TESTING AN INTEGRATED IMPLEMENTATION MODEL WITH DATA FROM A GENERALIZED DSS

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ABSTRACT

A model proposed by Schultz, Ginzberg & Lucas (1984) that integrates the factor and process approaches to implementation was field tested with data from a generalized decision support system. Significant associations were found between manager acceptance and user perceptions of support, user personal stake and system use. The results suggest that voluntary and non-voluntary use of a system have different precursors and may be encouraged in different ways. Although the overall model receives only partial support, the results of the study suggest approaches for further testing of network models of implementation.

INTRODUCTION

The difficulties associated with implementing management science models and information systems have prompted a number of studies of this process over the past fifteen years (see Schultz and Slevin, 1975b, Doktor, Schultz and Slevin, 1979, Lucas, 1981, or Schultz and Ginzberg, 1984, for summaries). These efforts can generally be classified into two types of research, factor studies and process studies.

Factor studies are generally cross-sectional in design; they attempt to identify key variables or factors associated with implementation success or failure. The success measure in these studies is generally some measure of model or system use, intention to use a system, or level of user satisfaction with a system. Factor research has investigated hundreds of variables which can be grouped into categories like organizational context, system characteristics, user attitudes, user demographics and user decision style.

There have been some consistent findings across factor studies, for example, on the importance of management support in successful implementation. The lack of more consistent findings from these studies is due in part to incomparable definitions of variables and widely varying settings for the research. Other problems include the treatment of factors as absolutes and the tendency to focus just on the context of implementation, not the process.

Process studies focus on the relationship between the quality of the implementation effort and implementation outcomes. Process is defined primarily in terms of the interactions between the system designers and the users of a system. Most process studies have used one of two types of

behavioral models to generate and test hypotheses: planned change models, e.g., Lewin/Schein (Zand and Sorenson, 1975) and Kolb/Frohman (Lucas and Plimpton, 1972, Ginzberg 1979), or diffusion of innovation models (Lawless, 1976). The outcome measures for this research have been both behavioral (use of a system) and attitudinal (satisfaction with a system).

The findings of the process studies are generally consistent, but they often do not go far enough to provide adequate guidance in real implementation efforts. The simple models used ignore issues of context and the constraints it can impose on the implementation process.

Schultz, Ginzberg and Lucas (1984) have proposed a model which attempts to integrate factor and process approaches to implementation (see Figure 1). The model does not view all factors as direct determinants of outcomes, but rather as a network of variables and interactions. The network represents a process. The model is meant to be generally applicable to management science and information systems implementation efforts. The derivation of the model is explained fully in Schultz, Ginzberg and Lucas (1984) and will not be repeated here.

The model in Figure 1 depicts a two stage implementation process in which managers first recognize the need for a system to aid certain users and then commission the system's development or recommend its adoption. The manager submodel in Figure 1 focuses on manager acceptance of the system. If the manager accepts the system, he or she is likely to both explicitly and implicitly encourage subordinates to use it.

Acceptance by the manager forms the link between the manager and user submodels. The user's perception of his or her manager's support is expected

to be a key determinant of the user's personal stake in the use of the system. Personal stake is hypothesized to influence system use both directly and indirectly through user acceptance of the system. Use is also expected to be associated with satisfaction and performance. The key variables in the user submodel then are personal stake, user acceptance and use.

Schultz, Ginzberg and Lucas (1984) contend that this basic model is applicable to a wide range of implementation efforts. However, in different situations different sub-sets of the model will be appropriate. For example, there may be no manager involved in the development of a small DSS for a single individual or a small group of users. In this instance, the manager part of the model would not apply. Similarly, in situations dealing with the adoption of existing systems or models, involvement by users or managers in system development is not relevant.

This paper describes a first field test of the model presented in Figure 1. The complexity and level of integration of the model require a larger sample size than has been common in prior studies of management science and information system implementation. In order to find a large enough sample while still maintaining control over some of the variables in the model, it was desirable to study a single system with a large user population. The system studied in this research project can be classified as a Generalized Decision Support System (see Ariav and Ginzberg, 1985). There has been little research to date on the implementation of Generalized DSS, so the results of this study are of interest for what they show about this type of system as well as their more general implications for the implementation model. In the course of the study it became apparent that the degree to which system use is

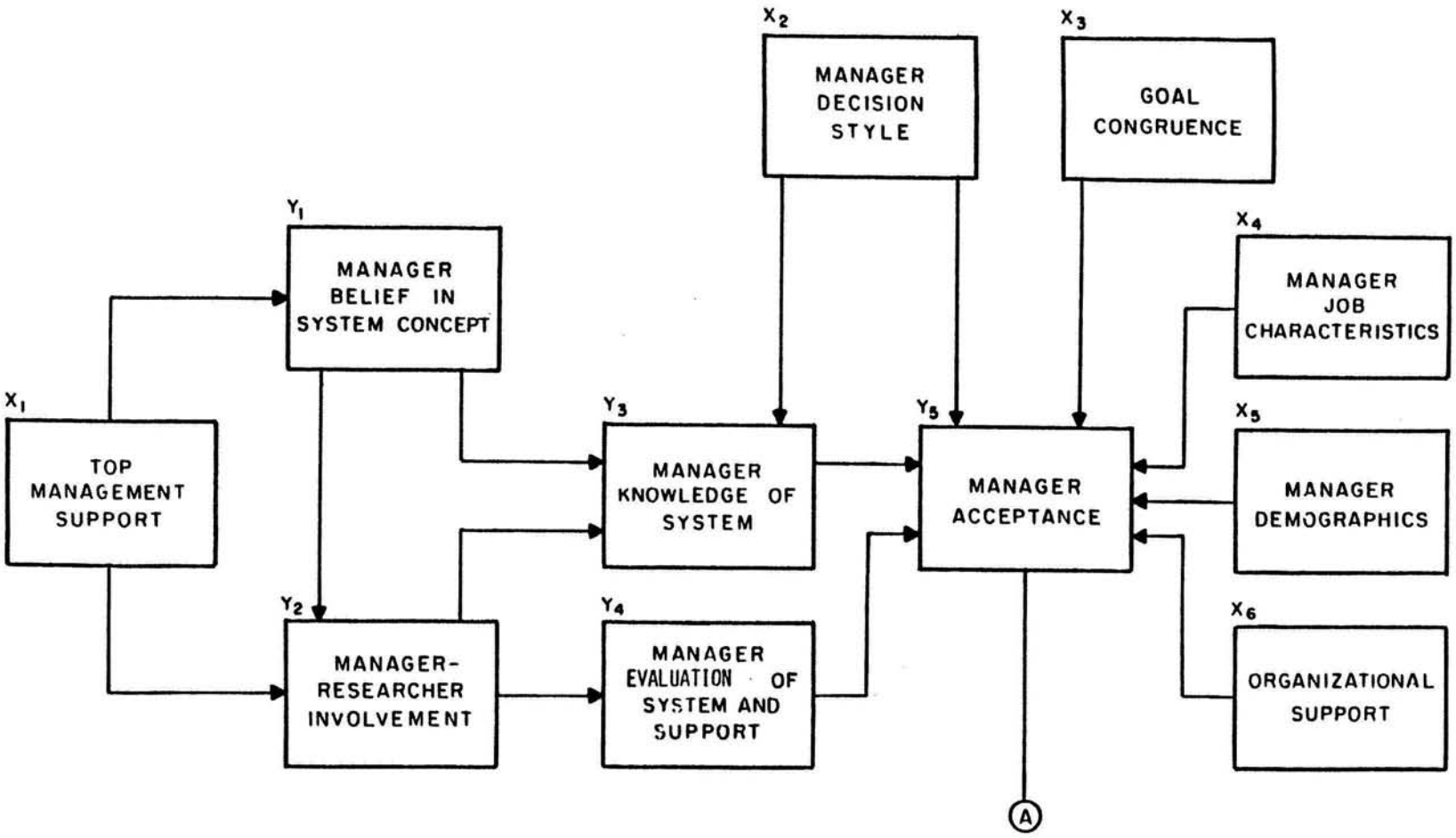
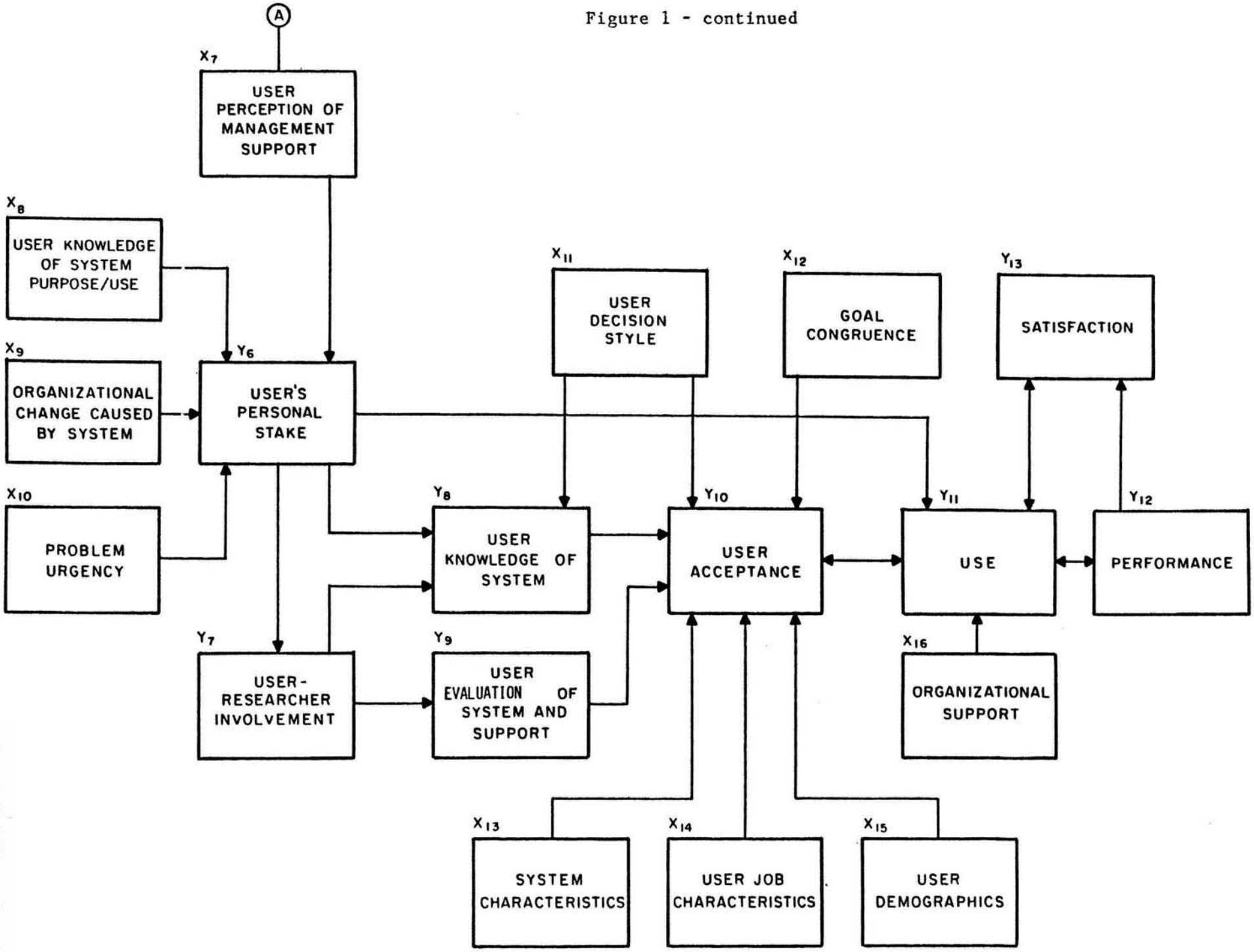


Figure 1

Figure 1 - continued



voluntary is an important issue to be considered in any model of the implementation process, and some preliminary results concerning the voluntarism of system use are presented.

A FIELD STUDY

In order to test the model in Figure 1, a field study was conducted of a generalized DSS in a large, multinational manufacturing firm. A generalized DSS is not tailored to a particular problem or decision situation (such as a fuel consumption model for an airline), but provides a set of tools and techniques which are applicable to a range of user decision problems. The use of generalized systems is increasingly popular for DSS since the demand for DSS support in most organizations exceeds the resources available for development. A large, generalized DSS may well provide capabilities that no single user could afford to develop or maintain. For example, it may provide both a greater range of functions and access to a larger database.

The implementation model shown in Figure 1 should be applicable to the adoption of a generalized DSS. The adoption of these systems is likely to be a two-stage process. First managers at a higher level in the organization than users approve the system. Because the system is to provide generalized tools to a group of users, it has visibility with management. Management's acceptance of the system should encourage its acceptance by users.

It appears, then, that both the manager and the user submodels are necessary to explain the adoption of a generalized DSS. Researcher involvement, however, is likely to drop out of both submodels. This type of

DSS is likely to be developed to meet a variety of user needs (both immediate and potential), with relatively little participation by any one user. In fact, generalized DSS are often acquired from outside the organization and adopted over a long period of time. The remainder of the implementation model should, however, be applicable to situations of generalized DSS adoption.

The generalized DSS studied in this research has evolved over a ten year period, and is intended for use by all types of planners in the firm. The company does a large amount of planning for new products and services. One group in the firm developed the system and it has been adopted by many users throughout the company.

The system provides on-line access to an extremely large sales and marketing database. A product planner could use the system to determine how many customers have Widget A with feature 1234. The product planner might be planning a replacement or enhancement that would affect feature 1234. He or she can also determine what other products the customer has and can estimate the likelihood that the new feature would be attractive to the customer. A variety of data extraction and statistical tools are available to the user of the system. At the time of the study there were approximately 600 registered users of the system (i.e., those who had revalidated their user ID's during the previous six months) and a potential user community of several times this number.

MEASUREMENT

Variables in the Model Tested

A general model like the one in Figure 1 must be modified when tested with data from a specific setting. In the manager submodel it was not meaningful to measure manager-researcher involvement since the system was developed a number of years ago as a general tool to meet a wide variety of needs. There also should be no variance in top management support since top management is the same for all participants in the study. Several variables were not included in the test because of change in the model that occurred during the study or because of measurement problems. For the manager submodel, the omitted variables include goal congruence, manager knowledge of the system, and manager belief in system concept.

In the user submodel, user-researcher involvement and goal congruence were not included (for reasons similar to those stated above), and it was necessary to eliminate user performance because company policy prohibited anyone outside of the firm measuring the performance of individual employees.

The operationalization of variables included in the study as well as brief descriptions or justifications for their inclusion in the model are presented here. More complete explanations and justifications of the variables in the model are available in Schultz, Ginzberg and Lucas (1984). Table 1, at the end of this section, includes a list of the variables in the study and reliability coefficients for multi-item scales.

Manager Submodel. Manager acceptance is the central variable in the manager submodel and the link to the user submodel. It represents the extent to which the manager wants the system accepted and used by subordinates. It

was measured by a five item scale (MACCPT) which includes reliance on the system's data for one's job, use of inquiry results for management presentations, centrality of the system to the job, impact on the job if the system is unavailable, and the extent the manager encourages subordinates to use the system.

Manager evaluation of system and support represents the manager's assessment of the quality of the system and its supporting mechanisms (both human and computerized). More favorable evaluations should lead to increased acceptance. It was measured by a four item scale (MEVAL) which included the levels of support provided by system management, file maintainers and computer operations and the quality of data available through the system.

Decision style has been investigated in a number of studies of implementation, and it is suggested that certain styles will predispose individuals towards analytic approaches to problem solving while other styles will have the opposite effect. The manager decision style variable employed two measures adapted from Vasarhelyi (1977), a single item self-report (MSTYLE1) and a seven item scale (MSTYLE2). The scaled variable had very low reliability and was dropped from the analysis.

Manager job characteristics represent the task responsibilities of the manager. Some tasks are more amenable to computer-based support than others, and should result in greater acceptance of the system. Three single items were used to measure manager job characterstics: the extent of planning for existing (MJOB1) and future products (MJOB2), and the product mix for planning (MJOB3).

Measurement

Characteristics of individuals have been found to be related to implementation behavior in a number of studies. The manager demographics measured in this study include technical versus nontechnical educational background (MEDUC), IS versus non-IS primary work experience (MWORK), time with company (MTIME1) and time in current job (MTIME2).

Organizational support refers to the degree to which organizational arrangements foster and facilitate access to and use of the system. It was measured by two single items: whether the system usage is charged to products or overhead (MCHARGE), and whether charging constrains department use of the system (MCONSTRAIN).

User Submodel. User perception of management support is the key link between manager and user in the two-stage model. Management support is the variable most frequently studied in implementation research. The user, however, cannot directly measure the manager's support and can report only his or her perception of management support. This variable was measured by a six item scale (PERSUP), which includes the extent the user's manager makes use of system output, expects specific output to answer his/her questions, tailors questions to the system's data structure, uses results of queries in meetings, considers ability to use the system in performance evaluation, and the extent the user is responsible for supplying the manager with information from the system.

User knowledge of system purpose concerns the extent to which the user knows how the outputs he or she produces from the system will be used. Without knowledge of how system outputs were to be used, users could not assess system importance or their stake in its use. This variable was

measured by a two item scale (KNOWPURP) which included the extent the user originates requests for information versus receives requests from others, and the extent the user knows how results of inquiries will be used.

Organizational change caused by the system should be important because of the general tendency of people to resist large changes. In the situation studied, since the system was already in use, the greater the change caused by the system the more likely it is that users would now resist giving it up. Two single item measures of organizational change were used: the number of additional staff required if the system were unavailable (CHANGE1) and the extent of the system's use by the present user's predecessor (CHANGE2).

Problem urgency has been found to be associated with system acceptance and use in prior implementation studies. It was measured by a two item scale (URGENCY) including a rating of the importance of problems for which the system is used and the time pressure for an answer.

Personal stake represents the degree to which the user's future rewards are linked to the use of the system. This variable has been found to be an important determinant of system adoption in several studies. The user's personal stake was measured by a four item scale (STAKE) including: the extent the system is a part of the user's job, the system's contribution to job performance, the impact on performance if the system is unavailable and the extent that others expect the user to use the system.

Without knowledge of a system's capabilities, the user cannot make a meaningful decision about accepting and using it. Knowledge of the system was measured by the score on an eight item objective test about system functions (TESTSCOR).

Measurement

Several variables in the user submodel closely parallel variables in the manager submodel. The user's evaluation of the system (EVAL) is measured by the average of ratings of data quality, data timeliness, and data importance to the user's job. These ratings were averaged across the classes of files (three classes were defined) accessed by each user. User decision style (STYLE1) is measured in the same way as manager decision style, using the single item self-report measure. Three single items measure user job characteristics (UJOB1, UJOB2, UJOB3) and are identical to the measures of manager job characteristics. Five single items are used to measure user demographics: technical or non-technical education (EDUC), IS or non-IS work experience (WORK), time with the company (TIME1), time in present job (TIME2) and time as a system user (TIME3).

System characteristics represent the features of the system and the fit between the system and the user's job. The system characteristic measured was the extent the user performs further computer-based analysis of data retreived with the system using either of two types of analysis tools (ANAL).

User acceptance represents the user's predisposition to personally use a specific system. It is a behavioral intention and should be a good predictor of actual use. It was measured with a two item scale (ACCEPT) which assesses the likelihood of the user's evaluating and switching to a new system providing the same data as the old. As such, this scale is a type of negative acceptance, a willingness to give up the existing system and adopt a new one.

Organizational support in the user submodel is conceptually similar to organizational support in the manager submodel. However, since users have "hands-on" access to the system while managers may not, different specific

measures are appropriate. Four single items measure organizational support in the user submodel: accessibility of a terminal (TERMINAL), charges to overhead versus products or projects (CHARGE), existence of an information center (SUPCTR) and the availability of a support staff (SUPSTAFF).

Two important dependent variables in implementation research are satisfaction with and use of a system. Three multi-item scales were used to measure satisfaction. The overall satisfaction scale (GENSAT) includes questions on the user's level of satisfaction with the language, its functions, file documentation, language documentation and the system in general. Satisfaction with response time, system availability and the communications network comprise a second scale (RESPSAT). Database satisfaction measures reactions to database completeness, accuracy and currency (DBSAT).

Two usage measures were employed. The first is a measure of the gross quantity of use, the number of inquiries made in the six month period prior to the administration of the questionnaires (USE). The second usage measure (BALANCE) addresses the balance of use across the various capabilities provided by the system.

Insert Table 1 about here

As can be seen in Table 1, the reliabilities of the multi-item scales (Chronbach's alpha) were generally high and are in the range acceptable for research at this stage of development.

Measurement

Measurement Instruments

Two questionnaires were developed for this study, one for managers and the other for users. The instruments were sent to all registered users of the system and their managers with a regular computer ID revalidation for the system. Questionnaires were anonymous, but were numerically coded to allow matching users to managers and to usage data.

The questionnaires were returned directly to the university and were not seen by anyone in the firm. The user questionnaires were sent to 597 users while 365 managers received instruments. There were 267 user and 145 manager questionnaires returned for response rates of 45% and 40%, respectively.

The company provided actual usage data in detail for one month and in summary for six months preceding the administration of the questionnaire. Detailed usage data showed the number of times a user had invoked each class of command available on the system. The numerical coding made it possible to associate a usage record with each user questionnaire.

RESULTS

The original hope in developing the model was that it could be estimated as a system of simultaneous equations (see Schultz, Ginzberg and Lucas, 1984). Unfortunately, an analysis of the zero order correlations showed that estimating the model as a complete system would not be appropriate. The analysis strategy then became one of estimating an ordinary least squares regression for each of the endogenous variables remaining in the model.

Results

Two approaches to the regressions were considered. Each regression could be done using stepwise inclusion of variables or all variables could be entered at once. Since there was strong a priori theory to support the proposed model, it seemed more appropriate to enter all variables in a single step. In several cases this led to an equation in which a majority of the independent variables had non-significant coefficients. (For all regressions performed in this study, p=.10 was adopted as the cutoff level for deciding whether a coefficient was significant.) In these cases, the equation was reestimated using only those variables having significant coefficients in the initial regression. While this did result in reduced amounts of variance explained (R^2), there was little difference in the beta values of the significant variables. In those cases where reestimation was deemed necessary, the R^2 of the reestimated equation is reported in the tables which follow.

Managers

The only regression possible for the manager submodel given the variables in the study is on manager acceptance (MACCPT). Manager acceptance is hypothesized to be a function of manager evaluation of system and support, decision style, job characteristics, demographics and organizational support. Due to a large number of missing observations for MEVAL, it was necessary to drop MEVAL from the regression. The regression is not significant and only one variable, MCHARGE, has a significant beta. Charging system usage directly to projects or products instead of to overhead is negatively associated with manager acceptance of the system.

Results

Insert Regression 1 about here

Users

In the user model there are five equations to be estimated -- for user personal stake, user knowledge of system capabilities, user acceptance, use and satisfaction. First is user personal stake, which is hypothesized to be a function of user perceptions of management support, user knowledge of system purpose or use, organizational change and problem urgency. Regression 2 shows the result of regressing these variables on STAKE. The regression is highly significant as are the coefficients for all but one of the variables, user knowledge of system purpose (KNOWPURP). The results for user personal stake are consistent with the predictions of the model: all of the independent variables except knowledge of system purpose or use are associated with user personal stake and together they explain more than half of the variance in STAKE.

Insert Regression 2 about here

User knowledge of the system's capabilities is hypothesized to be a function of user personal stake and decision style. The results in Regression 3, however, are insignificant for both the regression and for the individual variables.

Results

Insert Regression 3 about here

User acceptance should be, according to the model, a function of decision style, knowledge of the system, the user's evaluation of the system and support, system characteristics, user job characteristics, demographics and use. Regression 4 shows the result of regressing all of these variables on user acceptance. Note that ACCEPT is scaled such that lower scores imply greater acceptance. While the regression in total is significant, only five of the variables have significant coefficients (EVAL, ANAL, UJOB1, UJOB2, TIME3). Reestimating the equation using only these five variables shows that only one variable (TIME3) is significant. These results indicate that acceptance of this system increases with time as a system user. They provide little support, however, for this part of the model.

Insert Regression 4 about here

System use is hypothesized to be a function of user personal stake, user acceptance, organizational support and satisfaction. Regression 5 shows the results of the regression. While nearly 10% of the variance is "explained," the overall result is not significant and only one variable, personal stake, has a significant beta. Reestimating with STAKE as the only independent variable yields a significant result which explains 5% of the variance in USE. While the results are consistent with the findings of Schultz and Slevin

(1975a), Robey (1979), King and Rodriguez (1978) and others concerning the importance of user stake to successful implementation, they are disappointing with respect to the model.

Insert Regression 5 about here

The model hypothesizes that satisfaction is a function of use. The correlations of use with the three indices of satisfaction are all small and insignificant. Thus, there is no support for the model's contention that use leads to satisfaction, at least when use is measured by gross quantity of system inquiries.

The model in Figure 1 was developed with the assumption that use of a system would be voluntary. If use is not voluntary the relationships among acceptance, use and satisfaction would not necessarily be expected to conform to the model's predictions. That is, in the voluntary case, acceptance should lead to use and use to satisfaction. In fact, acceptance is significantly correlated with all three measures of satisfaction ($r = .23$, $.19$ and $.09$ for GENSAT, RESPSAT and DBSAT, respectively), but not with USE. USE is, however, correlated with personal stake. It appears that determinants of USE and of satisfaction are essentially different, which would be consistent with predictions one would make for a non-voluntary system. Perhaps the analysis would have been more favorable to the model if it had been possible to subset the sample based on whether use was voluntary or not.

Results

While total use of the system may not be voluntary, the nature of that use may be. It might be possible to perform a better test of this portion of the model if a different measure of use, one that more nearly reflects this voluntary aspect, were employed. The system studied provides numerous functions for data extraction and basic statistical analysis. Simple, rote use of the system can be accomplished using only one or two of these functions, while more sophisticated use would involve a wider range of functions. The authors contend that sophisticated use, the use of many system functions, is less likely to result if use is required than if it is voluntary. If this is so, a usage measure which reflects the degree of voluntary use can be calculated and used to test the model.

In an attempt to measure voluntary use, a modification of a measure developed by Stabell (1974) was calculated. This measure is the balance of function use (BALANCE); it is not sensitive to the total amount of use, but rather to the balance of use across the fourteen command categories in the system. The balance measure varies between 0 and 1. Individuals who do not use the system at all or who use only one category of function receive a score of 0, while those whose use is evenly balanced across the 14 categories receive a score of 1. (See the Appendix for computation details).

A new regression on use was performed using BALANCE (rather than USE) as the dependent variable. The results are shown in Regression 6. (The difference in sample size between Regressions 5 and 6 is because a number of users who used the system during the six month period did not use it during the one month of detailed data collection). The regression is significant, though only two of the independent variables (TERMINAL and SUPCTR) have significant coefficients.

Results

Insert Regression 6 about here

Finally, the model hypothesizes a linkage between the manager and user submodels through the user's perception of the manager's support for or acceptance of the system. The manager's acceptance scores (MACCPT) were attached to each appropriate user record (i.e., to the record of each user reporting to the manager) and a correlation matrix generated. Table 2 contains the correlation results. As suggested by the model, manager acceptance is correlated with user perception of support. It is also correlated with user personal stake, organizational change (the amount of change if the system were removed), the level of system use and problem urgency. Manager acceptance is uncorrelated with user satisfaction or the users' perceptions of organizational support.

Insert Table 2 about here

DISCUSSION

The results of this study can be viewed in two different ways, as a test of the research model of Figure 1 and as data about the implementation of the type of system investigated in the field study. There has been little or no research which has focussed on the problems of implementing Generalized DSS,

so the analysis at this level is of significant interest. This discussion first examines some implications of the study to the implementation of Generalized DSS and then turns to the broader questions of the research model.

Generalized DSS

Among the strongest results of this research are the linkages between manager acceptance and user perceptions of support, user personal stake and system use. These results suggest that manager action is important in the implementation process for this type of system. Favorable manager attitudes toward the system are recognized by subordinates and are translated into a perceived stake in the system, ultimately leading to system use.

In this study, the manner of charging for system use was the single variable significantly associated with manager acceptance; direct usage charges are correlated with lower levels of acceptance. This finding combined with the one above suggests that an important way to encourage system use is by not charging for it directly. This suggestion is not surprising, and is certainly consistent with the behavior of users in many organizations (consider the variations in use of campus computer facilities using different bases for charging).

User perceptions of management support, organizational change and problem urgency were all related to personal stake. User acceptance was related only to time as a system user. Personal stake, but not acceptance predicted total quantity of use. These results suggest that use of this system is less voluntary than the researchers believed at the start of the study (see the discussion below). It is possible that this is the case for many systems which would be classified as Generalized DSS; they are not tailored to the

user's specific needs, but provide the only mechanism for efficient accomplishment of important tasks. Thus, regardless of the user's preferences, the system must be (and will be) used. The nature and extent of that use, of course, may still be within the user's control.

Since the variables associated with use seem to be separate from those associated with acceptance for this system (and, by the argument made above, for other generalized DSS), management could attempt to impact use directly through such variables as user personal stake. This should be an appropriate strategy whenever use is primarily mandatory, as it provides the most direct and immediate way to impact use. If the relationships among acceptance and the dependent variables postulated in the model are correct in the case of voluntary use, the level of use in these cases would best be encouraged by addressing the variables associated with acceptance.

The importance of these results to the implementation of Generalized DSS can be summarized as follows. Generalized DSS are relatively expensive facilities which typically are adopted by an organization to meet a variety of decision support needs and do not exactly meet the needs of any user. They do provide a degree of support to all users, and may provide important organizational benefits of coordination and communication among users (in the situation studied, use of a common database for planning was the most important aspect of the system from the organization's perspective). By their nature, these systems are likely to be more important to the organization than they are to any single user. Thus, efforts to encourage the use of such systems should consider both voluntary and non-voluntary use, and should employ the mechanisms which address both types of use. Since these systems

are often adopted through a two-stage process, and since the impact of manager acceptance on subordinate stake (and ultimately use) is quite strong, steps necessary to assure manager acceptance of the system should be taken.

The Model

The results of this study provide only very modest support for the hypothesized model; for the most part, the R^2 values of the equations in the model are low. The model, however, is strongly grounded in past research. Each hypothesized linkage in the model has a basis in previous studies of information system and management science implementation (see Schultz, Ginzberg & Lucas, 1984, for a complete review of the prior studies). There are two sources of potential difficulty in this study, measurement problems and the research setting itself.

There is a need to clarify the conceptual meaning of the variable Evaluation of System and Support and to differentiate it from acceptance. Both evaluation and acceptance were treated as attitudes. A better approach might be to define evaluation as an attitude and acceptance as a behavioral intention.

Huber (1983) has argued that measures of decision style lack reliability. The data collected in this study support his contention; the intercorrelation of items in the multi-item scale were low as was the correlation between the scale and the single item measure. Researchers on implementation need a reliable, valid scale for decision style that does not require an excessive number of items. Since decision style is only one variable in implementation

research, it cannot dominate the data collection process as it would if some of the currently accepted tests for it (e.g., the Myers-Briggs indicator) were employed.

User knowledge of the system was measured by an objective test which required users to associate function names with system capabilities. A better measure would have been a test on knowledge of system capabilities and database contents.

Both system characteristics and job characteristics were tied closely to the specific setting studied, and their ranges were constrained by the nature of the sample. Dimensions which are generalizable across a variety of systems and jobs are needed.

The operationalization of user acceptance could more accurately be described as "unacceptance," the likelihood a user would examine and adopt an alternative system. A better measure, truer to the intent of the variable, would provide a positive operationalization of user acceptance similar to that used to measure manager acceptance.

During most of the study it appeared that usage of the system was voluntary rather than mandatory. In a voluntary situation, users are free to decide whether or not to work with a system. DSS, in general, have been considered to fall into the voluntary category. As discussed above, it now appears that usage may not have been as voluntary as first thought. Many users of the system were required to produce analyses for others in the department or for their managers. A number of employees of the firm indicated that this was the only system one could use to access the data. The need for data may have motivated individuals to use the system regardless of their feelings about it.

Discussion

If the suggestion made earlier that greater balance of use represents more voluntary use is correct, the analysis in the previous section has some important implications. Variables associated with level of use are essentially separate from those associated with acceptance. Use is related to stake, while acceptance is related to the user's evaluation of system quality, and to system, job and user demographic characteristics. The linkage between acceptance and use may be moderated by voluntarism. In a highly voluntary system acceptance and use should be correlated. In a system where use is mandatory, there should be no necessary relationship between these two variables. It is also likely that acceptance is related to satisfaction without the intervention of use. The relationships among dependent variables in implementation situations are complex and likely to be dependent on voluntarism.

The problem of assuring voluntary use for testing the model raises a difficult issue. A large sample size is needed for model testing, yet in systems such as the one described here it may be difficult to assure voluntary use. A DSS tailored to a specific problem (and perhaps even a specific user) is more likely to be a voluntary system, but such a system may have too small a number of users for statistical testing of the model. There is much work remaining to adequately test the model of implementation presented here, but further refinement and testing may well depend on success in finding an adequate number of voluntary system users.

The results of this study are one test of a network model of implementation. Hopefully, this model will be modified and extended, and will serve to guide further research on the implementation process.

APPENDIX

$$\text{BALANCE} = \frac{1}{\ln \text{COUNT}} \left(\ln \text{TOTUSE} - \frac{1}{\text{TOTUSE}} \sum_{i=1}^{\text{COUNT}} f(\text{USE}_i) \right)$$

$$\text{where } f(\text{USE}_i) = \begin{cases} 0, & \text{if USE}_i = 0 \\ (\text{USE}_i)(\ln \text{USE}_i), & \text{if USE}_i > 0 \end{cases}$$

COUNT = number of classes of operations provided by the system

USE_i = use of functions in class i during measurement period

$$\text{TOTUSE} = \sum_{i=1}^{\text{COUNT}} \text{USE}_i$$

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Variables in the Study

Variable	Name	Alpha
MANAGER SUBMODEL		
Manager evaluation of system and support	MEVAL	.80
Decision style	MSTYLE1	*
Manager job characteristics		
Planning for existing products	MJOB1	*
Planning for future products	MJOB2	*
Planning product type A vs. B	MJOB3	*
Manager demographics		
Educational background	MEDUC	*
Field of primary work experience	MWORK	*
Time with company	MTIME1	*
Time in current job	MTIME2	*
Organizational support		
System charges to products vs. overhead	MCHARGE	*
Charges constrain department use	MCONSTRAIN	*
Manager acceptance	MACCPT	.85
USER SUBMODEL		
Perception of management support	PERSUP	.83
Knowledge of system purpose/use	KNOWPURP	.57
Organizational change due to system		
No. added people in dept. if no system	CHANGE1	*
System use by predecessor	CHANGE2	*
Problem urgency	URGENCY	.51
Personal stake	STAKE	.87
User knowledge of system	TESTSCOR	**
Evaluation of system and support	EVAL	**
User decision style	STYLE1	*
System characteristics	ANAL	*
Job characteristics		
Planning for existing products	UJOB1	*
Planning for new products	UJOB2	*
Planning for product type A vs. B	UJOB3	*

(Continued on next page)

Variables in the Study (continued)

Variable	Name	Alpha
Demographics		
Educational background	EDUC	*
Work experience	WORK	*
Time with company	TIME1	*
Time in present job	TIME2	*
Time as system user	TIME3	*
User acceptance	ACCEPT	.78
Organizational support		
Terminal accessibility	TERMINAL	*
System charges to overhead	CHARGE	*
Existence of information center	SUPCTR	*
Availability of technical support staff	SUPSTAFF	*
Satisfaction		
Overall	GENSAT	.85
With response/availability	RESPSAT	.72
With database	DBSAT	.68
Use		
Number of inquiries in past six months	USE	*
Balance of inquiries across types	BALANCE	*

* Single item measure
** Coefficient alpha not meaningful

Table 1.

Regression for Management Acceptance -- MACCPT

R^2	= .090	R^2 (reestimated equation) = .049
n	= 98	
F	= 0.858 (p=.58)	

Manager Decision Style		
	MSTYLE1	.09*
		(.44)**
Manager Job Characteristics		
	MJOB1	.02
		(.86)
	MJOB2	-.18
		(.11)
	MJOB3	.01
		(.90)
Manager Demographics		
	MEDUC	-.00
		(.98)
	MWORK	-.00
		(.99)
	MTIME1	-.06
		(.63)
	MTIME2	.08
		(.47)
Organizational Support		
	MCHARGE	-.25#
		(.02)
	MCONSTRAIN	.02
		(.85)

* Beta ** Probability # Included in reestimated equation

Regression 1

Regressions for User Personal Stake -- STAKE

R^2 = .506
n = 169
F = 33.33
(p<.0001)

User Perception of Management Support	
PERSUP	.44*
	(.00)**
User Knowledge of System Purpose/Use	
KNOWPURP	.05
	(.36)
Organizational Change Caused by System	
CHANGE1	.15
	(.02)
CHANGE2	.15
	(.02)
Problem Urgency	
URGENCY	.21
	(.00)

* Beta ** Probability

Regression 2

Regression for User Knowledge of System Capabilities -- TESTSCOR

R^2 = .002
n = 232
F = 0.184
(p=.907)

User Personal Stake	
STAKE	.02*
	(.76)**
User Decision Style	
STYLE1	.04
	(.59)
STYLE2	.01
	(.89)

* Beta ** Probability

Regression 3

Regressions for User Acceptance -- ACCEPT

R^2 = .142 R^2 (reestimated equation) = .030
n = 172
F = 2.009
(p=.023)

User Decision Style		
	STYLE1	-.10*
		(.22)**
User Knowledge of System Capabilities		
	TESTSCOR	.10
		(.19)
User Evaluation of System and Support		
	EVAL	-.13
		(.10)
System Characteristics		
	ANAL	.14
		(.09)
User Job Characteristics		
	UJOB1	.17
		(.03)
	UJOB2	.19
		(.02)
	UJOB3	-.02
		(.80)
User Demographics		
	EDUC	.09
		(.23)
	WORK	.11
		(.15)
	TIME1	-.05
		(.56)
	TIME2	.11
		(.20)
	TIME3	-.18#
		(.03)
Use		
	USE	-.10
		(.22)

* Beta ** Probability # Included in reestimated equation

Regression 4

Regressions for Use -- USE

R^2 = .098 R^2 (reestimated equation) = .047
n = 144
F = 1.618
(p=.116)

User Personal Stake		
	STAKE	.18* #
		(.04)**
User Acceptance		
	ACCEPT	-.04
		(.69)
Organizational Support		
	SUPSTAFF	-.12
		(.20)
	TERMINAL	-.13
		(.14)
	CHARGE	.08
		(.36)
	SUPCTR	.12
		(.15)
Satisfaction		
	GENSAT	-.05
		(.61)
	RESPSAT	-.04
		(.71)
	DBSAT	.06
		(.54)

* Beta ** Probability # Included in reestimated equation

Regression 5

Regressions for Balance of Use -- BALANCE

R^2 = .213 R^2 (reestimated equation) = .076
n = 73
F = 1.897
(p=.069)

User Personal Stake	
STAKE	.01*
	(.91)**
User Acceptance	
ACCEPT	.13
	(.32)
Organizational Support	
SUPSTAFF	-.20
	(.12)
TERMINAL	-.25#
	(.05)
CHARGE	-.10
	(.42)
SUPCTR	.37#
	(.00)
Satisfaction	
GENSAT	-.03
	(.81)
RESPSAT	.09
	(.49)
DBSAT	-.18
	(.17)

* Beta ** Probability # Included in reestimated equation

Regression 6

MACCPT vs. User Submodel Variables

	r	n
PERSUP	.32***	107
STAKE	.41***	108
CHANGE1	.24*	82
CHANGE2	.34***	92
URGENCY	.21*	107
EVAL	-.01	94
GENSAT	-.01	99
RESPSAT	.02	101
DBSAT	.08	101
USE	.25**	108
ACCEPT	.02	105
SUPSTAFF	-.03	95
TERMINAL	.04	108
CHARGE	.09	101
SUPCTR	.14	74

*p<.05 **p<.01 ***p<.001

Table 2.