Executive Information Systems: Their Impact on Executive Decision Making

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ABSTRACT: An executive information system (EIS) is a computer-based information system designed to provide senior managers access to information relevant to their management activities. With such trends as globalization and intense competition increasing the importance of fast and accurate decision making, the use of these systems by executives may become a particularly important component of their decision-making behavior. Previous research on EIS has focused on descriptive studies of how and why EIS are used. This research empirically examines the effects of EIS use on aspects of the decision-making process by surveying 46 executive users of EIS. The frequency and duration of EIS use are shown to increase problem identification speed, decision-making speed, and the extent of analysis in decision making.

KEY WORDS AND PHRASES: decision making, executive information systems, executive support systems, problem identification.

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1. Introduction

DECISION MAKING IS RECOGNIZED AS ONE OF THE MOST IMPORTANT roles of executives. The availability of reliable information sources is a key component of executive decision making. Sources of information may be oral, written, or computer-based. The computer-based information sources remain the least studied in the context of executive decision making because executives have tended to use other managers and their own intuition as their primary information sources [25]. Recently though, the emergence of computer-based systems that are directly tailored for use by executive decision makers enables an examination of how executive use of computer-based information systems affects executives' decision-making processes.

Such systems, hereafter referred to as executive information systems (EIS), are computer-based information systems designed to allow a senior manager access to information relevant to his or her management activities. The idea of using computer-based information systems to support management is not new. In fact, a new philosophy of how computers could be used to support managerial decision making emerged under the name DSS during the late 1970s. Today, DSS have become firmly established in the mainstream of IS practice and applications have become common [12]. While DSS have been found to support upper management [19], this support is indirect since intermediaries frequently are responsible for preparing the analysis requested by executives. In addition, DSS tend to be narrow in scope, focusing on a particular decision. For these reasons, the literature on the impacts of DSS [1, 18] may fail to provide a complete picture of the effect of an EIS on executive decision making.

Initial research of EIS has consisted of descriptions of current implementations in organizations [2, 3, 4, 21, 38, 41], and empirical examinations of the important characteristics and purposes of EIS [5, 6, 50]. Yet research has not extended beyond the descriptive phase to a theoretically based inquiry into the effect such systems can have when used by senior managers. Obtaining responses from multiple users of EIS across many organizations, this research surveys the users of the systems to examine the following research question: what is the effect of EIS use on the decision-making process of executives?

2. Executive Information Systems

WHILE EIS DIFFER CONSIDERABLY IN THE NUMBER AND SOPHISTICATION of features, the most common feature of EIS is immediate access to a single database where all current financial and operational data can be found [35]. In many cases, the information made accessible was previously available but was difficult to access or use [42]. Features distinguishing EIS from such systems as management information systems and decision support systems include a non-keyboard interface, status access to the organizational database, drill-down analysis capabilities (the incremental examination of data at different levels of detail), trend analysis capabilities (the examination of data across desired time intervals), exception reporting, extensive graphics, the providing of data from multiple sources, and the highlighting of the information an executive

feels is critical. In addition, whereas the traditional focus of MIS has been on the storage and processing of large amounts of information, the focus of EIS is on the retrieval of specific information about the daily operational status of the company's activities as well as specific information about competitors and the marketplace [16, 48]. EIS are also distinct from DSS: whereas the purpose of EIS is the monitoring and scanning of the environment to give executives rapid exposure to changes in the environment, the purpose of DSS is to support ad hoc decisions as well as some routine analysis. And while the core of DSS is extensive modeling and analysis capabilities, the core of ESS is status information about the organization's performance [48].

Previous research has examined why EIS are used [50], has examined development methods that lead to successful implementation [10, 20, 49], and has examined the features executives find most useful [5, 41]. Research is now needed that examines the impact of EIS use.

There are several frameworks that could be used to study EIS, including EIS as a decision-making or problem-solving tool, EIS as a scanning tool, EIS as an internal monitoring tool, and EIS as a communication tool [8]. This research chose to examine EIS as a decision-making tool because decision making involves scanning, monitoring, and communicating and is therefore a broad framework for early research into the impacts of EIS use. Given that the postindustrial environment demands that organizations make faster decisions, and have better information acquisition and distribution [23], an information system designed to meet the needs of executives should address their decision-making needs. Furthermore, Rockart and DeLong [41, p. 256] suggest that a decision-making framework for researching EIS should provide new insights into how EIS provide value.

There are many decision-making variables that may conceivably be affected by the use of EIS. This study chooses to examine three decision-making process variables that have received considerable attention in recent theory on the impact of advanced information technology use on decision making in organizations and are well grounded in organizational research [22].

3. The Decision-Making Process

THE VARIABLES EXAMINED INCLUDE THE SPEED of problem identification, the speed of the decision-making process, and the extent of analysis in decision making.

3.1. The Speed of the Decision-Making Process

Rapid decision making has become more important as competitive situations have increased and information has become critical to organizational performance [11, 22]. Changes in technology and faster communication makes the time span of important changes critical [13]. The time frame of decision making has hardly been studied [33] although speed is considered particularly important in highly uncertain, dynamic, or "high-velocity" environments. Eisenhardt [11] found that the most effective firms of those studied made strategic decisions quickly. She identified confidence and anxiety

as key components determining the speed of the process. El Sawy [13] suggests that "to compete effectively in [today's] time-compressed information intensive environment, fast response is increasingly becoming a critical strategic capability."

Managers describe their environment as having increased competition and reduced time to make decisions [17]. One executive states: "we as decision makers are constantly being faced with situations where we are required to make more decisions than ever before" with "faster reaction times" [45]. Because information technology allows fast information processing and analysis, the availability and use of EIS by upper executives may contribute to the speed with which they identify problems and make decisions. The *speed of problem identification* is defined as the length of time between when a problem first arises and when it is first noticed. The *speed of decision making* is defined as the time between when a decision maker recognizes the need to make some decision to the time when he or she renders judgment [45].

3.2. The Extent of Analysis

Fredrickson and Mitchell [15] identified six characteristics of strategic decision making: process initiation, role of goals, means/ends relationship, explanation of strategic action, comprehensiveness in decision making, and comprehensiveness in integrating decisions (to form strategy). Analytic comprehensiveness as defined by Fredrickson and Mitchell [15] is the extent of analysis in situation diagnosis, alternative generation, alternative evaluation, and decision integration. This research is interested in the extent of analytic techniques used in decision making. *Analysis is defined as the "reflective thought and deliberation given to a problem and the array of proposed responses" [32]. Time spent on interrelating symptoms to get at the root cause of problems and the effort spent to generate solutions are examples of the analytic process [32].*

Although sometimes viewed as antithetical to fast decision making, extensive analysis may coexist with speed when an EIS is providing both real-time data and analytic tools. Typical MIS do not provide sufficient inquiry and analysis capabilities compared with their perceived importance to decision makers [31]. However, the information database of an EIS provides a source of raw information that can be used by analytical executives to perform their own analysis [41, p. 102].

4. Research Model and Hypotheses

THE PREVIOUS DISCUSSION OF RESEARCH RELATED TO DECISION MAKING in organizations suggests the research model shown in figure 1 concerning EIS use and an executive's decision making process.

The model states that the use of EIS by an executive will increase the speed of his or her problem identification, increase the speed of his or her decision making, and increase the extent of his or her analysis in decision making. Problem identification is separated from decision making because many EIS discussed in the literature up to now have been monitoring systems. If the sole purpose of the system is to improve an

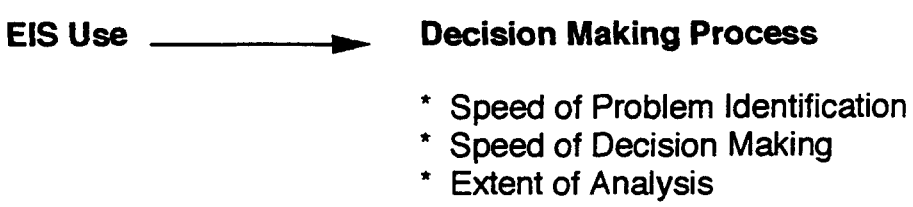

Figure 1. Research Model

executive's ability to monitor performance, it is probable that he or she may identify problems faster because of the system, but may not necessarily make a decision concerning the situation any faster. If, in fact, the EIS affected problem identification but not the entire decision-making process, this would be difficult to discern solely by a decision-making speed variable.

4.1. Hypotheses

The hypotheses examine the impact of EIS use on certain important characteristics of an executive's decision-making process. Consistent with DSS research, EIS use is defined both in terms of the frequency of system use by the executive and the length of time the executive has been using the EIS [30]. The hypotheses are worded using both the frequency of EIS use and the length of time of EIS use. The hypotheses concerning frequency of use assume that an executive who is actively using the system somewhat regularly will perceive greater results from his or her usage than an executive using the system only irregularly. The hypotheses concerning length of time of use assumes that the longer the system has been in use, the more likely that results have been observed. This is for two reasons: (1) use would presumably have been discontinued if it had not been producing a desirable impact, and (2) it may take time before impacts of system use are realized or noticed; frequency would not reveal such a time effect.

4.2.1. EIS and Problem Identification Speed

Internal monitoring and environmental scanning are key activities of senior managers [26]. Such activities provide "early warning indicators" which enable executives to identify and react faster to problems and to competitive trends and product changes [44]. One executive is quoted as saying, "what matters is how quickly I can get a comprehensive overview and draw conclusions from the data. The EIS helps me do that much faster" [41, p. 106]. By providing external data and by allowing quicker access to operational information, EIS enables faster scanning [41, p. 82]. And timely access to external and internal information may enable problems to be identified faster. The more frequent the use, the more likely problems will be identified faster. The longer the system has been in use, the more adept the executive will be in interpreting the information and determining where problems exist. It is therefore hypothesized that:

Hypothesis 1a: The more frequent the executive's use of EIS, the faster the speed of problem identification.
Hypothesis 1b: The greater the length of the executive's use of EIS, the faster the speed of problem identification.

4.2.2. EIS and Decision-Making Speed

The need for fast decision making has resulted from increased competition and the globalization of world markets. Causes of slow speed include the consideration of many alternatives, wide participation [52], political behavior [27], comprehensiveness [14], and scheduling and feedback delays [33]. Bourgeois and Eisenhardt [7] found that decision speed affects firm performance in high-velocity environments and is a key characteristic differentiating the consequences of strategic decisions. Arguing that the aspects of the decision process following problem or opportunity recognition might be more effective when using advanced information technology, Huber [22] suggested that the use of sophisticated information technologies would allow decision makers or their assistants to analyze information quickly. Hence, the use of such technologies would lead to more rapid and accurate identification of problems, would reduce the time required to authorize proposed organizational actions, and would reduce the time required to make decisions [22].

Eisenhardt [11] found that the most effective firms among the eight studied in the high-velocity environment made strategic decisions quickly and had a shorter time frame in which the decisions were made. The decisions were faster because real-time information was used and multiple alternatives were considered simultaneously. An EIS can provide such real-time information. The provision of real-time, accurate, and easily accessible information should allow executives to make decisions more quickly. Those executives who use the EIS the most frequently should notice the greatest increase in their decision-making speed; likewise, those who have used the system the longest will be accustomed to quickly assessing their needed information. It is therefore hypothesized that:

Hypothesis 2a: The more frequent the executive's use of EIS, the faster the speed of the decision-making process.
Hypothesis 2b: The greater the length of the executive's use of EIS, the faster the speed of the decision-making process.

4.2.3. EIS and the Extent of Analysis in Decision Making

Fredrickson and Mitchell [15] found that comprehensiveness is positively related to performance in stable environments but Fredrickson [14] found that it is negatively related to performance in unstable environments. One explanation of these results is that unstable environments require fast decision making for effective performance, but fast decision making is hindered by the comprehensive approach. Others have found that being inordinately analytic leads to slow decision

making or postponement of the decision until too late [39] and the stifling of creativity and innovation [34, 51].

Eisenhardt [11], however, found that the most effective firms used an analytic decision process, with the negative effects reduced by other behaviors such as the reliance on experienced cohorts. Her results suggest that in the unstable environments, comprehensiveness must involve simultaneous consideration of multiple alternatives and real-time information in order to avoid the slow, inefficient decision process found by Fredrickson [14]. Bourgeois and Eisenhardt [7] suggest that, as the speed of environmental change accelerates, effective executives deal with their extremely uncertain world by structuring it through a thorough, analytic process. An executive interviewed by Rockart and DeLong [41, p. 97] felt that the EIS allowed more time to be devoted to substantive analysis of operational problems, opportunities and potential acquisitions.

EIS can aid executives in the analytic process by providing real-time information and the means of understanding it through analytic capabilities. With its ability to facilitate analysis of problems with drill-down and trend analysis, an EIS may significantly increase the extent of a decision maker's analysis. Those using the EIS most frequently would be most likely to be doing their own analysis on the system, and those using the system for the longest time are likely to be comfortable using the EIS for analysis. It is therefore hypothesized that:

Hypothesis 3a: The more frequent the executive's use of EIS, the greater the extent of analysis in decision making.
Hypothesis 3b: The more frequent the executive's use of EIS, the greater the extent of analysis in decision making.

5. Methodology

THE STUDY USES A SURVEY INSTRUMENT TO GATHER DATA to test the relationships expressed in the hypotheses. The hypotheses will be tested for association rather than causality. While there is a theoretical argument for causality, it could not be tested directly using the survey methodology.

5.1. The Survey Instrument

In order to collect data on the variables described in the research model, a questionnaire was developed. The survey collected information on the use of the system and on the user's perceptions of the impact of the EIS on decision making. A pilot version of the survey was completed by several executives from a Texas bank. Suggestions were incorporated into a second version that was then piloted by two more executives. One additional suggestion was made and incorporated into the final version. Such a piloting process helps establish content validity [46]. Bias in response from misinterpretation of the instrument should therefore be reduced.

5.2. Measurements

In order to build upon previous research, a review of instruments used in other studies examining information technology and/or decision-making processes was undertaken. Because the speed of problem and decision making has been discussed in theory but has not yet been examined empirically (although it has received attention in DSS and GDSS experiments where direct measurement is possible), the items to measure the speed variables are derived from Huber's interpretation of these variables [22]. Items to measure extent of analysis were drawn from Miller and Freisen [32] and Fredrickson and Mitchell [15]. The items require that the user compare the current decision-making process to the process before the EIS was used. While relying on executives for the comparison may lead to two types of error—distortion and memory failure—there is no reason why there should be systematic bias in the responses [33]. Questions are expressed in terms of how the EIS has helped the decision-making process, rather than why the EIS is used. This research is interested in determining some results of EIS use rather than in determining the reasons behind EIS use.

5.2.1. Problem Identification Speed

The speed of problem identification is the time elapsed between the first appearance of signs of a problem and their detection. It is examined separately from the speed of decision making because the impact of an EIS may be more significant at this phase than at the other phases because of the daily monitoring of real-time information. Items measuring problem identification speed are:

To what extent has EIS helped you do the following:

- Identify potential problems faster
- Sense key factors impacting my area of responsibility
- Notice potential problems before they become serious crises

The respondents answered each question by circling the appropriate number on the scale:

To no extent	To a little extent	To some extent	To a large extent	To a great extent
1	2	3	4	5

The items are to be averaged together for the composite score for the variable problem identification speed. This same five-point scale was used for decision-making speed and extent of analysis.

5.2.2. Decision Making Speed

Speed of decision making is the span of time beginning with problem identification and ending with choice. Ideas were borrowed from Huber [22], who helped define and clarify the speed of decision making. The items measuring decision-making speed are:

To what extent has EIS helped you:
- Make decisions quicker
- Shorten the time frame for making decisions
- Spend less time in meetings

5.2.3. The Extent of Analysis in Decision Making

An analytic decision process is characterized by systematic methods of identifying problems, diagnosing problems, generating alternatives, and evaluating alternatives using computational techniques. Ideas from Fredrickson and Mitchell [15] are useful. They defined analytic comprehensiveness as the comprehensiveness in situation diagnosis, alternative generation, and alternative evaluation. As measures, they examined the breadth of participants' expertise, breadth of outside information sources used, breadth of problem causes and solutions considered, breadth of analysis techniques used, and breadth of factors considered important in the three phases. This research is interested in the analytic component rather than the comprehensiveness component. Miller and Friesen [32] suggest that analysis is characterized by the time spent on interrelating symptoms to get at the root cause of problems and the effort spent generating and analyzing solutions. Based on these ideas, the items measuring the extent of analysis in decision making are:

To what extent has EIS helped you:
- Spend significantly more time analyzing data before making a decision
- Examine more alternatives in decision making
- Use more sources of information in decision making
- Engage in more in-depth analysis

While analysis and speed are often viewed as contradictory, it is possible that an EIS enables both: not as much time need be spent gathering information so the increased time spent analyzing may be offset by the capabilities of the EIS.

5.2.4. EIS Use

EIS use is measured according to frequency of use by the individual respondent and according to the length of time it has been used by the individual respondent.

To measure an individual's frequency of EIS use, the user was asked:

With what frequency do you personally use the EIS?

The respondent answered according to the following scale:

Infrequently	Monthly	1–4 times per week	Daily
1	2	3	4

The length of use was determined by asking, "When did you first begin using the EIS?" The respondents answered the question by providing a month and year.

5.3. The Hierarchical Level of the Respondent

Research on EIS has typically used the vice president level and above in the term executive or senior manager. Mittman and Moore [36] defined executives as vice presidents and above. Sixty-four percent of their respondents were vice presidents. Isenberg [24] defined senior manager as general manager and above. Both consultants and developers of EIS have included vice presidents as "senior manager" or "executive" below the president [29, 44]. Others have called top management the president and one level below president, while middle is two levels below president [53]. The term "executive" in this research refers to a manager who is responsible for a contribution that materially affects the firm's ability to perform and obtain results [40]. This is operationalized as a manager reporting no more than two levels below the president or CEO.

5.4. Selection of Companies

Through an extensive review of business, trade, and academic journals, and through contact with the major suppliers of EIS equipment and consultants for EIS development, the researchers identified approximately 100 companies in the United States with an EIS. A contact person was identified in each company. The contact person was typically from the information systems department and had an important role in designing, developing, and/or maintaining the EIS.

The contact person was given the option of distributing the survey to selected users or providing us with the names of selected users whom we could contact. In all cases, the contact person chose to distribute the survey him or herself. The reason for this was that the contact person was typically at a lower hierarchical level than the users and did not want to be responsible for giving out their names.

This obviously introduces a possible source of response bias, namely, that the contact person would distribute the survey only to frequent users of the system. The contact person was requested to give the surveys to both frequent and infrequent users. Often the contact person was not even aware of who was a frequent user and who was not, so that the distribution was in effect random.

Another source of bias is that individuals who do not like the system and who do not use it but who have access to it are not included in the responses (i.e., there is an undercoverage problem). This bias was unavoidable because the survey and research are designed to examine the impact of EIS use as opposed to EIS availability for use. Therefore, responses from nonusers, even if the system is available for their use, would make no sense (the individual would leave the survey blank because it would not apply).

A final source of bias is that of nonresponse. This occurs when the contact person gives the survey to an individual who never completes it. This bias was difficult for the researchers to control since the researchers did not have the names of the individuals to whom the contact person distributed the survey. The degree of nonresponse as indicated by the nonresponse rate of individuals from participating

companies was 50 percent. The proportion including those companies with an EIS that did not elect to participate is estimated at 76 percent, again assuming that ten surveys would have been sent to each of the ten companies not choosing to participate.

5.5. Analytical Techniques

Because the major purpose of analysis is to assess the strength of associations among variables, correlation or regression is the appropriate method [47]. Bivariate correlation measures the strength and direction of association between two variables. Spearman's correlation coefficient was used because the Spearman coefficient is a nonparametric test that therefore does not make numerous assumptions about the parameters—in other words, it is a "distribution free" test that does not assume underlying continuity in the variables under study [43]. This results in conclusions that require fewer qualifications. Nonparametric tests are particularly useful for small sample sizes [43].

6. Analysis and Results

FORTY-SIX RESPONSES WERE RECEIVED FROM SENIOR MANAGERS. Of the total 34 contacts who agreed during the phone conversation to distribute surveys, responses were received from 23. The organizational response rate is thus 59 percent. The response rate for total surveys sent is 32 percent (sometimes not every survey sent to the organization was returned). The respondents were from 23 companies, representing financial services, electronics manufacturing, public utility, telecommunications, oil and gas, food products, and consulting industries.

6.1. Validity

Content validity—the representativeness of the measures [46]—was assessed by subjecting the survey to pilot testing by five executives and scrutiny by four professors in the field of decision making and information systems. The pilot testing suggested that the questions and instructions were clear.

Construct validity—the meaningfulness of the measures—was assessed by common factor analysis [28]. Reliability—the stability of the measures [46]—was assessed by Cronbach's alpha. Content validity, construct validity, and reliability ensure instrument validity.

6.2. Construct Validity

Construct validity addresses the question of whether the measures are true constructs describing the event or merely artifacts of the methodology [46]. Eigenvalues greater than 1 and scree plots were used in determining the number of factors. For an item to be considered in the composition of a variable, it had to have a loading of at least 0.5 on the factor, with no loading exceeding 0.3 on another factor, had to conform to a prior assignments, and had to add to the variable's reliability.

In general, factor analysis supported the proposed scales. Minor exceptions were that for problem identification speed, one item was not retained for failing to have high enough loadings, for decision-making speed, one item was not retained for failing to have high enough loadings, and one item was not included in the extent of analysis variable for failing to load properly.

6.3. Reliability

The mean of the items in each scale was used to combine the items into the scale. Cronbach's alpha was used to assess the interitem reliability of the final multi-item scales. While a reliability score of 0.6 is usually considered acceptable [37], all of the variable's reliability scores exceeded 0.8. Thus, although the items were largely derived indirectly from previous theory, the high alphas indicate that the variables are reliable. The factor loadings and reliability are shown in Table 1.

6.4. Variable Descriptive Statistics

Table 2 presents the mean, standard deviation, minimum, maximum, and number of responses for each variable.

6.5. Statistical Analysis Performed

Table 3 presents the correlations of the variables with each other. As would be expected, the decision-making variables are highly correlated with one another. This would be expected given that variables were purposely chosen that were thought to characterize decision making. However, in interpreting the correlations, one must keep in mind that two variables may be correlated with each other only because they share correlation with a common other variable.

It was necessary to ensure that it is viable to treat frequency of use and length of use as independent variables; in the case where a strong relationship exists, there would be no reason to have hypotheses for both variables. The correlation of length of use with frequency of use is 0.17 with a p value of 0.26. Thus, the two variables can be treated as independent variables; there does not appear to be a strong relationship between the two.

6.6. Hypotheses Testing

Hypothesis 1a predicted that the more frequent the use of EIS, the faster executives would notice problems. This hypothesis was supported. Problem identification speed was correlated with the frequency of EIS use ($r = 0.4$, $p = 0.006$). Hypothesis 1b predicted that the longer the EIS had been used, the faster the problem identification would occur. This was also supported: length of time of EIS use was correlated with problem identification speed ($r = 0.31$, $p = 0.04$).

Hypothesis 2a predicted that frequent use of EIS would increase the speed of the

Table 1 Factor Loadings and Reliability

Factor	Items	Cronbach's alpha
Factor 1: Problem identification speed	0.89	
Sense key factors impacting my area of responsibility		0.55
Notice potential problems before they become serious crises		0.84
Factor 2: Decision-making speed	0.92	
Make decisions quicker		0.56
Shorten the time frame for making decisions		0.67
Factor 3: Extent of analysis in decision making	0.87	
Spend significantly more time analyzing data before making a decision		0.55
Examine more alternatives in decision making		0.94
Use more sources of information in decision making		0.62

Table 2 Descriptive Statistics

Variable	*N*	Mean	Std. Dev.	Median	Min	Max
Problem identification speed	46	2.5	1	2.5	1	4.3
Decision making speed	46	2.3	1	2.3	1	4.5
Extent of analysis	43	2.2	0.91	2.3	1	4.3
Frequency of EIS use	46	3.3	0.87	3	1	5
Length of time of EIS use	45	32.2	25.6	26	4	99

Table 3 Spearman Correlation Coefficients

Variable	Frequency of EIS use	Length of EIS use	Problem identification speed	Decision-making speed	Extent of analysis
Frequency of EIS use					
Length of Eis use	0.17 0.26				
Problem identification speed	**0.4** **0.006**	**0.31** **0.04**			
Decision-making speed	**0.37** **0.01**	**0.37** **0.01**	0.77 0.0001		
Extent of analysis	**0.48** **0.0008**	**0.34** **0.02**	0.58 0.0004	0.69 0.0001	

decision-making process. This hypothesis was supported. Frequency of EIS use was correlated with decision-making speed ($r = 0.37, p = 0.01$). Hypothesis 2b predicted that the longer the EIS had been in use, the faster the decision-making process would be. This hypothesis was likewise supported. The length of time of EIS use was correlated with decision making speed ($r = 0.37, p = 0.0004$).

Hypothesis 3a predicted that the more frequent the use of EIS, the greater the extent of analysis before making a final decision would be. This hypotheses was supported. Frequency of EIS use was correlated with extent of analysis ($r = 0.48, p = 0.0008$). Hypothesis 3b predicted that the longer the EIS had been in use, the greater would be the analysis before decisions. This hypothesis was supported. Length of time of EIS use was correlated with the extent of analysis ($r = 0.34, p = 0.02$).

Table 4 summarizes the results of hypothesis testing.

7. Implications and Research Directions

THE PURPOSE OF THIS STUDY WAS TO EMPIRICALLY EXAMINE the relationship of executive information systems' use to the executive decision-making process. The research used results of a survey of 46 senior manager EIS users across 23 organizations to test hypotheses concerning the relationship of the frequency and length of time of EIS use with aspects of decision making. Six hypotheses were tested. All were supported.

Frequency of use and length of time of use are both significantly associated with an executive's decision-making process. Although Carlsson and Widmeyer [8] have suggested that the decision-making framework is not a good framework to research EIS, these results suggest that, in fact, EIS impact certain facets of the decision-making process and that future research should consider more decision-making variables.

While the extent of analysis in decision making and the speed of decision making are often viewed as incompatible, they were both related to EIS use. EIS use was positively and significantly associated with problem identification speed (H1) and decision-making speed (H2), as well as with the extent of analysis in decision making (H3). The more frequent the use and the longer the use, the faster the reported problem identification speed and decision-making speed, and the greater the extent of analysis.

Chen [9] found that the length of time an information system is in use does not affect a user's overall satisfaction with the system; this study indicates that there is a time effect involved in perceiving impacts from EIS use. The longer the user had been using the EIS, the greater the impact the user perceived and attributed to the EIS. And the more frequent the use, the greater the perceived impact. Thus, having a flexible EIS that will continue to be used over time becomes critical to an executive's perception of results from system use. However, maintaining an EIS is no trivial task and requires extensive support.

This study examined the effect of EIS use on executive decision making at the individual level of analysis, and determined that EIS use is related to problem identification speed, decision-making speed, and the extent of analysis in decision making. Future research can include other decision-making variables, can examine

Table 4 Support for the Hypotheses

Hypothesis	Support
H1a: The more frequent an executive's use of EIS, the faster the problem identification speed	Yes
H1b: The longer the executive's use of EIS, the faster the problem identification speed	Yes
H2a: The more frequent an executive's use of EIS, the faster the decision-making speed	Yes
H2b: The longer the executive's use of EIS, the faster the decision-making speed	Yes
H3a: The more frequent an executive's use of EIS, the greater the extent of analysis in decision making	Yes
H3b: The longer the executive's use of EIS, the greater the extent of analysis in decision making	Yes

effects at the organizational level of analysis, can compare executives using an EIS to those not using an EIS, and can determine whether the impacts observed in this study actually lead to better or more effective decision making. Once system usage is widespread enough to categorize systems into several basic types (such as monitoring, communication, analysis, or scanning), research can examine the various effects of the different types of EIS.

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