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An Empirical Investigation for EIS Utilization: On the Basis of TAM

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Ⅰ. Introduction

With the increased awareness of the importance of information technology (IT) in business, organizations continue to invest enormous sums of money in the acquisition of IT. Although there is some disagreement on the amount of IT investment in the literature, it is evident that organizations recognize IT as one of the most important weapons for their

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survival and success in a highly competitive environment. The reasons for heavy investment in IT vary, but the principal belief is that knowledgeable or professional workers will use the technology to become more productive in terms of quality, efficiency, and effectiveness (Thompson et al., 1994). However, individuals are sometimes unwilling to accept and use available systems and express a less than enthusiastic response to new technology, even though the systems may generate notable performance gains (Igbaria and Iivari, 1995). Since information technology which is not used cannot be effective, it is important to understand how individuals decide whether they will use it. Furthermore, understanding the factors that influence an individual's use of IT has been one of the most challenging issues in information systems (IS) research since the mid-1970s, when researchers and organizations began to find that adoption of new technology did not meet expectations (Compeau and Higgins, 1995). Of all types of information technology, executive information systems (EIS) are expected to have the greatest impact on executives' work performance. A survey of senior IS managers identified "facilitating and managing decision and executive support systems" as one of the most critical IS management issues for the 1990s (Niederman et al., 1991). Although the importance of EIS has been recognized in the literature, few attempts have been made to systematically investigate key factors in the successful utilization of an EIS. The empirical results from this study may prove useful for both IS researchers and practitioners interested in key factors affecting the utilization of an EIS. In particular, this study can contribute to researchers who are interested in understanding IT adoption and utilization processes. Some researchers have studied the direct relationship between key factors and IT utilization, while others have studied the relationship between perceptions towards IT and its utilization. There are few studies interlinking effects of key factors, perceptions, and utilization. By adopting a widely accepted theory of computer usage behavior (Technology Acceptance Model: TAM), the present study examines these relationships as well as the important factors that affect EIS utilization. This study also may benefit practitioners by enhancing their understanding of the issues in successfully designing and implementing an EIS. When planning a new system, IS practitioners would like to be able to predict whether the new system will be acceptable to users, diagnose the reasons why a planned system may not be fully acceptable to users, and take corrective action to increase the acceptability of the system--all in order to enhance the business impact resulting from the large investments in time and money associated with introducing new information technologies into organizations. This research may provide IS practitioners with

guidelines for all of these concerns.

Ⅱ. Prior Research

2.1 Executive Information Systems (EIS)

The term Executive Information Systems (EIS) originated at MIT in the late 1970s and early 1980s (Turban and Schaeffer, 1987). A survey reporting on current EIS practices suggests that EIS are providing effective computer support for executives in a large number of corporations (Watson et al., 1991). Leidner and Elam (1994) define an EIS as a computer-based information system designed to allow a senior manager access to information relevant to his or her management activities. There are many benefits associated with the use of EIS, from several perspectives. From the economic perspective, an EIS helps to reduce paper reports (Gelfond, 1988), to eliminate staff levels and administrative tasks in organizations (Gauthir, 1989), and consequently to decrease the costs associated with them. From the individual perspective, an EIS supports executive activities by providing on-line and fast access to data and information from internal and external sources. As a result, it can lead to a better understanding of the business (Rockart and DeLong, 1988), remove guesswork in financial forecasting (McCartney, 1989), keep executives up to date with operations (Gauthier, 1989), increase the quality of decision-making, and communication capacity and quality (Bergeron et al., 1991). Therefore, an EIS can have a tremendous positive impact on executive productivity. From the organizational perspective, an EIS facilitates the attainment of organizational objectives, provides a competitive advantage within an industry (Bergeron et al., 1991), and consequently can lead to higher levels of organizational performance (Paller and Laska, 1990). Even though there are obvious potential benefits of EIS, they have not been extensively used for a variety of reasons (Frolick, 1994; Watson et al., 1991). Understanding these reasons is important because they provide insights into what problems should be overcome to attain EIS success. One of the reasons may originate with the executives themselves. Many of today's executives are old enough to have missed the computer revolution. Consequently, they may not be comfortable with using computers. In addition, executives may not feel the necessity to use a computer because they

can always rely on staff personnel and subordinates who fulfill their information requests. Also, they may believe that the information of real value to executives is soft rather than hard, and that such information is usually obtained through interaction with other managers and staff. As a result, they are convinced that real executives do not use computers. Another reason can be found in the nature of executive work. Because of their busy schedules and travel requirements, executives have little time to examine, analyze, or understand the information produced by an EIS. Finally, the reason may come from the system itself. EIS seem to be a technology that is difficult to use, at least from most executives' perspective. In addition, an EIS is unlikely to provide the type of information needed by executives, since much of the information in an EIS is historical in nature and of little value for formulating future actions. Notwithstanding such criticisms, EIS will become key tools to executives. As emphasized by Gulden and Ewers (1989), in the era of reorganization, mergers and acquisitions, intense competition, and turbulent markets, executives need more effective ways to analyze their markets and competition and guide their operation and people. Since an EIS can facilitate these means by providing real-time information about internal and external environments of the organization, executives will depend more and more upon it. Moreover, continuous technological advances leading to more user-friendly EIS with high-quality color graphics and mouse or touch-screen operation will encourage executives to use it, without extensive computer literacy and training. Therefore, it is expected that more computing resources will be directed toward executives and EIS support for executive functions will continue to grow in the future.

2.2 Theoretical Framework: Technology Acceptance Model (TAM)

The current study employs the Technology Acceptance Model (TAM) as a main theoretical framework. TAM provides the means to understand the user's adoption and utilization process of information technology (IT) as well as to identify the factors that may influence IT adoption and utilization. Davis (1989) introduced TAM, which is an adaptation of a Theory of Reasoned Action (TRA) specifically refined for modeling user acceptance of information systems. In a comparison study between TAM and TRA, Davis et al. (1989) point out that the goal of TAM is to explain the determinants of computer acceptance that constitute general user behavior across a broad range of end-user computing technologies and user populations. TAM posits that computer acceptance

behavior is determined by two particular beliefs, perceived usefulness and perceived ease of use. Therefore, a primary purpose of TAM is to provide a basis for tracing the impact of external factors on two beliefs, namely perceived usefulness and perceived ease of use, and ultimately IT usage. Davis (1989) defines perceived ease of use as "the degree to which a person believes that using a particular system would be free of effort", whereas perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (p. 320). From this viewpoint, Venkatesh and Davis (1994) claim that TAM is designed to explain the variance in computer acceptance behavior as a function of a user's perceived usefulness and ease of use of a system.

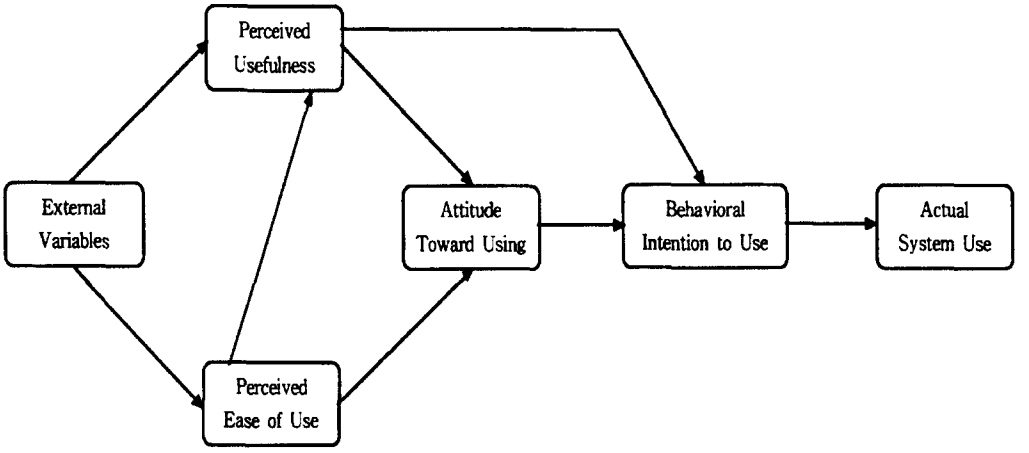
TAM is shown in Figure 1. According to this figure, external variables directly influence perceived usefulness and perceived ease of use. Also, external variables have an indirect effect on attitude toward using, behavioral intention to use, and actual usage behavior through their direct effect on perceived usefulness and perceived ease of use. Perceived ease of use has a causal effect on perceived usefulness. Attitude toward using is a function of two perceptions: perceived usefulness and perceived ease of use. A prospective user's overall attitude toward using a given system is theorized to be a major determinant of behavioral intention to use, and finally actual system use. Davis et al. (1989) suggest that the attitude-behavioral intention relationship implies that people form intentions to perform behaviors toward which they have positive concerns. The behavioral intention-usage (or behavior) relationship is strongly supported by numerous empirical studies (Sheppard et al., 1988; Davis, 1989; Davis et al., 1989). Both Davis et al. (1989) and Davis (1989) observe that behavioral intention is significantly related to behavior. Also, Sheppard et al. (1988) report a significant correlation of 0.53 between intention and behavior in their extensive meta-analysis of TRA. According to numerous studies on TAM (Adams et al., 1992; Davis, 1989 and 1993; Davis et al., 1989; Hendrickson et al., 1993; Segars and Grover, 1993; Subramanian, 1994), there are four main insights concerning the determinants of IT use:

(1) Perceived usefulness and perceived ease of use have been found to be critical factors and predictors of user intentions.

(2) Perceived usefulness has been found to be a major determinant of user intentions.

(3) Perceived ease of use has been found to be a secondary determinant of user intentions.

(4) User intentions have been significantly associated with system usage.



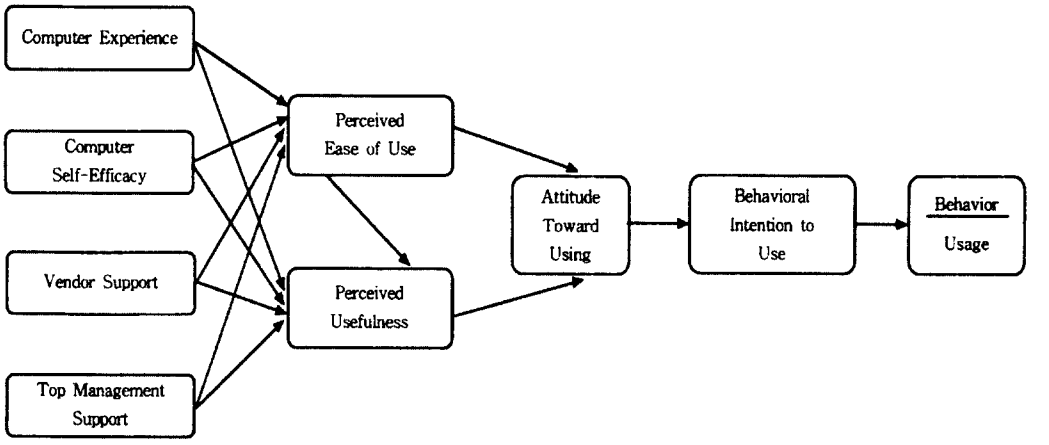
<Figure 1> Technology Acceptance Model (TAM)

III. Research Model and Hypotheses

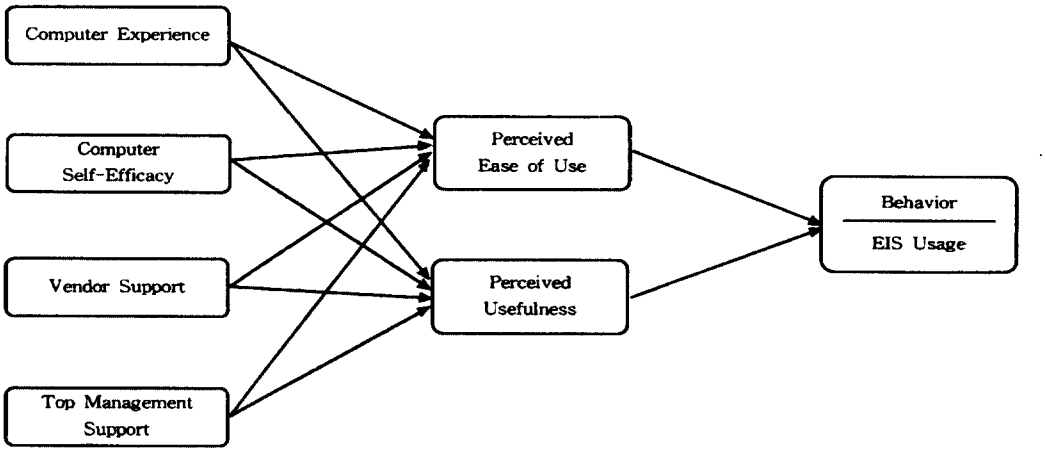
3.1 Research Model

This study is intended to identify and verify some key factors of EIS utilization by using the Technology Acceptance Model (TAM). The conceptual model and the research model for the current study are presented in Figure 2 and Figure 3, respectively. There are two differences between them. The first is that the two variables "attitude toward using" and "behavioral intention to use" are excluded in the research model since the variable of interest is actual behavior (i.e., EIS usage), and not attitude nor intention to use. The exclusion of these variables would not affect the validity of TAM because attitude and intention to perform a behavior generally predict the behavior (Ajzen and Fishbein, 1977; Davis et al., 1989). The second difference between the two figures is that the relationship between perceived ease of use and perceived usefulness is not included in the research model since the primary goal of this study is to investigate whether some factors influence EIS usage via an individual's perceptions, not to examine their relationship. In addition, many TAM

studies have provided enough empirical evidence on their relationship, suggesting that perceived ease of use is actually a causal antecedent to perceived usefulness, rather than a parallel determinant of systems usage.



<Figure 2> The Conceptual Model of EIS Usage



<Figure 3> The Research Model of EIS Usage

As the research model given in Figure 3 indicates, individual characteristics (computer

experience and computer self-efficacy), organizational support (top management support) and external support (vendor support) are each held to influence perceived ease of use and perceived usefulness. These variables are each assumed to influence EIS usage, indirectly through perceived ease of use and perceived usefulness. Thus, the research model encompasses 12 hypotheses regarding individual behavior toward an EIS.

3.2 Dependent Variable—System Utilization

A great number of researchers have suggested several surrogate measures for IS success and/or effectiveness. In general, these include: (1) system quality (Franz and Robey, 1986; Srinivasan, 1985), (2) information quality (Jones and McLeod, 1986; Mahmood, 1987), (3) system utilization (Baroudi et al., 1986; Barti and Huff, 1985; Raymond, 1985), (4) user information satisfaction (Baroudi et al., 1986; Barti and Huff, 1985; Raymond, 1985), (5) individual impact (Benbasat and Dexter, 1986; DeSanctis and Jarvenpaa, 1985), and (6) organizational impact (Benbasat and Dexter, 1986; Kaspar and Cerveny, 1985). In addition, critical success factors, if identifiable, have also been cited as a measure of IS success (Rockart, 1979). The existence of so many different success measures in the IS field makes it difficult to compare the results of similar studies, and thus to build a cumulative tradition for IS research. For instance, Raymond (1985) utilized two dependent variables as surrogate measures of IS success, which are 1) user's information satisfaction and 2) level of system utilization. Srinivasan (1985) argued that different measures of IS success usually produce different results because of the inherent characteristics of each measure. After reviewing a number of studies on IS success, DeLone and McLean (1992) pointed out that no single measure is intrinsically better than another, so that the choice of IS success measure depends in large part upon the objective of the study, the aspect of the information system which is addressed by the study, the independent variables under investigation, the research method, and the level of analysis.

Many researchers have suggested that system utilization is one of the most frequently reported measures of IS success. One of the most important reasons why a number of researchers have employed system utilization as a surrogate measure of IS success is that it, of all the measures identified above, is probably the most objective and the easiest to quantify, at least conceptually (DeLone and McLean, 1992). Second, it is highly correlated with the other surrogate measures of IS success (DeLone and McLean, 1992; Trice and

Treacy, 1988). Finally, system utilization seems to be a good indicator of IS success when use is voluntary (Adams et al., 1992; Goodhue, 1992). If use is voluntary, then a high level of use means that the decision maker perceives some benefits from the system. In instances where use is not discretionary, user information satisfaction measures are recommended as an index of IS success (DeLone and McLean, 1992; Goodhue, 1992). Executive information systems are most often used on a voluntary basis (Adams et al., 1992). Accepting this assumption implies that the employment of system utilization as an indicator of IS success is reasonably justified. However, it does not imply that system utilization is the ultimate measure of IS success. As pointed out by Anderson and Hoffman (1978), if systems operate regularly but do not influence management behavior, they become irrelevant adjuncts to individual and/or organizational performance. Therefore, use is considered as an important and necessary condition for the realization of potential benefits such as better decisions, increased decision making effectiveness, better understanding of problems, and so on.

3.3 Independent Variables and Hypotheses

Many researchers have attempted to identify a number of variables which may influence the success of IS use. Based on TAM, the proposed study is designed to identify important factors that are likely to be critical for EIS utilization, not to classify all potential factors. Although the independent variables included in this study are not comprehensive by any means, they may represent some relevant factors for system usage behavior.

3.3.1 Computer Experience

A user's computer experience may critically influence his/her perceptions and/or attitudes toward IS and system usage. Successful experience with an information technology usually improves a person's perceptions and attitudes toward using some technologies, by reducing or eliminating any existing fears. In general, most of the previous studies showed a positive correlation between computer experience and perception/attitude-behavior. Rivard and Huff (1988) found that the heterogeneity of users' computer experience was a significant variable in explaining why some viewed a tool as easy to use while others perceived the same tool as difficult to use. In a study of direct experience and attitude-behavior consistency, Fazio and Zanna (1981) found that attitude resulting from direct experience was a strong predictor of behavior. Nickell and Seado (1986) conducted a study to investigate the perceptions and

attitudes of small business owners/managers toward computers and how computers are used in business. From this study, they found that owners/managers with computer experience have a more positive perception and attitude toward computers. Based on this result, they argued that a lack of computer experience or a negative experience with computers may instill a negative perception and attitude about using IS. They pointed out the key role of education and training in changing negative perceptions and attitudes toward computers. Recently, Thompson et al. (1994) conducted a study that investigated influence of prior experience on personal computer utilization. In this study, they contended that the relationship between experience and behavior (i.e., IT usage) is not straightforward. They suggested three different possibilities in which such a relation could happen: (1) experience exerts a direct influence on behavior, (2) experience exerts an indirect influence on behavior, through intervening variables such as perception and attitude, and (3) experience moderates the effect of antecedent factors on intentions and behavior. By testing the above mentioned relationships, they found that experience influenced utilization directly, that indirect effects of experience on utilization were weakly present, and that the moderating effect of experience on perception and attitude, and utilization was quite strong.

Therefore, such findings suggest:

H1a : The higher the executives computer experience, the higher his/her perceived ease of use of an EIS.

H1b : The higher the executives computer experience, the higher his/her perceived usefulness of an EIS.

H1c : The effect of computer experience on EIS utilization will be mediated by perceived ease of use and perceived usefulness.

3.3.2 Computer Self-Efficacy

Bandura (1986) argued that two sets of expectations are the major cognitive forces driving individual behavior. The first set of expectations relates to outcomes. The rationale of this is that individuals will undertake behaviors if they believe such behaviors will lead to beneficial consequences. The usefulness construct employed in this study can be considered as expectations about outcomes, including increased productivity, performance, and effectiveness. The second set of expectations involves beliefs about one's ability to perform a particular behavior, that is, self-efficacy. Individuals will undertake behaviors if they convince their capabilities to successfully perform such behaviors. Bandura and his colleagues

(Bandura, 1977, 1982, 1986; Bandura et al., 1977) showed that personal self-efficacy has a positive impact on the formation of perceptions and attitudes. Also, Compeau and Higgins (1995) emphasized that self-efficacy influences decisions about what behaviors to undertake, the effort and persistence exerted in the face of barriers to the performance of those behaviors, and the attitude of the individual performing the behaviors. In general, self-efficacy is defined as "judgment of how well one can execute courses of actions required to deal with prospective situations" (Bandura, 1982, p. 122). Based on this definition, therefore, computer self-efficacy can be interpreted as the judgment that a person has about his or her own ability to use a computer competently in the accomplishment of a task. It does not refer to what one has done in the past, but to beliefs of what could be done in the future. Furthermore, it is not concerned with simple skills, but with judgments of the ability to apply those skills to broader tasks (Compeau and Higgins, 1995). Several researchers have explored the relationships between computer self-efficacy and a variety of computer behaviors (Burkhardt and Brass, 1990; Compeau and Higgins, 1995; Venkatesh and Davis, 1994). In most cases, they found that computer self-efficacy plays an important role in individuals' perceptions and behaviors, suggesting the need for further research to explore fully the role of computer self-efficacy in computing behavior. For example, Burkhardt and Brass (1990) reported that computer self-efficacy was related to early adoption and utilization of a new technology. Venkatesh and Davis (1994) examined the affect of self-efficacy on the perceived ease of use construct using two different information technologies (E-mail and Gopher) and found that perceptions about a new system's ease of use are anchored in a person's computer self-efficacy. Recently, Compeau and Higgins (1995) argued that computer self-efficacy plays a major role in the choices individuals make with respect to the use of computing technology. From a field survey of over 1,000 managers in a broad range of industries, they concluded that computer self-efficacy has not only a direct impact on IS usage, but also indirect impacts through its impact on outcome expectations, computer anxiety, and attitudes about IS use.

Through an analysis of the previous research mentioned above, it is evident that computer self-efficacy is an important determinant affecting users' perceptions about, and utilization of, technologies. Therefore, the following hypotheses are put forward:

H2a : The higher the executives computer self-efficacy, the higher his/her perceived ease of use of an EIS.

H2b : The higher the executives computer self-efficacy, the higher his/her perceived usefulness

of an EIS.

H2c : The effect of computer self-efficacy on EIS utilization will be mediated by perceived ease of use and perceived usefulness.

3.3.3 Vendor Support

In general, vendor support represents the extent to which vendors provide education, training, consulting, and technical assistance during IS development and implementation. The importance of vendor support for successful IS development and implementation has been widely emphasized by several researchers (Bajwa and Rai, 1994; Ettlie, 1986; Johnson, 1988; Watson et al., 1991). Bajwa and Rai (1994) investigated the relationship between vendor support and EIS success. In this study, they pointed out two reasons which make the penetration of EIS possible: the time constraints due to the nature of executive work and the aggressive marketing of the technology vendors. They emphasized an active vendor role for successful EIS development and use in the organization, since EIS is an emerging technology and thus the skills or know-how required to use EIS are not likely to be available in-house. They found that vendor support was not significantly correlated to EIS success; however, as mentioned by the authors, vendor support may be an important factor for firms that use EIS software packages developed by vendor(s). In their study, about 52% of the respondents used in-house developed EIS packages. This reason could result in their findings, i.e., no significant relationship between vendor support and EIS success. In another EIS study, Watson et al. (1991) emphasized vendor support as a key component of the EIS development framework. They found that it is particularly important in the initial phases of EIS development. In a study of successful hospital information systems, Johnson (1988) suggested that the level of vendor support has become as important as the system's functional features. In order to successfully implement and maintain hospital information systems, he recommended that IS managers find out what user support and technical support the vendors provide.

Based on the above findings and TAM, the following hypotheses are presented:

H3a : The higher vendor support, the higher the executives perceived ease of use of an EIS.

H3b : The higher vendor support, the higher the executives perceived usefulness of an EIS.

H3c : The effect of vendor support on EIS utilization will be mediated by perceived ease

of use and perceived usefulness.

3.3.4 Top Management Support

Top management support is essential for achieving significant success in applying information systems (IS). In general, it includes the terms "participation" and "involvement" of top management in IS activities, in which "participation" refers to top management's activities or substantive personal intentions in IS management and "involvement" reflects top management's perceptions and attitudes concerning IS (Jarvenpaa and Ives, 1991). The importance of top management support for IS success is widely recognized in the IS literature (Bajwa and Rai, 1994; Boltz, 1987; Houdeschel and Watson, 1987; Meador et al., 1984; Sanders and Courtney, 1985; Watson et al., 1991). Bajwa and Rai (1994) conducted a study investigating the relationship between top management support, IS management support, vendor support, and EIS success. They found that top management support was critical and significantly correlated with IS management support and vendor support. Simultaneously, top management support was also significantly associated with EIS success. Based on the results of this study, they concluded that EIS success without top management support was not likely to happen. In a descriptive study of the management information and decision support (MIDS) system at Lockheed-Georgia, Houdeschel and Watson (1987) emphasized senior executive support as one of the key factors contributing to the success of MIDS. In another EIS study, Watson et al. (1991) presented a framework for the development of EIS and analyzed data related to this framework from 50 firms that either have an EIS or are developing it. They found that most EIS development was spurred by a high senior executive who serves as the system's executive sponsor. For successful EIS implementation, Boltz (1987) also pointed out the need for a personal commitment from a member of top management who is interested in the system and is willing to spend a considerable amount of time with the EIS process. On the other hand, Meador et al. (1984) investigated the relationship between top management emphasis and DSS development and use. From the results of this study, they concluded that top management emphasis was the most important factor in DSS project approval and perceived DSS success. In another DSS study, Sanders and Courtney (1985) conducted a field study of 378 DSS users in 124 organizations to examine several variables in the user's environment that may influence the success of DSS. They measured DSS success as overall satisfaction and decision-making satisfaction with a DSS. They found that the level of top management support was an

important correlate of DSS success.

Based on previous findings and TAM, the following hypotheses are stated:

H4a : The higher top management support, the higher the executives perceived ease of use of an EIS.

H4b : The higher top management support, the higher the executives perceived usefulness of an EIS.

H4c : The effect of top management support on EIS utilization will be mediated by perceived ease of use and perceived usefulness.

IV. Data Collection

The mail survey was used to gather data to test the relationships expressed in the hypotheses. Because there is no comprehensive list of organizations and individuals with an EIS, contacts with EIS software vendors were made by telephone to identify potential individuals or companies with EIS. All but one vendor declined to participate, primarily citing company policy or possible loss of business. The company, which is a leading-edge EIS vendor, agreed to assist with this study. However, it would not allow direct access to a list of its customers. Instead, it distributed the questionnaires to its clients with a letter requesting their cooperation. A cover letter which addressed the purpose of the survey, including a definition of EIS, accompanied each questionnaire. Participants were assured complete confidentiality and were offered a copy of the results of the survey. A stamped return-addressed envelope was also included with the survey materials. No follow-up mailing was used in this study. Each respondent was requested to fill out the survey questionnaire and to send it back to the researcher.

V. The Measures

A review of the literature on IS implementation, innovation diffusion, and related areas was conducted to identify construct definitions and any existing measures of the model variables employed in this study. Based on this review, scales were formed for each of the

constructs. Previously developed and validated instruments were adopted directly. A few constructs of existing measures were adapted. Each of the measures used in the study is discussed below.

5.1 Computer Experience

This variable is measured using eight items developed by Pavri (1989). In his study, Pavri obtained a reliability coefficient (Cronbach's alpha) of 0.804, which exceeds the acceptable level of 0.7 (Nunnally and Bernstein, 1994). The respondents are asked to indicate, on a five-point scale, the extent of their exposure to different aspects of computer software, languages and development of computer systems, their overall computer skills, and their keyboard skills. These scores are averaged to obtain an overall computer experience score for each individual.

5.2 Computer Self-Efficacy

Based on existing measures, Compeau and Higgins (1995) developed a reliable measure for this variable. In their study, they obtained a reliability coefficient (Cronbach's alpha) of 0.95. This study utilizes their instrument with ten items. The respondents are asked to imagine they have been given a new software package for use in their job and to indicate, on a five-point scale, how confidently they use this unfamiliar package under a variety of conditions.

5.3 Vendor Support

This construct is measured by using a highly reliable instrument developed by Bajwa and Rai (1994), which obtained a reliability coefficient (Cronbach's alpha) of 0.87. The respondents are asked to specify, on a five-point scale, the degree of agreement or disagreement with the following four items: (1) vendor participation in the initial phases of EIS development and implementation, (2) cooperation in resolving technical problems, (3) training in initiating EIS use, and (4) communication to ensure product satisfaction.

5.4 Top Management Support

Based on a review of literature on top management support in the IS area, Bajwa and Rai (1994) developed a highly reliable instrument (Cronbach's alpha = 0.87). Top management support is measured by adapting their questions, which consist of six items. The respondents are asked to indicate, on a five-point scale, their extent of agreement or disagreement with the following four items: (1) resources allocated for EIS, (2) top management perception of EIS, (3) top management feedback on EIS applications, and (4) EIS as a priority of top management.

5.5 Perceived Ease of Use and Perceived Usefulness

The measurement scales of these variables are taken from Davis (1989), who developed, validated, and extensively pretested them. Originally, he generated fourteen items for each construct based on their definitions, which were later refined into six items per construct with high reliability (Cronbach's alpha of 0.93 for ease of use and 0.97 for usefulness). Further replications by Adams et al. (1992), Chin and Todd (1995), Hendrickson et al. (1993), and Mathieson (1991) support the strong psychometric properties of these measures. Given the six items per construct, the respondents are asked to assess, on a five-point scale, the degree of their agreement or disagreement concerning perceptions of EIS. The overall score for each construct is formed by averaging the respective six items.

5.6 System Utilization

Based on the various usage studies, Pavri (1989) developed a highly reliable measure (Cronbach's alpha = 0.87). The measure of system utilization employed in this study is borrowed from his research, which is divided into three dimensions: (1) the degree of EIS utilization to perform eight tasks--looking for trends, finding problems, planning, forecasting, budgeting, communicating with others, controlling and guiding activities, and making decisions; (2) actual time spent on EIS; and (3) frequency of EIS use. The first dimension asks the respondents to assess, on a five-point scale, the extent of their system usage for important business activities in their organizations. The second dimension asks the

respondents to specify how much time they normally spend each working day using their EIS. The third dimension asks the respondents to indicate how frequently they use their EIS. In general, frequency of use and amount of time spent using a system are typical usage metrics employed in IS research. These scores are averaged to provide an overall system utilization score.

VI. Data Analysis and Results

A total of 400 questionnaires was distributed for the current study. The number of returned questionnaires was 112, a response rate of 28.0%. Among them, fifteen responses were unusable because either too many values were missing (6 responses) or the EIS was no longer used (9 responses). Thus, 97 responses were used for the data analysis. The overall demographics of the respondents are presented in Table 1. With respect to the gender of the respondents, 72 (74.2%) were male and 25 (25.8%) were female. The primary age group of the respondents was from 31 to 50 (about 85%). The respondents of this study were very highly educated. Over 90% of the respondents had at least a university level of education. This high education level of respondents was expected as the majority of the respondents were managers. Self-reported job titles of respondents indicated that 33 (34.0%) belonged to corporate management positions such as CEO, President, VP Operations, CFO, Chief Operating Officer, and so on. Also, 21 respondents (21.6%) held top IS positions such as senior VP, associate VP, assistant VP, and Director of IS. Therefore, 55.6% of the respondents held top management positions. 25 respondents (25.8%) were functional middle managers, and 11 (11.3%) were IS middle managers. Therefore, 37.1% of the respondents belonged to middle management positions. Only 7 respondents (7.2%) held lower management positions, including 3 in functional lower management and 4 in IS lower management. Based on these statistics, it can be concluded that the EIS in this study were principally used by corporate high-level managers.

6.1 Reliability and Construct Validity

The reliability of a measure refers to its stability over a variety of conditions (Nunnally

Table 1. Description of Respondents

Characteristics	Frequency	Percent(%)
Gender		
Male	72	74.2
Female	25	25.8
Age		
Under 25	0	0.0
25-30	4	4.1
31-35	18	18.6
36-40	19	19.6
41-45	25	25.8
46-50	20	20.6
51-55	8	8.2
56-60	3	3.1
61-65	0	0.0
Over 65	0	0.0
Education		
Attended high school	0	0.0
Graduated from high school	1	1.0
Attended college/university	7	7.2
Graduated from college/university	35	36.1
Master study without a degree	15	15.5
Received a master degree	31	32.0
Post master study without a degree	7	7.2
Received a doctoral degree	1	1.0
Job Title		
Corporate mgmt. (CEOs)	33	34.0
Functional middle mgmt. (Managers)	25	25.8
Lower mgmt. (Supervisors)	3	3.1
IS top mgmt. (VPs, Directors, etc.)	21	21.6
IS middle mgmt. (Managers)	11	11.3
IS lower mgmt. (Prog. and Analysts)	4	4.1

and Bernstein, 1994). The Cronbach alpha coefficient is widely used for estimating the internal consistency reliability of a measure. Although there is no definite value for evaluating the reliability of a measure, the rule of thumb is that an alpha coefficient above

0.7 signifies high reliability (Nunnally and Bernstein, 1994; Pedhazur and Pedhazur Schmelkin, 1991). Table 2 presents the results of reliability testing. The alpha coefficients for this study ranged from a low of 0.740 (Vendor Support Construct) to a high of 0.941 (Perceived Usefulness Construct). As seen in Table 2, all alpha values were greater than 0.7. This result was expected as all the constructs used in this study are based on well-established instruments with high reliability scores from prior research. On the other hand, the purpose of construct validity is to assess the quality of correspondence between a theoretically-based construct and its operational measures (Babbie, 1995). One of the most powerful methods to test construct validity is factor analysis (Kerlinger, 1986).

Table 2. Reliability Test

Construct	Number of Items	Cronbach's Alpha (α)
Computer Experience	8	0.765
Computer Self-Efficacy	10	0.895
Vendor Support	4	0.740
Top Management Support	4	0.861
Perceived Ease of Use	6	0.890
Perceived Usefulness	6	0.941
Usage	10	0.856

Table 3 shows the results of the principal factor analysis by using a varimax rotation on items used to measure the study variables. All the constructs loaded onto single factors. Although there is no generally accepted standard on significance of factor loadings, the 0.3 criterion suggested by Nunnally and Bernstein (1994) was chosen. As shown in Table 3, all the items had factor loadings greater than 0.3.

Table 3. Factor Analysis

	1	2	3	4	5	6	7
COMPEXP1	0.33						
COMPEXP2	0.76						
COMPEXP3	0.54						
COMPEXP4	0.72						
COMPEXP5	0.62						
COMPEXP6	0.82						
COMPEXP7	0.66						
COMPEXP8	0.44						
COMPSE1		0.70					
COMPSE2		0.74					
COMPSE3		0.72					
COMPSE4		0.76					
COMPSE5		0.75					
COMPSE6		0.79					
COMPSE7		0.66					
COMPSE8		0.66					
COMPSE9		0.64					
COMPSE10		0.59					
VENDOR1			0.64				
VENDOR2			0.81				
VENDOR3			0.69				
VENDOR4			0.59				
TOP1				0.75			
TOP2				0.81			
TOP3				0.73			
TOP4				0.82			
EASE1					0.84		
EASE2					0.64		
EASE3					0.80		

Constructs : 1. Computer Experience
2. Computer Self-Efficacy
3. Vendor Support
4. Top Management Support
5. Perceived Ease of Use
6. Perceived Usefulness
7. Usage

Table 3. (Continued)

	1	2	3	4	5	6	7
EASE4					0.70		
EASE5					0.88		
EASE6					0.90		
USEFUL1						0.85	
USEFUL2						0.83	
USEFUL3						0.82	
USEFUL4						0.78	
USEFUL5						0.84	
USEFUL6						0.89	
USAGE1							0.67
USAGE2							0.62
USAGE3							0.75
USAGE4							0.74
USAGE5							0.62
USAGE6							0.58
USAGE7							0.72
USAGE8							0.87
USAGE9							0.55
USAGE10							0.45

Constructs : 1. Computer Experience
2. Computer Self-Efficacy
3. Vendor Support
4. Top Management Support
5. Perceived Ease of Use
6. Perceived Usefulness
7. Usage

6.2 Test of the Research Model

Multiple regression analysis was used to test the hypotheses of this study regarding direct effects of the four independent variables on perceived ease of use and perceived usefulness, and indirect effects of them on EIS usage via perceived ease of use and perceived usefulness.

6.2.1 Direct Effects of Independent Variables

Multiple regression analysis was conducted to examine the relationships of the four independent variables (computer experience, computer self-efficacy, vendor support, and top management support) with perceived ease of use and perceived usefulness of an EIS. Perceived ease of use and perceived usefulness of the EIS were regressed on all of the independent variables to assess their direct effects. Furthermore, EIS usage was also regressed on the six antecedent variables including perceived ease of use and perceived usefulness. The regression results are presented in Table 4. The data show that the

Table 4. Direst Effect of Independent Variables on Perceived Ease of Use, Perceived Usefulness, and Usage

Antecedent Variables	Standardized Regression Coefficients		
	Perceived Ease of Use	Perceived Usefulness	Usage
Computer Experience	0.283*	0.061	0.017
Computer Self-Efficacy	-0.100	0.234*	-0.066
Vendor Support	0.128	-0.026	-0.135
Top Management Support	0.019	0.305**	-0.066
Perceived Ease of Use			0.237*
Perceived Usefulness			0.378***
$R^{2)}$	0.107	0.170*	0.225*

independent variables as a whole explained 10.7% of the variance in perceived ease of use, but this is not significant at the 0.05 level. These independent variables explained 17.0% of the variance in perceived usefulness, which is significant at the 0.05 level. The six antecedent variables explained 22.5% of the variance in EIS usage (statistically significant at the 0.05 level). As shown in Table 4, computer experience had a direct effect on perceived ease of use. Thus, hypothesis 1a regarding the positive influence of computer experience on perceived ease of use of an EIS was supported. However, the other independent variables had no effect on perceived ease of use. Therefore, the hypotheses regarding their direct

effects on perceived ease of use were not supported. Both computer self-efficacy and top management support had direct effects on perceived usefulness of an EIS. Consequently, hypotheses 2b and 4b were supported. However, the other hypotheses regarding direct effects on perceived usefulness of an EIS were not supported. As expected, perceived ease of use and perceived usefulness had significant direct effects on EIS usage.

6.2.2 Mediating Effects of Perceived Ease of Use and Usefulness on EIS Usage

This study hypothesized that the four independent variables would influence EIS usage through perceived ease of use and perceived usefulness. These hypotheses were examined by adopting the procedure suggested by Wall et al. (1978). They proposed the following four criteria to test the mediating effect by multiple regression analysis, and concluded that a variable plays a role as a mediating variable if the four criteria are simultaneously satisfied.

Criterion 1 : The intervening variables should account for sizable proportions of the variance in the dependent variable;

Criterion 2 : The independent variables should add little to this when considered in the same analysis;

Criterion 3 : The independent variables alone should account for relatively little of the dependent variable variance; and

Criterion 4 : The intervening variables should add considerably to this when considered in the same analysis.

For this study, the first two criteria were tested by introducing the intervening variables (perceived ease of use and perceived usefulness) into a regression equation as primary predictors of the dependent variable (EIS usage). The four independent variables were then added as secondary predictors. As emphasized by Wall et al., these two analyses are not enough since they give an overestimate of the independent contribution of the intervening variables. This is because these variables were entered first into the regression analyses, which enable them to capture the variance they predict in common with the independent variables. Therefore, the last two criteria (3 and 4) are necessary to test the mediating effect appropriately. These criteria were tested by introducing the independent variables into a regression equation as primary predictors and then adding the intervening variables. The results of the analyses are summarized in Table 5. As shown in Table 5, perceived ease of use significantly accounted for 7.1% of the variance in EIS usage ($p \leq 0.01$). Also, perceived usefulness significantly explained 13.4% of the variance in EIS usage ($p \leq 0.001$). Therefore,

the first criterion suggested by Wall et al. was satisfied. However, the addition of each of four independent variables to the respective intervening variable did not improve the explained variance (R^2) in the dependent variable significantly (see the fifth column in Table 5). Thus, the second criterion was also satisfied. In addition, the four independent variables alone accounted for little of the EIS usage variance (see the third column in Table 5). Consequently, the third criterion was satisfied. The addition of the intervening variables to the equation improved significantly the explained proportion of dependent variable variance (see the sixth column in Table 5). Therefore, the fourth criterion was also satisfied. Based on the above results, perceived ease of use and perceived usefulness were found to fully mediate the relationships between all the identified independent variables and EIS usage. Therefore, all the hypotheses on mediating effects of perceived ease of use and perceived usefulness were supported.

Table 5. Multiple Regression Analyses Predicting the Outcome Variable (EIS Usage) from All Prior Variables

Independent Variables	Intervening Variables	R^2	Combined R^2	Increase in R^2 by Adding Independent Variables to the Intervening Variables	Increase in R^2 by Adding Independent Variables to the Indep. Variables
Computer Experience		0.008			
	Perceived Ease of Use	0.071**	0.072*	0.001	0.064*
	Perceived Usefulness	0.134***	0.139***	0.005	0.130***
Computer Self-Efficacy		0.000			
	Perceived Ease of Use	0.071**	0.072*	0.000	0.071**
	Perceived Usefulness	0.134***	0.142***	0.009	0.142***
Vendor Support		0.006			
	Perceived Ease of Use	0.071**	0.083*	0.011	0.077**
	Perceived Usefulness	0.134***	0.146***	0.012	0.140***
Top Management Support		0.003			
	Perceived Ease of Use	0.071**	0.073*	0.002	0.070*
	Perceived Usefulness	0.134***	0.138***	0.004	0.135***

Note : $^{***}p \leq 0.001$. $^{**}p \leq 0.001$. $^{*}p \leq 0.05$.

6.2.3 Results of the Study

The results in Table 4 and Table 5 report that the users' computer experience positively affected their ease of use perception of an EIS, and that the users' general computer self-efficacy and top management support significantly influenced their usefulness perception of the EIS. Additionally, the users' perceptions of ease of use and usefulness of the EIS fully mediated the relationships between the four independent variables of this study and system usage. A summary of the hypotheses and support for those hypotheses is presented in Table 6.

Table 6. Summary of Results

HYPOTHESES	RESULTS
H1a : The higher the executive's computer experience, the higher his/her perceived ease of use of an EIS.	Supported
H1b : The higher the executive's computer experience, the higher his/her perceived usefulness of an EIS.	Not Supported
H1c : The effect of computer experience on EIS utilization will be mediated by perceived ease of use and perceived usefulness.	Supported
H2a : The higher the executive's computer self-efficacy, the higher his/her perceived ease of use of an EIS.	Not Supported
H2b : The higher the executive's computer self-efficacy, the higher his/her perceived usefulness of and EIS.	Supported
H2c : The effect of computer self-efficacy on EIS utilization will be mediated by perceived ease of use and perceived usefulness.	Supported
H3a : The higher vendor support, the higher the executive's perceived ease of use of and EIS.	Not Supported
H3b : The higher vendor support, the higher the executive's perceived usefulness of and EIS.	Not Supported
H3c : The effect of vendor support on EIS utilization will be mediated by perceived ease of use and perceived usefulness.	Supported
H4a : The higher top management support, the higher the executive's perceived ease of use of an EIS.	Not Supported
H4b : The higher top management support, the higher the executive's perceived usefulness of an EIS.	Supported
H4c : The effect of top management support on EIS utilization will be mediated by perceived ease of use and perceived usefulness.	Supported

Ⅶ. Discussion and Conclusions

In today's highly dynamic and competitive business environment, executives need more effective ways to analyze their markets and competition and guide their operation and people for organizational survival and success. Since an executive information system (EIS) can facilitate access to and use of the information executives require about an organization's internal and external environments, it is expected that EIS use will become increasingly popular among executives in the future. Despite this anticipated trend in EIS use, most prior research in the field of EIS has been dominated by descriptive studies focusing on systems features, usage benefits, and development methodologies. Little empirical research on the key antecedents of successful EIS utilization has been published. The purpose of this study was to develop and test a model of the relationships between a variety of variables and executives' use of EIS. The Technology Acceptance Model (TAM), a widely accepted theory of computer usage behavior, lay at the core of this study. Based on TAM, a research model for EIS usage was developed, exploring the relationships between certain external variables and individuals' perceptions of EIS, and also examining how these perceptions can affect usage. This model proposed that four variables (computer experience, computer self-efficacy, vendor support, and top management support) are antecedents of perceived ease of use and perceived usefulness, and that they have indirect effects on EIS usage through perceived ease of use and perceived usefulness. A total of 12 hypotheses were tested using multiple regression analysis. The results showed that seven of these hypotheses were statistically supported. These results provide support for the TAM perspective, which assumes that the influence of external factors on computing behavior are channeled through the beliefs concerning perceived ease of use and perceived usefulness. In addition, the relationships of perceived ease of use and perceived usefulness to EIS usage are consistent with those found in previous studies. This indicates that perceived usefulness is strongly associated with EIS usage and that perceived ease of use is relatively less important overall in determining system usage. The implication of this finding might be that users are willing to grapple with difficult interfaces in order to access functionality which facilitates the performance of a task. Therefore, IS professionals and managers should emphasize the functionality of the system and should convey to users in a realistic way what the proposed system will consist of and what functions will be available to them. However, although a heavy emphasis on

perceived ease of use, particularly at the cost of functionality, is not desirable, perceived ease of use may influence the initial decision to adopt a system. In fact, it has been found that perceived ease of use is a critical factor of intention to use a computer technology (Davis et al., 1989; Moore and Benbasat, 1991). Therefore, the results of the present study clearly emphasize that organizations need to positively influence user perceptions and beliefs regarding ease of use and usefulness, in order to promote the effective use and acceptance of computer technology.

This study contributed to the IS area both theoretically and practically. First, the most significant contribution of this study is that it provides a stepping stone to build a cumulative tradition of research on IT adoption and utilization. This was accomplished by providing a framework for EIS utilization, identifying several key factors that are critical for EIS utilization, and empirically investigating the proposed relationships. Second, this study also contributes to the theory of the Technology Acceptance Model (TAM). As mentioned earlier, the theoretical grounding for this study originates mainly in TAM. Although research on TAM has provided insights into IS usage, it has focused on perceived ease of use and perceived usefulness as the determinants of usage rather than on the external factors affecting these determinants. Furthermore, TAM suggests that individuals will use an IT if they believe it will result in positive outcomes. It does not explicitly consider how individuals' expectations of their experiences, capabilities, and other factors influence their behavior. By dealing with these issues, this study provides critical insights for TAM. Third, this study provides more generalizability of the findings within EIS contexts than the findings made by case studies. Since EIS are relatively new, prior research in this area has been mostly achieved through case studies. Such case-based approaches are important, but the findings from these studies have limited generalizability due to inherent restrictions of the methodological approach taken. Finally, this study can provide IS practitioners with general guidelines for the successful implementation of EIS. By identifying the important factors of EIS usage, system professionals and managers should be able to plan their courses of action more effectively, thus enhancing users' acceptance and utilization of the system.

7.1 Limitations of the Study

Although this study provides several contributions for the IS community, some cautions

in interpreting the results should be pointed out. First, due to the difficulty in obtaining data about operational EIS, this study was conducted through the assistance of an EIS vendor. The resulting selection of participants may have brought in some bias. In addition, the total number of responses seems to be somewhat small for external validity or generalizability of the study, although the response rate (28.0%) was reasonable. Second, the research model accounted for only a portion of the variance in perceived ease of use (R^2 = 0.107), perceived usefulness (R^2 = 0.170), and EIS usage (R^2 = 0.225). Obviously, there are many other factors that can influence them which have not been examined in the present study. Improvements in the model by the inclusion of additional relevant variables could result in a model which has more explanatory power. Third, another limitation of this study was the use of self-report scales to measure the study variables, which suggests the possibility that common method variance may account for some of the results obtained. For example, in the case of the EIS usage scales, the respondents themselves answered several questions on their EIS use, which might be subjective and inaccurate. Although there is generally assumed to be a strong relationship between subjective and objective measures, there is little evidence to support this assumption. Finally, due to time and resource limitations, this study was a cross-sectional survey. Because a cross-sectional study addresses issues at only one point in time, it does not capture the complex interrelationships between variables that come into effect over time. A longitudinal study is more appropriate to capture such details, but this was beyond the scope of the present study.

7.2 Suggestions for Future Study

From this study, a number of future research areas can be derived. First, this study tested a number of hypotheses in the context of EIS. In view of the variety of modern computer technologies, further research applying this approach to different technologies is needed. A similar study in various technologies would increase the external validity of the results of this study. Second, on the basis of TAM, this study examined the impact of users' perceptions on their usage behaviors. However, users' perceptions of ease of use and usefulness can also be formed from behaviors. For example, an individual who uses an IS and is satisfied with it can develop positive perceptions toward it on the basis of this satisfactory usage. The effect of usage on perceptions has rarely been considered in IS research. A better understanding of this relationship can provide important implications for

the adoption and use of a new technology. Finally, another direction for future research is to examine the consequences of EIS usage. The implicit assumption of this study is that higher usage of EIS will result in better individual and organization performance. However, this may not always be true. Some evidence of usage leading to poor performance by managers has been found in the IS literature.

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<Abstract>

An Empirical Investigation for EIS Utilization: On the Basis of TAM

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Today, executives in the company operate their organizations under highly competitive environments with dynamic technological, economic, and political changes. Under these new environmental changes, they play the important role in establishing the future directions and strategic orientations of organizations. In general, executive information systems (EIS) are designed to support these roles of executives. They can help executives access and use the information they require about the organization's internal and external environments. In spite of such potential EIS support for executives, only a limited number of empirical studies have been published in this area. By employing a well-established theory of computer usage behavior (Technology Acceptance Model: TAM), this study systematically investigates the key factors in the successful utilization of an EIS. The empirical results from this study may prove useful for both IS researchers and practitioners.