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AN EMPIRICAL INVESTIGATION OF CRITICAL SUCCESS FACTORS APPLICABLE TO INFORMATION CENTERS

University of Georgia PH.D. 1987

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AN EMPIRICAL INVESTIGATION OF CRITICAL SUCCESS FACTORS APPLICABLE TO INFORMATION CENTERS

By

Simha R. Magal
B. Com. (Honors), The University of Delhi, 1979
M.B.A., Valdosta State College, 1982

A Dissertation Submitted to the Graduate Faculty
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AN EMPIRICAL INVESTIGATION OF

CRITICAL SUCCESS FACTORS

APPLICABLE TO

INFORMATION CENTERS

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SIMHA R. MAGAL
An Empirical Investigation of Critical Success Factors Applicable to Information Centers.
(Under the direction of HUGH J. WATSON and HOUSTON H. CARR)

End-user computing (EUC) is the direct hands-on use of computers by people who have problems for which computer-based solutions are appropriate. An information center (IC) has become an accepted and rapidly growing part of an organizations' formal support for EUC. Previous research on this phenomenon of EUC and the IC has been diverse. Whereas efforts have been aimed to identify critical success factors (CSF) applicable to ICs, these efforts were exploratory in nature. Furthermore, no attempts have been made to examine factors affecting the CSFs applicable to ICs.

This study explored the CSFs applicable to ICs and examined the effects of several parameters on the importance of the CSFs. The parameters of interest were the stages of IC evolution, age, size, and the hardware option supported. Data were gathered through a questionnaire administered to IC managers.

A principle components analysis was used to identify composite CSFs from the individual CSFs previously identified in the literature. MANOVA procedures, followed by multiple comparisons, were used to determine the effects

of the parameters of interest (stages, age, size, and hardware option) on the composite CSFs.

The study identified five composite CSFs applicable to ICs. In addition, the study found support for a stage hypothesis for IC evolution. Further, the specific effects of the stages, age, size, and hardware option were identified. However, due to the very small number of differences found (out of a large number of possible differences), it was concluded that the effects of these parameters on the importance of the composite CSFs were minimal.

Based on the identified composite CSFs, a model for an IC is proposed. In addition, a hypothesis relating the stages of IC evolution and the CSFs based model of an IC is proffered.

KEYWORDS: End-user Computing, Information Center, Critical Success Factors, Stage Hypothesis

TO MY PARENTS

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It is my sincere hope that I have not inadvertently omitted anyone. In the event I have, please accept my apologies and take comfort in the promise that I'll buy you a beer next time I run into you!

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CHAPTER ONE

INTRODUCTION

Historically, the development of computer applications has been the responsibility of MIS professionals. Much of their efforts were expended on developing systems for well structured applications. Several problems evolved over time. These problems included the growing demand for systems to suit less structured applications, the inflexibility of applications developed, and the difficulties of defining the requirements of the system. As a consequence, development methodologies that were once adequate were no longer sufficient. Over time, a variety of new tools and approaches evolved under the names of structured design techniques, prototyping, fourth generation languages, and end-user computing.

End-user Computing And The Information Center

End-user computing is the direct hands-on use of computers by the people who have a problem for which computer-based solutions are appropriate. It is the most recent and the most rapidly growing segment of information systems activity (Sprague & McNurlin, 1986). Predicted growth rates range from 50% to 90% per year (Rockart & Flannery, 1983). Several factors led to the evolution of

end-user computing. These factors included an applications backlog, an increased demand for more timely and ad hoc analysis, the availability of technology, and an increased awareness on the part of a better educated user community (Rockart & Flannery, 1983).

End-user computing, while attempting to resolve these problems, gave birth to several critical issues. These included issues of data management; support and education of end-users; evaluation, justification and charge back; coordination and control of end-user activity; and planning for end-user computing. A response to these issues was the information center.

An information center is a formal means for supporting end-user computing and has two underlying functions: (1) facilitating and (2) coordinating end-user computing activities. The specific services provided include training, user assistance, usage planning, product evaluation, consulting, security, marketing, project management, maintenance of PC equipment, and the creation of computer and communications interface software (Sprague & McNurlin, 1986).

The information center has effectively dealt with some of the issues of end-user computing, such as education, training, and hardware/software compatibility (or lack thereof). Several other issues remain unanswered, and new ones have arisen. These include issues of security; data proliferation and integrity; charge back; relationships

among personnel; promotion and marketing of information center services; and the efficient use of information center resources (Carr, 1984).

Like all natural and man-made systems, an information center progresses through different stages of growth. Nolan is credited with applying the concept of the S-curve of system growth to data processing systems (Nolan, 1979). Lucas and Sutton describe the stages of growth of end-user computing (Lucas and Sutton, 1977).

Although the stage hypothesis has not been supported by empirical research (Drury, 1983; Lucas & Sutton, 1977; King and Kramer, 1983), it has a certain intuitive appeal. As a result it continues to be used to characterize the growth of systems. To date, no attempt has been made to apply the concept of the S-curve of system growth to information center. There is evidence that such a stage hypothesis for ICs may be appropriate. For instance, the 1985 AMA report on information centers reveals several patterns that may be used to characterize the stages of growth for ICs (The American Management Association, 1985). These patterns relate to hardware, software, training, budget, users, and management controls. Much effort is being expended to better understand the information center concept. Some of this effort has been focused on the information needs of information center managers as determined by their critical success factors.

The Information Needs Of IC Managers

In order to operate an organizational unit, the person charged with this responsibility is in need of certain information. Several approaches have been advocated for identifying such information needs. Among these approaches are the by-product technique, the null approach, the key indicator system, the total study process, and the critical success factors (CSF) method (Rockart, 1979). The most recent of them is the critical success factors method. CSFs are those few areas where "things must go right" for the organization to flourish (Rockart, 1979). Management must constantly monitor performance in these areas for which they need certain information. This information represents the critical information needs of management. Therefore, identifying these areas of activities - critical success factors - is tantamount to identifying the information requirements of management.

CSFs for information centers have been investigated in studies which have identified a number of such critical success factors across several information centers (Leitheiser & Wetherbe, 1985; Sumner, 1985a; Sumner, 1985b). A thorough review of such literature has revealed a list of 22 CSFs applicable to information centers. (see Appendix A1). To date, no attempt has been made to determine if all of these CSFs are equally important, whether they are equally relevant to all information centers or, whether they

change as an IC grows. Neither have factors affecting these CSFs been investigated.

The Objectives Of The Study

The primary objective of this study is to determine how the critical success factors for information centers change as the IC progresses through its stages of growth. A secondary objective is to investigate the sensitivity of the critical success factors to certain IC parameters. These are the global parameters of age, size, and the hardware option in effect.

Importance Of The Research

There is little doubt that information centers as a formal means for supporting end-user computing are here to stay. This fact is evidenced by the rapid growth in the number of information centers that have been established. It is estimated that 40% of all businesses have an information center in place (The American Management Association, 1985). Furthermore, budgetary expenditures for information centers are growing. It is estimated that in 1984, information center managers approved, on an average, nearly $1,000,000 on hardware and software (The American Management Association, 1985). This sum is clearly a non-trivial one.

Some researchers have formally investigated different aspects of information centers including management considerations (Hammond, 1982), success, problems, and critical success factors (Leitheiser & Wetherbe, 1985;

Sumner, 1985a; Sumner, 1985b). While the findings and conclusions of these studies represent significant contributions to our understanding of information centers, they are nonetheless descriptive and exploratory in nature. There continues to be much disagreement regarding several aspects of information centers including the very conduct and environment of an information center (Carr, 1984).

Identifying critical success factors is an accepted method of determining information requirements. Much of the evidence on CSFs for information centers remains anecdotal. Some of the factors alluded to include planning (Miles, 1983); data availability, organizational culture, service provided (Morse and Laurence, 1984); and communication between users and information center staff (Murrey, 1983). Formal studies on the information needs of information center managers reveal a substantial list of CSFs (Leitheiser & Wetherbe, 1985; Sumner, 1985a; Sumner, 1985b).

However, there is little evidence to determine which CSFs are applicable to which type of information center. Furthermore, no attempts have been made to investigate the variables affecting these critical factors. Without such evidence, managers of information centers have limited use of these CSFs. As managers of ICs are faced with changing problems and issues that accompany growth, knowledge of the CSFs applicable during the different stages of growth will be useful. This study was an attempt to provide the IC manager with this knowledge.

In addition to providing the IC manager with knowledge of the CSFs applicable during the stages of growth, this study investigated the effects of the parameters of age, size, and the hardware option on these CSFs. Hence, the contributions of this study lie in enabling IC managers to better understand the nature of CSFs as they apply to their own information centers as well as other information centers; and in contributing towards a more refined framework for information center research.

The Conceptual Model

The basic conceptual models for this study are depicted in Figures 1.1 and 1.2 in page eight. The models depict the fundamental relationships of interest. This is an attempt to study the nature of the CSFs applicable to ICs at different stages of growth, and the sensitivity of these CSFs to the global parameters of age, size, and the hardware option in effect.

The Stages of Growth

Information centers evolve from creation to becoming a mature organizational unit integrated with the rest of the organization. Typically, this evolution progresses through 4 stages which may be characterized in terms of several important parameters. These parameters include hardware configuration, variety of software, the scope of use of the software, type and extent of training provided, the IC budget, and the nature of the users (The American Management Association, 1985). These four stages are an adaptation of

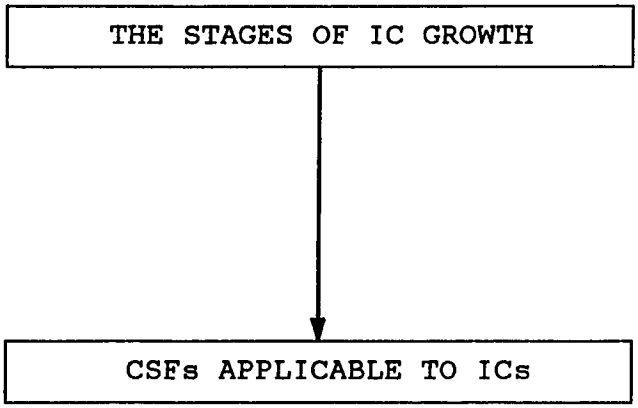

Figure 1.1: Effects of Stages of Growth on ICs

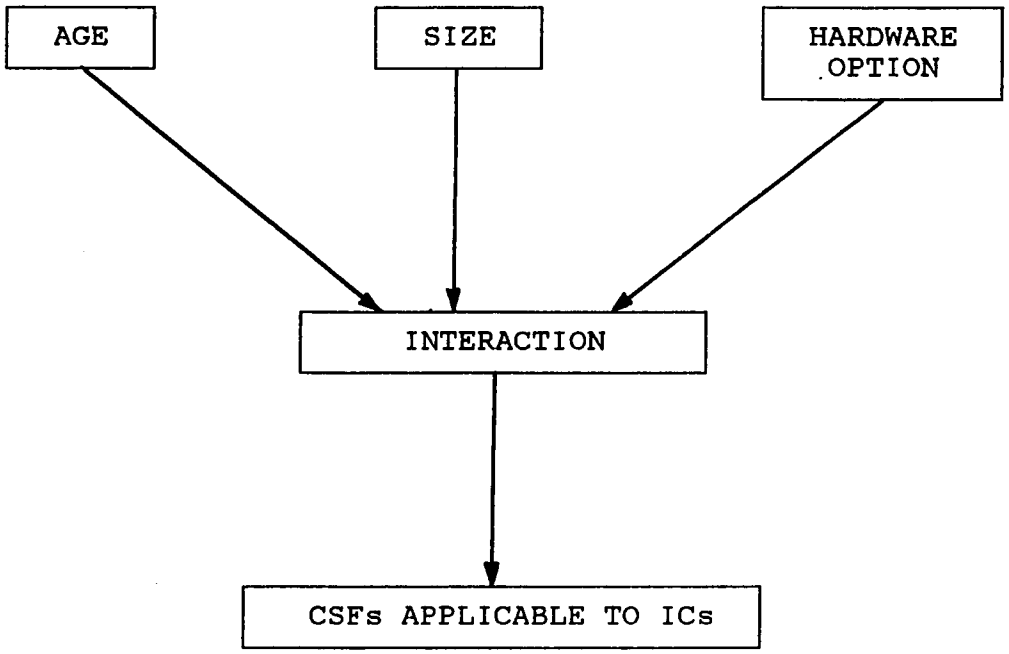

Figure 1.2: Effects of age, size, and hardware option on CSFs

Nolan's stage hypothesis to information centers. These stages are initiation, expansion, formalization, and maturity.

Initiation.

An information center (IC) typically evolves out of a need to coordinate the proliferation of end-user computing in an organization. The primary goal is to establish responsibility for facilitating and controlling end-user computing and to minimize any disruption which may arise due to the new concepts and technology associated with end-user computing.

During the initiation stage, the primary users (clients) of the information center are the pioneers of end-user computing in the organization. These users generally tend to be self-motivated and place few demands on the IC. Hardware alternatives are many and represent those existing prior to the creation of the IC. The variety of software products is limited as is the scope of the use of such software.

The IC staff is small, consisting of one or two people. A variety of training methods are often used (experimented with). The IC is a centralized organizational unit with limited hardware, software, and personnel at start up and is characterized by informal management practices. A small budget, if any, is used for planning purposes; few formally established policies and plans exist. Activities are prioritized on a First-In-First-Out basis; Other

managerial activities such as performance evaluation, charge back for services, and management control, are also performed informally, if at all.

Expansion.

This stage sees steep increases in hardware, software, IC staff and users (clients). It is a period of contagious, unplanned growth characterized by growing duties and responsibilities for the information center.

The number and variety of users increases, placing a greater demand on IC services both in terms of the number of requests and the level of expertise needed to respond to these requests. The IC staff moves toward specialization to cope with this increased demand. The training methods used are few as the staff finishes experimentation and settles for those which work best. The number of products supported increases along with the scope of use of such products.

Managerial activity is sales-oriented, and is aimed at encouraging the growth of end-user computing in the organization. Control mechanisms remain lax and informal; few standards are established; planning and performance evaluations are loosely organized; priorities for activities are based on broad guidelines. The IC remains centralized and continues to be responsible for hardware and software acquisition.

The end of this stage is characterized by a crisis for management due to the tremendous growth in the IC activities and budget.

Formalization.

During this stage in the evolution of an information center, the primary objective is to control runaway growth, particularly the growth in expenditures.

Managerial activities are formally and consciously conducted in an attempt to curb this tremendous growth. This stage is characterized by a proliferation of control mechanisms; formal priority setting for activities; budget justification; performance evaluation; and initiation of standards and charge back procedures. Formal administrative and supervisory positions are created and filled in the IC to carry out these management control functions.

Users' backgrounds widen to include those from additional departments such as research and development and public relations. User skill are relatively high, placing demands on IC staff to possess a very high level of expertise. IC staff specialization is high.

During this stage, some of the functions of the IC are decentralized to the user departments. These functions include those unique to the user departments as well as an increased involvement in defining policies and procedures.

Maturity.

The maturity stage is difficult to characterize completely because few ICs have reached this stage in their evolution. However, a few trends are emerging.

Separate ICs may be created within the user departments, absorbing the functions and responsibilities

of the centralized IC. The staff of these user department ICs are highly specialized to meet the specific needs of the departments, and may themselves go through training to ensure that they possess the requisite skills. These multiple ICs may be independent, having their own budgets and decision making processes. A major focus is to refine the control mechanisms instated during the formalization stage.

The centralized IC, if it still exists, has responsibilities of a more global nature. Their functions are centered around monitoring and coordinating the activities of the various ICs in the user departments. The manager of such an IC may be a senior executive providing input to the corporate strategic planning process. The collection of ICs in the various user departments are treated as a major corporate resource and are managed and controlled in that light.

The model in Figure 1.1 illustrates the primary relationship of interest. This is the effects of the different stages of growth on the CSFs applicable to ICs.

The Critical Success Factors

This study is concerned with the information needs of managers of information centers as determined by their CSFs. Prior studies have identified several CSFs applicable to information centers (Leitheiser & Wetherbe, 1985; Sumner, 1985a; Sumner, 1985b). Appendix A1 contains a comprehensive

list of 22 CSFs mentioned in the literature as being applicable to information centers.

The Parameters Of Interest

Also of concern is the sensitivity of the CSFs to the age of the information center, the size of the information center, and the hardware option used. These parameters are time-based. That is, they change over time. The age of an information center is obviously related to time and needs no further explanation. Typically, information centers begin small and grow over time. Also, information centers typically support either a microcomputer or a mainframe environment at start-up and evolve over time to support both microcomputers and mainframes.

The model in Figure 1.2 depicts the effects of the interaction among the time-based parameters on the CSFs applicable to ICs.

The Hypotheses

The conceptual model presented above leads to the following hypothesis:

H1: The significance of the critical success factors for information centers differs by the stage of growth the IC is progressing through.

H2: The significance of the critical success factors for information centers differs by the global parameters of age, size, and the hardware option supported.

The Research Methodology

A field study is appropriate when the objective is to identify the effects of independent variables (Van Horne, 1973). Since the basic objectives of this study is to determine the effects of the stages of IC growth and the parameters of age, size, and the hardware option supported, a field study was deemed appropriate.

Data Collection

Data for this study was gathered using a questionnaire administered to managers of information centers. The sample was randomly selected from the list of information center managers subscribing to the Information Center magazine. Seven observations per variable is a sufficiently large sample for statistical analysis. The total number of variables included in this study is 26, thereby requiring a sample size of between 180 and 260.

The Instrument

The questionnaire consisted of three parts. The first part included descriptions of the four stages of IC growth and the managers were asked to indicate the stage that best describes the one their IC is presently in. The second part addressed the parameters of interest; managers were asked to identify the age of the information center, the number of full time staff employed, the number of users, and the hardware options used. The third part of the questionnaire addressed CSFs applicable to information centers. The managers of the information centers were asked to rate the

importance of the CSFs to their information center. They were asked to rate the importance of each critical success factor on a seven-point Likert scale. This methodology for analyzing an information center's CSFs has been adapted from one proposed by Leitheiser and Wetherbe (Leitheiser & Wetherbe, 1985).

Pre-testing The Instrument

The questionnaire was be pre-tested using a sample of 10 information center managers. The purpose of such a pre-test is three fold. First, the pre-test sample of managers were asked to include additional CSFs not already included in the questionnaire and which they feel are significant. This is aimed at minimizing the possibility of the list of CSFs being incomplete. Appendix A2 contains the updated list of the CSFs. Secondly, the managers were asked to comment on the clarity of the questions asked. This is to identify potential bias due to leading questions, as well as identifying ambiguous questions. Finally, the managers were asked to verify the accuracy of the descriptions of the four stages of growth. Comments and recommendations made by the pre-test sample of mangers were incorporated into the final questionnaire.

Data Analysis

Preliminary analysis included descriptive statistics. The primary analytical tools were multivariate analysis of variance (MANOVA) and factor analysis.

Identifying Composite CSFs

A principle components analysis followed by a varimax (orthognal) rotation was used to identify the inherent structure among the 26 CSFs. The resulting principle component factors - the composite CSFs - were used in the hypotheses testing.

Effects Of Stages Of IC Growth On The CSFs

In order to test for the effects of the stages of IC growth on the composite CSFs, the sample was first divided into four groups, each representing ICs in the four stages. A MANOVA procedure was used to test for differences in the ratings of the composite CSFs across these groups. Multiple comparisons of the composite CSF ratings between the groups of ICs were used to determine the nature of the difference.

Effects Of Age, Size, And Hardware Option On CSFs

Testing for effects of age, size, and the hardware option on the composite CSFs involved two steps. First, the ICs were divided into groups representing different ages and sizes based on natural groupings suggested by the data. Next, a MANOVA procedure was used to test for the effects of age, size, and hardware option on the composite CSFs. This tested for differences in the ratings of the composite CSFs between the various groups of ICs identified in the previous step. Multiple comparisons of the composite CSF ratings among the groups of ICs were used to determine the nature of the differences.

Limitations And Key Assumptions

A limitation of this study is that it does not address the effectiveness of the information centers. The exclusion of effectiveness is intentional and is aimed at limiting the scope of the study in order to make it manageable. The consequences of this exclusion are not expected to be severe. The adverse effects of excluding effectiveness of information centers may be minimized by an assumption. It is assumed that managers of information centers are able to identify their CSFs. Identifying CSFs does not in any way require the information centers to be effective. Nor does it require the information center managers to have access to information on these CSFs. The study leaves it to the perceptions of the managers of information centers to determine what information is needed for their information center to be effective. And perception, of course, is reality.

Finally, it is recognized that the list of 22 CSFs identified by prior studies may not be exhaustive. In order to minimize the consequences of this, the questionnaire was pre-tested and the information center managers were permitted to include additional CSFs that they deem important and are not part of the questionnaire. The additional CSFs identified by the managers were then included in the final questionnaire.

Description Of Proposed Chapters

This study includes six chapters: Introduction, Review of Related Literature, Research Methodology, Results, Analysis of the Results, and Summary and Conclusions. The contents of each is described below and closely follows a format suggested by Davis and Parker (Davis & Parker, 1979).

1. Introduction:

The introduction consisted of an overview of the study and briefly discusses the general problem area; the specific problem; the importance of the research; the methodology used; limitations and key assumptions and contributions to be made.

2. Review of Related Literature:

The review of related literature is a complete review of relevant prior research and includes literature on end-user computing, information centers, stage theories, and critical success factors.

3. Research Methodology:

This chapter consists of an explanation of exactly how the research was conducted. It includes the data collection methods and the data analysis techniques used.

4. Results:

This chapter presents the findings and includes a summary of the data gathered as well as the results of the analytical techniques used.

5. Analysis of the Results:

This chapter explains the conclusions that may be drawn from the analysis of the data along with the implications with regard to the purposes of this study.

6. Summary:

This chapter summarizes the study with an emphasis on the results obtained and the contributions made. Suggestions for future research are also outlined.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter presents a review of relevant literature and is divided into four sections. The first section introduces the concept of end-user computing (EUC) leading to a discussion of information centers (IC) as formal methods of supporting EUC in the second section. The third section reviews the stage theory as it has been applied to organizations in general, its applicability to information systems, and to information centers. The fourth section discusses critical success factors (CSF) as means of identifying management's information requirements, as well as CSFs applicable to ICs.

End-user Computing

End user computing is the direct hands-on use of computing technology by people who have problems for which computer-based solutions are appropriate. Davis (1982) identifies three characteristics of EUC. The first characteristic is that EUC is the direct and immediate use of computers by end-users as opposed to the traditional methods of relying on the information systems (IS) professionals to deliver systems. The second characteristic of EUC is that the information requirements for the system

are defined and changed by the end-users themselves. Traditionally, this is the function of the systems analyst or the information analyst. The third major characteristic of EUC is that the development of the system is under the control of the end-user. This too is different from traditional systems development where control resides primarily with the information systems department.

The Significance Of End-User Computing

EUC has become a very major part of an organization's mechanism for delivering information to its decision makers. With regard to the impact of EUC on organizations, Benjamin (1982) concluded that end-user systems will substantially increase IS spending as a percent of revenue. He further predicts that EUC will take up 75% of an organization's information processing capacity by 1990. This is up from 40% in 1980. Finally, the approach to IS management will move away from managing the supply to managing the demand for information. A recent study identified EUC as the second most important key issue for the 1980's, the most important being IS planning (Dickson, Leitheiser, Wetherbe, & Nechis, 1984).

Forces Toward End-user Computing

The reasons for the evolution and rapid growth of EUC has been the focus of several studies. Essentially, the various forces toward EUC growth may be traced back to a difference between the demand for information and the ability of the traditional IS department to supply this

information. The increased complexity and volatility of the modern business environment put pressure on information technology to assist the decision maker. Information technology assisted the decision maker by providing capabilities for more effective analysis (McLean, 1979; Rockart & Flannery, 1983). This, combined with an increased awareness on the part of better educated end-users (Rockart & Flannary, 1983), and the availability of cheaper and easy-to-use technology (Rockart & Flannary, 1983; Rivard & Huff, 1982) resulted in an increased demand for information.

The traditional methods of delivering information fell short of meeting this demand. One result was the time lag between requesting a system and the system being delivered. This time lag was due to the long development cycles of traditional approaches (Rockart & Flannery, 1983; Gremillion & Pyburn, 1983; Martin, 1982), and was not acceptable to the decision makers. Secondly, the IS departments of most organizations did not have the resources needed to cope with this demand (Gremillion & Pyburn, 1983). Finally, the nature of the applications needed to generate the new information demanded made traditional approaches to applications development inappropriate (Rockart & Flannery, 1983).

Solutions to the problem of the disparity in demand for and the supply of applications focused on measures to increase the supply as well as measures to restrict demand. On the demand side, the high price of development through

realistic chargeback systems and bureaucratic hurdles resulted in the users developing systems independent of the IS department (Krausharr & Shirland, 1985). On the supply side, increased IS resources and improved productivity of the IS department through better tools and techniques was proposed (Krausharr & Shirland, 1985; McLean, 1979). In addition, alternative development methodologies were identified. These methodologies included using software packages (Gremillion & Pyburn, 1983), prototyping (Gremillion & Pyburn, 1983; Naumann & Jenkins, 1982; Krausharr & Shirland, 1985), and, most recently, end-user computing (McLean, 1979; Krausharr & Shirland, 1985; Gremillion & Pyburn, 1983).

The Nature Of EUC Applications

While EUC is a viable alternative to traditional development methodologies, it is not an attempt to replace these existing methodologies. In fact, EUC is applicable to only certain kinds of applications. Gremillion and Pyburn identify three criteria useful in determining appropriate development methodologies. These criteria are (1) the commonality of the application developed, (2) the scope of the impact of the application, and (3) the structuredness of the application (Gremillion & Pyburn, 1983). They conclude that EUC is conducive to those applications which are less structured, small in scope of impact, and uncommon.

This conclusion has been supported by investigations of the characteristics of EUC applications. McLean (1979)

first introduced a classification of applications in terms of their scope of impact. He classified applications as being either personal, departmental or corporate. The composition of the EUC applications appears to have changed over the last few years. In 1983 Rockart and Flannery determined that 52% of the EUC applications were personal with the remainder being equally divided between single departmental and multi-departmental. More recently, Sumner (1985a; 1985b) found that single departmental applications accounted for nearly 67% of EUC applications, personal applications 27%, and multi-departmental barely 7%. This suggests a move from a narrow to a wider scope of impact of EUC applications.

In terms of the specific type of applications developed, the primary focus of EUC applications is either report generation, inquiry involving simple analysis, or complex analysis of data. Rockart and Flannery (1983) found that 50% of all EUC applications in their study involved complex analysis. Sumner (1985a; 1985b) found contradictory evidence in her study which showed that query and simple analysis accounted for the bulk of EUC applications. In addition, she noted that EUC did not affect the IS backlog significantly, and that users would not have requested such applications from the IS department. More recently, Sprague and McNurlin (1986) identify several specific uses or activities supported by EUC. These are:

1. accounting, reporting and calculating aid

2. search and retrieval aid
3. communications aid
4. presentation aid
5. planning, scheduling, monitoring aid
6. analysis aid
7. memory aid
8. record processing aid
9. learning aid
10. aid in developing new applications programs
11. aid in decision making
12. writing aid

Nature Of The End-Users

End-users are of different types and several attempts have been made to arrive at a classification scheme. McLean (1979) identifies three types of end-users: - (1) DP professionals, those who write code for others to use; (2) DP amateurs, those who write code for their own use; and (3) non-DP trained users, those who use code written by others. Rockart and Flannery (1983) identify six categories of end-users.

1. non programmer end-users
2. command level users
3. end-user programmers
4. functional support staff
5. centralized EUC support staff
6. DP programmers

Of these, the first three types of end-users identified by Rockart and Flannery (1983) may be termed as direct end-users or decision makers as they directly utilize the computing technology for decision making. The last three types of end-users may be thought of as indirect end-users or decision supporters as they primarily aid others in utilizing computing technology for decision making.

The Benefits Of End-user Computing

EUC provides an alternative to traditional applications development methodologies and can overcome many of the problems of these methodologies. Specifically, Davis (1982) identifies three benefits - (1) EUC reduces the IS department's work load, (2) EUC eliminates problems associated with information requirements by making the user rather than an analyst perform this task, and (3) EUC transfers implementation to the end-users. Rivard and Huff (1984) determined that reduction of applications backlog of the IS department was reduction in personal and departmental applications and not corporate (multi-departmental) applications. This is not surprising as much of the EUC efforts are focused on the former two areas. However, factors other than EUC may have caused this reduction. These factors include increased IS resources, "modern" programming languages, and reduction in requests from the users (Rivard & Huff, 1984).

In addition to a reduction in the applications developed by the IS department, EUC has played a role in

reducing the applications maintenance workload for the IS department. Rivard and Huff (1984) determined that most of the reduction in the applications development workload is in perfective maintenance (i.e., in enhancements to existing applications). There was some reduction in corrective maintenance, (i.e. rectifying errors), and in adaptive maintenance, (i.e. changes in data, files). Finally, Rivard and Huff (1984) identify increased user productivity and reduced outside timesharing as benefits of end-user computing.

Risks Of End-User Computing

While providing several valuable benefits, EUC is not free from drawbacks. The risks of EUC relate to the change in the role of the user to include applications development and are potentially disastrous if left untended. These risks may be viewed form two perspectives: (1) the IS department's: and (2) the end-user's.

From the viewpoint of the IS department, potential risks arise from the elimination of the specialized function of the systems analyst (Davis, 1982). Specifically, problems include a limited user ability for information requirements analysis, lack of control procedures, poor documentation, backup, and security (Benson, 1983). Further, EUC may encourage undesirable information behavior (Davis, 1982) such as generating information because it is possible to do so rather than because it is needed; or

generating information because possession of such information may give the end-user perceived or actual power.

Another potential risk arises in terms of creating unstable systems in an stable environment (Davis, 1982). That is, an end-user may develop and utilize a system and then move to another job, leaving behind a system that may or may not be usable by others. This risk is related to poor documentation procedures on the part of the end-users. Encouraging private systems (Davis, 1982) is another potential risk of EUC. This refers to systems developed and used by the end-users without revealing the existence of such systems, thereby maintaining sole control of the system.

From the viewpoint of the user, the possibility of getting sidetracked from managing to programming is a legitimate worry. This is compounded by the likelihood that the label of a "computer type" may lock the user into a staff position (Benson, 1983).

In a recent study, Alavi and Weiss (1985) have categorized the potential organizational risks of EUC based on the different stages of end-user applications life cycle; (See Appendix B1).

It should be emphasized that these risks of EUC are potential risks, and may be avoided by taking certain measures. Davis (1982) suggests several such measures. These include the creation of an analyst/advisor function to review EUC applications, organizational policies and

guidelines for documentation and review of EUC applications, training users in formal systems analysis, automatic documenting procedures and quality control mechanisms, training users in quality assurance and control, and motivating users to follow "professional" development practices (Davis, 1982). Alavi and Weiss (1985) suggest control mechanisms for reducing or eliminating several risks of EUC during the different stages of end-user applications life cycle. These measures are listed in Appendix B1.

Issues Of EUC

EUC has addressed some of the problems and issues of traditional development methodologies such as the applications backlog and the appropriateness of such methodologies for end-user applications. Several other issues remain unanswered and new ones have arisen. Henderson and Treacy (1984) classify EUC issues into four major groups. These are the technological infrastructure, data management, support, and evaluation and justification issues.

The technological infrastructure includes software, hardware and communications. Specific questions regarding software include responsibility for software development, ownership of software, software piracy (Sprague & McNurlin, 1986), and professionalism of the programming effort in terms of documenting and testing (Keen & Woodman, 1984). In terms of the hardware and communications, the issues

primarily deal with hardware compatibility and the hidden costs of hardware (Keen & Woodman, 1984).

Data management issues include access (Benson, 1983), data integrity, privacy and security (Sprague & McNurlin, 1986). The diversity and interdependence of the end-users makes providing appropriate support, training and education a non-trivial task (Henderson & Treacy, 1984). Specifically, the type and extent of education, the type of hardware supported - mainframe, micro, or both - are critical issues (Benson, 1983).

Finally, the responsibility for EUC activities is an issue. This deals with the questions of planning for EUC (Benson, 1983), evaluation, justification (Henderson & Treacy, 1984) and control (Rockart & Flannery, 1983; Benson, 1983) of such EUC activities.

The criticality of these issues changes as EUC evolves over time. Henderson and Treacy (1984) discuss these changes as EUC activities evolve from the initial systems to rapid growth to maturity. The initial investment in hardware, software and communications technology is generally below some threshold level. Also the level of complexity of technology is low making the issue of technological infrastructure not very critical. As EUC activities evolve, technological complexity increases, the number of users and interdependence among users increases, as does data sharing and transfer. The criticality of the issues of technological infrastructure increases and peaks

during the growth phase. This is followed by a declining importance of technological infrastructure issues as policies and standards are well established. The focus is on treating technology as an investment.

Data management is relatively unimportant during the early stages as most of the data is entered by the users and applications tend to remain simple. During the growth phase, concerns of reliability, consistency, and security make data management a critical issue. The criticality of data management continues to increase beyond the growth stage as the economic value of data is difficult to establish.

With regard to evaluation and justification, Henderson and Treacy note that this is not a critical issue initially. As the size of the investment in EUC activities increases over time, evaluation and justification becomes critical. Finally, support and education is always an important issue, although their importance may decline over time as users become self sufficient. Resolution of these issues requires a comprehensive strategy for EUC of which there appears to be a dreath (Rockart & Flannery 1983).

Strategies For End-User Computing

The existence of a coherent EUC strategy in few organizations may be explained by the infancy of EUC activities in such organizations. As EUC activities evolve, so will management's understanding of such activities leading to the implementation of a strategy. This is based

on the stages of management understanding, namely unawareness followed by awareness and reaction followed by enlightenment and reaction (Keen & Woodman, 1984).

Several studies have attempted to identify the key elements of EUC strategy. Keen and Woodman (1984), suggest that any EUC strategy should be based on the following four elements:

1. coordination rather that control, with IS professionals playing the role of supporters.
2. long term technological architecture, with microcomputers as one component of the overall resources.
3. defining codes of good practice, adapting such codes from traditional DP practices.
4. emphasis on business justification, both quantitative and qualitative.

Gulden (1984) recommends an EUC strategy also based on four elements. These four elements are:

1. provide enough mainframe and micro power to satisfy user demands while placing rational limits on proliferation of technologies.
2. make end-user technology as accessible and easy to use as possible.
3. enforce minimal cost/benefit criteria that provide some protection against improper usage of the computer, and protect the end-users from their own mistakes.
4. seek out high-value applications.

Gulden suggests that the fourth element may perhaps be the most significant element of any EUC strategy.

El Sawy (1985) favors cultural infusion as a method for managing EUC. Cultural infusion is a technique for introducing information technologies into organizations and includes three steps. First is matching technology with user needs, followed by introducing applications to a sub group of users (cultural infusion), followed by inside-out diffusion of technology from the core (initial sub group) to other users in the organization.

Munro and Huff (1985) suggest four strategies for EUC growth based on two variables - acceleration, or the rate of growth, and control, due to forces constraining users freedom of choice regarding EUC. These strategies are based on a combination of high or low acceleration and high or low control, and are depicted in Figure 2.1.

The laissez-faire strategy is the starting point for most organizations and reflects a low interest on the part of the end users and a consequent low need for controls. The containment strategy is a deliberate effort on the part of management to slowly and carefully diffuse EUC throughout the organization. This strategy involves defining very specific limits to growth accompanied by strict controls. The controlled growth strategy is a reflection of a desire for rapid widespread growth of EUC activities but in a carefully controlled environment. Finally the expansionist

strategy reflects an uninhibited growth in EUC activities with little direction or control (Munro & Huff, 1985).

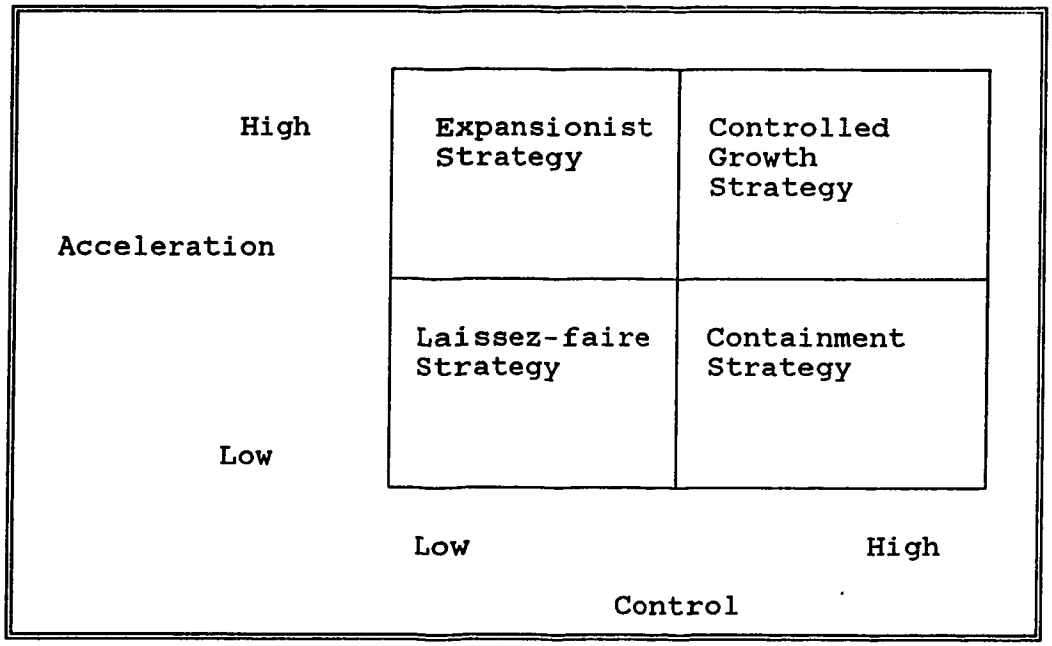

Figure 2.1. Four Strategies for End-User Computing Growth

Organization For End-User Computing

A final aspect of EUC is organizing to support such activity. The alternatives are varied. Davis (1982) identifies several possibilities. An extreme possibility is that an organization may not view EUC as a viable tool for its computing needs and may have an explicit policy against EUC. A second possibility would be that an organization recognizes the utility of EUC but does not provide any support organization nor does it have any stated policies regarding EUC. The third option is similar to the second but with the organization having some stated policy

supporting EUC. The other options involve putting formal support organizations in place. One form of support is to assign analysts to the user areas to assist in EUC activities and another is the use of an information center with programmers or assistants.

The support provided for end-users is varied. In terms of the hardware options available, Davis (1982) identifies four. These are external time sharing, internal time sharing based on a centralized mainframe, stand alone micro computers, and networked microcomputers. In terms of the software, Davis (1982) identifies several possibilities. The variety of software used include planning languages such as LOTUS 1-2-3 and other DSS generators, procedural languages such as BASIC and APL, very high level languages (VHLL) such as FOCUS and RAMIS, statistical analysis packages such as SAS and SPSS, and data base management systems such as dBASE II and dBase III.

Summary Of EUC literature

The concept of users developing their own applications evolved due to a disparity in the demand for and the supply of information. This disparity was primarily due to a combination of problems with traditional development methodologies, the availability of easy to use technology, increased complexity and volatility of the modern business environment, increased awareness on the part of better educated end-users, and limited resources of the IS department. Whereas EUC is a viable alternative to

traditional development methodologies, it is not a substitute for the these methodologies. EUC is only appropriate for less structured applications that are uncommon and have a small scope of impact. A majority of the applications developed are personal in nature and involve report generation and inquiry. The applications are developed by a wide variety of end-users ranging from those with sophisticated technical skills to those who rely on others for such skills.

Although providing these end-users with capabilities to develop their own applications is potentially beneficial, the consequences of this could also be hazardous. These potential risks relate to lack of proper training in applications development procedures, data management techniques, security measures, etc. However, the potential risks of EUC may be reduced through proper planning and appropriate control mechanisms.

While EUC has resolved several problems and issues of traditional applications development, other issues remain unaddressed. These relate to the basic technological infrastructure, data management, support, and evaluation of EUC activities. Several strategies have been suggested to manage end-user computing ranging from very cautious ones to those that seek to rapidly diffuse EUC technology throughout the organization. These strategies call for formalization of EUC activities within organizations in order to coordinate and control the growth of EUC. Several

organizational structures exist for formally supporting EUC including the use of an information center.

The Information Center

Faced with the growing significance and impact of end-user computing, organizations sought methods for formally embracing EUC, while at the same time acquiring the ability to monitor this phenomenon. One alternative for doing so was to establish an information center.

Definition And Premise

An information center is a formal way by which an organization provides support for its end-user computing activities. Hammond (1982), in his description of the "original" information center at IBM Canada defines an IC as "a portion of the IS department dedicated to support the users in activities such as report generation and modification, data manipulation and analysis, spontaneous inquiries, etc." He further states the premise on which the IC is based. This premise is that "if provided with proper education, technical support, usable tools, data availability, and convenient access to the system, users may directly and rapidly satisfy a portion of their business area requirements that depend on an IS environment" (Hammond, 1982).

The term information center connotes different images to different persons. For instance, Torgler (1983) considers an information center to be "neither a process nor a product, but a strategy a DP manager can use to support

and manage a company's burgeoning information needs." The AMA Report on information centers (The American Management Report, 1985) determined that over 46% of the respondents to their questionnaire had an ICs that fit the description of "discrete functional units charged with assisting end-users in computer applications." The report provides a more comprehensive definition of an IC as a "functional unit, staffed with technological trainers and data processing professionals, and charged with assisting end-users in computer applications. While such a unit may go by various names, an emerging consensus calls it the Information Center" (The American Management Association, 1985).

Finally, Munro and Huff (1985) define an information center as "a physical location within an organization within which is housed computing facilities plus staff professionals whose job is to assist end users in themselves applying the technology to solve their immediate information problems."

Functions And Services

An information center has two basic functions: (1) to facilitate end-user computing; and (2) to coordinate end-user computing (Leitheiser & Wetherbe, 1985). These functions are accomplished by providing specific services including end-user training, technical support, software evaluation, and data management. Sumner (1985a; 1985b) identifies several other services provided by an IC. These include (1) consulting, (2) hotline, (3) debugging

assistance, (4) newsletter, (5) information clearinghouse (6) prototyping, (7) developing data dictionaries for user developed applications, and (8) documentation support for user developed applications.

The nature of the services provided by information centers is not static. Nor do all information centers provide all of these possible services. Rather, the services an IC provides depends on several factors which are (The American Management Association, 1985):

1. The corporate environment - the company's size, business function, and degree of centralization.
2. The technological environment - the style of information technology the company had in place before an information center was created.
3. The planning environment - the process of research and consultation that led to an information center.
4. The training environment - the method and manner of instruction in computer usage offered to non data processing professionals

Furthermore, the nature of the services provided by an IC change over time. Sprague and Mcnurlin identify the changing nature of IC services provided, as is depicted in Table 2.1

Summary Of Information Center Literature

An information center is a formal means for supporting EUC with two underlying functions (1) facilitating and (2) controlling EUC activities. Although the term information

Table 2.1

The Changing Nature of IC Services

Services offered by IBM Canada's "original" IC (1974)
Training
user assistance
usage planning
product evaluation
consulting
security
marketing
Typical IC services offered in 1983
computer literacy education
training on use of products
PC support
consulting
help center with hotline
product evaluation
hardware and software standards
support for "standard" products
marketing of services
Additional services offered by ICs in 1985
creation of computer and communication interface software
data administration
installing and testing new software releases
maintenance of PC equipment
project management of user developed systems
quality assurance of user written sw
prototype development by IC staff

Note: From Sprague, R. H. and McNurlin, B. C. Information systems management in practice. New Jersey: Prentice-Hall pp. 313 - 319.

center has been used to mean different things, an emerging concensus views it as a discrete functional unit staffed with trainers, educators, product specialists, and other personnel needed to fulfill the goals of the IC. The underlying premise behind the "original" IBM Canada IC was that if provided with the means to do so, users will themselves develop applications and thereby satisfy a portion of their information needs.

Services offered by ICs include training, technical support, software evaluation, and data management. The specific nature of the services offered by any one IC depends on several factors namely, the corporate environment, the technological environment, the planning environment, and the training environment.

The Stage Hypotheses

All systems, natural as well as man-made, exhibit the tendency to grow over time, in the process changing some or all of their objectives, functions, activities, etc. This tendency is typically characterized as the stage hypotheses. Haire (1959) studied the growth of biological systems and found that the processes of growth is grounded in their organization, their environment, and in the interdependence of shape, size, and function. With regard to social systems, Coffey, Athos and Renolds (1975) identify three stages of growth. These stages are formation and initial development; stabilization and dynamic equilibrium; and change or decline and dissolution.

The evolution of organizations has been concern of several studies. For instance, Lippitt and Schmidt (1967) characterize the stages of organizational growth in terms of birth, youth and maturity. This is followed by decline if certain critical concerns and key issues are ignored. Another study suggests the existence of five stages of growth for organizations (Greiner, 1972). Each stage contains a relatively calm period which is ended by a management crisis marked by a "revolution." The five stages suggested by Greiner are:

1. growth through creativity followed by crisis of leadership.
2. growth through direction followed by crisis of direction.
3. growth through delegation followed by crisis of control.
4. growth through coordination followed by crisis of red tape.
5. growth through collaboration followed by unknown crisis.

Greiner (1972) argues that the key dimensions of organizational growth are age and size. The age of the organization is significant because "problems and decisions are rooted in time." The size of an organization are directly related to the problems of coordination and communication. Gremillion (1984) noted that several writers associate changes in organizational structure that accompany

increases in size to a need to deal with increasing complexity. As problems with communications and integration increase, organizations seek out innovative mechanisms to overcome them. One such innovation is an information system (Galbraith, 1973).

With regard to information centers, the age and size of the IC have been identified as key variables in several studies. (Sumner, 1985a; Sumner, 1985b; Leitheiser & Wetherbe, 1985; Carr, 1984). Karten (1985) suggests that the size of the IC as determined be the IC staff size is a key variable in the success or failure of an information center. In addition, the nature of the hardware configuration supported by an information center has been the concern of several studies. (Carr, 1984; Benson, 1983; Davis, 1985)

Stage Hypotheses For Information Systems

Nolan and Gibson are credited with applying the concept of a stage hypotheses to information systems. In their study, Gibson and Nolan (1974) determined that EDP budgets, when plotted over time, took the shape of a S-shaped curve with three distinct turning points. These turning points correspond to major changes or events in the evolution of information systems and lead to four stages of growth. These stages may be characterized by changes in the nature of applications, level of specialization of personnel, and the management practices in use. The four stages of growth were labeled initiation, expansion or contagion,

formalization or control, and maturity or integration and were described as follows.

The initiation stage is characterized by cost reduction accounting applications, specialization for computer efficiency, and lax management practices. The expansion stage is marked by a proliferation of applications into functional areas. The DP personnel specialize to develop a variety of applications and management is sales oriented. This stage is characterized by contagious growth resulting in a tremendous growth in the DP budget. The next stage is a reaction to this growth in the DP budget and involves a moratorium on new applications with an emphasis on control. The maturity stage involves integration of applications utilizing data base technology, refining the control mechanisms imposed in the previous stage, and resource-oriented planning.

Nolan later expanded the four stage hypotheses to include six stages (Nolan, 1979). Essentially, the third stage of the four-stage model was broken up into three separate stages. The six stages of EDP growth are initiation, contagion, control, integration, data administration, and maturity. Nolan used the following benchmarks to identify these stages:

1. the rate of DP expenditures
2. the technological configuration
3. the applications portfolio
4. DP planning and control

5. DP organization

6. user awareness (Nolan, 1979).

Taggart and Sibley (1979) studied the technical orientation and user involvement during the various stages of growth. They drew three conclusions from their study. First, they found that technical orientation dominates during the early stages of growth and continues to grow in importance. Second, user involvement is almost non existent during the early stages but increases during the later stages. Finally, the technical emphasis always overshadows user involvement, regardless of the stage of growth. More recently, McFarlan and Mckinney (1983) use the concept of stages of evolution in describing the phases of technological assimilation in organizations. They contend that organizations proceed with diffusing technology in four stages. These stages are identification and initial investment, experimentation and learning, management control, and widespread technology transfer. The stage theory has been applied to office automation systems by Zizman (1978) and Meyer (1983) and Hirschheim (1985). Theses studies have essentially adapted Nolan's four-stage model with appropriate modifications. Zizman (1978) focuses on the differences between automation and mechanization as a key issue is the stages of growth for office automation. Meyer (1983) identifies predictors of growth in office automation as being the organizational environment, the existence of a formal charter, the skills and motivation of

the personnel involved, and the tactics used for implementing office automation technologies. Hirschheim (1985) adds a new dimension to the stage theory in addition to identifying five stages of office automation growth as opposed to the four stage model. The new dimension is based on the fact that not all organizations will approach the introduction of technology with the same "frame of mind." He identifies three types of organizational approaches to information technology. The procrastinator, the innovator, and the learner. The first kind of organization is "extremely cautious and conservative" and is basically risk aversive. This type of organization will wait for other organizations to experiment rather than be on the leading edge. The innovators on the other hand are willing to take risks and be industry leaders, and the learners fall somewhere in between. Hirschheim argues that depending on the approach an organization takes, the shape of the growth curve will be different. The procrastinator will experience a low level of growth which will also be slow. The innovator will experience the steepest and greatest growth while the learner will experience the smoothest growth.

Finally, the stage theory has been applied to end-user computing which is also derived from the S-shaped pattern of system growth expounded by Nolan (Sprague & Mcnurlin, 1986).

The Validity Of The Stage Hypotheses

In addition to the application of the stage theory to various forms of information systems, several studies have

attempted to find empirical support for it (Drury, 1983; Lucas & Sutton, 1977; Benbasat, Dexter, & Mantha, 1980; King & Kramer, 1983). However, none of theses attempts at validation have been entirely successful. Drury, for instance, found that while benchmark variables used to identify the stages of growth by Nolan changed across the stages, the rates of change were different. Also, Drury determined that the stages of growth could not be validated by the entire set of benchmark variables due to interaction among them.

Despite unsuccessful validation attempts, the stage theory continues to be used, primarily because it has a certain intuitive appeal that makes it attractive. It is the "best known and most widely tested and accepted model for computer and organizational growth and maturity" (Mahmood & Becker, 1985). In addition, Mahmood and Becker, in a comprehensive evaluation of the attempts to validate the stage theory find fault in the methodology used in such attempts. They contend that the validation studies fail to capture the essence of the Nolan's stage model because of measurement problems. For instance, they argue that the validation attempt by Lucas and Sutton (1977) was flawed because the sample consisted of county governments whose budgeting processes is different from business organizations and is therefore not representative.

A Stage Hypotheses For Information Centers

In a recent study of various aspects of information centers, Sumner (1985a; 1985b) concludes that "the evolution of the information center will follow a stage evolution," and refers to Mills' descriptions of a five stage model for IC growth. In the first stage, users satisfy individual data needs by making queries and generating reports. The second stage sees simple applications requiring more complex logic. In the third stage, data sharing between applications is recognized and efforts are made to consolidate data, minimize redundancy, and improve data integrity. The fourth stage involves extending existing applications to other uses involving the use of sophisticated applications software. The IC becomes a development center incorporating more traditional systems development techniques and technologies. In the fifth stage, business systems planning for end-user computing begins to occur and IC analysts are moved into functional areas (Mills, 1983).

This description of the stages of information center growth while accurate is none-the-less restricted and fails to consider certain key elements. The 1985 AMA report on information centers investigated ICs with regard to several elements critical to a comprehensive description of the stages of IC growth. The elements of ICs addressed in the report included (1) the goals of the IC, (2) the nature of the planning processes, (3) the organization, (4) staffing, (5) control procedures, (6) priority criteria, (7) policies,

(8) evaluation (9) training, (10) and the nature of the end-users.

According to The American Management Association (1985), "there appears to be a 'critical mass' of microcomputers that generally triggers the creation of an information center or a similar unit." The basic objective at start-up is to achieve compatibility of hardware and software, changing to the diffusion of end-user technology within the organization. Very little planning is performed at creation. Planning processes are gradually initiated and become well established toward maturity. The ICs are centralized at start up and move toward the user's functional areas with maturity. Initially, control measures are formal and centralized, the responsibility for control being transferred to user functional areas as the IC evolves. Few policies exist, with priorities based on a first-in-first-out rule. As the IC evolves, these policies and priority criteria become well-defined. The information centers are rarely evaluated during their early stages, but with the growth in expenditures in later stages, evaluation becomes a key issue and evaluation procedures are put in place.

The IC staff is small at start up with little or no specialization. Their functions include providing a wide variety of services to the end-users. The end-users, at start up, are highly motivated and place few demands on the IC staff. As the IC becomes more popular, users from

diverse background and levels of expertise seek the services of the IC. This results in a rapid increase in the number, the variety and the level of expertise of the IC staff, followed by an increased level of specialization. During the later stages of growth, the IC staff begins to fill administrative and supervisory capacities. Ultimately, the users demand such specialized services that the ICs are decentralized and moved to the user functional areas.

Summary Of Literature On The Stage Theory

The stage theory, describing the evolution and growth of systems, has been applied to different kinds of systems including biological systems, social systems, organizations, and information systems. Each stage is characterized by several key variables and has different goals and functions. Gibson and Nolan (1974) are credited with arriving at a stage hypotheses for information systems. Several studies have attempted to validate this stage hypotheses but with little success. However, due to the intuitively appealing nature of the stage theory, it continues to be applied in a variety of settings. For instance, stage theories have been investigated for office automation systems, end-user computing, and for the assimilation of technology within organizations.

Little research exists with regard to a stage hypotheses for information centers. However, there is evidence that a stage theory for inforation centers is appropriate. For instance, the findings of The American

Management Association (1985) suggests that information centers evolve through various stages based on changes in several key variables. These key variables include the goals, the planning processess, the organization, staffing, control procedures, policies, evaluation, training, etc. The only formal attempt at arriving at a stage hypotheses for information centers fails to consider several of these key variables (Miles, 1985).

Critical Success Factors

In order to operate an organizational unit, the person charged with this responsibility is in need of certain information. Several approaches have been advocated for identifying management's information needs. One method is the critical success factors method popularized in the field of information systems by Rockart (1979). Critical success factors (CSF) are :

> the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization. They are the few key areas where 'things must go right' for the business to flourish" (Rockart, 1979).

CSFs are the critical areas of the business that management must constantly monitor to ensure that results obtained are satisfactory. In order for management to properly monitor these areas and ensure results they need information on the performance in these areas. This information constitutes

the key information for management. Therefore, identifying these few areas leads to identifying the key information needs of management. CSFs can be identified from several sources, and Rockart suggests four such sources: (1) the nature of the industry; (2) the organization; (3) the organization's environment; and (4) temporal organizational factors (Rockart, 1979).

The use of CSFs to identify managerial information needs has several advantages and disadvantages. Boynton and Zmud (1984) identify several of each. On the positive side, they note the CSF approach (1) provides effective support to the planning process, (2) develops insights into information services that can impact a firm's competitive position, and (3) the approach is received enthusiastically by senior management who identify easily with the thrust of the CSF concept. On the negative side, they note that (1) the farther removed managers are from senior positions the more difficult it is for them to identify meaningful organizational CSFs, (2) managers not involved in strategic and tactical planning can experience difficulty dealing with the conceptual nature of CSFs, and (3) it is difficult for certain managers to ascertain their information needs using only CSFs.

Alternatives To The CSF approach

Several alternatives exist for identifying the information needs of management. These include:

1. the by-product technique

2. the null approach
3. the key indicator system
4. the total study process
5. the application transfer team (ATT) method
6. business systems planning
7. executive applications survey (EAS)
8. requirements, needs and priorities (RNP) method.

Rockart (1979) evaluated the first four of these methods while Batiste and Jung (1985) evaluate the next three and suggest the RNP method. The by-product technique does not directly identify information needs. Rather, the information provided to management is a by-product of other systems, such as a transactions processing system. This information takes the form of reports and constitutes only one source of management information. The null approach takes the position that the activities of top executives are constantly changing and therefore, it is not possible to determine their information needs. The information needed is dynamically generated, most often subjective, informal, and delivered by word of mouth. Although this view of management information is appropriate, it nonetheless ignores the fact that top management does require regularly supplied information.

The third method of determining information needs evaluated by Rockart is the key indicator system method. This method proposes to (1) identify key indicators of the health of the organization and collect information on each

indicator, (2) provide information on these indicators to management on an "exception reporting basis," and (3) deliver the information in an "attractive form" using color display, graphics, etc. This approach sounds very similar to the CSF approach, but it is different in one respect. In Rockart's evaluation the key indicator system focuses primarily on "core financial data," failing to consider other aspects of management's information needs, and therein lies its drawback.

The last technique evaluated by Rockart is the total study process which involves the following:

1. query a widespread sample of managers to (a) understand the business, (b) determine information needed to manage the business, and (c) understand the capabilities of the existing information system.
2. identify gaps between existing systems and those needed. This gap constitutes management's information needs.

The total study process, while simple in theory, is a extensive process and generally very expensive. Batiste and Jung (1984) concur with Rockart on this aspect of the total study process when they evaluated business systems planning (BSP), a subset of the total study process. Further, Batiste and Jung conclude that many of the benefits of BSP are already in place in organizations. In addition to BSP, Batiste and Jung evaluated two others - the applications transfer team (ATT) and executive applications survey (EAS)

- and determined that all three methodologies suffer from a common drawback. The key elements in these methods is manpower commitment required, particularly that of the chief executive. In their opinion, obtaining this commitment is very difficult.

Specifically, the ATT approach is useful only after initial requirements are know. The objective is to firm up specific needs and cost/benefit relationships. The EAS is geared to matching requirements definition with the characteristics of existing applications software. Faced with the limitations of these approaches, Batiste and Jung propose the requirements, needs, and priorities (RNP) method for identifying management's information needs. The RNP method is a combination of BSP, ATT, CSF approach, while minimizing the time and effort required. RNP involves "understanding the processes present in operating a business, and the factors that are critical for success in those processes, and the obstacles that prohibit or impede the attainment of success" (Batiste & Jung, 1984). The specific steps in RNP include an executive session, task force analysis, and executive presentation. The function of the executive session is to "gain perspective on the business problem and to define the detail and scope of the study." The task force analysis "resolves the problem issues and develops a set of recommendations for further action." The findings and recommendations of the task force

analysis is presented to the executives during the executive presentation.

The Use Of The CSF Approach

Although there are several methods available for identifying the information needs of management, each with its advantages and disadvantages, the CSF approach is used extensively. Boynton and Zmud (1980) conclude that while the CSF approach is most useful for information resource planning, it remains useful for determining information requirements of high level management. With regard to specific uses of the CSF approach, Munro and Wheeler (1980) used this method for determining the information requirements for management control. Meadors and Mezger (1984) included CSF identification as one of the steps in the process of selecting an end-user programming language. (The CSF approach was utilized to prioratize the list of needed features of an end-user language.) Shank, Boynton and Zmud (1985) use the CSF approach in identifying corporate information needs and subsequently in developing a corporate information systems plan.

CSFs For Information Centers

With regard to the critical success factors applicable to information centers, the literature reveals a substantial list. Leitheiser and Wetherbe (1985), through a telephone survey of twenty seven (twenty five were usable) information center managers, investigated IC successes, failures and critical success factors. The most frequently mentioned

CSFs were the timeliness of the services provided (36%) and the competence of the IC staff (36%). Included in the list of top 10 CSFs were:

1. selecting and supporting the "right" software packages (28%)
2. end-user training (24%)
3. monitoring and coordinating end-user developments (20%)
4. obtaining top management support (20%)
5. responsiveness to user requests (16%)
6. promotion of IC services (12%)
7. establishing good communications with user departments (12%)
8. the cost effectiveness of the solutions provided (12%).

In another study based on case studies, Sumner (1985a; 1985b) identified several CSFs applicable to information centers. The CSFs mentioned by at least two of the thirteen information center managers in her sample were:

1. responsiveness to user needs
2. top management support
3. quality staff
4. user satisfaction
5. effective training
6. adequate resources
7. market for services.

Brancheau, Vogel and Wetherbe (1985) investigated information centers from the viewpoint of the end-user. Their findings included a list of CSF which the end-users were asked to identify by putting themselves in the shoes of their IC manager. The most frequently cited CSFs were IC staff related. Specifically, the CSFs identified were:

1. competence in technical skills
2. business understanding
3. service orientation
4. communication skills
5. knowledge of current developments
6. the quality of the people.
7. The availability and responsiveness of IC services
8. provision of adequate and appropriate training
9. appropriate equipment and software
10. sufficient research into new products
11. support by management.

Finally, evidence of other CSFs applicable for information centers exists in the form of anecdotal reports in trade journals. Among these were

1. defining the IC mission (Marks, 1985)
2. promotion of IC services
3. establishing career paths for IC staff
4. establishing priority criteria for work
5. establishing chargeback criterion (Halladay, 1985).

Table 2.2 is an inclusive list of the CSFs pertaining to information centers.

Table 2.2

CSFs Applicable to Information Centers

1. timeliness of service
2. competent staff
3. support right software packages
4. end-user training
5. monitor and coordinate end user developments
6. top management support
7. response to requests
8. promotion of IC services
9. communication with users
10. cost effective solutions
11. atmosphere for users
12. system performance
13. IC staff's understanding of users' business and problems
14. organizational acceptance of IC
15. manage end user expectations
16. provide services to distributed sites
17. define IC mission
18. users' understanding of data processing
19. reliability of applications developed
20. end user commitment to the IC concept
21. establishing career paths for IC staff
22. establishing priority criteria for work
23. establishing a chargeback criterion

Summary Of CSF Literature

Several methods have been advocated for identifying management's information needs. Among these are the by-product technique, the null approach, the key indicator system, the total study process, the application transfer team method, business systems planning, executive applications survey, requirements, needs, and priorities

method, and the critical success factor method. Each has its advantages and disadvantages and each is appropriate under certain conditions. The critical success factor (CSF) approach to idenyifying information needs was popularized in the field of information systems by by Rockart (1979). CSFs are those few areas of business where favorable results will ensure success.

The CSF approach has been used extensively over the other methods. For instance, Munro and Wheeler (1980) determined the information requirements for management control using the CSF approach, Meadors and Mezger (1984) used the CSF approach to prioratze the list of needed features of an end-user language, Shank, Boynton, and Zmud (1985) identified corporate information needs in developing a corporate information systems plan. Several studies have attempted to identify CSFs applicable to information centers. These studies have collectively identified a total of twenty three CSFs relevant to different types of ICs.

CHAPTER THREE

THE RESEARCH METHODOLOGY

This chapter describes how the research was conducted and includes the design and pre-testing of the questionnaire, the sample selection, and the analytical techniques used. The basic approach to this research was that of a field study. Van Horn (1973) defines a field study as:

> the study of one or more organizations within an experimental design framework, but without experimental control. Large amounts of data are collected for use in attempts to isolate the effects of independent variables.

Since the basic objectives of this study are to identify the effects of independent variables - the stages of growth and the parameters of age, size and hardware options - a field study was deemed appropriate. Data was collected by means of a questionnaire administered to managers of information centers (see appendix C1).

The Questionnaire

The original questionnaire consisted of four parts. The first defined the terms used in the questionnaire. Part two was concerned with the stages of growth, part three with

the parameters of interest, and part four with the critical success factors.

In order to ensure that the terms used in the questionnaire were understood to mean the same by all the respondents, three key terms were defined at the very beginning of the questionnaire. These terms were (1) end-user computing,(2) information center, and (3) critical success factors.

In order to determine the effect of the stages of IC growth on the critical success factors, it was first necessary to ascertain which stage of growth each information center was in. A description of each of the stages was provided and the managers of ICs were asked to identify the stage that most closely represented the present stage of their IC. In addition they were asked if their ICs had progressed through the stages as described, if their IC was presently in stage II or beyond.

The descriptions of the four stages of IC growth were based on the behavior of certain benchmark variables over time. This approach is similar to the one used by Nolan (1979) when he proposed a stage hypothesis for information systems. The benchmark variables for information centers and their behavior over time were identified from the literature (Mills, 1983; The American Management Association, 1985). These benchmark variables are:

1. goals of the IC
2. planning procedures

3. organization
4. staffing
5. control mechanisms
6. priority criteria
7. policies
8. evaluation methods
9. training
10. nature of the users

Changes in these benchmark variables were used to identify the four stages of IC growth. The behavior of these variables across the four stages is described in tables 3.1 - 3.4.

The next part of the questionnaire addressed the the age of the IC, the size of the IC both in terms of the number of the full time equivalent staff and in terms of the number of users, and the hardware option in effect. These parameters were used to classify information centers into different groups.

Next the IC managers were provided a list of critical success factors identified by prior studies as being elevant to information centers. The managers were asked to indicate on a seven-point Likert scale the importance of each of the CSFs to their IC. This methodology was adopted from one used by Leitheiser and Wetherbe (1985). In addition, the managers were asked to indicate to what extent

Table 3.1

Benchmark Variables During Stage I(Initiation) Of IC growth.

Benchmark Variables	Descriptions
goals of the IC	Compatibility of hardware and software
planning procedures	None
organization	Centralized
staffing	Small; no specialization
control mechanisms	IC control
priority criteria	First-in-first-out
policies	Few; informal
evaluation methods	None
training	Diverse methods; limited hardware and software; limited scope of use of hardware and software
nature of the users	Self motivated; low variety; from functional areas; place limited demands on IC

Table 3.2

Benchmark Variables During Stage II (Growth) Of IC growth.

Benchmark Variables	Descriptions
goals of the IC	Diffusion of technology
planning procedures	Initiated
organization	Centralized
staffing	Rapid increase; limited specialization; increased skill variety and level of expertise
control mechanisms	IC control
priority criteria	Broad guidelines
policies	Loosely organized
evaluation methods	Initiated
training	Selected methods; increase in number of hardware and software; increase in scope of use of hardware and software
nature of the users	Diverse backgrounds; increased dependence on IC

Table 3.3

Benchmark Variables During Stage III (Formalization) Of IC Growth.

Benchmark Variables	Descriptions
goals of the IC	Control growth
planning procedures	Well developed
organization	Beginning to decentralize
staffing	Increasing specialization; Administrative and supervisory staff included; need for training for IC staff
control mechanisms	IC control with increased input from user departments
priority criteria	Well defined
policies	Well defined
evaluation methods	Well defined
training	Specialized; computer based
nature of the users	Increased diversity; staff areas such as research and development and public relations

Table 3.4

Benchmark Variables During Stage IV (Maturity) Of IC growth.

Benchmark Variables	Descriptions
goals of the IC	Coordination
planning procedures	Well defined; IC planning part of corporate planning;
organization	Decentralized
staffing	Specialized to meet needs of user departments
control mechanisms	User control; refine controls implemented during formalization
priority criteria	Well developed
policies	Well developed
evaluation methods	Well developed
training	Highly specialized; computer based
nature of the users	Specific departments

they considered their IC was succeeding in fulfilling its functions.

Pre-testing The Questionnaire

Once the initial questionnaire was constructed, it was administered to 11 IC managers as a pre-test. The purpose of this pre-test was to (1) evaluate the accuracy and completeness of the descriptions of the stages of IC growth, (2) evaluate the clarity and completeness of the list of CSFs, and (3) evaluate the clarity of the questions. The sample of 11 IC managers was selected from two sources: (1) the list of IC managers used in a prior study (Carr, 1984); and (2) members of the UGA MIS Industry Advisory Board. The IC managers were contacted by telephone and their participation in the study solicited. Six of the 11 managers in the pre-test sample responded and their comments resulted in the following changes to the original questionnaire.

The definition of the term information center was modified to clarify that an information center was a physical facility for the purposes of this research. This was to avoid confusion with other definitions which treat ICs as a way of thinking or a strategy, rather than a physical facility.

In the description of the first stage of IC growth, the primary cause for the creation of ICs was stated as the need to coordinate EUC activities. The pre-test suggested that ICs are also created to introduce the concept of EUC in an

organization in light of perceived benefits. This was incorporated into the descriptions of the stages of IC growth. Two questions regarding the stages of IC growth were added. One question asked the managers to what extent they agreed with the descriptions of the four stages of IC growth. This was to serve as a further measure of validity of the descriptions. The other question asked for the number of months the ICs were in each stage. This was to estimate a time frame for a stage hypotheses for information centers.

To the parameters of interest, the only change was the addition of two questions, one seeking the size of the IC budget and the other the size of the organization's MIS budget. These were added to determine whether the growth pattern for ICs followed the S-curve of systems growth identified by Nolan and Gibson (1974).

The pre-test also suggested several changes to the list of CSFs in order to increase the clarity of the meaning of some CSFs. Wording changes were incorporated into the new questionnaire. In addition, three CSFs not included in the original questionnaire were identified and included in the new questionnaire. Finally, one section permitting the respondents to offer comments and suggestions was added. Specifically, the IC managers were asked to identify the three most critical problem or issues they face. They were also asked to project the future role of the information

center with regard to such aspects as the services provided, and the location within the organization.

The Sample

Once the pre-testing of the questionnaire was completed and appropriate changes incorporated, the questionnaire was mailed to 1,450 managers of information centers. The sample for the full-scale study was selected from those IC managers subscribing to The Information Center Magazine. The use of this subscription list as the source of potential participants was considered appropriate for several reasons. Given that the magazine is geared toward the needs of IC managers and users, and that the list was maintained by job function, the subscription list was considered an excellent source of participants for the study. Second, the list of over thirty thousand IC managers covered a wide geographic area and a large distribution of industries.

With 26 dependent variables (the CSFs) and a requirement of 10 observations per variable, the total number of observations needed for statistical analysis was 260. Anticipating a response rate between 20% and 30%, the number of questionnaires to be administered was calculated to be between 870 and 1300. Finally, a minimum of 5,000 names of IC managers had to be acquired, due to the policies of The Information Center Magazine. These 5,000 names were randomly selected from a total of over 30,000. Every third name from the list of 5,000 was used to obtain the 1,450 IC managers to whom the questionnaire was sent. Only 1,450

were sent the questionnaires as a balance between need and cost limitations.

Data Analysis

The analysis of the gathered data was performed in three parts. The first part entailed descriptive statistics on the different variables including frequency distributions, mean values, and variances for the appropriate variables. The second step involved a factor analysis of the CSFs in order to identify composite CSFs. These composite CSFs were then used in testing the two hypotheses in the third step.

In order to test the hypothesis that the significance of the CSFs for ICs differs by the stage of growth through which the IC is progressing, a MANOVA procedure was used. Mmultiple comparisons of the significance of the composite CSFs between the four stages were employed to identify the nature of the difference. In order to test the hypothesis that the significance of the CSFs for ICs differs by the age, size, and the hardware option supported, the ICs were first classified into groups representing different ages and sizes. The classification was based on natural groups suggested by the data. Aanother MANOVA procedure was used to test for overall differences in CSFs across the various groups. Multiple comparisons of the significance of the composite CSFs between the various groups were employed to identify the nature of the differences.

CHAPTER FOUR

THE RESULTS

This chapter describes the results of the data analysis and is divided into six sections. In the first section, the grouping of the ICs based on age, size, and hardware option is explained. The second section addresses the univariate statistics for the various independent variables. The third section describes the univariate statistics for the dependent variables - the CSFs. The fourth section examines the underlying structure of the CSFs as determined through a factor analysis of the 26 CSFs. The fifth section tests the hypothesis regarding the stages of growth and the last section tests the hypothesis regarding the parameters of age, size, and the hardware option in use. The statistical analysis package used was the Statistical Analysis System (SAS). The discussion of the findings is deferred to the next chapter.

Grouping Of The ICs

The variables of age, staff size, and the number of users were continuous in nature. The ICs were grouped into categories based on natural break points suggested by an examination of the data. Cumulative frequency distributions

were used to identify these break points. The values of the variables associated with the two largest jumps in the cumulative distributions were used to divide the ICs into the various categories. Such a methodology was deemed appropriate given the lack of precedence for categorizing ICs.

With regard to age, the ICs were divided into three age groups; ICs that were 23 months old or less; ICs that were between 23 and 35 months old; and ICs 35 months old or over. These three groups were termed young, moderately old, and old ICs.

With regard to staff size, the ICs were divided into three staff groups: ICs with two or fewer full time equivalent staff; ICs with between two and 3.5 full time equivalent staff members; and ICs having 3.5 or more full time equivalent staff members. These three groups were named ICs with small, medium, and large staff size.

The user groups consisted of ICs with 175 or less users, between 175 and 450 users, and 450 or more users. The resulting three groups were termed ICs with small, medium, and large number of users.

Univariate Statistics - Independent Variable

Overall means were computed for the variables age, staff size, number of users, IC budget, MIS budget, number of months in each of the stages of growth, the respondents evaluation of the accuracy of the descriptions of the four stages of growth, and the significance of the 26 CSFs to the

ICs. In addition, frequency distributions were generated for the stages of growth, whether or not the ICs followed the stages of evolution suggested by the descriptions, the respondents' evaluations of the descriptions of the four stages of evolution, and the significance of the 26 CSFs. Finally, means and frequency distributions were obtained for the appropriate variables broken down by the independent variables of the stage of evolution, age group, staff group, and user group.

The Stages Of IC Growth

Of the 311 respondents, 43 (13.9%) classified themselves as being in stage I (initiation) of the four stages of evolution. Another 112 (36.2%) indicated that they were in stage II (expansion) . One hundred and twenty eight (41.4%) were in stage III (expansion) and 26 (8.4%) were in stage IV (maturity). Of those who were past the initialization stage, only 17 (6.4%) indicated that they had not followed the stages of evolution.

On an average, those ICs presently in stage II were in stage I for 12.0 months. Those ICs in stage III were in stage I for 10.8 months, and in stage II for 15.8 months. Finally, those ICs in stage IV spent 10.5 months in stage I, 13.2 months in stage II, and 12.3 months in stage III.

The respondents were asked to indicate on a seven point Likert scale their evaluation of the accuracy of the descriptions of the four stages. The frequency distributions of the evaluation of the descriptions are

Table 4.1

Evaluation Of The Accuracy Of The Descriptions Of The Four Stages Of IC Growth

	Strongly Disagree With Descriptions						Strongly Agree With Descriptions
STAGE I	1	2	3	4	5	6	7
Frequency	4	16	18	16	59	105	67
Percent	1.4	5.6	6.3	5.6	20.7	36.8	23.5

Mean = 5.4; standard deviation = 1.47; N = 285

STAGE II	1	2	3	4	5	6	7
Frequency	3	13	11	29	58	85	41
Percent	1.3	5.4	4.6	12.1	24.2	35.4	17.1

Mean = 5.3; Standard deviation = 1.40; N = 240

STAGE III	1	2	3	4	5	6	7
Frequency	1	3	12	19	31	52	21
Percent	0.7	2.2	8.6	13.7	22.3	37.4	15.1

Mean = 5.3; Standard deviation = 1.31; N = 139

STAGE IV	1	2	3	4	5	6	7
Frequency	1	1	1	7	6	2	4
Percent	4.5	4.5	4.5	31.8	27.3	9.1	18.2

Mean = 4.7 Standard deviation = 1.58; N = 22

reproduced in Table 4.1. On an average, the description of stage I received a rating of 5.4, stage II received 5.3, stage III 5.3, and stage four 4.7.

The age of the ICs

The age of the youngest IC was one month and the oldest, 76 months. The mean age of the ICs was 29.5 months, with a standard deviation of 16.4 and a median of 26.5 months. One hundred and thirteen (35.4%) of the ICs fell in the category of young ICs, 92 (28.5%) in the category of moderately old, and 104 (36.2) in the category of old ICs. The descriptive statistics for the age of the ICs are summarized in Table 4.2.

The Size Of The ICs

The smallest IC had no full time staff and the largest had 50. The ICs had, on an average, 5.8 full time equivalent staff, with a standard deviation of 6.1 and a median of 3.8. Seventy eight (25.2%) were classified as small, 54 (15.5%) as medium, and 177 (57.3%) as large.

The smallest IC had 4 users and the largest had 8,000 users. The average size was 615.9 with a standard deviation of 997.1 and a median of 254.3. One hundred and seventeen (37.9%) fell in the group of small ICs, 80 (25.9%) in the medium group, and 112 (36.3%) in the large group. The descriptive statistics for the size of the ICs are produced in Table 4.2.

Table 4.2

Descriptive Statistics For Age, Size And The Budgets

Variable	Mean	Median	Std Dev	Max	Min
Age (months)	29.5	26.5	16.4	76	1
Staff size	5.8	3.8	6.1	50	0
User size	615.9	254.3	977.1	8000	4
IC budget ('000)	656	315	1,051	8,000	2
MIS budget ('000)	13,852	4,693	27,046	250,000	100

The Hardware Option Supported

Of the 311 respondents, 174 (55.9%) supported both mainframes as well as microcomputers, 40 (12.9%) supported only mainframes, and the remaining 97 (31.2%) supported only microcomputers.

The Budgets

Eighty eight (27.9%) of the respondents did not indicate their IC budget. These included ICs without a separate budget as well those ICs whose managers were reluctant to reveal this information. Of those 222 who provided the information, the size of the smallest budget was $2,000 and the largest $8,000,000, with an average of $656,121 and a standard deviation of $1,051,057.

In regard to the question about the organizations MIS budget, 109 (35.4%) did not respond. Of those 199

responding, the smallest MIS budget indicated was $100,000 and the largest $250,000,000 with an average of $13,852,020 and a standard deviation of $27,046,126.

One hundred and eighty one reported both their IC budget and their MIS budget. On an average, the IC budget was 12.9% of the MIS budget with a standard deviation of 19.9. The descriptive statistics for the budgets are summarized in Table 4.2.

Stages vs. Age, Size, And Hardware Option

Table 4.3 summarizes the distribution of the ICs, grouped by the stages of growth and age, number of users, staff size, and the hardware option supported. Chi-square tests were conducted to test for relationships among these variables. The results indicate that there is an association between:

1. stages of IC growth and age ($P < 0.001$)
2. stages of IC growth and number of user ($P < 0.001$)
3. stages of IC growth and staff size ($P < 0.001$)
4. stages of IC growth and the hardware option supported ($P < 0.001$).

A cursory examination of the distributions in Table 4.3 reveal that there appears to be a positive relationship between the stages of IC growth and the age, user, and staff groups. The nature of the relationship between the stages and the hardware option supported was unclear from this brief examination. However, one problem with the data is that a chi-square test requires a minimum of five

observations per cell whereas, several cells in Table 4.3 have less.

Table 4.3

Stage vs. Age, Staff, User, Hardware Option

		Stages of growth			
		I	II	III	IV
Age group	young	39	50	23	1
	mod. old	2	35	48	7
	old	2	27	57	26
User group	small	31	52	32	2
	medium	7	30	35	8
	large	5	30	61	16
Staff group	small	33	33	7	3
	medium	6	22	22	4
	large	4	57	97	19
Hardware option	mainframe	6	16	10	8
	micro	17	45	33	1
	mixed	20	51	85	17

Univariate Statistics - Dependent Variables

The dependent variables in the study were the 26 critical success factors applicable to information centers. The IC managers were asked to indicate, on a seven point Likert scale, the significance of each of the CSFs to their IC. Table 4.4 reproduces the mean ratings for the 26 CSFs and their relative ranks, and appendix D1 contains the frequency distributions of the ratings of the 26 CSFs. On

Table 4.4

Mean Significance Ratings And Relative Ranks Of The 26 CSFs.

Critical Success Factors	S	R
1. competent staff	6.6	1
2. communication with users	6.3	2
3. top management support	6.3	2
4. reliability of applications developed	6.1	4
5. end-user training	5.9	5
6. IC staff's understanding of users' business and problems	5.8	6
7. training for IC staff	5.8	6
8. organizational acceptance of the information center	5.7	8
9. standardized hardware and software	5.6	9
10. liaison function with end-user departments	5.6	9
11. support right software packages	5.5	11
12. cost effective solutions	5.3	12
13. manage end user expectations	5.2	13
14. promotion of IC services	5.1	14
15. atmosphere for users	5.1	14
16. commitment of end-users to the IC concept	5.1	14
17. define IC mission	5.0	17
18. establishing career paths for IC staff	4.9	18
19. priority criteria for work	4.7	19
20. provide services to distributed sites	4.5	20
21. control procedures to ensure standards, policies, etc. are adhered to	4.4	20
22. system performance	4.4	22
23. monitor and coordinate end user applications developments	4.1	23
24. users' understanding of data processing	4.0	24
25. response to applications development requests	3.8	25
26. establishing a chargeback criterion	3.1	26

KEY: S = Significance rating on a seven point scale
R = Relative rank of the 26 CSFs

an average, the three most highly rated CSFs across the four stages of IC growth were:

1. a competent staff (6.6 / 7.0)
2. communication with the users (6.3 / 7.0)
3. top management support (6.3 / 7.0)

These statistics on the CSFs reflect their overall nature, and do not include the effects of the various independent variables. The next step in the analysis was to study the effects of the various independent variables on the significance of the CSFs.

CSFs vs. The Stages Of Growth

Appendix D2 contains the mean ratings for the 26 CSFs for each of the four stages of IC growth. Table 4.5 reproduces the mean ratings of the most important CSFs. The data indicate that the most important CSFs are virtually identical for the four stages of IC growth.

Table 4.5

The Most Important CSFs For The Four Stages Of IC Growth.

Critical Success Factors	Stage of IC growth I	II	III	IV
- competent staff.....	6.4*	6.6*	6.7*	6.6*
- top management support	6.4*	6.2*	6.3*	6.0
- communication with users ...	6.2*	6.3*	6.4*	6.3*
- reliability of services provided	5.7	6.2*	6.1*	6.3*
- end-user training	5.8	6.0	5.9	6.3*

NOTE 1: astrisk indicate the three most important
NOTE 2: more than three astrisk per stage implies a tie

During stage I, a competent staff, top management support, and communication with users were rated as being the three most important factors. The three most important CSFs for stage II were the same, with reliability of services provided tying for third place with top management support. This was true of stage III also. During stage IV a competent staff appeared to be the most important CSFs with communication with users, reliability of services provided, and end-user training all tying for second place.

CSFs vs. Age Groups

Appendix D3 contains the mean ratings for all 26 CSFs for each age group. Table 4.6 reproduces the mean ratings of the most important CSFs along with the overall ratings for these CSFs. The data indicate that the most important CSFs for the three age groups are also virtually identical.

Table 4.6

The Most Important CSFs For The Three Age Groups And The Overall Ratings.

Critical Success Factors	Age groups Y	M-O	O	ALL
1. competent staff.....	6.6*	6.7*	6.7*	6.1
2. top management support....	6.4*	6.1*	6.3*	6.3
3. communication with users .	6.4*	6.4*	6.2*	6.3
4. reliability of services provided	6.0	6.1*	6.1	6.1

NOTE 1: astrisks indicate the three most important
NOTE 2: more than three astrisks per age group implies a tie
NOTE 3: Y = young IC M-O = moderately old IC
O = old IC ALL = overall

With regard to the most important CSFs for the age groups, competent staff, top management support, and communication with the user are the three most important for all age groups. In addition, reliability of services was included for moderately old age groups

CSFs vs. Staff Groups

Appendix D4 contains the mean ratings for all 26 CSFs for each staff group. Table 4.7 reproduces the mean ratings of the most important CSFs.

For the ICs grouped by the size of their staff, the three most important CSFs were the same regardless of the grouping. These were a competent staff, top management support, and communication with the users.

Table 4.7

The Most Important CSFs For The Three Staff Groups And The Overall Ratings.

Critical Success Factors	Staff Size Group			
	S	M	L	ALL
1. competent staff.....	6.5	6.7	6.7	6.1
2. top management support ...	6.3	6.4	6.2	6.3
3. communication with users .	6.3	6.3	6.4	6.3

NOTE : S = small IC
M = medium sized IC
L = large IC
ALL = overall

Table 4.8

The Most Important CSFs For The Three User Groups And The Overall Ratings.

Critical Success Factors	User Group S	M	L	ALL
1. competent staff.....	6.6	6.6	6.7	6.1
2. top management support ...	6.4	6.2	6.2	6.3
3. communication with users .	6.2	6.5	6.4	6.3

NOTE : S = small IC
M = medium sized IC
L = large IC
ALL = overall

CSFs vs. User Groups

Appendix D5 contains the mean ratings for all 26 CSFs for each of the user groups. Tables 4.8 reproduces the mean ratings of the most important CSFs.

The data indicate that a competent staff, top management support, and communication with the users are the most important CSFs for all three user groups.

CSFs vs. The Hardware Option Supported

Appendix D6 contains the mean ratings for all 26 CSFs for each of the hardware option supported. Tables 4.9 reproduces the mean ratings of the most important CSFs.

A competent staff, top management support, and communication with the users were the three most important CSFs regardless of the hardware option supported. In

addition, reliability of services provided was tied for third place for those ICs supporting primarily mainframe.

The Structure Of The CSFs

In order to determine the underlying structure of the critical success factors, a principle components analysis was performed followed by a varimax (orthogonal) rotation.

The Analysis

During the initial investigation for potential factors, the prior communality estimates were set at unities, as is recommended when deriving Principle Component factors

Table 4.9

The Most Important CSFs For The Three Hardware Options And The Overall Ratings.

Critical Success Factors	Hardware Option			
	MA	MI	MX	ALL
1. competent staff.....	6.8*	6.6*	6.7*	6.6*
2. top management support	6.6*	6.4*	6.1*	6.3*
3. communication with users ...	6.3*	6.3*	6.4*	6.3*
4. reliability of applications developed.....	6.3*	6.0	6.0	6.1

NOTE 1: astrisks indicate the three most important
NOTE 2: more than three astrisks per group implies a tie
NOTE 3: MA = predominantly mainframes
MI = predominantly microcomputers
MX = both mainframes and microcomputers
ALL = overall

(Nunnaly, 1967). The minimum eigenvalue for which a factor was to be retained was specified as 1.0. The results of this initial investigation revealed seven potential factors

satisfying the minimum eigenvalue criterion. However, on only six factors did two or more variables load with a loading coefficient of 0.50 or greater. Only one variable loaded on factor seven. Consequently, only six factors were considered significant (Nunnaly, 1967).

Two additional Principle Component procedures were utilized, one limiting the maximum number of factors to six and one limiting the maximum number of factors to five. Table 4.10 lists the CSFs that loaded for each factor when five factors were retained and Table 4.11 reproduces the rotated factor patterns for the five factor solution.

The results of the six factor and five factor analysis are virtually identical. Furthermore, from a conceptual viewpoint, the five factor solution appeared to be more sound. Therefore, the five factor solution was deemed more appropriate and was used in later analyses.

Of the 26 CSFs, 20 loaded on one factor only with a loading of 0.5 or greater, while the other six either loaded on two factors or not at all. The CSFs with a high (>0.40) secondary loadings were:

1. performance of user developed applications
2. clear definition of responsibilities, procedures, policies, etc. for users, IC staff, and the MIS department
3. career paths for IC staff

However, retaining these CSFs with the factor on which they had their primary loadings was conceptually sound. Those

Table 4.10

CSFs Comprising The Five Factors

FACTOR ONE: COMMITMENT TO THE IC CONCEPT	
CSF# 6	Top management support
8	Promote IC services
14	Organizational acceptance of IC concept
20	Commitment of end-users to IC concept
21	Career paths for IC staff
FACTOR TWO: QUALITY OF IC SUPPORT SERVICES	
CSF# 3	Support software packages
4	end-user training
19	reliability of services provided
24	standardized hardware and software
25	training for IC staff
2	a competent staff
FACTOR THREE: FACILITATION OF END-USER COMPUTING	
CSF# 9	Communication with users
10	cost effective solutions
11	atmosphere for users
13	understanding user's business and problems
15	manage end-user expectations
26	liaison function with end-user departments
FACTOR FOUR: ROLE CLARITY	
CSF# 16	provide services to distributed sites
17	clear definition of responsibilities, procedures, policies, etc.
18	user understanding of data processing
22	charge back criterion
23	control procedures to ensure standards, policies, etc are adhered to
FACTOR FIVE: COORDINATION OF END-USER COMPUTING	
CSF# 1	priority criteria for work
5	monitor and coordinate end-user applications development
7	respond to applications development requests
12	performance of user developed applications

Table 4.11

Rotated Factor Loadings For The Five Factor Solution

	CSF#	Factor1	Factor2	Factor3	Factor4	Factor
	1	.04687	.04145	-.13285	.17942	.56762
*	2	.24528	.42288	-.04399	.08197	.03273
	3	.03875	.53976	.14668	-.11246	-.01314
	4	-.00570	.60853	.22357	.04452	-.04717
	5	.06732	.00857	.18645	.05436	.72576
	6	.65871	.01108	-.05701	.15317	.12205
	7	.03269	-.01318	.02427	-.06617	.71334
	8	.58116	.09958	.33035	-.01040	-.10406
	9	.24082	.26052	.55820	-.02650	-.03945
	10	.08241	.05486	.59252	.31647	.06128
	11	.14423	.14356	.61906	.18837	-.13711
**	12	.10733	.12326	.41347	.04201	.50854
	13	.01367	.17483	.61097	.04318	.29667
	14	.77047	.11869	.20017	.01319	.03593
*	15	.29852	.03187	.40213	.33141	.16484
	16	-.18237	.26457	.19993	.50109	.01184
**	17	.47497	.22950	.02735	.54376	.10936
	18	.11484	.00701	.13249	.53351	.11755
	19	.13403	.57333	.22327	.11131	.13661
	20	.67262	.08850	.18082	.06173	.12464
**	21	.50014	.27256	.06208	.44940	.06353
	22	.07675	-.06355	.10045	.66558	-.14017
	23	.15733	.35084	-.04542	.52953	.29918
	24	-.06789	.56131	.01390	.19500	.06806
	25	.25479	.64362	.13543	.14536	.00981
*	26	.09940	.34831	.43413	-.02681	.33973

NOTE: The highest loadings are underlined
* = primary loading of < 0.5000
** = secondary loading of > 0.4000

CSFs that failed to load with coefficients of 0.5 or greater were:

1. a competent staff
2. manage end-user expectations
3. liaison function with the end-user departments

In order to test the reliability of these composite factors, Pearson inter-correlations among the CSFs in each

factor were used to compute Cronbach alpha coefficients. The results are shown in Table 4.12.

With regard to acceptable levels of coefficients, several heuristics have been suggested. For instance, Nunnaly (1967) proposes a coefficient of 0.80 or higher, and Treacy (1985) suggests that a value of 0.7 or higher is acceptable. However, when using a previously unvalidated data gathering instrument in exploratory research, a reliability coefficient of 0.50 or higher is considered sufficient (Srinivasan, 1985).

Table 4.12

Cronbach Alpha Reliability Coefficients For The Five Factor Solution

Composite Factor	Cronbach Alpha Coefficient
F1: Commitment to IC concept	0.73
F2: Quality of IC support services	0.63
F3: Facilitation of end-user computing ..	0.69
F4: Role clarity	0.59
F5: Coordination of end-user computing ..	0.59

The reliability coefficient obtained ranged from 0.59 for the role clarity (Factor #4) and coordination of end-user computing (Factor #5) to 0.73 for commitment to the IC concept (Factor #1). Since the instrument utilized in this

had not been previously validated, these lower reliability coefficients were considered acceptable.

Scores were generated for each factor representing a simple average of the values of the constituting CSFs. These factor scores were used in later steps in the analysis.

Table 4.13 summarizes the descriptive statistics on the five composite factors. In descending order of the mean significance ratings, the composite factors were:

1. Quality of IC support services
2. Facilitation of end-user computing
3. Commitment to the IC concept
4. Coordination of end-user computing
5. Role clarity

Table 4.13

Descriptive Statistics On The Five Composite Factors

Factor	Mean	Median	Min	Max
Quality of IC support services	5.9	6.0	3.3	7.0
Facilitation of EUC	5.6	5.7	3.0	7.0
Commitment to IC concept	5.4	5.6	1.6	7.0
Coordination of EUC	4.2	4.3	1.3	7.0
Role clarity	4.2	4.2	1.0	6.6

Stages vs. Composite Factors

Table 4.14 reproduces the mean significance rating of the composite factor scores for the four stages of growth. The data suggest that relative importance of the four composite factors is the same regardless of the stage of IC growth.

Composite Factors vs. Age, Size, And Hardware Option

Tables 4.15 - 4.18 present the mean significance ratings of the composite scores broken down by the age groups, staff groups, user groups, and the hardware option

Table 4.14

Mean Values Of The Five Composite Scores For The Four Stages Of IC Growth And Overall Means

Composite Factors	Stage I-	II	III	IV	ALL
1. Quality of IC support services	5.7	6.0	5.9	6.1	5.9
2. Facilitation of end-user computing	5.4	5.6	5.6	5.5	5.6
3. Commitment to IC concept.	5.3	5.4	5.5	5.1	5.4
4. Role clarity	3.8	4.2	4.3	4.2	4.2
5. Coordination of end-user computing	4.3	4.2	4.3	3.9	4.2

supported. The data suggest that the three most importance of the five factors are the same regardless of age groups, user group, staff group, or the hardware option supported. The three most important composite factors for these groups were:

Table 4.15

Mean Values Of The Five Composite Scores For The Three Age Groups

Composite Factors	Age groups			
	Y	M-O	O	ALL
1. Quality of IC support services	5.9	5.9	6.0	5.9
2. Facilitation of end-user computing	5.6	5.5	5.5	5.6
3. Commitment to IC concept	5.5	5.3	5.3	5.4
4. Role clarity	4.0	4.1	4.4	5.2
5. Coordination of end-user computing	4.3	4.2	4.1	5.2

NOTE 1: Y = small IC M-O = moderately old ICs
O = large IC ALL = overall values

Table 4.16

Mean Values Of The Five Composite Scores For The Three User Groups

Composite Factors	User groups			
	S	M	L	ALL
1. Quality of IC support services	5.9	5.9	6.0	5.9
2. Facilitation of end-user computing	5.5	5.6	5.6	5.6
3. Commitment to IC concept	5.3	5.4	5.5	5.4
4. Role clarity	4.1	4.1	4.4	5.2
5. Coordination of end-user computing	4.5	4.2	3.9	5.2

NOTE: S = Small IC M = medium sized ICs
L = large IC ALL= overall values

Table 4.17

Mean Values Of The Five Composite Scores For The Three Staff Groups

Composite Factors	Staff groups S	M	L	ALL
1. Quality of IC support services	6.0	5.9	5.9	5.9
2. Facilitation of end-user computing	5.6	5.5	5.6	5.6
3. Commitment to IC concept	5.4	5.3	5.4	5.4
4. Role clarity	4.1	4.0	4.3	5.2
5. Coordination of end-user computing	4.5	4.3	4.1	5.2

NOTE: S = Small IC M = medium sized ICs
L = large IC ALL= overall values

Table 4.18

Mean Values Of The Five Composite Scores For The Three Hardware Options Supported

Composite Factors	Hardware option MA	MI	MX	
1. Quality of IC support services	6.0	6.0	5.9	5.9
2. Facilitation of end-user computing	5.5	5.6	5.5	5.6
3. Commitment to IC concept	5.7	5.3	5.4	5.4
4. Role clarity	4.5	4.1	4.2	5.2
5. Coordination of end-user computing	4.3	4.5	4.1	5.2

NOTE: MA = predominantly mainframes
MI = predominantly microcomputers
MX = both mainframes and microcomputers

1. Quality of IC support services
2. Commitment to IC concept
3. Facilitation of end-user computing

Hypothesis Regarding The Stages Of Growth

The next step in the analysis of the data was to test the hypothesis regarding the stages of IC growth which stated that:

> The significance of the critical success factors for information centers differs by the stage of growth the IC is progressing through.

A MANOVA procedure was utilized to test for significant differences in the composite five factors computed in the previous step of the analysis.

Hypothesis testing

The multivariate test statistics for overall differences in mean values of the composite CSFs across the four stages of growth are reproduced in Table 4.19.

Table 4.19

Multivariate Statistics For Overall Effects Of The Stages Of Growth On The Five Factors

Wilks' Criterion = 0.9138	
F (15,784.4) = 1.74;	Prob. > F = 0.0398
Pillai's Trace = 0.8804	
F (15, 858) = 1.73;	Prob. > F = 0.0407
Hotelling-Lawley Trace = 0.0924	
F (15, 848) = 1.74;	Prob. > F = 0.0389

These statistics indicate that the stages of IC growth have a significant effect on the composite CSFs thereby providing support for this hypothesis. The specific nature of these differences were then studied through all possible pairwise comparisons using the Scheffe multiple for family confidence. Tables 4.20 and 4.21 summarize the nature of the significant differences.

Table 4.20

Summary Of The Significant Effects Of The Stages Of IC Growth On The Composite CSFs

Independent variable	Effect on	F-value	df	pr. > F
Stage of IC growth	composite CSF #2: Quality of IC support staff	2.62	3, 288	0.0471
	composite CSF #4: Role clarity	3.15	3, 288	0.0254

Table 4.21

Confidence Interval Indicating Significant Differences In The Composite CSFs For The Stage Of IC Growth

Independent variable	Composite CSF	Confidence interval Lower limit	Mean	Upper limit
Stage of IC growth	Role clarity			
	Stage III - stage I:	0.0415	0.5415	1.0414

The comparisons indicated that the differences were with regard to composite CSF #2 - quality of IC support services - and CSF #4 - role clarity. However, the specific nature of the differences in the quality of IC support services could not be determined through the multiple comparisons. The comparisons did reveal that role clarity was more important during stage III (formalization) than stage I (initiation) of IC growth.

Hypothesis Regarding Age, Size, and H/W Option

The hypothesis concerning the parameters of age, size, and the hardware option supported stated that:

> The significance of the critical success factors for information centers differs by the global parameters of age, size, and the hardware option used.

A MANOVA procedure was used to test for the effects of age group, staff size group, user group, and the hardware option supported on the composite CSFs.

Hypothesis Testing

Table 4.22 reproduces the multivariate statistics for overall affects of age group, staff group, user group, and hardware option on the five composite CSFs. These statistics indicate significant affects on the CSFs by:

1. age group
2. user group
3. hardware option supported

Table 4.22

Multivariate Statistics For Overall Effects Of Ege Group, Staff Group, User Group, And The Hardware Option On The Five Factors

Statistics for the effects of age group:

Wilk's criterion = 0.9223;
F (10,558) = 2.30; Prob. > F = 0.0188
Pillai's trace = 0.0798;
F (10,560) = 2.28; Prob. > F = 0.0127
Hotelling-Lawley trace = 0.0845;
F (10,556) = 2.33; Prob. > F = 0.0110

Statistics for the effects of user group

Wilk's criterion = 0.8697;
F (10,558) = 4.10; Prob. > F = 0.0001
Pillai's trace = 0.1336;
F (10,560) = 4.01; Prob. > F = 0.0001
Hotelling-Lawley trace = 0.1506;
F (10,556) = 4.19; Prob. > F = 0.0001

Statistics for the effects of staff group

Wilk's criterion = 0.9494;
F (10,558) = 1.47; Prob. > F = 0.1481
Pillai's trace = 0.0508;
F (10,560) = 1.46; Prob. > F = 0.1512
Hotelling-Lawley trace = 0.0530;
F (10,556) = 1.47; Prob. > F = 0.1452

Statistics for the effects of hardware option supported

Wilk's criterion = 0.9023
F (10,558) = 2.94; Prob. > F = 0.0013
Pillai's trace = 0.1000;
F (10,560) = 2.95; Prob. > F = 0.0013
Hotelling-Lawley trace = 0.1057;
F (10,556) = 2.94; Prob. > F = 0.0013

These statistics provide support for the second hypothesis. All possible pairwise comparisons, using the Scheffe multiple for family confidence were performed in order to determine the specific nature of the differences. Tables 4.23 and 4.24 summarize the nature of the differences. The comparisons indicated the following differences:

With regard to the age groups, composite CSF #4 - role clarity - was significantly different. Specifically, role clarity was more important for old ICs than for young ICs. With regard to the user groups, composite CSF #5- coordination of end-user computing - was significantly different. Specifically, coordination of end-user computing was more important for smaller ICs than larger ICs.

With regard to the hardware option supported, composite CSF #4 - role clarity - and composite CSF #5 - coordination of end-user computing - were significantly different. Role clarity was more important for those ICs supporting predominantly mainframes than those supporting predominantly microcomputers as well as those supporting both mainframes and microcomputers. Coordination of end-user computing was more important for ICs supporting predominantly microcomputers than those supporting both mainframes and microcomputers.

Summary

This chapter presented the results of the analysis of the data gathered. The ICs were grouped according to their stage of evolution, age, size, and the hardware option

supproted, in order to thest the following two hypotheses:

H1: The significance of the critical success factors for information centers differs by the stage of growth the IC is progressing through.

H2: The significance of the critical success factors for information centers differs by the global parameters of age, size, and the hardware option supported.

Prior to testing these hypotheses, a principle components analysis was employed to identify composite factors representing the 26 individual CSFs identified from the literature. Five composite factors were identified, and these were used in testing the hypotheses.

The study found support for both these hypotheses, and multiple comparisons were employed to determine the exact nature of these differences. Very few specific differences were revealed by these comparisons.

The next chapter presents an analysis of the obtained results, along with the implications.

Table 4.23

Summary Of The Significant Effects Of Age Group, User Group, And Hardware Option On The Composite CSFs

Independent variable	Effect on	F-value	df	pr. > F
Age group	CSF #4: Role clarity	3.69	2, 283	0.0261
User group	CSF #5: Coordination of EUC	11.43	2, 283	0.0001
Hardware option	CSF #4: Role clarity	3.83	2, 283	0.0229
	CSF #5: Coordination of EUC	5.02	2, 283	0.0072

Table 4.24

Confidence Interval Indicating Significant Differences In The Composite CSFs For Age, # Of Users, Hardware Option

Independent variable	Cmposite CSF	Confidence interval Lower limit	Mean	Upper limit
Age group	Role clarity old - young	0.0190	0.3533	0.6875
User group	Role clarity small - large	0.3089	0.6384	0.9679
Hardware option	Role clarity			
	mainframe - mixed	0.0306	0.4755	0.9204
	mainframe - micro	0.0226	0.4973	0.9721
	Coordination of EUC			
	micro - mixed	0.0742	0.3785	0.7007

CHAPTER FIVE

ANALYSIS OF THE RESULTS

This chapter discusses the results of the analysis of the data and is divided into six sections. Section one deals with the critical success factors applicable to information centers; section two addresses the composite CSFs; section three discusses the stages of information center evolution; the next section addresses the first hypothesis - regarding the effects of the stages of IC growth on the CSFs; the fifth section deals with the parameters of age, size, and the hardware option supported; and the last section discusses the effects of these parameters on the CSFs.

CSFs Applicable To ICs

A review of the literature revealed 26 CSFs that had been identified as being relevant to ICs. This study found that of these, the three most important were a competent staff, communication with the users, and top management support.

A Competent Staff

The basic functions of an information center are to facilitate and coordinate end-user computing. With regard to the facilitation function, an IC serves to "help end

users to help themselves" (Leitheiser & Wetherbe, 1985). This it does by providing certain services to end-uses. The "core" services include trouble shooting (hotline / technical support), consulting, and training (Brancheau, Vogel and Wetherbe, 1985; Sumner, 1985a). These "core" services are labor intensive (i.e., the successful delivery of these services depends on the IC staff). Hence, it is not surprising that a competent staff is among the most important of the CSFs. This is reinforced by the finding that two other staff related CSFs were rated among the top ten. These were IC staffs' understanding of users' business and problems and training for IC staff.

Communication With The User

The facilitation and coordination functions of an IC are often in conflict with one another. On the one hand the IC attempts to promote the growth of end-user computing, while at the same time trying to control the growth. One of the key issues deals with resolving this conflict and finding the balance between promoting growth and controlling. Brancheau, Vogel and Wetherbe (1985) found that the problem was not one of philosophical differences between the IC and the end-users. Rather, the problem lay, in part, in a lack of communication between the users and the IC. This includes communicating to the users the roles and responsibilities of the users, the IC, the IS department, and the users; as well explaining the

capabilities of the IC to the users so that they form reasonable expectations of the IC.

Top Management Support

Top management support for the IC is the last of the top three CSFs. The success or failure of any new endeavor is very often determined by the amount of top management support for the endeavor. In addition to obtaining top management support, equally important is maintaining this support. The implementation and continued existance of an information center may well be a function of how long top management supports the concept. In fact, it has been suggested that lack of top management support for the initiation of a formal IC may result in the emergence of an underground IC (Ramsey, 1986).

The Composite CSFs

By their very nature, CSFs are few in number, generally between three and seven. However, the literature provides a substantial list of CSFs applicable to ICs. An attempt was made to identify a few, independent composite CSFs by grouping those individual CSFs representing the same construct.

A principle components analysis of the 26 CSFs revealed the existence of five composite factors - the composite CSFs. The reliability coefficients associated with two of the factors were lower than desirable. In addition, some of the individual CSFs did not fit "cleanly" into the composite factors (i.e., loadings less than 0.5 or high secondary

loadings). Further study is necessary to eliminate these problems and reinforce the findings of this study. None-the-less, given the exploratory nature of this study, the results are acceptable and useful. In order of rated importance, these composite CSFs were:

1. Quality of IC support services
2. Facilitation of end-user computing
3. Commitment to IC concept
4. Role clarity
5. Coordination of end-user computing

As composite critical success factors, these five areas represent those in which an IC manager must strive for favorable results in order for the IC to succeed in fulfilling its mission.

Quality Of IC Support Services

The individual CSFs comprising this composite factor include:

1. support for software packages
2. end-user training
3. standardized hardware and software
4. training for IC staff
5. a competent staff
6. reliability of services provided

These first three individual CSFs comprising the compsoite CSF are directly associated with the type of support provided by the IC. A competent staff and the reliability of the services provided reflect on the quality

of the support provided. Training for IC staff implies the need for the staff members to keep pace with the developments in technology in order to maintain the quality of the support.

One way an information center fulfills its objectives is by providing certain services. These services are the more tangible and visible aspects of an ICs operations,as a result, the successful delivery of quality services is given major consideration. Therefore, establishing and maintaining the quality of the IC staff and services should be among an IC manager's paramount concerns. This is reflected in this composite CSF being rated the most important of the five.

Mechanisms, such as periodic performance evaluations of the IC staff as well as applications developed against pre-established criteria, may be used to monitor and maintain the quality of the services provided and the systems developed.

Facilitation Of End-user Computing

One of the primary objectives of an information center is to facilitate end-user computing. That is, provide the means for the end-users to fulfill their own computing needs. Historically, information technology has been notorious for promising more than it is capable of delivering. In order for an IC to avoid being in such an adverse situation, the purpose, nature, and expected benefits of the IC must be understood by (and communicated

to) all concerned. This is part of an ICs facilitation function. Users' expectations of the information center must be carefully managed by understanding the users needs and comparing these needs to the capabilities of the IC technology.

Another aspect of the facilitation function of an IC is to ensure continued subsistence by being able to justify its existence through emphasizing cost effective solutions; while at the same time encouraging users to continue utilizing the IC facilities by providing a proper atmosphere for these users.

The following CSFs comprising this composite factor represent those associated with how well an IC fulfills its facilitation function.

1. communication with the user
2. atmosphere for users
3. understanding users' business and problems
4. managing end-user expectations
5. liaison function with the end-user departments
6. cost effective solutions

Commitment To The IC Concept

The CSFs included in this composite factor were:

1. top management support
2. promotion of IC services
3. organizational acceptance of the IC concept
4. commitment of end-users to the IC concept
5. career paths for IC staff

These represent factors not directly related to the functions of an IC, but those concerned with developing and maintaining an environment for the IC to establish itself and deliver its services.

End-user computing and the information center represent a new concept in computing in many organizations and new concepts and ideas are invariably accompanied by change. With regard to the IC, this change may be in the way of formality (standards, prescribed ways of doing things, etc.) for users who, until the implementation of the IC, were satisfying their computing needs in an informal manner. In addition, the change may take the form of innovative avenues of acquiring desired information for new users.

The success of the IC in overcoming any resistance to change, and properly managing this change, requires an organizational culture that is willing to change. A favorable organizational culture is represented by top management support, organizational acceptance of the IC concept, and commitment of the end-users to the IC concept.

In addition to an initial endeavor to manage change, this composite CSF reflecting a commitment to the IC concept includes an obligation to ensure continued existence. This involves promoting IC services throughout the organization as well as efforts to minimize IC staff turnover by establishing career paths for them.

Role Clarity

End-user computing and the information center do not attempt to replace traditional applications development methodologies. The IC provides end-users with an alternative to traditional methodologies for developing personal and in some cases, departmental applications. The development of multi-departmental or corporate applications remains the responsibility of the traditional IS department.

The roles and responsibilities of the users, the IC, the IS department, as well as that of top management must be well established at the onset to avoid potential problems. For instance, while common wisdom states that the ICs role is in assisting users in developing applications (not developing the applications for the users), there may be situations where developing applications for the users may be appropriate. In situations involving applications involving (and affecting) more than one person, the IC may be charged with the responsibility of coordinating such development; or this coordination may be the responsibility of the individual user departments; or the IS department. These situations must be clearly delineated in defining the roles and responsibilities of the various groups.

One of the major issues of end-user computing is the lack of professionalism on the part of the users. Policies and procedures for documentation, testing, debugging, security, etc. must be included in the role definition.

Finally, not only is it necessary to clearly define the roles and responsibilities of the various groups, it is also necessary to initiate control mechanisms to ensure that the different groups fulfill their obligations. Control procedures that have been suggested include charging back for IC services, and review of user developed applications by analysts.

The significance of defining the roles of the various groups - the end-users, the IC, the IS department, and top management - is reflected in this composite factor which includes the following individual CSFs:

1. Clear definition of responsibilities, procedures, policies, etc. for users, IC staff, and the IS department
2. control procedures to ensure standards, policies, etc. are adhered to
3. user understanding of data processing
4. providing services to distributed sites
5. charge back criterion

Coordination Of End-user Computing

A major function of an information center is to coordinate end-user computing activities throughout the organization. This is to either prevent or correct an uncontrolled proliferation of EUC and the associated problems and issues. Coordination includes such things as avoiding duplication of efforts, ensuring compatability of hardware and software, efficient resource allocation, etc.

This composite CSF reflects the coordination aspect of the IC and includes:

1. establishing a priority criteria for work
2. monitoring and coordinating end-user applications developments
3. performance of user developed applications
4. response to applications development requests

Summary Of The Composite CSFs

In summary, it was determined that the 26 individual CSFs identified in the literature as being relevant to ICs may in fact be represented by five composite factors, each composite factor encompassing several of the individual CSFs. As such, these composite CSFs represent those areas where an IC manager must strive to achieve favorable results in order for the IC to succeed in its mission. In fact, these composite CSFs represent the ultimate mission of an IC along with an environment condusive to fulfilling this mission.

Stages Of IC Evolution

This study explored a stage hypothesis for IC evolution by identifying benchmark variables characterizing the growth of the ICs. Descriptions of the four stages of IC evolution were derived by tracing the changes in the following benchmark variables:

1. goals of the IC
2. planning procedures
3. organization

4. staffing
5. control mechanisms
6. priority criteria
7. policies
8. evaluation methods
9. training
10. nature of the users

Compatibility of hardware and software is the primary goal at start-up (stage I), follwed by diffusion of technology in stage II. The rapid, often runaway growth in the use of EUC technology leads to curbing this growth during stage III. As EUC activities spread throughout the organization the goal becomes one of coordinating these EUC activities.

Planning is virtually non-existent during stage I and is initiated only during stage II. By the time an IC evolves into stage III, planning procedures are well developed and eventually (stage IV) the IC plan becomes a part of the global corporate plan.

Typically, ICs tend to be centralized during the early stages (I and II) and some functions become decentralized into the user departments during the later stages (III and IV). The centralized IC, if it still exists takes on the role of coordinating the activities of the ICs in the user departments.

The size of the IC staff is typically very small (mean = 5.8) during all stages; however, the skills, level of

specialization, and need for supervisory and administrative functions increases as an IC evolves.

Initially, control is centralized with numerous control mechanisms aimed at curbing growth being initiated during stage III. Stage IV sees refinements of existing control mechanisms and an increased influence from the user departments. Priority criteria are based on a first-in-first-out basis changing to well developed procedures during the later stages. Evaluation procedures are initiated only during stage II and are refined during the later stages.

With regard to training, a variety of methods are used during stage I and is provided for limited hardware and software. Stage II sees a reduction of the training methods and an increase in the scope of such training. In the last stages, the training tends to be very specialized, perhaps computer-based.

Finally, in stage I, the users are typically self-motivated and place limited demands on the IC staff. With the goal of diffusion of technology, the user base expands, increasing the demand for IC services. Eventually, decentralized ICs serve the needs of users from specific functional areas.

Whereas, no formal attempt was made to empirically validate a stage hypothesis for the evolution of ICs, the respondents were asked to evaluate the descriptions of the stages on a seven point Likert scale. The results indicated a strong support for a stage hypotheses for information

centers as outlined by the descriptions. The descriptions of the first three stages were evaluated favorably (> 5.0 / 7.0) while the description of the fourth stage received a lower rating. This lower rating reflects an uncertainity about what stage IV is like due to the few ICs that are in this stage of evolution (8.4%). Over three fourths of the IC were in stage II or stage III indicating that ICs have progressed beyond initiation, but have yet to reach maturation.

Effects Of The Stages Of Evolution On The CSFs

This study tested two hypotheses, the first of which sought to examine the effects of the stages of IC evolution on the CSFs applicable to ICs. Specifically, the hypothesis stated that:

> The significance of the critical success factors for information centers differs by the stage of growth the IC is progressing through.

The data suggests that the relative importance of the five composite CSFs is the same for all stages of IC evolution. However, the data also show that certain composite CSFs are more important during some stages than other thereby providing support for the hypothesis regarding the effects of the stages of evolution on the CSFs.

Specifically, the stages of IC evolution were found to have an effect on two of the composite CSFs: (1) the quality of IC support services and (2) role clarity. However, the exact nature of the effect on the quality of IC support

services was not determinable. Role clarity was considered more important in stage III (formalization) than in stage I (initiation).

The formalization stage is a response to the contiguous growth in the previous (expansion) stage. The primary objective in the formalization stage is to curb this growth through control mechanisms. Delineating policies, roles and responsibilities, and implementing control mechanisms to ensure the compliance, is used as a mechanism to limit EUC activities (e.g., applications development) to those that are productive. Hence it should be expected that role clarity is more important in the formalization stage as there is a need for a clear definition of what is appropriate.

Age, Size, And The Hardware Option Supported

On an average, an IC was 30 months old and had 616 users supported by 6 full time equivalent staff members. The median IC was 27 months old, with 4 full time equivalent staff members supporting 254 users. Most of them supported both mainframes and microcomputers, followed by support for microcomputers only, and lastly support for mainframes only. There appears to be a positive association between these variables and the stage of IC evolution. The data suggests that as an IC progresses through the stages of evolution, it gets older, has more users, and has a larger staff. The nature of the relationship between the stages and the hardware option supported was not clear. However, due to

the failure of some of the assumptions of the Chi-square test to hold, these observations are not concrete.

Effects Of Age, Size And Hardware Option On The CSFs

The second hypotheses tested in this study sought to examine the effects of age, size, and the hardware option supported on the CSFs. Specifically, this hypothesis stated that:

> The significance of the critical success factors for information centers differs by the global parameters of age, size, and the hardware option supported.

The relative importance of the five composite CSFs were found to be the same regardless of the categorization of ICs based on age, size, or the hardware option supported. However, the effects of these variables were noticeable when considering the importance of any given composite CSFs between the categories, thereby providing support for the second hypothesis.

The variables of age, size as measured by the number of users, and the hardware option supported were found to have an effect on the composite CSFs. However, the size of the IC staff did not have a significant effect on the composite CSFs. The composite CSF role clarity was affected by age, number of users and the hardware option while composite CSF coordination of EUC was effected only by the hardware option supported.

The Age

The importance of role clarity was found to be different for ICs of different ages. Specifically, role clarity was more important for older ICs than for younger ICs. This finding compliments the finding that role clarity is more important in stage III that in stage I. This was expected as there is a positive association between age and the stages of IC evolution.

The Number Of Users

Role clarity was found to be more important for ICs with a small number of users than for ICs with a large number of users. This finding is contradictory to expectations given a positive association of the number of users with the stages of IC growth; (the effect of the number of users was expected to be similar to the effects of the stages of growth, not the opposite effect that was found). This could be the result of some intervening variable or variables not included in this study. One could speculate that in a large user group, the availability of informal assistance from "expert" users diminishes the need for well defined roles; whereas, in a small user group, without the benefit of such informal assistance, there is a need for well defined avenues for assistance. One could further speculate that small user groups, most often associated with fledgling ICs with coordination as the primary objective, would require the roles of various groups to be well defined.

The Hardware Option

With regard to the hardware option supported, role clarity was found to be more important for ICs supporting predominantly mainframes than those supporting predominantly microcomputers as well as those supporting both. Arguably, a mainframe environment is more formal and involves more security and control measures than a microcomputer environment. In an environment with both mainframes and microcomputers, the microcomputer tends to be the primary source of computing power and has the influence of making the environment less formal. The greater complexity of a mainframe environment calls for more role clarity in such an environment than in others.

In addition, coordination of EUC was found to me more important for a microcomputer environment than for a mixed environment. This is contrary to expectations and one can only speculate that some intervening variable or variables not included in this study are the cause.

Conclusion

The results of this study suggest the existence of five composite CSFs applicable to information centers, made up of several individual CSFs identified in the literature. Not surprisingly, the composite CSFs reflect the nature of an IC, its mission, and the environment within which it operates. Two of the composite CSFs - facilitation of EUC and coordination of EUC - reflect the two fundamental goals of an IC; fulfilling these goals include providing certain

services, the quality of which services is the concern of a third composite CSF. In order to adequately fulfil its functions, an IC needs the proper environment to operate in - an environment where the place of the IC within the organization is properly defined (role clarity) and where the mission of the IC is recognized and supported (commitment to the IC concept).

The above arguement suggests that the five composite CSFs are not mutually exclusive. Rather, collectively they represent a fundamental model of an IC where failure to recognize and monitor any one of the composite CSFs could undermine the effectiveness of the IC. This model of an IC is depicted in figure 5.1.

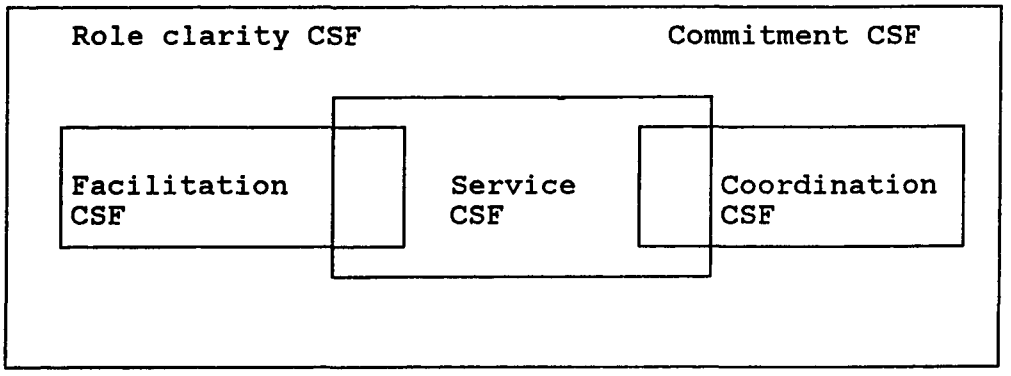

Figure 5.1: A Critical Success Factor based model for information center

Secondly, this study provides strong evidence in support of a stage hypothesis for IC evolution. This stage hypothesis is based on the movement of these benchmark variables as an IC evolves. Knowledge of what these

variables are, in itself, is valuable to an IC manager. Perhaps more significant is the knowledge of how these variables bahave as the IC evolves. A stage hypothesis for IC evolution provides an IC manger with this knowledge, armed with which he or she will be able to anticipate changes and plan for the future directions of the IC.

It is important to note that while the four stages of IC evolution have different characteristics (in terms of their benchmark variables), the relative importance of the five composite CSFs is the same for all stages. Moreover, only one (out of 30) comparisons of the importance of the composite CSFs between stages revealed a difference (role clarity was more important in stage III than in stage I).

Finally, the relative importance of the five composite CSFs were found to be the same regardless of the age, size, or the hardware option supported (i.e., for any given category of ICs, the relative importance of the composite CSFs were the same). Differences in the relative importance of the composite CSFs were expected between the categories (e.g., the importance of any given composite CSF was expected to differ between ICa of different sizes). Few such differences were found, some contradictory and inconclusive. In addition, the composite CSFs that were different were the ones with the lowest reliability coefficients. These results should be regarded in this light.

In the final analysis, despite the finding of statistically significant differences, the evidence is overwhelmingly in favor of consistency of the importance of the composite CSFs among the various categories of ICs. This is due to the few differences found from among the many possibilities (six out of 48 possible multiple comparisons).

Summary

To summarize, this study supports the notion of a stage hypothesis for the evolution of information centers. The study also identifies five composite CSFs applicable to ICs. The evidence was in favor of consitency in the importance of these composite CSFs among the different categories of ICs. This led to a model of an IC based on its composite CSFs.

CHAPTER SIX

SUMMARY

This chapter summarizes the study and is divided into four sections. The first section summarizes the study purpose, followed by the methodology used. The next section summarizes the findings of the study and the last section provides suggestions for future research.

Summary Of The Study Purpose

End-user computing (EUC) is the direct hands-on use of computers by people who have a problem for which computer-based solutions are appropriate. EUC was a response to the failure of traditional development methodologies to meet the growing demand for information. The end-users looked toward cheaper and easy-to-use computing-technology to satisfy part of their information needs on their own.

The rapid and widespread proliferation of end-user computing accompanied by a variety of hardware and software resulted in several problems. These included problems associated with compatibility of hardware and software, data security and integrity, professionalism on the part of the end-users, etc. One approach to combating these problems was implementing an information center. An information center is a formal means for supporting EUC and has two

primary functions: (1) facilitating end-user computing; and (2) coordinating end-user computing activities.

Several attempts have been made to study the nature of information centers. The various areas investigated include the IC premise, management considerations, successes, problems, and critical success factors applicable to ICs. However, no attempts have been made to explore a stage hypothesis for IC evolution. Neither have factors affecting CSFs applicable to ICs been investigated.

The basic objectives of this study were to identify the effects of the stages of IC evolution, age, size, and the hardware option supported on the CSFs applicable to ICs. Specifically, the following two hypotheses were tested:

H1: The significance of the critical success factors for information centers differs by the stage of growth the IC is progressing through.

H2: The significance of the critical success factors for information centers differs by the global parameters of age, size, and the hardware option used.

Summary Of The Study Method

A field study involving the use of a questionnaire was utilized to gather the necessary data. The questionnaire was administered to managers of information centers, and consisted of three parts. First, verbal descriptions of the four stages of IC evolution were provided and the IC

managers were asked to indicate which stage most closely described the stage their IC was in. The second part sought data on the parameters of age, size, and the hardware option supported. Finally, the IC managers were provided with a list of critical success factors identified in the literature as being applicable to ICs. The managers were asked to indicate on a seven-point Likert scale the importance of each CSF to their IC.

The questionnaire was pre-tested, resulting in some changes which were incorporated into the final questionnaire. This final questionnaire was administered to 1490 IC managers, 311 (21%) of whom responded.

The data analysis involved several steps. First descriptive statistics on the different variables were obtained. Next, the 26 CSFs were factor analyzed to identify independent composite factors. Finally, MANOVA procedures were used to test the two hypotheses followed by all possible pairwise comparisons to determine the nature of the differences.

Summary Of The Study Findings

The results indicated that there are five composite critical success factors that are relevant to information centers. These were: (1) quality of IC support services; (2) facilitation of end-user computing; (3) commitment to the IC concept; (4) role clarity; and (5) coordination of end-user computing. These CSFs represent the basic nature of an IC

and were used in suggesting an IC model describing the goals and the operating environment of the IC.

Second, the study found evidence in support of a stage hypothesis for information centers. Additionally, it was found that for any given stage of evolution, the relative importance of the five composite CSFs was the same. However, role clarity was found to be more important during stage III than in stage I.

The ICs were categorized into different groups based on their age, size as measured by the number of users, size as measured by the number of full time staff, and the hardware option supported The relative importance of the five composite CSFs were found to be the same regardless of the categorization. However, role clarity was found to be affected by age, number of users, and the hardware option supported while coordination of end-user computing was found to be effected by the hardware option supported.

The study suffers from several limitations. First, verbal descriptions of the stages of IC evolution were used to identify which stage the ICs were in rather than the measurement of benchmark variables. In addition, very few ICs were in stage IV of evolution. Therefore the conclusions regarding stage IV must be regarded with caution. Second, the reliability coefficients of two of the five composite CSFs were low. The consequence of low reliability is a reduced probability of identifying significant differences. Finally, the categorization of ICs

by age, size, and hardware option were based on natural breaks suggested by the data. Although this was considered appropriate given a lack of precedence for categorization, other forms of categorization may reveal different results.

Suggestions For Future Research

Further research is necessary to supplement and reinforce the findings of this study. First, the list of critical success factors used in the questionnaire must be refined to improve the reliability of the composite CSFs. In addition, re-phraizing the questions could increase reliability coefficients. Second, the identification of the stages of IC evolution must be performed through measurement of the benchmark variables rather than verbal descriptions. This is to enable a better classification of the ICs into the appropriate stages. Other models for the evolution of ICs (e.g., a six stage model) may be investigated. In addition, different forms of categorization of the ICs must be explored. The effects of other variables need to be investigated. For instance, the skill and knolwdege levels of the end-users may effect the importance of the critical success factors. Finally, it is necessary to associate the critical success factors with success measures to determine if indeed these CSFs can be associated with successful ICs. The evaluation of ICs must be performed from the perspectives of at least four groups - the end-users, the IC management, IS management, and top management. User information satisfaction is one way of obtaining the users

perspective. The IS management may be concerned with how the IC complements the IS departments' efforts. Top management may be concerned with efficient resource utilization.

In summary, it is necessary to replicate this study using composite CSFs with improved reliabilities and better identification of the stages of IC evolution through benchmark variables.

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Appendix A1: List of CSFs applicable to ICs identified from the literature

1. establish priority criteria for work
2. maintain a competent staff
3. support the"right" software packages
4. provide effective end-user training
5. monitor and coordinate end-user developments
6. obtain top management support
7. quickly respond to development requests
8. promote information center services
9. establish good communication with user
10. deliver solutions in a cost effective way
11. create a comfortable atmosphere for users
12. maintain good system performance
13. understand users´ businesses and problems
14. gain organizational acceptance of IC concept
15. manage end-user expectations
16. provide services to distributed sites
17. define IC mission
18. encourage user understanding of DP
19. provide reliable services
20. obtain end-user commitment
21. establish career paths for IC staff
22. establish a charge back criterion

Appendix A2: The updated list of CSFs applicable to ICs

1. priority criteria for work
2. competent staff
3. support right software packages
4. end-user training
5. monitor and coordinate end user applications developments
6. top management support
7. response to requests
8. promotion of IC services
9. communication with users
10. cost effective solutions
11. atmosphere for users
12. system performance
13. IC staff's understanding of users' business and problems
14. organizational acceptance of the information center
15. manage end user expectations
16. provide services to distributed sites
17. define IC mission
18. users' understanding of data processing
19. reliability of applicationsdeveloped
20. commitment of end-users to the IC concept
21. establishing career paths for IC staff
22. establishing a chargeback criterion
23. control procedures to ensure standards, policies, etc. are adhered to
24. standardized hardware and software
25. training for IC staff
26. liaison function with end-user departments

Appendix B1: Organizational Risks and Control Mechanisms Associated with the Life Cycles of End-User Applicatins

Source: Alavi, M. and Weiss, I. " Managing the Risks Associated With End-User Cod-User Applications," Journal of Management Information Systems, Volume II, Number 3, Winter 1985-86, p. 19.

	End-user application life cycle stages	Organizational risks	Control mechanisms
Analysis	Analysis of end-user tools	Ineffective use of monetary resources	Cost/benefit analysis
		Incompatible end-user tools Threats to data security and integrity	Hardware/software standards Policy for end-user access to corporate data base
	Analysis of end-user application	Overanalysis and insufficient search for the solution	Provide user training in problem solving and modeling
		Solving the wrong problem	Involve analyst in the design process for review
Design	Conceptual design of end-user application	Applying the wrong model	Technical training Reviews
		Mismatch between the tools and applications	Policy for technical reviews
	Development of end-user application	Little or no documentation	Enforce documentation standards Include documentation in development process
		Lack of extensive testing	Testing/validation standards User training in application quality assurance
		Lack of validation and quality assurance	Analyst/auditor "walk-through" Auditor reviews
		Redundant development effect	End-user training in modeling application development Common application library
		Inefficient expenditure of non-DP personnel time	Management policy for limits on allocation of non-DP personnel time Support from analyst
Implementation	Operation of end-user application	Threats to data integrity	Input data validation routines User training in data integrity issues
		Taxing the mainframe computer resources	Management policy on the role of end-user computing Integrating EUC and DP planning Control of EUC growth through budgets and charge-backs
		Threats to security	Access control via pass words Physical access control (restricted areas) Standards for backups
	Maintenance	Failure to document and test modifications	Maintenance Review by analyst
		Failure to upgrade the application	Periodic system review by user analyst

Appendix C1: The Information Center Questionnaire

Dear Information Center Manager:

At The University of Georgia we are conducting research on end-user computing and information centers, and would like to obtain your participation in an important research project. The project involves an investigation of the factors affecting the success of information centers. An understanding of these factors should improve the effectiveness of an information center.

I understand that you manage an information center in your organization. I would like to request your cooperation in completing the enclosed questionnaire which gathers data on the characteristics of your information center and your perceptions of factors that may be critical to its success. The questionnaire should take approximately *** minutes to complete.
If you are not the manager of your organization's information center, please forward this questionnaire to the person who presently manages it.

Please respond to the questions as they apply to your information center at the present time. If there is more than one information center in your organization, please provide responses as they apply to the information center that you manage. An explanation of terms is provided at the back of the questionnaire.

All of the data gathered will be held in confidence. No reference to specific individuals or organizations will be made in any report. The only information provided will be of a summarized and statistically analyzed nature from the entire group of respondents.

I would appreciate it if you would complete the questionnaire within the next few days. A stamped addressed return envelope is enclosed.

Your opinions are very important to us and will provide many answers to questions on information centers. In appreciation of your cooperation, I will be pleased to sent you a summary of the study findings. If you have any questions, please contact me at (404) 542-3105 or (404) 542-1294.

Thanks in advance for your cooperation.

Sincerely,

Simha R. Magal

THE INFORMATION CENTER QUESTIONNAIRE

Definition of Terms

End-User Computing (EUC) - the direct hands-on use of computers by the people who have a problem for which computer-based solutions are appropriate.

Information Center (IC) - a physical facility used to formally support end-user computing and has two underlying functions: (1) facilitating and (2) coordinating end-user computing activities. The specific services provided include training, user assistance, usage planning, product evaluation, consulting, security, marketing, project management, maintenance of PC equipment, and the creation of computer and communications interface software.

Critical Success Factors (CSF) - those few areas of activity where "things must go right" for the organizational unit to flourish. As such, these CSFs require constant and careful monitoring by management.

PART I: THE EVOLUTION OF INFORMATION CENTERS

Information centers evolve from creation to becoming a mature organizational unit integrated with the rest of the organization. Typically this evolution progresses through four stages. A brief description of each of the four stages of evolution for information centers is listed below. Please read each description and answer the questions following them.

STAGE I: INITIATION

An information center (IC) most frequently evolves out of a need to coordinate the proliferation of end-user computing in an organization. However, some ICs are created to introduce the concept of end-user computing into the organization because of perceived benefits. In either case, the primary goal is to establish responsibility for facilitating and controlling end-user computing and to minimize any disruption which may arise due to the new concepts and technology associated with end-user computing.

During the initiation stage, the primary users (clients) of the information center are the pioneers of end-user computing in the organization. These users generally tend to be self-motivated and place few demands on the IC. Hardware alternatives are many and represent those existing prior to the creation of the IC. The variety of software products is limited as is the scope of the use of such software.

The IC staff is small, consisting perhaps of one or two people. A variety of training methods are used (experimented with). The IC is a centralized organizational unit with limited hardware, software, and personnel at start up and is characterized by informal management practices. Few formally established policies and plans exist. Activities are prioritized on a First-In-First-Out basis; Other managerial activities such as performance evaluation, charge back for services, and management control, are also performed informally, if at all.

STAGE II: EXPANSION

This stage sees steep increases in hardware, software, IC staff and users (clients). It is a period of contagious, often unplanned growth characterized by growing duties and responsibilities for the information center.

The number and variety of users increases, placing a greater demand on IC services both in terms of the number of requests and the level of expertise needed to respond to these requests. The IC staff moves toward specialization to cope with this increased demand. The training methods used

are few as the staff finishes experimentation and settles for those which work best. The number of products supported increases along with the scope of use of such products.

Managerial activity is sales-oriented, and is aimed at encouraging the growth of end-user computing in the organization. Control mechanisms remain lax and informal; few standards are established; planning and performance evaluations are loosely organized; priorities for activities are based on broad guidelines. The IC remains centralized and continue to be responsible for hardware and software acquisition.

The end of this stage is characterized by a crisis for management due to the tremendous growth in the IC activities and budget.

STAGE III: FORMALIZATION

During this stage in the evolution of an information center, the primary objective is to control the runaway growth, particularly the growth in expenditures.

Managerial activities are formally and consciously conducted in an attempt to curb this tremendous growth. This stage is characterized by a proliferation of control mechanisms; formal priority setting for activities; budget justification; performance evaluation; and initiation of standards and charge back procedures. Formal administrative and supervisory positions are created and filled in the IC to carry out these management control functions.

Users' backgrounds widen to include those from additional departments such as research and development and public relations. User skill are relatively high, placing demands on IC staff to possess a very high level of expertise. IC staff specialization is high.

During this stage, some of the functions of the IC are decentralized to the user departments. These functions include those unique to the user departments as well as an increased involvement in defining policies and procedures.

STAGE IV: MATURITY

The maturity stage is difficult to characterize completely because few ICs have reached this stage in their evolution. However, a few trends are emerging. Separate ICs may be created within the user departments, absorbing the functions and responsibilities of the centralized IC. The staff of these user department ICs are highly specialized to meet the specific needs of the departments, and may themselves go through training to ensure that they possess the requisite skills. These multiple ICs may be

independent, having their own budgets and decision making processes. A major focus is to refine the control mechanisms instated during the formalization stage.

The centralized IC, if it still exists, has responsibilities of a more global nature. Their functions are centered around monitoring and coordinating the activities of the various ICs in the user departments. The manager of such an IC may be a senior executive providing input to the corporate strategic planning process. The collection of ICs in the various user departments are treated as a major corporate resource and are managed and controlled in that light.

1. Which ONE of the stages described above MOST CLOSELY characterizes your information center AT THE PRESENT TIME?
(Please check one)

_____ Stage I: Initiation _____ Stage II: Expansion

_____ Stage III: Formalization _____ Stage IV: Maturity

2. If you checked stage II, III, or IV, did your information center evolve through the previous stage(s) described above?

____ yes ____ no

3. If you checked "yes" to question 2 above, please indicate the number of months your IC was in each of the previous stages of IC growth. (answer all that apply)

____ months in stage I ____ months in stage II

_____ months in stage III

4. Please indicate below to what extent you agree or disagree with the accruacy and completeness of the descriptions of each of the four stages if information center growth.

	Strongly Disagree						Strongly Agree	Dont Know
Stage I	1	2	3	4	5	67		X
Stage II	1	2	3	4	5	67		X
Stage III	1	2	3	4	5	67		X
Stage IV	1	2	3	4	5	67		X

Part II: The Characteristics of Interest

The following questions relate to the general characteristics of your information center.

1. How many months has your information center been in operation as of the end of May, 1986?

_____ months.

2. How many full time equivalent staff does your information center employ?

_____ full time equivalent staff

3. What is your estimate of the number of users in the user community supported by your information center?

_____ users in the user community.

4. What is the predominant type of hardware supported by your information center?

_____ Predominantly mainframes

_____ Predominantly microcomputers

_____ Both mainframes and microcomputers

5. What is the size of the total budget (including hardware, software, personnel, etc,) for your IC for 1986?

$ _____

6. What is the size of the total budget (including hardware, fortware, personnel, etc.) for your MIS function for 1986?

$ _____

Part III: Critical Success Factors

The following questions relate to the critical success factors that may be applicable to your information center. Please rate each of the following factors on how important you consider it to be for the success of your information center at the present time.

Circle the number that best corresponds to your perceptions of importance of each factor. Circle "1" to indicate low or no importance and "7" to indicate high importance. You may add up to 2 factors at the end.

	LEVEL OF IMPORTANCE LOW HIGH
1. priority criteria for work	1-2-3-4-5-6-7
2. a competent staff	1-2-3-4-5-6-7
3. support software packages	1-2-3-4-5-6-7
4. end-user training	1-2-3-4-5-6-7
5. monitor and coordinate end-user developments	1-2-3-4-5-6-7
6. top management support	1-2-3-4-5-6-7
7. respond to development requests	1-2-3-4-5-6-7
8. promote information center services	1-2-3-4-5-6-7
9. communication with user	1-2-3-4-5-6-7
10. cost effective solutions	1-2-3-4-5-6-7
11. atmosphere for users	1-2-3-4-5-6-7
12. system performance	1-2-3-4-5-6-7
13. understand users' businesses and problems	1-2-3-4-5-6-7
14. organizational acceptance of IC concept	1-2-3-4-5-6-7
15. manage end-user expectations	1-2-3-4-5-6-7
16. provide services to distributed sites	1-2-3-4-5-6-7

17. clear definition of responsibilities, procedures, policies, etc. for users, IC staff, and the MIS department. 1-2-3-4-5-6-7
18. user understanding of data processing 1-2-3-4-5-6-7
19. reliability of services provide 1-2-3-4-5-6-7
20. commitment of end-users to IC concept 1-2-3-4-5-6-7
21. career paths for IC staff 1-2-3-4-5-6-7
22. charge back criterion 1-2-3-4-5-6-7
23. control procedures to ensure standards, policies, etc. are adhered to 1-2-3-4-5-6-7
24. standardized hardware and software 1-2-3-4-5-6-7
25. Training for IC staff 1-2-3-4-5-6-7
26. Liaison function with the end-user departments 1-2-3-4-5-6-7

In your opinion, how successful is your information center in fulfilling its functions? (Please circle one)

Low level of Success — high level of success

1 2 3 4 5 6 7

Appendix D1: Ratings of the significance of the CSFs

CSF #1: PRIORITY CRITERIA FOR WORK

Mean = 4.7

	1	2	3	4	5	6	7
Frequency	5	18	33	89	67	54	35
Percent	1.7	6.0	11.0	29.6	22.3	17.9	11.6

CSF #2: A COMPETENT STAFF

Mean = 6.6

	1	2	3	4	5	6	7
Frequency	1	0	0	2	17	66	225
Percent	0.3	0.0	0.0	0.6	5.5	21.2	72.3

CSF #3: SUPPORT SOFTWARE PACKAGES

Mean = 5.2

	1	2	3	4	5	6	7
Frequency	3	3	12	37	94	92	69
Percent	1.0	1.0	3.9	11.9	30.3	29.7	22.3

CSF #4: END-USER TRAINING

Mean = 5.9

	1	2	3	4	5	6	7
Frequency	1	4	8	14	61	107	116
Percent	0.3	1.1	2.6	4.5	19.6	34.4	37.3

CSF #5: MONITOR AND COORDINATE END-USER APPLICATIONS DEVELOPMENTS

Mean = 4.1

	1	2	3	4	5	6	7
Frequency	13	37	60	67	79	42	12
Percent	4.2	11.9	19.4	21.6	25.5	13.5	3.9

KEY: 1 = low importance
7 = high importance

CSF #6: TOP MANAGEMENT SUPPORT

Mean = 6.3

	1	2	3	4	5	6	7
Frequency	1	2	4	13	39	79	172
Percent	0.3	0.6	1.3	4.2	12.6	25.5	55.5

CSF #7: RESPOND TO APPLICATIONS DEVELOPMENT REQUESTS

Mean = 3.8

	1	2	3	4	5	6	7
Frequency	37	51	47	60	57	45	14
Percent	11.9	16.4	15.1	19.3	18.3	14.5	4.5

CSF #8: PROMOTE IC SERVICES

Mean = 5.1

	1	2	3	4	5	6	7
Frequency	6	7	26	56	84	91	41
Percent	1.9	2.3	8.4	18.0	27.0	29.3	13.2

CSF #9: COMMUNICATION WITH THE USER

Mean = 6.3

	1	2	3	4	5	6	7
Frequency	0	0	0	10	37	99	165
Percent	0.0	0.0	0.0	3.2	11.9	31.8	53.1

CSF #10: COST EFFECTIVE SOLUTIONS

Mean = 5.3

	1	2	3	4	5	6	7
Frequency	3	2	23	52	93	72	65
Percent	1.0	0.6	7.4	16.8	30.0	23.2	21.0

KEY 1 = low importance
7 = high importance

CSF #11: ATMOSPHERE FOR USERS

Mean = 5.1

	1	2	3	4	5	6	7
Frequency	5	7	24	54	96	81	43
Percent	1.6	2.3	7.7	17.4	31.0	26.1	13.9

CSF #12: PERFORMANCE OF USER DEVELOPED APPLICATIONS

Mean = 4.4

	1	2	3	4	5	6	7
Frequency	8	30	44	73	88	47	20
Percent	2.6	9.7	14.2	23.5	28.4	15.2	6.56

CSF #13: UNDERSTANDING USER'S BUSINESS AND PROBLEMS

Mean = 5.8

	1	2	3	4	5	6	7
Frequency	1	3	7	21	65	121	92
Percent	0.3	1.0	2.3	6.8	21.0	39.0	29.7

CSF #14: ORGANIZATIONAL ACCEPTANCE OF IC CONCEPT

Mean = 5.7

	1	2	3	4	5	6	7
Frequency	7	3	11	26	70	96	97
Percent	2.3	1.0	3.5	8.4	22.6	31.0	31.3

CSF #15: MANAGE END-USER EXPECTATIONS

Mean = 5.2

	1	2	3	4	5	6	7
Frequency	3	2	19	61	100	85	40
Percent	1.0	0.6	6.1	19.7	32.3	27.4	12.9

KEY: 1 = Low importance
7 = High importance

CSF #16: PROVIDE SERVICES TO DISTRIBUTED SITES

Mean = 4.5

	1	2	3	4	5	6	7
Frequency	24	25	32	44	91	61	32
Percent	7.8	8.1	10.4	14.2	29.4	19.7	10.4

CSF #17: CLEAR DEFINITION OF RESPONSIBILITIES, PROCEDURES, POLICIES, ETC.

Mean = 5.0

	1	2	3	4	5	6	7
Frequency	7	13	29	54	78	71	59
Percent	2.3	4.2	9.3	17.4	25.1	22.8	19.0

CSF #18: USER UNDERSTANDING OF DATA PROCESSING

Mean = 4.0

	1	2	3	4	5	6	7
Frequency	13	32	72	80	75	29	10
Percent	4.2	10.3	23.2	25.7	24.1	9.3	3.2

CSF #19: RELIABILITY OF SERVICES PROVIDED

Mean = 6.1

	1	2	3	4	5	6	7
Frequency	0	0	3	16	56	119	117
Percent	0.0	0.0	1.0	5.1	18.0	38.3	37.6

CSF #20: COMMITMENT OF THE END-USERS TO THE IC CONCEPT

Mean = 5.1

	1	2	3	4	5	6	7
Frequency	4	8	21	51	93	91	43
Percent	1.3	2.6	6.8	16.4	29.9	29.3	13.8

KEY: 1 = Low importance
7 = High importance

CSF #21: CAREER PATHS FOR IC STAFF

Mean = 4.9

	1	2	3	4	5	6	7
Frequency	7	15	27	57	94	64	47
Percent	2.3	4.8	8.7	18.3	30.2	20.6	15.1

CSF #22: CHARGE BACK CRITERION

Mean = 3.1

	1	2	3	4	5	6	7
Frequency	86	54	47	51	36	19	17
Percent	27.7	17.4	15.2	16.5	11.6	6.1	5.5

CSF #23: CONTROL PROCEDURES TO ENSURE STADNARDS, POLICIES, ETC. ARE ADHERED TO

Mean = 4.4

	1	2	3	4	5	6	7
Frequency	12	30	42	73	97	49	26
Percent	3.9	9.6	13.5	23.5	25.4	15.8	8.4

CSF #24: STANDARDIZED SOFTWARE AND HARDWARE

Mean = 5.6

	1	2	3	4	5	6	7
Frequency	2	5	17	28	65	106	87
Percent	0.6	1.6	5.5	9.0	21.0	34.2	28.1

CSF #25: TRAINING FOR IC STAFF

Mean = 5.8

	1	2	3	4	5	6	7
Frequency	1	3	8	26	71	100	102
Percent	0.3	1.0	2.6	8.4	22.8	32.2	32.8

KEY: 1 = Low importance
7 = High importance

CSF #26: LIAISON FUNCTION WITH END-USER DEPARTMENTS

Mean = 5.6

	1	2	3	4	5	6	7
Frequency	2	5	12	29	67	117	77
Percent	0.6	1.6	3.9	9.3	22.2	37.6	24.8

KEY: 1 = Low importance
7 = High importance

Appendix D2: Mean significance ratings of the 26 CSFs for the four stages of IC growth

Critical Success Factors	Stage I	II	III	IV
1. priority criteria for work....	4.8	4.7	4.6	4.3
2. competent staff.....	6.4	6.6	6.7	6.6
3. support right software packages	5.3	5.6	5.4	5.5
4. end-user training	5.8	6.0	5.9	6.3
5. monitor and coordinate end user applications developments	4.8	4.0	4.1	3.7
6. top management support	6.4	6.2	6.3	6.0
7. response to requests	4.0	3.8	3.8	3.0
8. promotion of IC services	4.7	5.2	5.2	4.5
9. communication with users	6.2	6.3	6.4	6.3
10. cost effective solutions	5.0	5.4	5.3	5.0
11. atmosphere for users.....	4.7	5.1	5.1	5.3
12. system performance	4.3	4.3	4.4	4.5
13. IC staff's understanding of users' business and problems..	5.7	5.9	5.9	5.5
14. organizational acceptance of the information center	6.0	5.5	5.8	5.1
15. manage end user expectations .	5.0	5.1	5.2	5.3
16. provide services to distributed sites	3.8	4.6	4.6	4.6
17. define IC mission	4.7	5.0	5.2	4.7
18. users' understanding of data processing	3.8	4.0	4.0	3.7
19. reliability of applications developed.....	5.7	6.2	6.1	6.3
20. commitment of end-users to the IC concept	5.1	5.2	5.2	4.8
21. establishing career paths for IC staff	4.5	4.8	5.2	5.0
22. establishing a chargeback criterion	2.6	2.9	3.3	3.3
23. control procedures to ensure standards, policies, etc. are adhered to.....	4.0	4.3	4.5	4.5
24. standardized hardware and software.....	5.5	5.7	5.6	5.7
25. training for IC staff.....	5.3	5.7	6.0	6.0
26. liaison function with end-user departments.....	5.7	5.8	5.5	5.7

Appendix D3: Mean significance ratings of the 26 CSFs for the three age groups

Critical Success Factors	AGE GROUP Y	M-O	O
1. priority criteria for work....	4.7	4.7	4.5
2. competent staff.....	6.6	6.7	6.7
3. support right software packages	5.5	5.6	5.4
4. end-user training	5.8	6.0	6.0
5. monitor and coordinate end user applications developments	4.2	4.1	3.9
6. top management support	6.4	6.1	6.3
7. response to requests	4.0	3.7	3.6
8. promotion of IC services	5.2	5.0	4.9
9. communication with users	6.4	6.4	6.2
10. cost effective solutions	5.3	5.2	5.2
11. atmosphere for users.....	5.0	4.9	5.3
12. system performance	4.4	4.4	4.4
13. IC staff's understanding of users' business and problems..	5.9	5.8	5.7
14. organizational acceptance of the information center	5.9	5.6	5.5
15. manage end user expectations .	5.2	5.1	5.2
16. provide services to distributed sites	4.2	4.6	4.8
17. define IC mission	4.9	5.0	5.2
18. users' understanding of data processing	4.1	3.8	4.0
19. reliability of applications developed.....	6.0	6.1	6.1
20. commitment of end-users to the IC concept	5.3	5.1	5.0
21. establishing career paths for IC staff	4.8	4.9	5.0
22. establishing a chargeback criterion	2.8	2.8	3.6
23. control procedures to ensure standards, policies, etc. are adhered to.....	4.2	4.5	4.4
24. standardized hardware and software.....	5.6	5.5	5.8
25. training for IC staff.....	5.7	5.8	5.9
26. liaison function with end-user departments.....	5.7	5.7	5.5

Appendix D4: Mean significance ratings of the 26 CSFs for the three staff groups

Critical Success Factors	STAFF GROUP S	M	L
1. priority criteria for work....	5.0	4.6	4.5
2. competent staff.....	6.5	6.7	6.7
3. support right software packages	5.6	5.3	5.5
4. end-user training	6.0	5.9	5.9
5. monitor and coordinate end user applications developments	4.2	4.1	4.1
6. top management support	6.3	6.4	6.2
7. response to requests	4.2	4.1	3.5
8. promotion of IC services	5.0	5.0	5.1
9. communication with users	6.3	6.3	6.4
10. cost effective solutions	5.4	5.1	5.3
11. atmosphere for users.....	4.9	4.8	5.2
12. system performance	4.5	4.4	4.3
13. IC staff's understanding of users' business and problems..	5.9	5.9	5.8
14. organizational acceptance of the information center	5.8	5.7	5.6
15. manage end user expectations .	5.1	4.8	5.3
16. provide services to distributed sites	4.2	4.6	4.6
17. define IC mission	4.9	4.9	5.1
18. users' understanding of data processing	3.9	3.9	4.0
19. reliability of applications developed.....	6.1	6.0	6.1
20. commitment of end-users to the IC concept	5.2	4.9	5.2
21. establishing career paths for IC staff	4.8	4.6	5.1
22. establishing a chargeback criterion	3.0	2.4	3.3
23. control procedures to ensure standards, policies, etc. are adhered to.....	4.5	4.3	4.3
24. standardized hardware and software.....	5.9	5.6	5.5
25. training for IC staff.....	5.7	5.9	5.8
26. liaison function with end-user departments.....	5.8	5.7	5.5

Appendix D5: Mean significance ratings of the 26 CSFs for the three user groups

Critical Success Factors	USER GROUP S	M	L
1. priority criteria for work....	5.0	4.6	4.3
2. competent staff.....	6.6	6.6	6.7
3. support right software packages	5.4	5.6	5.5
4. end-user training	5.9	5.9	6.0
5. monitor and coordinate end user applications developments	4.3	4.2	3.8
6. top management support	6.4	6.2	6.2
7. response to requests	4.4	3.5	3.3
8. promotion of IC services	4.9	5.1	5.2
9. communication with users	6.2	6.5	6.4
10. cost effective solutions	5.2	5.4	5.3
11. atmosphere for users.....	4.8	5.3	5.2
12. system performance	4.4	4.4	4.2
13. IC staff's understanding of users' business and problems..	5.9	5.8	5.7
14. organizational acceptance of the information center	5.6	5.6	5.7
15. manage end user expectations .	5.0	5.3	5.2
16. provide services to distributed sites	4.4	4.3	4.8
17. define IC mission	4.9	5.1	5.2
18. users' understanding of data processing	4.0	3.9	4.0
19. reliability of applications developed.....	6.0	6.0	6.1
20. commitment of end-users to the IC concept	5.0	5.3	5.2
21. establishing career paths for IC staff	4.7	4.9	5.1
22. establishing a chargeback criterion	2.9	2.8	3.5
23. control procedures to ensure standards, policies, etc. are adhered to.....	4.3	4.4	4.4
24. standardized hardware and software.....	5.6	5.7	5.6
25. training for IC staff.....	5.7	5.8	5.9
26. liaison function with end-user departments.....	5.8	5.5	5.5

Appendix D6: Mean significance ratings of the 26 CSFs for the three hardware options supported

Critical Success Factors	Hardware Option MA	MI	MX
1. priority criteria for work	4.7	4.8	4.6
2. competent staff	6.8	6.6	6.7
3. support right software packages	5.4	5.6	5.4
4. end-user training	6.1	6.0	5.9
5. monitor and coordinate end user applications developments	3.9	4.5	3.9
6. top management support	6.6	6.4	6.1
7. response to requests	3.8	4.1	3.6
8. promotion of IC services	5.1	4.9	5.2
9. communication with users	6.3	6.3	6.4
10. cost effective solutions	4.9	5.5	5.2
11. atmosphere for users	5.1	5.0	5.1
12. system performance	4.8	4.5	4.2
13. IC staff's understanding of users' business and problems	5.8	5.9	5.8
14. organizational acceptance of the information center	5.9	5.7	5.6
15. manage end user expectations	5.2	5.2	5.1
16. provide services to distributed sites	4.7	4.6	4.4
17. define IC mission	5.5	4.8	5.0
18. users' understanding of data processing	4.2	3.7	4.0
19. reliability of applications developed	6.3	6.0	6.0
20. commitment of end-users to the IC concept	5.6	4.9	5.2
21. establishing career paths for IC staff	5.3	4.6	5.5
22. establishing a chargeback criterion	3.5	2.8	3.1
23. control procedures to ensure standards, policies, etc. are adhered to	4.6	4.6	4.2
24. standardized hardware and software	5.4	5.9	5.5
25. training for IC staff	6.0	5.6	5.9
26. liaison function with end-user departments	5.6	5.7	5.6