Information Engineering Implementation in Organizations: A Study of Factors Affecting Success

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ABSTRACT

Many companies have experienced high failure rates in software development for large complex systems. In order to improve systems development, some companies have turned to the technical innovation called Information Engineering. This new concept is an approach to software development which imposes a rigorous discipline on the systems development process. Previous publications have provided experiences of success and failure in Information Engineering implementation, but these are anecdotal in nature and are not the results of empirical study. This study systematically searches a broad base of literature to identify factors important to the successful implementation of a technical innovation like Information Engineering. While numerous factors could affect the implementation of Information Engineering, this study includes five important factors reported in the literature: management support, user participation, change agents, task changes, and training and education. Analysis of the results from 56 organizations in the United States shows that these five factors have significant impact on the successful implementation of Information Engineering in organizations.

INTRODUCTION

One of the newest and most promising software development methodologies is Information Engineering (IE). Information Engineering is an integrated, full lifecycle systems development approach with automated tool support which can be useful in assisting information systems managers in imposing a rigorous discipline on the systems development process. Furthermore, Information Engineering is based on solid conceptual foundation and has been refined in many ways since its initial proposal (Martin, 1990). The advent of the IE approach offers the potential to automate work tasks for those who analyze and design computer systems.

In recent years, IE has moved from the research laboratory to practical applications in the workplace. There have been a growing number of success stories involving organizations that have made a strong commitment to IE technology. The favorable publicity surrounding high-profile Information Engineering implementations has helped to encourage dramatic increases in Information Engineering adoption. Data modeling has become a mainstream information systems approach, and Information Engineering is the most popular approach used (Bird, 1992). Despite the publicized success stories, the successful implementation of Information Engineering technology is by no means assured. At least one major systems development failure has occurred when Information Engineering was utilized in the project (Wilder, 1992). If Information Engineering technology is to live up to its full potential, managers will require an understanding of what factors critically affect successful implementation.

Previous publications have provided some guidelines to increase the odds of success with Information Engineering (Jaakkola, 1991; Kerr, 1991; Martin, 1992). However, these guidelines are based on experiences and opinions. These experiences are anecdotal in nature, and

are not the results of scientific study. Empirical evidence is needed to answer critical questions about the most effective means of implementing Information Engineering in organizations. Few empirical studies have been performed on the issues involved in the implementation of complex systems development methodological approaches. Little is known about the types of problems encountered and the methods that have been found to be effective in dealing with those problems. The lack of empirical research on this topic is symptomatic of a general paucity of empirical research on all aspects of systems analysis and design (Davis, 1992). In this paper we report on a descriptive mail survey study that was undertaken to gain insight into the implementation of IE in organizations. To obtain a managerial perspective, the targeted survey respondents were Information Systems (IS) managers who were supervising a work group using IE. The purpose of the study was to investigate managerial perceptions and practices related to several IE implementation issues.

BACKGROUND

Implementation of an information system refers to the process of preparing an organization for a new system and introducing the system in such a way as to assure its successful use. Implementation is typically a complex process, as the introduction of a new information system to an organization will often change established organizational procedures and concepts (Davis and Olson, 1985). To effectively deal with the organizational changes brought about by a new information system, a manager needs to view implementation as an ongoing process that is associated with the entire development of a system, from its initiation through system analysis and design, as well as maintenance (Lucas, 1981).

Researchers and practitioners have long recognized the problematic nature of introducing computer systems into an organization (Ackoff, 1960; Bostrom and Heinen, 1977; Lucas, 1975; Mann and Williams, 1960). Over the last twenty-five years a large body of research has been generated relating to the implementation of computer-based systems for organizational applications. While early research focused on the implementation of operations research and management science (OR/MS) models (Churchman and Schainblatt, 1965; Schultz and Slevin, 1975; Zand and Sorensen, 1975), more recent work has tended to focus on the implementation of management information systems (MIS) (Ginzberg, 1981; Lucas, et al., 1990; Lucas, 1981; Markus, 1981; Swanson, 1974). Thus far, there has been little formal research pertaining to IE implementation.

One reason for the lack of IE implementation research is the newness of the technology. The development of IE into an integrated, full lifecycle software development approach with automated tool support did not occur until the late 1980s (Martin, 1990). Therefore, IE technology had not begun to gain a substantial foothold in the workplace until the 1990s. As a result, there have been relatively few opportunities for researchers to explore the managerial aspects of IE technology in a natural work environment. A second reason for the lack of studies has been corporate secrecy. Organizations that have been investing in development of the IE methodological framework often view the technology as an important competitive weapon. They are therefore reluctant to divulge their activities or open their doors to researchers (Westrup, 1993).

Recently, several articles have appeared which offer insights into some of the organizational issues associated with IE implementation (Leonard-Barton and Deschamps, 1988; Orlikowski, 1993). However, the generalizability of the findings that have been reported are somewhat limited as they are based on single organizations or are anecdotal in nature. To date, no systematic multiorganizational study with findings related to IE implementation has been reported. While existing implementation research offers a valuable foundation for guiding the implementation of MIS technology, investigative research into IE implementation is required in order to verify, extend, and delimit the existing body of implementation research. This study involved a survey of IS managers and considered implementation factors relevant to those involved with the application of IE.

IE technology embodies several distinctive characteristics that may differentiate IE implementation from other types of implementation efforts. First, IE may be more troublesome to implement than conventional IS, because IE can change control over knowledge and skill, resulting in changes in roles, responsibilities, and power among systems developers (Orlikowski, 1993). Second, the connotation associated with the term "automated systems development" may create concerns of being replaced among systems developers, or unfounded expectations that IE is a panacea among users. These characteristics need to be considered when introducing IE into an organization.

The objective of this study is to investigate managerial perceptions and practices germane to IE implementation strategy. This investigation should result in more information about the ways in which the management of IE implementation may be similar, or different, from that of other information systems. This study addresses the implementation issues of Information Engineering at the organization level of analysis. This research was under-

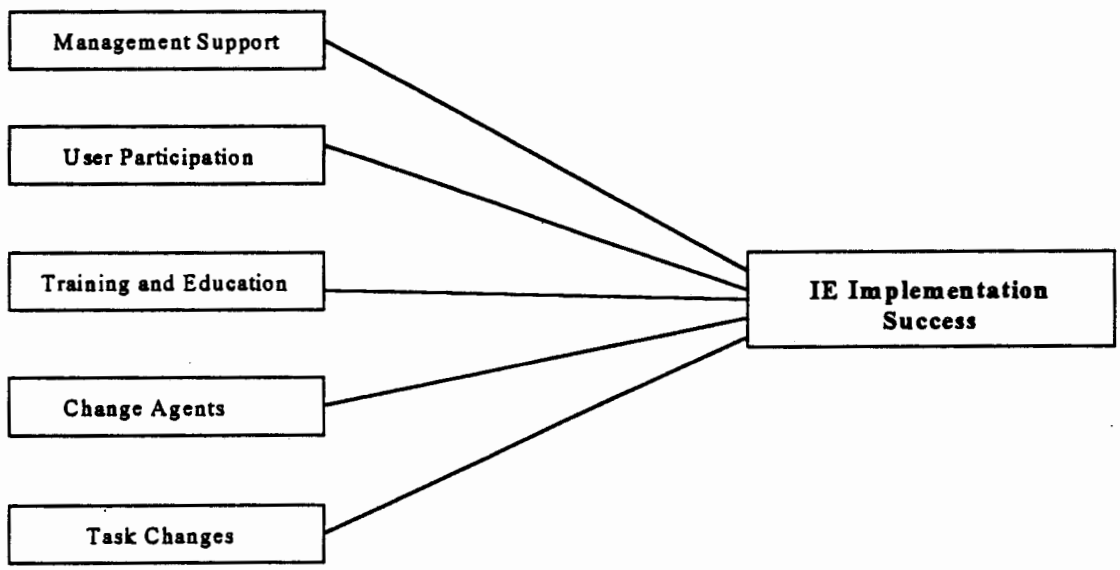
taken to provide managers of information technology with insight into which organizational change practices may assist in the implementation process of innovations such as the automated software development approach of Information Engineering.

THE INFORMATION ENGINEERING METHODOLIGICAL FRAMEWORK

Information Engineering is a composite group of tangible and intangible elements, consisting of software, procedures and training designed to bring integration to the development of applications software within organizations. The implementation of Information Engineering infuses radical change into the systems development environment of an organization and enables the development of truly cross-functional systems applications. This functionality can be expensive in terms of both time and money, often requiring a capital investment in excess of $1 million and a commitment of over three years.

When an organization adopts the Information Engineering approach for systems development, it must select a methodology and an automated Computer Aided Software Engineering (CASE) toolset which supports Information Engineering. The methodology establishes formalized, detailed procedures for software development, which are in accordance with the principles of Information Engineering. The automated CASE toolset makes the practical application of Information Engineering feasible,

Figure 1
Research Variables



and provides a necessary control mechanism to ensure complete, consistent and continuous application of the approach by the developer. Organizations typically utilize products offered by vendors as their methodology and CASE toolset.

RESEARCH QUESTION

The overall objective of this study is to address the research question: "What important variables affect the successful implementation of Information Engineering in organizations?" The dependent variable is the MIS manager's perception of the success of Information Engineering. Figure 1 shows the five independent variables identified in the literature: management support; user participation; training and education; change agents; and task changes.

IMPLEMENTATION ISSUES

To help focus the investigation, the OR/MS and MIS empirical literature was researched, as well as the anecdotal IE literature, to identify implementation issues which may need to be considered when approaching IE implementation. While numerous factors could affect the implementation of IE, this study includes five of the significant factors found in the studies reviewed in the literature: management support, user participation, training and education, change agents, and task changes. A discussion of these issues and the rationale for investigating them is provided below.

Management Support: Management support has been identified by a number of researchers as a key factor of implementation success (Neal and Radnor, 1973; Lucas, 1975; Alter, 1980; Sanders and Courtney, 1985). Management support and involvement in the information systems development process can increase the possibility that the logical and physical designs of IS reflect properly the organizational goals and objectives, as well as organizational needs. The most consistent finding across prior implementation studies is the importance of management support and leadership in successful implementation (Lucas, 1994). Management can support implementation efforts by encouraging and promoting system development efforts and by providing the resources needed for system development including financial support.

User Participation: User participation has been advocated for the system development process (Lucas, 1981; Alter, 1980). User participation is viewed as a means of increasing user commitment and fostering a sense of user ownership for a system. Advocates of user participation also suggest that it enhances systems quality since the assessment of systems requirements is more complete (Davis and Olson, 1985). Numerous investigations have explored the relationship between user participation and various system measures for MIS (Swanson, 1974; Tait and Vessey, 1988). While several of these studies indicate that user participation has a positive correlation with system success, the benefits of user participation have not been convincingly demonstrated, as the overall research findings in this area are mixed (Ives and Olson, 1984).

Training and Education: The level of user training and education is related to the level of performed information requirement analysis. With user training, users can acquire the ability to make clear their information requirements, and they can understand and evaluate the advantages and limitations of system (Montazemi, 1988). In one study, it was suggested that system designer and user can be viewed as equal members of the problem-solving team, and hence allowing mutual teaching or education to occur, in a form of knowledge transfer among participants. This interactive form of education has been shown to produce designs of higher quality (Boland, 1978). Other researchers also proposed relationships among user training, system design quality, and success of IS (Zmud and Cox, 1979; Bruwer, 1983; Sanders and Courtney, 1985; Cheney, Mann and Amoroso, 1986). With training and education, users can understand and represent information requirements that are faithful reflections of organizational contexts, and they can completely understand the present design quality of IS being developed. Training programs need to be offered to reduce resistance caused by ignorance and uncertainty. Additionally, specific knowledge, often of a technical nature, may be required in order to perform certain assigned tasks.

Change Agents: During the 1960s and 1970s, researchers at Northwestern University conducted a number of studies on the implementation of operations research models. These studies looked at the effectiveness of management science groups in industry, collecting empirical data from hundreds of firms. Included among the factors found by the researchers that affected the success of management science projects in these groups was the use of liaison groups, or change agents, with business expertise to work with users during implementation (Radnor, Rubenstein, and Bean, 1968; Radnor, Rubenstein, and Tansik, 1970; Neal and Radnor, 1973; Bean, Neal, Radnor and Tansik, 1975 , Bean and Radnor, 1979). In another study, the researchers found that the presence of a third-party change agent tended to help the user overcome power asymmetries and establish effective communications among the parties working on the design task (Debrabander and Thiers, 1984). A change agent interacting with the participants appears to influence the potential for successful implementation of a technical innovation. The assistance of a change agent appears to reduce their resistance to change,

and thereby increases the possibility of their acceptance of the innovation.

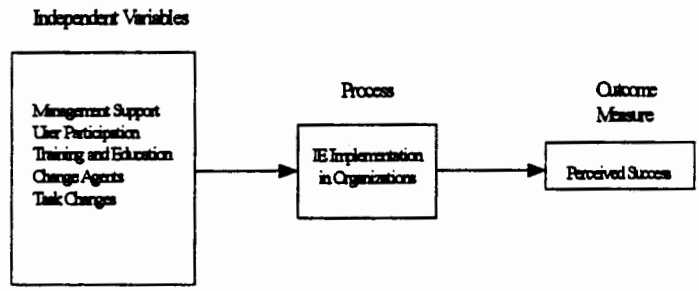
Task Changes: Research has shown that the process of implementing change is more difficult than it might seem. The task of changing the behavior of organizations, groups and individuals has may often be a difficult and frustrating endeavor. In one study, the authors recommended a facilitative environment that promotes the acceptance of change through several factors, including the structural and cultural changes necessary to inculcate the system into the organizational routine (Zmud and Cox, 1979). In a recent case study involving Information Engineering implementation, it was noted that IS developers experienced major changes in their responsibilities, skillsets, and work norms. Systems development under Information Engineering required considerable negotiation with users and other project team members (Orlikowski, 1993). These job task and content changes appear to reduce certain of the forces that contribute to the resistance to change, and thereby increase the potential for the acceptance of the innovation in the organization.

Perceived Success: Different measures of system success have been utilized since the early 1980s. Several measures have related to quantitative issues such as commercial profitability (Benbasat and Dexter, 1982; Sharda, et al., 1988) and level of system usage (Feurst and Cheney, 1982; Mykytyn, 1988). Other measures have resorted to less quantitative means such as user satisfaction (Galletta and Lederer, 1989; Ives et al., 1983) and the system's perceived benefits (David, 1989). The most appropriate measure for use depends upon the goals of the individual study. User satisfaction has been characterized as "a substitute for objective determinants of information system effectiveness" (Ives, et al., 1983), and has been widely used. Since the use of a complex approach such as Information Engineering results in various outcomes, some beneficial and others not beneficial, it is difficult to determine an objective measure of success. Furthermore, the real impact of using Information Engineering is reflected in the continued support from IS management and its use in new projects. Due to these considerations, the MIS manager's perceived success of the Information Engineering implementation is used in this study as the outcome measure.

THE RESEARCH DESIGN

The organizational response to a technical innovation such as IE can be strongly influenced by the way in which managers plan and carry out the implementation process (Ginzberg, 1981). To increase the probability for implementation success, it is advantageous for managers to have an appreciation for the factors which can promote implementation. As the foregoing discussion indicates, research studies involving conventional computer-based systems have identified a number of factors that appear to be important to implementation success. It would be of value to IE implementors to investigate whether these findings can be generalized to IE. To gain insight into the IE implementation process, a survey study of IS managers was undertaken. The research objective was to determine the extent to which the five independent variables described above affect the successful implementation of Information Engineering in organizations. This research model is depicted in Figure 2.

Figure 2
Research Model



Based on this model, the following set of hypotheses were developed for this study. Each is stated in null hypothesis form.

Hypothesis 1 - Management Support

H_o: There is no significant relationship between the degree of management support experienced and the successful implementation of the Information Engineering approach in the organization.

Hypothesis 2- User Participation

H_o: There is no significant relationship between the degree of user participation experienced and the successful implementation of the Information Engineering approach in the organization.

Hypothesis 3 - Training and Education

H_o: There is no significant relationship between the degree of training and education received by the participants and the successful implementation of the Information Engineering approach in the organization.

Hypothesis 4 - Change Agents

H_o: There is no significant relationship between the degree of utilization of a change agent and the successful implementation of the Information Engineering approach in the organization.

Hypothesis 5 - Task Changes

H_o: There is no significant relationship between the degree of change in participants' job tasks made by the organization and the successful implementation of the Information Engineering approach in the organization.

The dependent variable in this study is the MIS manager's perception of the success of the implementation of Information Engineering in their organization. Each of the managers was asked to evaluate their IE implementation success on a nine point Likert scale ranging from "low success," through "moderate success," to "high success." The independent variables reflect the organizational and human factors associated with the implementation. For each measure, the IS manager was asked to evaluate its applicability to their implementation experience on a five point Likert scale ranging from "very inaccurate" to "very accurate." The measures used in this study for each of the five independent variables are displayed in Table 1.

METHODOLOGY

Sample

A cross-sectional mail survey involving 146 different IE implementations was performed. To gain perspective of IE, the targeted respondents were IS managers who supervised a work group actively using IE for at least six months. The survey was aimed at IS managers, since they were expected to be the most appropriate informational sources due to their managerial position and comprehensive knowledge of their respective organization, work group, and IE.

The sampling procedure consisted of three steps. First, a proprietary, master list of organizational sites in the United States that were known to have experience with IE was made available to the researchers, on a confidential basis, through the cooperation of a major international consulting firm active in IE. No restrictions or limitations were placed on the research by the benefactor firm. This proprietary list consisted of 196 organizations, actively using IE, which are geographically dispersed throughout North America and exhibit a wide diversity of both organizational types and primary business functions. The key criterion for sample selection was organizational experience with IE technology. Second, each of the organizational sites from the master list was contacted by phone in an attempt to determine whether the organization actively used IE for systems development. If so, then the manager of the work group using IE was identified as a potential respondent for the survey. Third, each of the managers identified was contacted personally by phone to confirm that they matched the profile of the target survey respondent and that their systems development approach was IE. These managers were also asked if they would be willing to participate in a mail survey relating to IE in the workplace.

Of the 196 companies included on the proprietary list supplied to the researcher, 45 had insufficient information to make a telephone contact with the IS manager, four stated that they had not yet actively implemented IE, and one declined to participate. This resulted in a sample size of 146 organizations. There were no cases in which there was more than one potential respondent from an organization For this study, one data point was collected per confirmed adopter organization through the managerial questionnaire. There was no attempt to "triangulate" the findings by collecting data from other members of the work group using IE.

Survey Instrument

Data for this study were collected by a written mail questionnaire which consisted primarily of multiple-choice and Likert scale items. Specific questionnaire items were developed to collect data relevant to the objectives of the study, as well as descriptive information. The questionnaire was pre-tested to establish validity, and

Table 1
Research Variables and Measures

Research Variable	Measure Component Description	Cronbach's Alpha
Management Support	-Encouraged IE in systems development -Fostered widespread acceptance of IE -Allocated sufficient resources -Supported the introduction of IE -Supported the development of IE -Recognized the importance of IE -Willingly participated in IE systems development	.84
User Participation	-Users clearly communicated needs during development -New systems proven by acceptance and utilization -Fostered a sense of user-ownership for the system -Want to continue additional IE development -User needs were actively solicited during development -Performed extra efforts necessary to get the job done	.73
Training and Education	-Received technical support on the new system -Received user-training on operating the new system -Meet with user groups or attend IE conferences -Introduced standards and measurement techniques	.77
Change Agency	-Able to win acceptance and credibility with the staff -Built rapport with staff and stabilized the process -Upon completion, consultants were released	.27
Task Changes	-Increased level of interaction with users -Encouraged acceptance by management -Needed higher levels of communication with users -Made task changes necessary to establish IE -Provided positive feedback on the value of IE -Models used as a foundation for new IE projects -Thinking of data as organizationwide data models -Used management techniques to support data models	.72

individual items were combined into scales and the reliability of the items were tested. To encourage a high and reliable response the survey instrument was designed to be brief and free of specialized jargon. The average survey completion time was approximately twenty minutes.

Prior to mailing, the survey questionnaire was subjected to qualitative pre-testing and pilot testing (Straub, 1989). First, the questionnaire was reviewed by three individuals with a professional background similar to that of the sample group, including supervisory experience and familiarity with IE. These individuals were encouraged to identify weaknesses in the instrument and to comment on the overall format and readability of the questionnaire. Based on these comments, revisions were made and the questionnaire was subsequently submitted for pilot testing to MIS managers at seven additional companies who matched the profile of the desired sample respondent. After follow-up telephone interviews with these professionals, only minor modifications were necessary to the survey instrument following this pilot study.

Procedure

A survey questionnaire was mailed to each IS manager of the sample group along with a cover letter and stamped, self-addressed return envelope. In both the cover letter and the survey instructions, all respondents were promised anonymity, as well as a copy of survey results. To assess nonresponse bias, comparisons between respondents were made with respect to the type of the prospective respondent's organization.

RESULTS

In total, 61 questionnaires were returned by the managers, representing a response rate of 42%. However five respondents returned questionnaires which were incomplete or otherwise not usable. This reduced the effective number of usable questionnaires received from respondents to 56. The composition of the sample respondents is displayed in Table 2. Based on two chi-square tests performed on the compositions of the source, sample, and respondents, there did not appear to be any nonresponse bias as to the distribution of organizational type. A sizable majority (84%) of responses were from large commercial organizations. Other respondents were from large government agencies (11%), and education organizations (5%).

Table 2
Composition of Sample Respondents

Industry Classification	Respondents n (%)
Manufacturing	14 (25)
Commercial Banking	5 (9)
Diversified Finance	4 (7)
Insurance	4 (7)
Retail	2 (4)
Transportation	4 (7)
Utilities	14 (25)
Education	3 (5)
Government Agencies	6 (11)
Total	56 (100)

The calculated reliabilities for each of the variable scales representing the independent variables are displayed in Table 1. Four of the scales were found to have Cronbach's alpha values exceeding 0.7, and are considered adequate for the present exploratory study (Gay and Diehl, 1992). Analysis of the data indicates that the variable scale change agents lacks homogeneity among the items. This may be due to the few (3) items in the pool making-up the scale. However, the instrument in this survey was designed to capture a composite value for each variable scale, not to develop a specialized scale for measuring individual sub-constructs. Therefore a low value on one scale is not considered detrimental to the purposes of the study. In fact, since the value obtained for reliability of the instrument as a whole was 0.91, the study is considered to reflect more than adequate reliability (Gay and Diehl, 1992).

RESULTS OF ANALYSIS

Bivariate regression was used to test each of the formulated hypotheses between the independent variable scale and the dependent variable measure. With a single independent variable, the hypothesis that the population R SQUARE is zero is identical to the hypothesis that the population slope is zero (Neter, Wasserman and Whitmore, 1993). That test may be obtained from the analysis-of-variance table, and is detailed below for each of the independent variables. The application of bivariate regression to the data set (N=56) indicates whether each null hypothesis is accepted or rejected at an appropriate level of significance. Table 3 summarizes the results of this data analysis.

Table 3
Bivariate Regression Results (N=56)

	Independent Variable Scales	F value	Significance of F
Hypothesis 1	Management Support	15.50	0.0002*
Hypothesis 2	User Participation	24.27	0.0000*
Hypothesis 3	Training and Education	12.31	0.0009*
Hypothesis 4	Change Agency	4.89	0.0313*
Hypothesis 5	Task Changes	44.17	0.0000*

*-Significant at the 0.05 level.

DISCUSSION OF RESULTS

From the analysis of data collected it was possible to test the five hypothesis as presented previously. Each of the null hypotheses was rejected at the 0.05 level, indicating a strong relationship between each independent variable and the successful implementation of Information Engineering. The results for each variable is discussed below.

Management support for Information Engineering was a significant factor in explaining differences in the degree of the IS manager's perception of the successful implementation of the Information Engineering approach in their organization. Organizations with higher degrees of management support had higher degrees of success in implementing Information Engineering. Support of management for Information Engineering presumably creates a climate that encourages members of the organization to implement new methodologies that may deliver more effective systems supporting organizational processes. Organizations where management recognizes the importance of new technologies such as Information Engineering appear willing to allocate sufficient resources to make the implementation successful.

User participation was a significant factor in explaining differences in the degree of the IS manager's perception of Information Engineering implementation success. Organizations with higher degrees of user participation had higher degrees of success in implementing Information Engineering. The behavior of the participants that reflects a sense of ownership in the systems project, as well as a willingness to use the system, has a significant impact on the implementation of a new methodology such as Information Engineering. Additionally, a high level of interaction among the participants enhances the eventual success of a complex methodology such as Information Engineering.

Training and education was a significant factor in explaining differences in the degree of the IS manager's perception of the successful implementation of the Information Engineering. Organizations with higher degrees of training and education had higher degrees of success in implementing Information Engineering. The results suggest that managers who are implementing a complex technical innovation such as Information Engineering should provide training and education in the form of both overview and technical training to managers, developers and user personnel as appropriate. Enrollment in training and education programs appears to facilitate successful implementation of a complex framework like Information Engineering.

The use of change agents such as internal or external consultants was a significant factor in explaining differences in the degree of the IS manager's perception of the successful implementation of the Information Engineering approach in the organization. Organizations with higher degrees of usage of change agents had higher degrees of success in implementing Information Engineering. Thus, the use of a knowledgeable consultant to lead in the technical aspects and to act as a catalyst for participatory involvement is critical to the successful implementation of a complex methodology such as Information Engineering. This factor of change agency appears complex in its nature, and may contain multiple facets necessary to ensure creation of a set of conditions where Information Engineering can be self-administered by the organization's staff. Accordingly, this factor is included as a topic for future research later in this chapter.

The degree of task changes made with respect to systems developers and managers after the introduction of Information Engineering was a significant factor in explaining differences in the degree of the IS manager's perception of the successful implementation of the Information Engineering. Organizations with higher degrees of task changes made for developers and managers had higher degrees of success in implementing Information Engineering. Information Engineering emphasizes shared data, automated toolsets and data modeling which makes decidedly different demands upon developers, users, and managers. Management desirous of implementing a complex technical innovation such as Information Engineering should be aware that the traditional tasks of all involved personal will require changes to meet the needs of the new environment.

STUDY LIMITATIONS AND CONCLUSIONS

The results of the data collected from over 50 organizations in the United States using Information Engineering as their framework for systems development showed that the five variables identified have significant influence on the perceived success of the implementation. Management has control over several of the factors considered important to IE implementation. Therefore the results of this study can be used to guide managers in developing an implementation strategy. Significant unanswered questions remain relating to the implementation and the use of software development methodologies and other technical innovations. As the costs of these technical innovations and their attendant risks of failure to the adopting organization soar, the need for research to address these issues grows in importance. It is likely that much of the future understanding of software development methodologies such as Information Engineering will be derived from the observation of the implementation and use of the processes themselves. Successful implementation of complex technical innovations is possible, but it requires proactive management of the organizational change process.

The cross sectional sample in this study was chosen for its diversity, and includes organizations from both the profit and non-profit sectors, from different industries within the profit sector, and from firms of various sizes. A limitation of this organizational approach is found in the lack of control of possible confounding variables in areas such as organizational factors, departmental issues, and IE project dimensions. The reader has to carefully interpret the results and question their generalizability beyond Information Engineering and to less sophisticated systems development environments.

A major limitation of this study stems from the relatively small sample size. It is large enough to provide good representation, but too small to allow exploration of interactive relationships among independent variables and their effect on implementation success. Additional research is needed to further understand the determinants of IE implementation success.

This study raises important questions that deserve attention in future research. Are these results generalizable to organizations located in countries beyond North America? What about generalizability to other full lifecycle systems development environments such as SAP?

What about the impact on eventual IE success of the projects selected for early development? What about the individual components of IE such as the toolset, methodology and training selected and their effect on IE success? Additional research is needed to further understand the determinants of IE implementation research. This is especially true with regard to change agents due to the complex nature of change and the role played by the change agent. Organizational change is an area that has received much attention in the recent literature, and further study will yield more insights.

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