model on manager's job performance and visibility														+
4. User's perception of computer potential in clerical and managerial tasks								x						
5. Manager's perception of task nature -- e.g., rational, programmable										x				
B. GOALS AND PRIORITIES														
6. Group member recognition of project priority											L			
7. Management sees congruence between study and organizational objectives				x										
8. Model will make goals clearer, more congruent and more attainable														+
9. Degree of model (or system) relevancy to client's organizational role									3					
C. OR/MS GROUP COMPETENCE														
10. OR/MS group reputation for success			x											
D. SYSTEMIC CHANGE														
11. User expectation of change in executive decision-making														+
12. Expected changes in communication systems and interpersonal relations														+/0
13. User expectation of effects on relations with others														+
14. Expected changes in structure & co-workers														0

Factor Cluster, sub-cluster & factor:	McKinsey & Co.	Evan & Black	Rubenstein et al.	Harvey	Dickson & Powers	Vertinsky	Drake	Lucas	Manley	Gibson	Smith et al.	Carter et al.	Bean et al.	Schultz & Slevin
VII. PERCEPTIONS (continued)														
E. THE MODEL/SOLUTION														
15. User's perception of output quality								x						
F. MANAGEMENT ATTITUDES, CAPABILITIES & DESIRES														
16. User's perception of degree of management support of computer use								x						
VIII. EXPRESSED ATTITUDES														
A. MANAGEMENT AND CLIENT ATTITUDES TOWARDS TECHNOLOGY														
1. Receptivity or opposition to OR/MS			x											
2. Belief in advance that the specific techniques and the MS approach could work				x										+
3. Attitude towards various types of computer usage										x				
B. ATTITUDES TOWARDS TECHNICAL GROUP														
4. User attitudes towards design team members												L		
5. User confidence in model developers														+
C. MANAGEMENT/CLIENT ATTITUDES TOWARDS SPECIFIC PROJECT														
6. Decision maker's desire for useful results							?							
7. Management/client overall attitude toward model, project												H		+
D. TECHNICAL GROUP ATTITUDES														
8. Towards user department												L		
9. Technical group members are interested and committed											H			
IX. UNDERLYING ATTITUDES AND MOTIVES														
A. ATTITUDE TOWARD CHANGE														
1. Management and employee resistance or receptivity to change		0				x						L		
2. Management attitude towards risk and uncertainty						x								
B. MANAGEMENT CULTURE AND WORLD VIEW														
3. Future orientation of management				x										
4. Management sensitivity to environment and environmental changes				x										
5. Managerial value system -- continuous vs. discontinuous						x								
6. Manager's group identification										x				
7. Management curiosity and search drive						x								

Factor Cluster, sub-cluster & factor:	McKinsey & Co.	Evan & Black	Rubenstein et al.	Harvey	Dickson & Powers	Vertinsky	Drake	Lucas	Manley	Gibson	Smith et al.	Carter et al.	Bean et al.	Schultz & Slevin
IX. UNDERLYING ATTITUDES AND MOTIVES (continued)														
C. EFFECTED USER MOTIVATIONS														
8. Client 'attitude orientation' to CEO support of project									x					
9. Client 'attitude orientation' to project urgency									x					
10. Client 'attitude orientation' to perceived relevancy of project to his org'l role									x					
11. Client 'attitude orientation' to involvement in implementation									x					
12. Client 'attitude orientation' to project complexity									x					
X. ORGANIZATION HISTORY														
A. OR/MS INNOVATIVENESS														
1. Early start of organization's OR/MS activity (relative to industry)													G/O	
B. ORGANIZATION POLITICS														
2. Past political battles in the organization										x				

Appendix III: Issues to Be Resolved at Each Stage in the Kolb-Frohman Model

Scouting

1. Search for and choice of an entry point appropriate to the problem and potential action requirements.

2. Client/consultant mutual understanding of motives.

Entry

1. Clear statements of goals and expectations, purpose of action, and desired level of adoption (in the Huysmans sense).

2. Tentative statement of resources available, including commitment.

3. Establishing a trusting relationship and a mutual willingness to influence and be influenced.

4. Establishing 'felt need' for action or change, and a willingness to change.

5. Forming a team, including all relevant personnel.

Diagnosis

1. Understanding the problem in the client's terms.

2. Shared understanding of the problem (i.e., definition) through joint diagnosis.

3. Gathering data to define the problem and interdependencies; anticipating the consequences of change.

Planning

1. Operational definition of goals; specification of specific behavioral objectives for change.

2. Gaining client understanding of and commitment to plans.

Planning (cont.)

3. Consideration of alternative courses of action:
   a. Measuring technical quality.
   b. Testing them out in some manner (e.g., simulation).

4. Selection of the 'best' solution (multi-dimensional, involving trade-offs).

5. Gathering necessary resources, especially from the client organization.

6. Defining reasons for evaluation and specifying necessary data to meet these reasons.

7. Setting priorities.

8. Specification of an evolutionary plan of action.

9. Cycling back through Entry, etc. to assure that objectives, problem definition, and solution all fit together and are understood by both parties.

Action

1. Implementing the 'best' solution; flexibility in following plan, modifying it where necessary.

2. Managing the consequences of change, both anticipated and unanticipated; dealing with resistance as information about the client system.

3. Training the client system for change; introducing information necessary to induce change.

Evaluation

1. Application of previously defined measures to assess progress towards previously defined goals and objectives.

2. Determination of success of the evaluation process itself:
   a. Were the reasons for evaluating the system met?
   b. Were they the right reasons?
   c. If not met, why did Evaluation fail?

Evaluation (cont.)

3. Decision to evolve or terminate:
   a. Recognizing changes in the social system.
   b. Looping back to Planning if modification of the system or further action is necessary.

Termination

1. Confirmation of new behavior patterns.

2. Meeting of level of adoption goals.

3. Timing relationship to end neither too early nor too late.

4. Capability to adapt implanted in both the social and the technological systems; processes of evolution and diffusion underway if appropriate.

5. Assuring completion of the transfer of 'ownership' and responsibility for the system to the client.

Appendix IV: The Screening Questionnaire and Scoring for Technology Type

Background information for projects included in this study was gathered using an instrument titled "Screening Questionnaire." As the scope of the research did not allow a detailed investigation of each project's structure, etc., this questionnaire provides the only non-process information available for most of the projects studied.

Organization____________________

Name____________________

Title____________________

I. General information

1. Project Title (for identification only):

2. Project Description (a sentence or two briefly describing the project -- type, purpose, etc.):

3. Are both user and design personnel available for interview or response to a questionnaire?

   Yes _____ No _____

4. Organization background information:

   a. Industry:

   b. Client department (what part of the organization -- e.g., sales, advertising, finished goods assembly -- was the primary system user a member of?):

5. Project size:

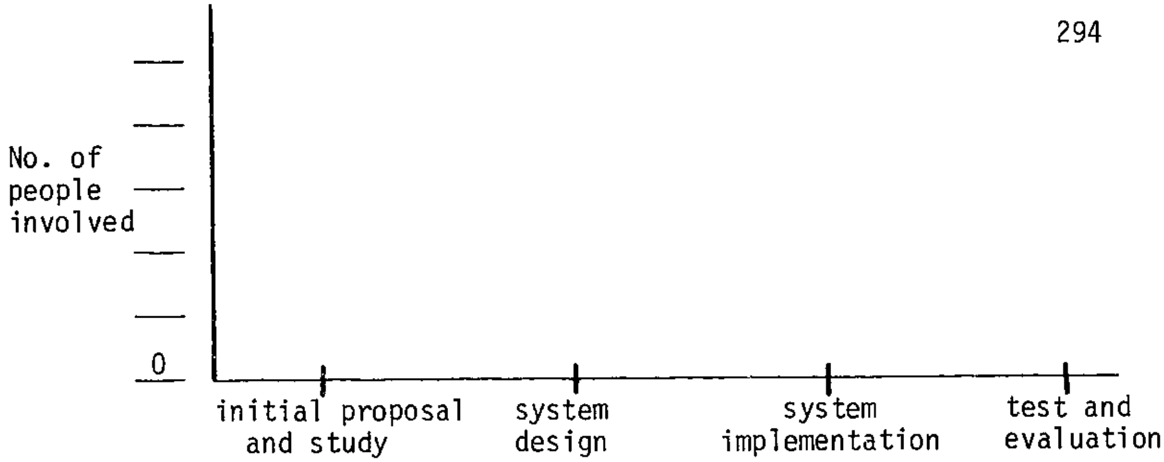
   a. Development period (include entire design-implementation cycle):

      Approximate start date:

      Approximate completion date (or date when the project was dropped):

   b. Approximate budget for this project:

   c. Manpower history: If possible, please fill in the graph below by scaling the vertical axis and then marking the number of people involved (approximate) at the various points in the project's life. Also, if possible, assign approximate dates to the stages listed along the horizontal axis.



Dates: ________ ________ ________ ________

6. The system designer and the user were employees of
   a.___ the same department in the same organization.
   b.___ different departments in the same organization.
   c.___ different organizations (i.e., designer was an outside consultant).
   d.___ other, please specify: ______________________________.

7. User-designer interaction during implementation was
   a.___ direct.
   b.___ through an intermediary or liason.
   c.___ other, please explain: ______________________________.

II. System type

For each question in this section please check all items that apply.

1. The system was designed to provide:
   a.___ the information needed for a specific non-recurring (i.e., one-time) decision.
   b.___ the information needed for a specific, but recurring decision.
   c.___ information useful to a user (or users) generally in performing his work.
   d.___ analytic capability useful for a specific type of decision.
   e.___ analytic capability generally useful to a user (or users) in performing his work.
   f.___ other, please specify: ______________________________.

2. The system was designed to be used primarily by:
   a.___ clerical employees.
   b.___ staff specialists.
   c.___ line managers.

3. It was originally intended that the system be used by:
   a.___ a single user.
   b.___ a small group of users (e.g., 2-7).
   c.___ a large group of users.

4. It was expected that the system would result in:
   a.___ little or no change in work content (tasks) for system users.
   b.___ little or no change in work procedures for system users.
   c.___ considerable change in work content for users.
   d.___ considerable change in work procedures for users.
   e.___ little change in either work content or procedures for any employees not directly using the system.
   f.___ considerable change in either content or procedures for some non-users.

5. It was expected that installing this system would:
   a.___ enable management (staff or line) to make better decisions than it previously had.
   b.___ enable management (staff or line) to perform tasks (e.g., types of analyses, decisions) they previously were unable to perform due to lack of appropriate facilities.
   c.___ enable management to perform tasks they previously had no time to perform.
   e.___ enable clerical personnel to handle data more efficiently.

6. System operation is:
   a.___ non-computerized.
   b.___ batch processing computer runs.
   c.___ remote entry batch processing.
   d.___ on-line terminal -- hard copy.
   e.___ on-line terminal -- video display.

7. Interaction with the system is:
   a.___ carried out directly by the user(s) of the information.
   b.___ carried out by an intermediary who interacts with the information user.
   c.___ other, please explain: ______________________________
   ____.

8. System output can be described as:
   a.___ data on current operations.
   b.___ historical data on company operations.
   c.___ projections of future company operations.
   d.___ historical data on the environment (industry, economy, etc.).
   e.___ projections of future environments.
   f.___ other, please specify: ____
   ____.

9. System output:
   a.___ is produced automatically at regular intervals.
   b.___ is produced automatically when certain events occur (e.g., variance reports triggered by a variance greater than some prespecified percentage).
   c.___ is produced only upon request.

10. Analytic capabilities of the system include:
   a.___ data retrieval.
   b.___ report formating.
   c.___ simple models (e.g., balance sheet or income statement produced by adding up existing numbers).
   d.___ projective models (e.g., models which produce new number out of existing numbers).
   e.___ statistical routines.
   f.___ optimizing models or programs.
   g.___ routines for sensitivity testing.
   h.___ other, please specify: ____
   ____.

III. Evaluation

1. The system's technical quality was:

|——————|——————|——————|——————|——————|

exceptionally high | above average | average | below average | very poor

2. System usage:

   a. Compared to the expected level, system usage was:

|——————|——————|——————|——————|——————|——————|

much higher | higher | about the same | lower | much lower | system was never used

b. Did usage level change considerable during the time the system was being used? Yes _____ No _____

If so, what was the change in usage?

increased considerably	increased somewhat	decreased somewhat	decreased considerably	dropped to zero

What is the time span over which this change in usage took place?

_____________________ months

3. Generally, the system:

greatly exceeded expectations	exceeded expectations	met expectations	failed to meet expectations	fell far below expectations

4. Which of the following best describes the system's benefits?
   a.___ provided a substantial and measurable monetary payoff.
   b.___ benefitted us in a number of ways, though the monetary value is hard to assess.
   c.___ probably benefitted us.
   d.___ provided no benefits.
   e.___ was a waste of money and effort.

Thank you.

Please return this questionnaire to:

Michael J. Ginzberg
E53-314
Alfred P. Sloan School of Management
50 Memorial Drive
Cambridge, Mass. 02139
(phone: 617-253-6607)

Scoring for technology type:

Operationalizing the definitions of technology type presented in Chapter V was accomplished through the questions in section II of the Screening Questionnaire ("System Type").

A. One-shot models:

One-shot models are distinguished from all other efforts by the response to question II.1. A response of a alone -- "The system was designed to provide the information needed for a specific non-recurring (i.e., one-time) decision." -- marks a project as a one-shot modelling effort, unless there is further information which specifically contradicts this judgement.

B. DSS scaling:

Projects which are not judged to be one-shot efforts are ranked on the degree to which they look more like DSSs than they do like conventional information systems. The nine criteria employed are listed in Chapter V; they are operationalized in questions 1, 2, 4, 5, 6, 7, 8, 9 & 10 of section II of the Screening Questionnaire.

A project is awarded 1 point for each criterion on which it looks more DSS-like than conventional. Thus, scores range from 0 (conventional) to 9 (DSS). The responses to each question which earn a 'DSS point' follow:

Question No.	DSS response(s)
II.1.	d or e included in response
II.2.	b and/or c, and a not included
II.4.	c, and a not included
II.5.	b included
II.6.	d and/or e alone Note: response of a alone indicates an error; system should not have been included in study

Question No.	DSS response(s)
II.7.	a alone
II.8.	c, d, or e included in response
II.9.	c alone
II.10.	d, e, f, or g included in response

Note: On questions 1, 7, 8, and 10 there is a response labeled "Other, please specify." These must be individually interpreted on a case by case basis.

Appendix V: The Survey Questionnaires

Center for Information Systems Research
Massachusetts Institute of Technology
Alfred P. Sloan School of Management
50 Memorial Drive
Cambridge, Massachusetts, 02139
(617) 253-1000

The attached questionnaire is part of a study of the implementation of computer systems being conducted by the Center for Information Systems Research at the Sloan School of Management, M.I.T. The aim of the study is to identify the main characteristics of effective implementation from a detailed analysis of specific projects in a variety of organizations.

This questionnaire will be given to both user and designer personnel. It should take about 40 minutes of your time to complete; most of the questions can be answered very quickly based on your recollection of the project, and will not require detailed numbers or records.

All responses to this questionnaire will be kept confidential, although the overall results of this research (without project or company identification) will be made available to all participants. A questionnaire of this type is the most convenient and speedy way to collect the amount of data we need for this study; however, we are anxious to obtain any other data or opinions that you feel are relevant, and will be happy to talk to you about the questionnaire or the study as a whole.

A stamped pre-addressed envelope is attached for returning the questionnaire. Please feel free to phone me at 617-253-6607.

Your cooperation in this research is genuinely appreciated.

Michael J. Ginzberg

I. Background information

* 1. Organization: ______________________________

2. Project Title: ______________________________

* 3. Your Department: ______________________________

* 4. Your Name (optional): ______________________________

5. When did you become involved with this project (e.g., after the system was designed but before it was built)?

6. Briefly describe your role in this project.

7. Before becoming involved with this project, how much experience with computer systems and models did you have (check all that apply)?

   a.___ extensive experience with systems similar to this one

   b.___ some experience with systems similar to this one

   c.___ extensive experience with other types of computer projects

   d.___ some experience with other types of computer projects

   e.___ little or no computer system experience

8. How frequently are you faced with new decisions or new tasks in your job?

   a.___ daily or more often

   b.___ a few times a week

   c.___ a few times a month

   d.___ once a month

   e.___ once every few months

   f.___ once a year or less often

*This information is needed for identification only, and will not be used in any reports, published or unpublished, of this study.

9. How would you characterize the environment (e.g., markets, customers, products, competition, government regulation) that you deal with in your work?

   a.___ very stable

   b.___ stable with seasonal variations

   c.___ changing

   d.___ rapidly changing

   e.___ other, please specify: ______________________________

   ____

II. System usage

1. How frequently do you use the system or receive output from it (e.g., twice a day, once a week)?

2. a. If the system is on-line: how long is your average terminal session?

   b. If the system is batch: how much time do you usually spend with the output of any one run?

III. Project History

This section includes a large number of statements which describe various aspects of system development efforts. To the right of each statement is the following legend:

VC C N U VU

These five symbols mean:

- VC = the statement is Very Characteristic of the project being described;
- C = the statement is generally Characteristic of the project (i.e., while not completely accurate, the statement is more true than false);
- N = the statement is Neither characteristic nor uncharacteristic of the project, or the statement is not applicable;
- U = the statement is generally Uncharacteristic of the project (i.e., more false than true); and
- VU = the statement is Very Uncharacteristic of the project.

For each of the statements that follow, please circle the symbol which best describes that statement as a characterization of some aspect of your project. For example, consider the statement:

> We felt it important to have an implementation timetable.

If you feel that the people involved in your project were strongly in favor of following a project timetable, you should circle VC.

(VC) C N U VU

If you believe that people were generally in favor of such a timetable but did not see it as very important, you should circle C.

VC (C) N U VU

If, on the other hand, you believe that there was no concern for having a timetable or that there was a definite reluctance to have one, you should circle U or VU respectively. Finally, if the question of a timetable makes no sense in the context of your project, you should circle N.

In responding to these statements, please rely on your own knowledge and beliefs about the project in question. There are no right or wrong answers; all we are looking for is an accurate description of what occurred. Feel free to write any comments you might have directly on the questionnaire (next to the statements they relate to).

A note on terminology:

This questionnaire was designed to be used in collecting data from a wide range of project situations. Thus, the wording of some statements may not seem to accurately fit your project. Please try to keep the following definitions in mind while filling out the questionnaire.

A PROJECT refers to the following sequence of events:

1. the identification of some type of business problem (or opportunity);
2. the design of a computerized model or computer-based information system to solve that problem (or exploit that opportunity);
3. the installation (or implementation) of the computer-based system;
4. the evaluation of the computer-based system and the way it is used, and any modification to the system made as a result of this evaluation.

The major participants in a project are the CLIENT (or USER) and the CONSULTANT:

The CLIENT is normally the user of the information produced by the model or system, and may also physically operate the system (e.g., he may operate the terminal if the system is on-line).

The CONSULTANT is the person responsible for the technical end of system development, and may also be the system designer. He (she) may be either an internal (same company as the client) or an external (different company from the client's) consultant.

Both CLIENT and CONSULTANT may be either an individual or a small group. Thus, the terms CLIENT and CONSULTANT and the pronouns I and ME should be considered to refer to the appropriate group, when a group, rather than a single person, was involved.

The consultant who worked with us on this project wasn't the only one we talked to about it.	1.	VC	C	N	U	VU
At the very start the consultant talked to a number of people in our organization about this project's potential.	2.	VC	C	N	U	VU
In retrospect, we should have better defined what we wanted before selecting a consultant.	3.	VC	C	N	U	VU
The consultant was called in because of his experience with this type of problem.	4.	VC	C	N	U	VU
It's hard to say why we chose the consultant we did for this project.	5.	VC	C	N	U	VU
We undertook this project mainly because of its long term value to the organization.	6.	VC	C	N	U	VU
The aim of this project was to provide me with a specific solution to an existing problem.	7.	VC	C	N	U	VU
The project was designed to provide me with techniques for solving specific problems.	8.	VC	C	N	U	VU
It was planned that this project would lead us to make greater use of analytic aids in our decision making.	9.	VC	C	N	U	VU
A distinct aim of this project was to lead me to make decisions in a different fashion.	10.	VC	C	N	U	VU
One aim of this project was to lead me to consider new areas and issues in my work.	11.	VC	C	N	U	VU

Agreement on what we wanted and expected of this project was not really reached before we got down to implementing the solution.	12.	VC	C	N	U	VU
We didn't worry about discussing goals at the start; we all knew what we wanted.	13.	VC	C	N	U	VU
The consultant's commitment to seeing this project through was never in doubt.	14.	VC	C	N	U	VU
Leadership on this project was comfortably shared and was never a hassle.	15.	VC	C	N	U	VU
If we had realized at the beginning the amount of resources (e.g., people, time, money) required, the project might not have been started.	16.	VC	C	N	U	VU
The consultant felt that his job was solving the problem as presented.	17.	VC	C	N	U	VU
Right from the start, changing our working procedures was something we really didn't want to do.	18.	VC	C	N	U	VU
Some of our people were never convinced that this project was necessary, but we went ahead with it anyway.	19.	VC	C	N	U	VU
We tried to minimize the number of people who had to be involved with this project.	20.	VC	C	N	U	VU
During implementation we felt that the consultant had the responsibility for solving problems.	21.	VC	C	N	U	VU
Having people other than the consultant and user(s) involved in problem analysis was felt to be important.	22.	VC	C	N	U	VU

I think the consultant really tried to see things my way.	23.	VC	C	N	U	VU
A large part of our time was spent pinning down the exact nature of the problem.	24.	VC	C	N	U	VU
Understanding the problem required our considering a large part of the organization beyond the immediate user group.	25.	VC	C	N	U	VU
The consultant did the lion's share of the data gathering needed to pin down the requirements for this project.	26.	VC	C	N	U	VU
Changes in work routines and procedures were an important consideration in assessing the proposed system.	27.	VC	C	N	U	VU
The consultant required a good deal of our time during the effort to define the problem.	28.	VC	C	N	U	VU
Our people were just too busy to participate much in problem diagnosis.	29.	VC	C	N	U	VU
The consultant never really found out much about our business.	30.	VC	C	N	U	VU
The problem was so obvious that there was no question about what the right solution should be.	31.	VC	C	N	U	VU
Predicting the way the system would fit into our work procedures was too complex to assess in advance of implementation.	32.	VC	C	N	U	VU
As part of our planning we felt it important to periodically rethink our goals and problem definition.	33.	VC	C	N	U	VU

We made sure we had defined specific measures of expected changes before actually implementing the system.	34.	VC	C	N	U	VU
There was no need to define detailed objectives for this project.	35.	VC	C	N	U	VU
We didn't fully understand the system until it was up and running.	36.	VC	C	N	U	VU
We didn't realize how much effort it would take to implement this system.	37.	VC	C	N	U	VU
I never was convinced that we had the best solution to our problem.	38.	VC	C	N	U	VU
Testing out the proposed solution and its implications before implementing it was time consuming, but we did it anyway.	39.	VC	C	N	U	VU
With more effort the system could have met our original expectations.	40.	VC	C	N	U	VU
When special skills were required to aid in developing the system, we tried hard to find the right people in our organization.	41.	VC	C	N	U	VU
I was never sure of exactly what data we needed to evaluate this project.	42.	VC	C	N	U	VU
In evaluating the system, management was interested in different measures from the ones we (the users) thought were important.	43.	VC	C	N	U	VU
Though many problem areas were diagnosed, we were able to work first on those that were most critical.	44.	VC	C	N	U	VU

Rather than worrying about setting priorities, we dealt with each problem as it came up.	45.	VC	C	N	U	VU
When we started on implementing the system we had a clear cut plan to guide us.	46.	VC	C	N	U	VU
While an implementation plan was laid out, we left it loose so we could roll with the punches.	47.	VC	C	N	U	VU
At times in the planning stage, we seemed to move backwards as we redefined our goals, the problem, or the solution.	48.	VC	C	N	U	VU
From a technical standpoint, the implemented system is quite good.	49.	VC	C	N	U	VU
All things considered, it would have been difficult to come up with a better system than the one we implemented.	50.	VC	C	N	U	VU
In implementing the system we tried to take into account potential users' reactions to and opinions about what we were doing.	51.	VC	C	N	U	VU
Though things didn't always go smoothly, we felt it best to stick to our implementation plan.	52.	VC	C	N	U	VU
When the system was first made available for use, few of us knew what to do with it.	53.	VC	C	N	U	VU
Formal training in the use of the new system was very limited.	54.	VC	C	N	U	VU
Training sessions in the system and its meaning for our work were run for both users and non-users.	55.	VC	C	N	U	VU

As we implemented the system we knew that some users were unhappy, but we felt the best time to deal with that was after the completed system was available.	56.	VC	C	N	U	VU
I know this project met its goals, but we haven't collected any data to prove it.	57.	VC	C	N	U	VU
If I were doing this project over, I would be more careful in planning how to evaluate the implemented system.	58.	VC	C	N	U	VU
After some initial use we felt that certain changes to the system were important.	59.	VC	C	N	U	VU
We haven't yet done a serious evaluation of this project.	60.	VC	C	N	U	VU
There is really no need to evaluate projects of this sort.	61.	VC	C	N	U	VU
Though some changes to the system seemed appropriate, we just never got around to making them.	62.	VC	C	N	U	VU
Some formal evaluation soon after the system was operational was seen as necessary before we could decide on our next step.	63.	VC	C	N	U	VU
Though we collected some data for project evaluation, we haven't done anything with it.	64.	VC	C	N	U	VU
We would really find it hard to go back to our old way of doing things.	65.	VC	C	N	U	VU
The system still doesn't fit well with our organization's way of doing things.	66.	VC	C	N	U	VU

I am still uncomfortable about using the system in my work.	67.	VC	C	N	U	VU
I haven't yet learned to deal with the changes caused by the system in who is important around here.	68.	VC	C	N	U	VU
All in all, I am quite happy with the outcome of this project.	69.	VC	C	N	U	VU
The benefits we expected from this system never really materialized.	70.	VC	C	N	U	VU
The project provided me with the answers I needed.	71.	VC	C	N	U	VU
The system provided me with the techniques to solve my problem.	72.	VC	C	N	U	VU
I tend to rely more on analytic aids in my work now that this system has been installed.	73.	VC	C	N	U	VU
The decisions I make have changed as a result of having this system.	74.	VC	C	N	U	VU
It probably wasn't necessary for the consultant to stay involved with this project as long as he did.	75.	VC	C	N	U	VU
After the system had been turned over to us, we found there were loose ends we couldn't handle.	76.	VC	C	N	U	VU
Keeping the system running well requires the continued involvement of the consultant.	77.	VC	C	N	U	VU
We've changed too fast for this system to keep up.	78.	VC	C	N	U	VU

It isn't clear who should be responsible for changes and additions to the system.	79.	VC	C	N	U	VU
It was easy for us to take over responsibility for the system once it was implemented.	80.	VC	C	N	U	VU
We feel confident in our ability to manage and use the system.	81.	VC	C	N	U	VU

Comments

Please feel free to add any comments you wish about the project described, or about this questionnaire.

The following pages include the 81 questionnaire items from the Consultant version of the Survey Questionnaire.

I wasn't the only consultant the client spoke to about this project.	1.	VC	C	N	U	VU
At the very start, I talked to a number of people in the client organization about this project's potential.	2.	VC	C	N	U	VU
In retrospect, the client should have thought out his own needs more fully before calling me in.	3.	VC	C	N	U	VU
I was called in because of my experience with this type of problem.	4.	VC	C	N	U	VU
I never really knew why the client wanted me to work on this project.	5.	VC	C	N	U	VU
The clients undertook this project mainly because of its long term value to the organization.	6.	VC	C	N	U	VU
The aim of this project was to provide the user with a specific solution to an existing problem.	7.	VC	C	N	U	VU
The project was designed to provide the user with techniques for solving specific problems.	8.	VC	C	N	U	VU
It was planned that this project would lead management (or a particular user) to make greater use of analytic aids in their decision making.	9.	VC	C	N	U	VU
A distinct aim of this project was to lead the user to make decisions in a different fashion.	10.	VC	C	N	U	VU
One aim of this project was to lead the user to consider new areas and issues in his work.	11.	VC	C	N	U	VU

Agreement on what we wanted and expected of this project was not really reached before we got down to implementing the solution.	12.	VC	C	N	U	VU
We didn't worry about discussing goals at the start; we all knew what we wanted.	13.	VC	C	N	U	VU
My commitment to seeing this project through was never in doubt.	14.	VC	C	N	U	VU
Leadership on this project was comfortably shared and was never a hassle.	15.	VC	C	N	U	VU
If the client had realized at the beginning the amount of resources (e.g., people, time, money) required, the project might not have been started.	16.	VC	C	N	U	VU
We felt that our job was solving the problem as presented.	17.	VC	C	N	U	VU
Right from the start, changing their working procedures was something the client really didn't want to do.	18.	VC	C	N	U	VU
Some of the client's people were never convinced that this project was necessary, but they went ahead with it anyway.	19.	VC	C	N	U	VU
We tried to minimize the number of people who had to be involved with this project.	20.	VC	C	N	U	VU
During implementation the client seemed to feel that responsibility for solving problems was ours.	21.	VC	C	N	U	VU
Having people other than the consultant and user(s) involved in problem analysis was felt to be important.	22.	VC	C	N	U	VU

I really tried to see things from the client's point of view.	23.	VC	C	N	U	VU
A large part of our time was spent pinning down the exact nature of the problem.	24.	VC	C	N	U	VU
Understanding the problem required our considering a large part of the organization beyond the immediate user group.	25.	VC	C	N	U	VU
I did the lion's share of the data gathering needed to pin down the requirements for this project.	26.	VC	C	N	U	VU
Changes in work routines and procedures were an important consideration in assessing the proposed system.	27.	VC	C	N	U	VU
I required a good deal of the client's time during the effort to define the problem.	28.	VC	C	N	U	VU
Client personnel were just too busy to participate much in problem diagnosis.	29.	VC	C	N	U	VU
I never really found out much about the client's business.	30.	VC	C	N	U	VU
The problem was so obvious that there was no question about what the right solution should be.	31.	VC	C	N	U	VU
Predicting the way the system would fit into the client's work procedures was too complex to assess in advance of implementation.	32.	VC	C	N	U	VU
As part of our planning we felt it important to periodically rethink our goals and problem definition.	33.	VC	C	N	U	VU

We made sure we had defined specific measures of expected changes before actually implementing the system.	34.	VC	C	N	U	VU
There was no need to define detailed objectives for this project.	35.	VC	C	N	U	VU
The client didn't fully understand the system until it was up and running.	36.	VC	C	N	U	VU
The client didn't realize how much effort it would take to implement this system.	37.	VC	C	N	U	VU
The client never was convinced that we had the best solution to his problem.	38.	VC	C	N	U	VU
Testing out the proposed solution and its implications before implementing it was time consuming, but we did it anyway.	39.	VC	C	N	U	VU
With more effort the system could have met our original expectations.	40.	VC	C	N	U	VU
When special skills were required to aid in developing the system, we tried hard to find the right people in the <u>client's</u> organization.	41.	VC	C	N	U	VU
I was never sure of exactly what data we needed to evaluate this project.	42.	VC	C	N	U	VU
In evaluating the system, management was interested in different measures from the ones we thought were important.	43.	VC	C	N	U	VU
Though many problem areas were diagnosed, we were able to work first on those that were most critical.	44.	VC	C	N	U	VU

Rather than worrying about setting priorities, we dealt with each problem as it came up.	45.	VC	C	N	U	VU
When we started on implementing the system we had a clear cut plan to guide us.	46.	VC	C	N	U	VU
While an implementation plan was laid out, we left it loose so we could roll with the punches.	47.	VC	C	N	U	VU
At times in the planning stage, we seemed to move backwards as we redefined our goals, the problem, or the solution.	48.	VC	C	N	U	VU
From a technical standpoint, the implemented system is quite good.	49.	VC	C	N	U	VU
All things considered, it would have been difficult to come up with a better system than the one we implemented.	50.	VC	C	N	U	VU
In implementing the system we tried to take into account potential users' reactions to and opinions about what we were doing.	51.	VC	C	N	U	VU
Though things didn't always go smoothly, we felt it best to stick to our implementation plan.	52.	VC	C	N	U	VU
When the system was first made available for use, few users knew what to do with it.	53.	VC	C	N	U	VU
Formal training in the use of the new system was very limited.	54.	VC	C	N	U	VU
Training sessions in the system and its meaning for the client's work were run for both users and non-users.	55.	VC	C	N	U	VU

As we implemented the system we knew that some users were unhappy, but we felt the best time to deal with that was after the completed system was available.	56.	VC	C	N	U	VU
I know this project met its goals, but we haven't collected any data to prove it.	57.	VC	C	N	U	VU
If I were doing this project over, I would be more careful in planning how to evaluate the implemented system.	58.	VC	C	N	U	VU
After some initial use we felt that certain changes to the system were important.	59.	VC	C	N	U	VU
We haven't yet done a serious evaluation of this project.	60.	VC	C	N	U	VU
There really is no need to evaluate projects of this sort.	61.	VC	C	N	U	VU
Though some changes to the system seemed appropriate, we just never got around to making them.	62.	VC	C	N	U	VU
Some formal evaluation soon after the system was operational was seen as necessary before we could decide on our next step.	63.	VC	C	N	U	VU
Though we collected some data for project evaluation, we haven't done anything with it.	64.	VC	C	N	U	VU
The client group would really find it hard to go back to their old way of doing things.	65.	VC	C	N	U	VU
The system still doesn't fit well with the user organization's way of doing things.	66.	VC	C	N	U	VU

The client is still uncomfortable about using the system in his work.	67.	VC	C	N	U	VU
Some members of the client organization haven't yet learned to deal with the changes caused by the system in who is important in their organization.	68.	VC	C	N	U	VU
All in all, I am quite happy with the outcome of this project.	69.	VC	C	N	U	VU
The benefits we expected from this system never really materialized.	70.	VC	C	N	U	VU
The project provided the client with the answers he needed.	71.	VC	C	N	U	VU
The system provided the user with the techniques to solve his problem.	72.	VC	C	N	U	VU
The user tends to rely more on analytic aids in his work now that this system has been installed.	73.	VC	C	N	U	VU
The decisions the users make have changed as a result of having this system.	74.	VC	C	N	U	VU
It probably wasn't necessary for me to stay involved with this project as long as I did.	75.	VC	C	N	U	VU
After the system had been turned over to the users, they found there were loose ends they couldn't handle.	76.	VC	C	N	U	VU
Keeping the system running well requires my continued involvement.	77.	VC	C	N	U	VU
The user has changed too fast for this system to keep up.	78.	VC	C	N	U	VU

It isn't clear who should be responsible for changes and additions to the system.	79.	VC	C	N	U	VU
It was easy for us to hand responsibility for the system over to the user once it was implemented.	80.	VC	C	N	U	VU
The clients feel confident in their ability to manage and use the system.	81.	VC	C	N	U	VU

Comments

Please feel free to add any comments you wish about the project described, or about this questionnaire.

Appendix VI: Scoring the Survey Questionnaires.

Chapter VI describes the method used to calculate scores for the seven stage of the implementation process. These calculations require that the questionnaire items be separated into groups associated with each of the stages, and that each item be assigned an orientation; that is, whether an answer of "Characteristic" indicates favorable or unfavorable resolution of the issue addressed by the item. This appendix lists the items included in each stage (by item number) and indicates their orientations (F for favorable resolution, U for unfavorable).

	Item No.	Orientation
Scouting:	1	F
	2	F
	3	U
	4	F
	5	U
Entry:	6	F
	12	U
	13	U
	14	F
	15	F
	16	U
	17	U
	18	U
	19	U
	20	U
	21	U
	22	F

	Item No.	Orientation
Diagnosis:	23	F
	24	F
	25	F
	26	U
	27	F
	28	F
	29	U
	30	U
	31	U
	32	U
Planning:	33	F
	34	F
	35	U
	36	U
	37	U
	38	U
	39	F
	40	U
	41	F
	42	U
	43	U
	44	F
	45	U
	46	F
	47	F
	48	F
Action:	49	F
	50	F
	51	F
	52	U
	53	U
	54	U
	55	F
	56	U
Evaluation:	57	U
	58	F
	59	F
	60	U
	61	U
	62	U
	63	F
	64	U

	Item No.	Orientation
Termination:	65	F
	66	U
	67	U
	68	U
	70	U
	75	U
	76	U
	77	U
	78	U
	79	U
	80	F
	81	F

Appendix VII. Questionnaire Item Data

The tables in this appendix were prepared on the Scientific Time Sharing Corporation APL*PLUS system, and follow the APL convention of using a bar at the top of the number to indicate a quantity less than zero; i.e., ¯1.00 is to be read as -1.00.

VII.A. Within Stage Inter-Item Correlations

The following tables present the inter-item correlations for all items within a stage. User and designer correlations measured by Goodman and Kruskal's Gamma (see Goodman & Kruskal, 1954) are presented separately.

User Scouting:

	1	2	3	4	5
1	1.000				
2	¯0.311	1.000			
3	¯0.860	¯0.185	1.000		
4	¯0.460	0.427	0.234	1.000	
5	0.086	¯0.214	0.446	0.541	1.000

User Entry:

	6	12	13	14	15	16	17	18	19	20	21	22
6	1.000											
12	0.281	1.000										
13	0.189	0.071	1.000									
14	¯1.000	0.547	0.556	1.000								
15	¯1.000	0.060	0.426	0.844	1.000							
16	¯1.000	0.010	0.329	0.518	0.633	1.000						
17	¯0.835	¯0.445	0.277	0.255	0.350	0.276	1.000					
18	¯0.408	¯0.099	0.027	¯0.132	0.143	0.345	0.091	1.000				
19	¯0.528	¯0.181	0.398	¯0.035	0.382	0.358	0.512	0.055	1.000			
20	¯0.537	¯0.095	0.232	¯0.130	0.285	0.186	0.502	¯0.179	0.300	1.000		
21	¯0.412	0.051	¯0.116	0.029	0.149	0.157	0.000	0.110	0.256	0.095	1.000	
22	0.326	0.271	0.645	0.119	¯0.269	0.005	0.192	¯0.120	¯0.165	0.354	¯0.328	1.000

User Diagnosis:

	23	24	25	26	27	28	29	30	31	32
23	1.000									
24	0.145	1.000								
25	0.477	0.023	1.000							
26	0.286	¯0.337	¯0.220	1.000						
27	¯0.243	¯0.184	0.051	¯0.337	1.000					
28	0.387	0.570	0.277	0.130	0.233	1.000				
29	¯0.398	0.367	0.272	¯0.210	0.389	0.471	1.000			
30	0.754	0.186	¯0.026	¯0.063	0.230	0.350	0.531	1.000		
31	¯0.048	0.255	0.050	0.082	¯0.313	0.627	0.173	0.315	1.000	
32	0.558	0.040	0.493	¯0.184	0.110	¯0.031	0.653	0.404	0.446	1.000

User Planning:

	33	34	35	36	37	38	39	40	41	42	43	44	45
33	1.000												
34	0.323	1.000											
35	0.351	0.400	1.000										
36	¯0.445	0.226	¯1.000	1.000									
37	¯0.392	0.438	¯1.000	0.207	1.000								
38	¯0.328	0.253	¯1.000	0.625	0.337	1.000							
39	0.369	0.117	0.268	0.383	¯0.521	0.357	1.000						
40	0.113	0.144	¯1.000	0.753	0.298	0.383	0.022	1.000					
41	0.233	0.495	0.368	¯0.322	0.298	0.314	0.245	0.064	1.000				
42	0.147	0.465	¯1.000	0.409	0.190	0.665	0.111	0.177	0.145	1.000			
43	0.056	0.160	0.000	¯0.176	¯0.109	0.391	¯0.120	¯0.172	¯0.248	0.313	1.000		
44	0.031	0.273	0.024	0.326	¯0.110	0.262	0.372	0.088	0.198	0.402	¯0.139	1.000	
45	0.061	0.602	0.828	0.586	¯0.073	0.684	0.648	0.207	0.080	0.209	¯0.084	0.423	1.000
46	¯0.143	0.606	0.459	0.471	0.529	0.713	¯0.140	0.204	0.239	0.554	0.119	0.104	0.518
47	0.286	¯0.233	¯1.000	0.068	¯0.435	0.222	0.609	0.048	0.154	0.185	¯0.084	0.277	0.037
48	0.484	¯0.145	¯0.024	¯0.350	¯0.487	¯0.545	0.224	¯0.258	0.000	0.158	¯0.369	¯0.289	¯0.412

	46	47	48
46	1.000		
47	¯0.204	1.000	
48	¯0.465	0.556	1.000

User Action:

	49	50	51	52	53	54	55	56
49	1.000							
50	0.760	1.000						
51	¯1.000	0.000	1.000					
52	¯0.302	¯0.130	0.145	1.000				
53	0.262	¯0.085	0.323	0.514	1.000			
54	0.365	0.194	0.654	0.188	0.435	1.000		
55	¯0.170	0.175	0.205	0.006	¯0.156	0.513	1.000	
56	0.691	0.448	¯0.156	0.459	0.336	0.074	0.101	1.000

User Evaluation:

	57	58	59	60	61	62	63	64
57	1.000							
58	¯0.773	1.000						
59	¯0.717	0.664	1.000					
60	0.600	¯0.343	0.290	1.000				
61	0.364	¯0.103	¯1.000	0.760	1.000			
62	0.743	¯0.466	¯1.000	0.388	0.554	1.000		
63	0.233	¯0.008	¯0.268	0.387	0.254	0.252	1.000	
64	0.467	¯0.270	0.667	0.842	0.116	0.145	0.606	1.000

User Termination:

	65	66	67	68	69	70	75	76	77	78	79	80	81
65	1.000												
66	0.702	1.000											
67	0.508	0.453	1.000										
68	0.619	0.773	0.600	1.000									
69	0.797	0.763	0.209	0.552	1.000								
70	0.761	_0.886	_0.238	0.620	0.887	1.000							
75	0.471	¯0.044	¯1.000	_0.274	0.404	0.381	1.000						
76	_0.572	_0.463	0.170	¯0.074	0.621	_0.755	_0.217	1.000					
77	¯0.058	¯0.307	0.204	¯0.307	0.155	¯0.228	¯0.439	0.203	1.000				
78	_0.144	_0.383	0.707	_0.017	0.448	_0.057	0.225	_0.004	0.216	1.000			
79	¯0.560	¯0.455	0.667	¯0.032	0.101	¯0.397	_0.250	¯0.398	0.327	_0.400	1.000		
80	0.656	0.494	0.657	0.257	0.560	0.725	¯0.115	0.565	0.373	¯0.287	0.476	1.000	
81	0.738	0.481	0.859	0.700	0.785	0.688	¯0.284	0.640	0.704	0.261	0.556	0.938	1.000

Designer Scouting:

	1	2	3	4	5
1	1.000				
2	0.293	1.000			
3	¯0.561	¯0.575	1.000		
4	0.030	0.641	0.080	1.000	
5	¯1.000	1.000	¯1.000	¯1.000	1.000

Designer Entry:

	6	12	13	14	15	16	17	18	19	20	21	22
6	1.000											
12	¯0.429	1.000										
13	0.355	¯0.114	1.000									
14	¯1.000	1.000	¯1.000	1.000								
15	¯0.475	0.438	¯0.128	1.000	1.000							
16	0.355	¯0.114	0.273	¯1.000	¯0.128	1.000						
17	¯0.381	¯0.556	0.663	¯1.000	¯0.375	¯0.140	1.000					
18	0.086	¯0.044	0.593	1.000	0.315	0.440	¯0.123	1.000				
19	0.725	0.109	0.096	¯1.000	¯0.286	0.396	¯0.437	0.470	1.000			
20	¯0.143	¯0.099	0.677	¯0.200	¯0.269	0.304	0.656	0.456	0.014	1.000		
21	¯0.303	0.208	0.364	1.000	¯0.141	¯0.120	0.486	0.056	¯0.272	0.512	1.000	
22	0.000	¯0.037	0.717	1.000	0.543	0.111	0.238	0.621	0.036	0.570	0.433	1.000

Designer Diagnosis:

	23	24	25	26	27	28	29	30	31	32
23	1.000									
24	1.000	1.000								
25	0.217	0.705	1.000							
26	1.000	¯0.250	¯0.400	1.000						
27	0.462	¯0.020	¯0.096	0.071	1.000					
28	0.231	0.344	0.197	0.094	0.470	1.000				
29	1.000	0.474	0.116	¯0.459	¯0.020	¯0.136	1.000			
30	1.000	1.000	¯0.278	1.000	0.059	0.581	0.830	1.000		
31	¯1.000	0.388	0.514	¯0.333	¯0.114	0.044	0.161	¯1.000	1.000	
32	¯1.000	¯1.000	0.185	0.576	¯0.508	¯0.477	¯0.185	¯1.000	¯0.280	1.000

Designer Planning:

	33	34	35	36	37	38	39	40	41	42	43	44	45
33	1.000												
34	0.548	1.000											
35	0.719	0.429	1.000										
36	¯0.094	0.297	¯0.070	1.000									
37	0.396	0.295	0.416	0.571	1.000								
38	¯0.091	0.175	¯0.068	0.795	0.560	1.000							
39	0.359	0.067	¯0.137	¯0.191	¯0.605	¯0.455	1.000						
40	0.325	0.283	0.1 93	0.209	0.520	0.311	¯0.476	1.000					
41	0.516	¯0.089	0.510	¯0.522	¯0.291	¯1.000	0.527	¯0.635	1.000				
42	¯0.167	0.366	0.134	0.726	0.662	0.615	¯0.6 92	0.652	¯0.228	1.000			
43	¯0.123	0.290	0.195	0.257	0.748	0.672	¯0.825	0.359	¯0.295	0.436	1.000		
44	0.189	0.298	0.407	¯0.375	¯0.146	¯0.639	0.333	¯0.346	0.547	0.288	0.070	1.000	
45	0.016	¯0.160	0.297	0.045	0.261	¯0.191	0.224	¯0.408	0.573	0.235	0.058	0. 910	1.000
46	0.172	0.569	0.544	0.313	0.500	0.517	0.097	¯0.067	0.241	0.189	0.458	¯0.143	0.400
47	¯0.138	¯0.408	0.165	¯0.556	0.382	¯0.073	¯0.041	¯0.451	¯0.010	0.281	0.245	¯0.034	0.000
48	0.650	0.472	0.378	¯0.140	¯0.094	¯0.185	0.421	0.360	0.3 94	¯0.057	¯0.463	¯0.220	¯0.415

	46	47	48
46	1.000		
47	¯0.250	1.000	
48	0.200	0.000	1.000

Designer Action:

	49	50	51	52	53	54	55	56
49	1.000							
50	1.000	1.000						
51	1.000	0.606	1.000					
52	1.000	0.462	0.152	1.000				
53	1.000	0.225	0.391	¯0.158	1.000			
54	1.000	0.233	0.294	¯0.408	0.548	1.000		
55	1.000	0.333	¯0.034	¯0.127	0.205	0.792	1.000	
56	1.000	¯0.190	1.000	0.174	¯0.190	¯0.061	¯0.237	1.000

Designer Evaluation:

	57	58	59	60	61	62	63	64
57	1.000							
58	¯0.497	1.000						
59	¯0.469	0.128	1.000					
60	0.583	0.117	0.408	1.000				
61	0.607	¯0.099	0.121	0.806	1.000			
62	0.224	¯0.164	0.034	0.486	0.484	1.000		
63	0.221	¯0.672	0.446	0.688	0.524	0.407	1.000	
64	0.519	¯0.291	¯0.291	0.472	0.520	0.106	0.611	1.000

Designer Termination:

	65	66	67	68	69	70	75	76	77	78	79	80	81
65	1.000												
66	0.575	1.000											
67	0.833	0.948	1.000										
68	0.739	0.642	0.698	1.000									
69	¯1.000	0.353	0.273	0.649	1.000								
70	0.556	0.776	0.807	0.474	0.806	1.000							
75	¯1.000	¯0.067	¯0.136	¯0.293	0.778	0.538	1.000						
76	0.308	0.484	0.108	0.192	¯0.362	0.208	0.133	1.000					
77	0.271	0.540	0.241	0.358	¯1.000	0.041	¯1.000	0.631	1.000				
78	0.474	0.936	0.957	0.300	0.419	0.965	0.556	0.324	0.333	1.000			
79	0.537	0.620	0.671	0.932	0.444	0.640	0.070	¯0.317	0.333	0.730	1.000		
80	0.088	0.600	0.542	0.157	0.050	0.302	0.194	0.301	0.415	0.689	¯0.179	1.000	
81	0.467	0.980	1.000	0.589	0.563	0.833	0.179	0.048	0.425	1.000	0.769	0.553	1.000

VII.B. User Mean and Median Item Scores

The following tables present separately for each of the three complexity groups the mean and median scores of successful and unsuccesful users on each of the 71 questionnaire items not included in either measure of the dependent variable. The calculated value of the Mann-Whitney U statistic (see Siegal, 1956) is also presented for each item.

High Complexity Group Users

SCOUTING

ITEM	SUCCESS (N=10) MEAN	SUCCESS (N=10) MEDIAN	FAILURE (N=8) MEAN	FAILURE (N=8) MEDIAN	M-W U
1	1.200	1.500	0.750	1.000	33.5
2	1.100	1.000	1.125	2.000	34.5
3	1.100	1.500	0.250	0.000	20.5
4	1.200	1.500	0.875	1.000	32.5
5	1.400	2.000	1.000	1.000	29.0

ENTRY

ITEM	SUCCESS MEAN	SUCCESS MEDIAN	FAILURE MEAN	FAILURE MEDIAN	M-W U
6	1.300	1.500	1.625	2.000	33.5
12	0.500	1.000	0.250	0.500	35.5
13	1.100	1.000	0.250	1.000	21.5
14	1.400	1.500	1.500	2.000	36.0
15	1.200	1.000	0.625	1.000	29.5
16	0.900	1.000	0.375	0.500	28.0
17	-1.000	-1.000	-0.500	-1.000	28.0
18	0.200	0.500	0.375	1.000	37.0
19	-0.400	-1.000	-0.625	-1.000	35.0
20	0.400	1.000	-0.500	-1.000	21.0
21	0.300	0.500	-0.750	-1.000	18.5
22	0.400	1.000	-0.125	0.000	29.5

DIAGNOSIS

ITEM	SUCCESS MEAN	SUCCESS MEDIAN	FAILURE MEAN	FAILURE MEDIAN	M-W U
23	1.100	1.000	0.625	0.500	32.5
24	0.000	0.000	0.125	0.000	37.5
25	0.200	1.000	-0.250	-0.500	33.0
26	0.600	1.500	0.000	0.000	29.0
27	0.600	1.000	0.500	1.000	37.5
28	-0.100	0.000	0.000	0.000	38.5
29	1.100	1.000	0.375	0.500	27.5
30	1.000	1.500	0.500	1.000	30.5
31	0.300	1.000	1.125	1.000	23.5
32	1.200	1.000	0.000	0.500	16.0

High Complexity Group Users

PLANNING

ITEM	SUCCESS (N=10) MEAN	SUCCESS (N=10) MEDIAN	FAILURE (N=8) MEAN	FAILURE (N=8) MEDIAN	M-W U
33	0.100	0.500	0.625	1.000	28.5
34	0.200	0.000	-0.125	0.000	34.0
35	0.900	1.000	1.375	1.000	30.5
36	0.900	1.000	0.625	1.000	36.0
37	0.400	0.500	-0.250	-1.000	29.0
38	1.100	1.000	0.375	1.000	27.5
39	0.400	1.000	0.000	0.500	32.0
40	1.000	1.000	0.000	0.500	21.5
41	0.900	1.000	0.500	0.500	29.0
42	1.100	1.000	0.375	0.500	26.0
43	0.300	1.000	0.250	1.000	40.0
44	0.300	0.500	0.125	0.500	37.5
45	0.900	1.000	0.125	0.000	23.5
46	0.600	1.000	0.625	1.000	39.5
47	0.400	1.000	0.375	1.000	40.0
48	-0.300	-0.500	0.875	1.000	10.5

ACTION

ITEM	SUCCESS MEAN	SUCCESS MEDIAN	FAILURE MEAN	FAILURE MEDIAN	M-W U
49	1.400	1.000	0.625	1.000	25.0
50	0.900	1.000	0.375	0.500	25.0
51	0.900	1.000	0.500	0.500	30.0
52	-0.700	-1.000	-0.875	-1.000	36.5
53	0.400	0.500	0.125	0.500	35.5
54	0.000	0.000	-0.500	-0.500	30.0
55	0.400	1.000	0.375	1.000	37.0
56	-0.400	-1.000	-0.625	-1.000	37.0

EVALUATION

ITEM	SUCCESS MEAN	SUCCESS MEDIAN	FAILURE MEAN	FAILURE MEDIAN	M-W U
57	0.900	1.000	-0.375	0.000	15.5
58	-0.600	-1.000	0.750	1.000	15.0
59	0.700	1.000	1.125	1.000	31.5
60	0.500	1.000	-0.250	0.000	26.5
61	1.000	1.000	1.375	1.500	31.0
62	1.100	1.000	0.625	0.500	24.5
63	0.500	0.500	-0.250	-0.500	25.5
64	1.000	1.000	0.375	0.500	23.0

High Complexity Group Users

TERMINATION

	SUCCESS (N=10)		FAILURE (N=8)		M-W
ITEM	MEAN	MEDIAN	MEAN	MEDIAN	U
65	0.400	0.000	¯1.250	¯1.000	5.5
66	0.900	1.000	¯0.250	¯0.500	16.0
67	1.500	2.000	0.500	1.000	12.5
68	0.600	0.500	0.125	0.000	24.5
70	1.100	1.000	¯0.250	¯0.500	12.0
75	0.700	1.000	0.875	1.000	35.0
76	0.300	1.000	¯0.750	¯1.000	16.5
77	0.200	0.500	¯0.375	¯0.500	29.0
78	1.100	1.000	0.375	0.500	24.0
79	1.000	1.000	1.125	1.000	39.0
80	1.000	1.000	0.125	0.000	19.5
81	1.400	1.000	0.000	0.000	9.0

Medium Complexity Group Users

SCOUTING

	SUCCESS (N=8)		*FAILURE* (N=3)		*M-W*
ITEM	*MEAN*	*MEDIAN*	*MEAN*	*MEDIAN*	*U*
1	¯0.500	¯1.500	¯0.333	0.000	11.5
2	0.750	1.500	1.333	2.000	10.0
3	1.625	2.000	0.000	0.000	2.0
4	1.000	1.500	¯0.667	0.000	3.5
5	1.625	2.000	0.000	0.000	1.5

ENTRY

	SUCCESS		*FAILURE*		*M-W*
ITEM	*MEAN*	*MEDIAN*	*MEAN*	*MEDIAN*	*U*
6	0.625	1.500	1.667	2.000	8.5
12	0.375	0.500	¯1.000	¯1.000	7.5
13	0.625	1.500	0.000	1.000	7.5
14	1.500	2.000	¯0.333	¯1.000	5.5
15	1.500	1.500	¯0.667	¯2.000	6.0
16	1.750	2.000	0.667	2.000	10.0
17	¯0.500	¯1.500	0.000	0.000	9.0
18	1.125	1.000	0.333	0.000	7.5
19	0.000	0.000	0.333	0.000	10.5
20	0.000	0.500	¯1.000	¯1.000	8.0
21	0.750	1.500	1.000	1.000	11.5
22	¯0.250	0.000	1.000	1.000	7.0

DIAGNOSIS

	SUCCESS		*FAILURE*		*M-W*
ITEM	*MEAN*	*MEDIAN*	*MEAN*	*MEDIAN*	*U*
23	1.250	1.500	1.333	1.000	11.0
24	0.125	1.000	0.667	1.000	11.0
25	¯0.750	¯1.500	0.667	1.000	5.5
26	0.500	1.000	0.667	1.000	11.0
27	0.625	1.000	0.333	0.000	10.5
28	0.750	1.000	0.333	1.000	11.0
29	1.000	1.000	0.333	0.000	5.0
30	1.625	2.000	0.333	0.000	1.5
31	0.375	1.000	¯0.333	0.000	7.5
32	1.000	1.500	0.000	0.000	5.5

Medium Complexity Group Users

PLANNING

	SUCCESS (N=8)		FAILURE (N=3)		M-W
ITEM	MEAN	MEDIAN	MEAN	MEDIAN	U
33	0.125	0.500	0.333	0.000	11.0
34	1.125	1.000	0.667	1.000	7.0
35	1.500	1.500	0.333	1.000	8.0
36	0.875	1.000	0.000	0.000	6.5
37	0.625	1.000	0.000	0.000	9.5
38	1.500	2.000	¯1.000	¯1.000	1.5
39	¯0.125	0.000	2.000	2.000	1.5
40	1.500	2.000	¯0.667	¯1.000	0.5
41	0.500	1.000	0.333	0.000	9.5
42	1.125	1.500	¯0.333	0.000	3.5
43	1.500	1.500	0.000	0.000	2.0
44	1.000	1.000	¯0.333	0.000	2.0
45	1.125	1.500	0.667	1.000	7.5
46	1.250	1.500	0.000	0.000	4.0
47	¯0.375	¯1.000	¯0.333	0.000	10.5
48	¯1.375	¯2.000	0.333	0.000	2.5

ACTION

	SUCCESS		FAILURE		M-W
ITEM	MEAN	MEDIAN	MEAN	MEDIAN	U
49	1.625	2.000	0.333	1.000	7.0
50	1.500	1.500	0.000	¯1.000	6.0
51	1.125	1.000	0.333	0.000	4.5
52	¯0.250	0.000	0.000	0.000	10.5
53	1.000	1.000	1.333	2.000	9.5
54	0.750	1.000	¯1.000	¯1.000	3.0
55	0.250	1.000	¯0.667	¯1.000	7.0
56	1.125	1.000	¯0.333	0.000	1.0

EVALUATION

	SUCCESS		FAILURE		M-W
ITEM	MEAN	MEDIAN	MEAN	MEDIAN	U
57	1.125	1.000	0.000	0.000	3.0
58	¯1.125	¯1.000	0.000	¯1.000	7.0
59	0.250	1.000	1.667	2.000	2.5
60	0.375	0.500	0.333	0.000	12.0
61	1.250	1.000	0.333	0.000	4.0
62	1.000	1.000	¯0.667	¯1.000	4.0
63	¯0.125	¯0.500	0.667	0.000	7.0
64	0.625	1.000	1.000	1.000	9.5

Medium Complexity Group Users

TERMINATION

	SUCCESS (N=8)		*FAILURE* (N=3)		*M-W*
ITEM	*MEAN*	*MEDIAN*	*MEAN*	*MEDIAN*	*U*
65	1.375	2.000	1.333	2.000	12.0
66	1.750	2.000	0.000	0.000	0.0
67	1.375	1.500	1.333	1.000	11.0
68	0.875	1.000	1.000	1.000	11.0
70	1.625	2.000	0.000	0.000	1.5
75	1.500	2.000	0.333	0.000	6.0
76	0.625	1.000	0.333	0.000	11.0
77	¯0.375	¯1.000	¯0.333	¯1.000	11.5
78	1.125	1.000	¯0.333	0.000	2.0
79	1.500	1.500	1.333	2.000	12.0
80	1.125	1.000	1.333	2.000	10.0
81	1.625	2.000	1.667	2.000	11.5

Low Complexity Group Users

SCOUTING

	SUCCESS (N=7)		*FAILURE* (N=2)		*M-W*
ITEM	*MEAN*	*MEDIAN*	*MEAN*	*MEDIAN*	*U*
1	1.000	1.000	2.000	2.000	2.0
2	0.714	1.000	2.000	2.000	3.0
3	0.571	0.000	0.000	0.000	6.0
4	0.286	0.000	¯1.500	¯1.500	0.5
5	1.286	2.000	0.000	0.000	5.0

ENTRY

	SUCCESS		*FAILURE*		*M-W*
ITEM	*MEAN*	*MEDIAN*	*MEAN*	*MEDIAN*	*U*
6	1.857	2.000	2.000	2.000	6.0
12	0.286	1.000	0.000	0.000	6.5
13	0.571	1.000	0.500	0.500	7.0
14	1.000	2.000	0.500	0.500	6.0
15	1.000	1.000	¯1.500	¯1.500	1.5
16	0.714	1.000	0.000	0.000	4.5
17	¯0.571	¯1.000	0.000	0.000	5.0
18	1.143	1.000	1.500	1.500	5.0
19	0.857	1.000	¯1.500	¯1.500	0.5
20	¯0.429	0.000	¯1.500	¯1.500	4.5
21	0.429	1.000	¯1.500	¯1.500	1.0
22	0.000	0.000	0.000	0.000	7.0

DIAGNOSIS

	SUCCESS		*FAILURE*		*M-W*
ITEM	*MEAN*	*MEDIAN*	*MEAN*	*MEDIAN*	*U*
23	1.286	1.000	0.000	0.000	2.5
24	0.714	1.000	1.000	1.000	6.0
25	0.000	¯1.000	2.000	2.000	2.0
26	0.857	1.000	0.000	0.000	4.0
27	0.857	1.000	1.500	1.500	4.0
28	1.000	1.000	2.000	2.000	2.0
29	0.857	1.000	1.500	1.500	4.5
30	1.286	1.000	0.000	0.000	6.0
31	0.857	1.000	¯0.500	¯0.500	4.0
32	0.286	1.000	¯0.500	¯0.500	5.0

Low Complexity Group Users

PLANNING

ITEM	SUCCESS (N=7) MEAN	SUCCESS (N=7) MEDIAN	FAILURE (N=2) MEAN	FAILURE (N=2) MEDIAN	M-W U
33	1.143	1.000	¯0.500	¯0.500	3.0
34	0.429	1.000	0.000	0.000	5.5
35	1.429	1.000	1.500	1.500	6.5
36	0.286	1.000	0.000	0.000	7.0
37	¯0.429	¯1.000	¯1.500	¯1.500	2.5
38	1.429	1.000	¯0.500	¯0.500	2.0
39	1.000	1.000	¯0.500	¯0.500	3.5
40	0.429	0.000	¯2.000	¯2.000	0.0
41	1.429	1.000	1.500	1.500	6.5
42	0.857	1.000	0.000	0.000	4.0
43	0.429	1.000	0.500	0.500	7.0
44	1.143	1.000	1.500	1.500	5.0
45	1.000	1.000	0.000	0.000	3.5
46	0.714	1.000	0.000	0.000	4.5
47	0.571	1.000	¯0.500	¯0.500	4.5
48	¯0.429	¯1.000	¯0.500	¯0.500	6.5

ACTION

ITEM	SUCCESS MEAN	SUCCESS MEDIAN	FAILURE MEAN	FAILURE MEDIAN	M-W U
49	1.571	2.000	0.000	0.000	1.5
50	1.571	2.000	¯1.000	¯1.000	0.0
51	0.857	1.000	0.500	0.500	6.5
52	¯0.857	¯1.000	0.000	0.000	4.0
53	0.429	1.000	0.000	0.000	5.5
54	0.571	1.000	¯0.500	¯0.500	4.0
55	0.714	1.000	¯0.500	¯0.500	3.5
56	¯0.571	¯1.000	¯1.500	¯1.500	3.0

EVALUATION

ITEM	SUCCESS MEAN	SUCCESS MEDIAN	FAILURE MEAN	FAILURE MEDIAN	M-W U
57	1.143	1.000	¯1.000	¯1.000	0.0
58	¯0.286	0.000	1.000	1.000	2.0
59	1.429	1.000	1.500	1.500	6.5
60	0.714	1.000	0.500	0.500	7.0
61	1.429	2.000	1.500	1.500	6.0
62	0.286	1.000	¯1.500	¯1.500	1.0
63	0.857	1.000	0.500	0.500	4.5
64	1.286	1.000	1.500	1.500	5.5

Low Complexity Group Users

TERMINATION					
	SUCCESS (N=7)		*FAILURE* (N=2)		*M-W*
ITEM	*MEAN*	*MEDIAN*	*MEAN*	*MEDIAN*	*U*
65	1.571	2.000	1.500	1.500	6.0
66	1.714	2.000	1.000	1.000	2.0
67	1.857	2.000	0.000	0.000	4.0
68	1.429	2.000	1.500	1.500	6.5
70	1.571	2.000	1.000	1.000	3.0
75	1.429	1.000	2.000	2.000	3.0
76	0.857	1.000	-0.500	-0.500	4.0
77	-0.429	-1.000	-1.500	-1.500	3.5
78	1.143	1.000	-0.500	-0.500	1.5
79	1.571	2.000	-1.500	-1.500	0.5
80	1.143	1.000	0.000	0.000	6.0
81	1.857	2.000	0.500	0.500	4.0

BIOGRAPHICAL NOTE

Michael J. Ginzberg was born on April 8, 1947, in Cincinnati, Ohio, the son of Mr. and Mrs. M. Gerson Ginzberg. He attended secondary school in Montrose, New York, and graduated in June 1965.

Mr. Ginzberg entered the Massachusetts Institute of Technology in September 1965. He received the S.B. degree in Management in June 1969. As an undergraduate, he was elected to Tau Beta Pi, and he received the Sloan School Senior Prize for 1969.

From June 1969 to May 1971, Mr. Ginzberg worked as a Systems Designer in the corporate offices of United Nuclear Corporation. During this period, he also attended the Iona College Graduate Division of Business Administration, receiving the M.B.A. degree in August 1971. From May to September, 1971, he worked as the New England Sales and Technical Representative for Scientific Time Sharing Corporation.

Mr. Ginzberg entered the Alfred P. Sloan School of Management at M.I.T. on a National Defense Education Act Fellowship in September 1971. During the Spring of 1974, he taught a course on Advanced Concepts in Managerial Information for Planning and Control with Professor Peter Lorange of the Sloan School.

Mr. Ginzberg has accepted a position as Assistant Professor at the Columbia University Graduate School of Business beginning July 1975.