

An Empirical Analysis of the Relationships Among Personal Characteristics, Perceived Attributes, and ESS Utilization

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In today's rapidly and dramatically changing business environments, corporate executives must play critical roles for organizational survival and success. To perform these roles successfully, they may need more effective ways to systematically analyze a variety of information derived from organization's internal and external sources. Executive support systems (ESS) are made to help executives access and use the information they require about the organization's environments. The purpose of this study is to investigate the important factors that influence the successful ESS utilization. Based on a review of information systems literature, this study examines the relationships among personal characteristics, perceived attributes, and ESS utilization. The study develops and tests the research model, which proposes that personal characteristics (age, education, cognitive style, and computer experience) and perceived attributes of the system (ease of use and usefulness) have a direct influence on ESS utilization, and that personal characteristics have an indirect influence on ESS utilization through perceived attributes of the system. The results showed that the users' cognitive style and perceived attributes had direct effects on ESS utilization. Additionally, perceived attributes were found to fully mediate the relationships between age, education, computer experience, and ESS utilization. From a theoretical standpoint, the study contributes to a better understanding of factors influencing successful ESS utilization. From a practical standpoint, the study may help information systems (IS) managers and professionals plan their courses of action more effectively for an extensive use of ESS in organizations.

Key Words: Executive Support Systems, Cognitive Style, Computer Experience, Perceived Ease of Use, Perceived Usefulness

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I. INTRODUCTION

A business executive plays a critical role in an organization under today's rapidly

changing business environments. King (1985) argues that the most important role of chief executive officers (CEOs) is to create a vision for the organization's future and to lead the organization toward it. More spe-

cifically, Mintzberg (1973) characterizes major roles of executives as three areas, consisting of ten distinct activities: (1) Interpersonal Roles: figurehead (functions as the leader of the organization, performing some duties of a ceremonial nature), leader (functions as the senior manager in the organization, responsible for motivation, staffing, training, and promotion), and liaison (functions as a major link to the environment); (2) Informational Roles: monitor (functions as the organization's nerve center of internal and external information about the organization), spokesman (functions as a communicator of information to outsiders on the organization's plans, policies, strategies, etc.), and disseminator (functions as a provider distributing information to organizational members); and (3) Decision Roles: entrepreneur (functions as an intelligence officer, seeking opportunities and problems in the organization and its environment for new ideas and initiatives), negotiator (functions as the organization's top representative, negotiating major commitments for the organization), disturbance handler (functions as arbitrator, taking corrective action when the organization faces important or unexpected disturbances), and resource allocator (functions as the absolute authority for allocating organizational resources of all kinds). The above essential roles of executives have

been supplemented by Senge (1990), who stated that the leaders in a learning organization play the role of designers, teachers, and stewards, instead of captains and heroes. These kinds of executives' roles become even more important in today's highly competitive global economy. To perform these roles successfully, they may need more effective ways to systematically analyze a variety of information derived from organization's internal and external sources, such as corporate key performance indicators, customers, competitors, suppliers, markets, economic trend, and so on. In general, executive support systems (ESS) are directed at supporting critical roles and activities of executives. They can help executives access and use the information they require about the organization's internal and external environments. By using various sources of information, executives can understand the business better, keep up to date with operations, and increase the quality of decision-making, and communication capacity and quality. Therefore, ESS can have a tremendous positive impact on executive's work performance (Bergeron et al., 1991; Paller and Laska, 1990). A research survey on ESS practices reports that ESS are providing effective computer support for executives in a large number of corporations (Watson et al., 1991). In addition, it is believed that by providing

information about the external environment, competitive information, and better environmental scanning, ESS facilitate the accomplishment of organizational objectives and provide a competitive advantage within an industry. Consequently, they can lead to higher levels of organizational performance (Bajwa et al., 1998; Bergeron et al., 1991; Watson et al., 1997). Although ESS can generate notable performance gains, executives are sometimes unwilling to accept and use available systems. Since information technology (IT) which is not used cannot be effective, it is important to understand how executives decide whether they will use it. Furthermore, a better understanding of factors that determine user acceptance of IT is one of the most challenging issues in the business world because of the frequent rejection by users of systems in which a huge investment might have been made (Compeau and Higgins, 1995). Current ESS are becoming more enterprise-wide with better integration of other applications, such as decision support systems, expert systems, group support systems, and World Wide Web technology. Although these systems are rapidly evolving and are popularly increasing in organizations, it is surprising to find very little empirical research on topics related to the subject in the information systems (IS) literature. In particular, there is a marked lack of empirical research

focusing on the key antecedents of successful ESS utilization. The main purpose of this study is to examine and identify the factors that influence the utilization of ESS. The primary research question addressed by this study is: "What are the factors that contribute to differences in ESS usage?" The key questions guiding the research include: 1) what are the major factors that influence an individual's use of ESS?, and 2) what relationships between the identified factors influence the use of ESS?

A substantial body of IS literature reports that there are interactions and intervening effects between such factors. However, most IS researchers have measured the relationship between various independent variables and IT utilization directly, without paying attention to intervening variables. For example, some researchers have studied the direct relationship between key factors and IT utilization, while others have studied the relationship between attitudes/perceptions towards IT and its utilization. There are few IS studies interlinking effects of some key factors, attitudes/perceptions, and utilization. This might limit the strength of the research results. In contrast, by applying a widely accepted theory of computer usage behavior (Technology Acceptance Model), this study investigates these relationships as

well as the important factors that affect ESS utilization.

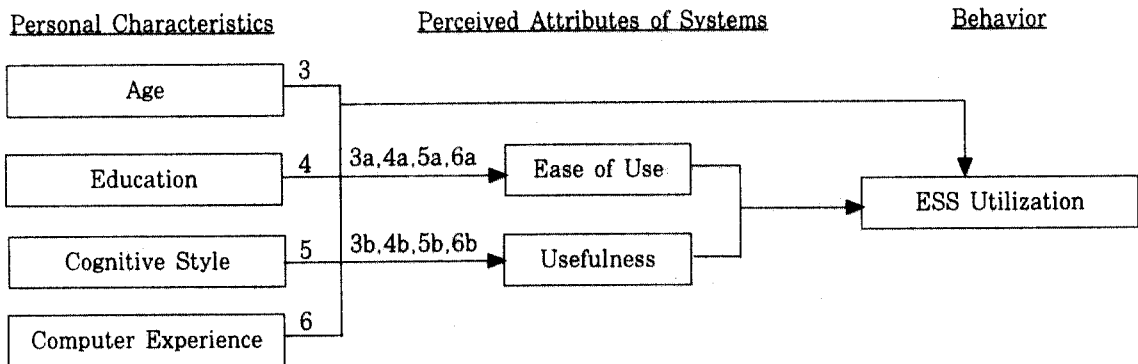
II. RESEARCH MODEL AND HYPOTHESES

Many studies have attempted to identify a number of variables which may influence the success of IS use. Based on a review of IS literature, this study includes two classes of factors that are likely to be critical for ESS utilization: (1) perceived attributes of systems, and (2) personal characteristics. Two variables included in perceived attributes of systems are perceived ease of use and perceived usefulness. The variables of personal characteristics are age, education, cognitive style, and computer experience. Among other potential personal characteristics, gender is

not included in the study due to the expected unbalance among respondents. The research model for this study is shown in Figure 1. The model posits that ESS utilization is a function of six variables, namely, perceived ease of use, perceived usefulness, age, education, cognitive style, and computer experience. These variables are hypothesized to have a direct influence on ESS utilization. The model also proposes that age, education, cognitive style, and computer experience are expected to influence ESS utilization through the effects on perceived ease of use and perceived usefulness. A detailed discussion of these variables and the hypotheses incorporating them is presented below.

2.1 Perceived Attributes of Systems

Several researchers have used theories of behavior from referent disciplines to ex-



(Figure 1) The Research Model of ESS Utilization
(Numbered arrows indicate the hypotheses described in the study)

plain system usage, such as the theory of reasoned action (TRA), the theory of planned behavior (TPB), the theory of innovation adoption and diffusion, and the technology acceptance model (TAM) (Ajzen, 1989; Davis, 1989; Davis et al., 1989; Mathieson, 1991; Rogers, 1983). Among these, TAM is widely accepted as a theory to explain computer usage behavior in the IS discipline (Davis, 1989; Davis et al., 1989). In a comparison study between TAM and TRA, Davis et al. (1989) suggested that the purpose of TAM is to explain the determinants of computer acceptance that include general user behavior across a broad range of end-user computing technologies and user populations. A fundamental concept of TAM is that an individual's computer usage behavior is performed on the basis of two particular beliefs, perceived ease of use and perceived usefulness, which in turn cause certain attitudes to be formed, leading to an intention to use the system and ultimately the occurrence of actual computer usage.

Many empirical studies on TAM have shown that perceived ease of use and perceived usefulness are critical factors and predictors of user attitudes and intentions, that attitudes and intentions are significantly associated with usage behavior, and that the use of IT is thus determined by

perceived ease of use and perceived usefulness (Adams et al., 1992; Davis, 1989 and 1993; Davis et al., 1989; Igarria et al., 1997). Davis (1989) conducted two studies (one using a file editor and electronic mail and the other using two graphics software packages) to develop new measurement scales for perceived ease of use and perceived usefulness. In both studies, he found that perceived ease of use and perceived usefulness are significantly correlated with system usage. However, perceived usefulness has a greater correlation with usage behavior than did perceived ease of use. Davis et al. (1989) found that intentions measured after a one-hour introduction to a word processing system (WriteOne) are significantly correlated 0.35 with system use 14 weeks later, and that the intention-usage correlation is 0.63 at the end of this time period. Also, they reported that perceived usefulness strongly influences peoples' intentions and perceived ease of use has a small but significant impact on intentions as well. In a later study, Davis (1993) found that TAM fully mediates the effects on usage behavior of system characteristics, which explain 36% of the variance in usage. He also found that perceived usefulness is 50% more influential than perceived ease of use in determining usage, which underlines the importance of incor-

porating the appropriate functional capabilities in new systems. On the other hand, Adams et al. (1992) conducted two studies replicating Davis' work (1989) in order to evaluate the psychometric properties of the perceived ease of use and perceived usefulness scales and to examine their relationship to system usage. In each study, they found that Davis' scales demonstrate properties of both reliability and validity. In addition, they found that the results of testing their relationship to system usage are consistent with previous research for study 1, which suggests that perceived usefulness is an important determinant of system usage. However, the results of study 2 are somewhat mixed, but indicate the importance of both perceived ease of use and perceived usefulness. In a recent study, Igarria et al. (1997) found that perceived ease of use is a strong factor in explaining perceived usefulness and PC usage, and that perceived usefulness has a direct effect on PC usage. Based on these findings, two perceived attributes of systems (ease of use and usefulness) are expected to influence ESS utilization significantly.

(1) Perceived Ease of Use

Perceived ease of use has been generally recognized as a key factor increasing acceptance and utilization of a technology. Davis

(1989) defines it as "the degree to which a person believes that using a particular system would be free of effort" (p. 320). Its definition suggests that all else being equal, an individual is more likely to accept a technology perceived to be easier to use, because of less efforts needed to use it. On the other hand, several studies have shown complexity (reversely similar to ease of use) to be an important factor in adoption and diffusion of innovations (Rogers, 1983; Thompson et al., 1991; Tornatzky and Klein, 1982). For example, Thompson et al. (1991) found that perceived complexity has a strong effect on PC use. Tornatzky and Klein (1982) reported that the more complex the innovation, the lower its rate of adoption. Based on the findings of many studies on TAM and innovation, the following hypothesis is proposed.

Hypothesis 1: The ease of use, as perceived by the user, will be positively related to the ESS utilization.

(2) Perceived Usefulness

TAM proposes that perceived usefulness is a primary determinant of IT usage. This assumes a positive usefulness-use-outcome relationship. Within an organizational context, people will use a system high in

perceived usefulness for any expected performance consequences, such as promotion, economic benefits, and other rewards (Davis, 1989). Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320). It is closely similar to relative advantage in adoption and diffusion of innovations, which may be measured in many ways such as profitability, social benefits, time saved, or hazards removed (Rogers and Shoemaker, 1971). Based on reviewing a number of innovation studies, Rogers (1983) and Tornatzky and Klein (1982) emphasized the importance of relative advantage on diffusion of an innovation. Therefore, the findings on TAM and innovation studies lead to the following hypothesis.

Hypothesis 2: The usefulness, as perceived by user, will be positively related to the ESS utilization.

2.2 Personal Characteristics

Personal characteristics included in this study are age, education, cognitive style, and computer experience. In IS studies, these variables have been demonstrated to be directly associated with IS-related behaviors. In addition to this direct re-

lationship, there may exist another possibility of an indirect relationship between personal characteristics and IT use, through intervening variables such as individual beliefs. This possibility can be justified from TAM. According to TAM, external variables (e.g., individual differences, system features) exert an indirect influence on actual usage behavior through perceived ease of use and perceived usefulness. Therefore, this study proposes direct and indirect relationships between personal characteristics and ESS utilization.

(1) Age

Age has been reported to be negatively associated with IS-related behaviors. The rationale for this is that older managers are likely to have less computer knowledge and training, be less flexible and more resistant to change, and consequently hold unfavorable perceptions and attitudes toward IT. Jarvenpaa and Ives (1991) found that an executive's age is a significant predictor of progressive use of IT. Fuerst and Cheney (1982) observed that younger decision makers are more receptive to new ideas and more inclined to use new decision-making techniques. On the other hand, Hambrick and Mason (1984) proposed that older executives might be less able to grasp new ideas and learn new

behaviors. They presented three possible explanations. The first is that older executives may have less physical and mental stamina. The second is that older executives have greater psychological commitment to the organizational status quo. The third is that older executives may be at a point in their lives at which financial security and career security are important. Their social circles, their spending traits, and their expectations about retirement income are established. Thus, any risky behavior that might interrupt these is generally avoided. From this above evidence and TAM, the following set of hypotheses is developed.

Hypothesis 3: The executive's age will be negatively related to the ESS utilization.

Hypothesis 3a: The effect of age on ESS utilization will be mediated by perceived ease of use.

Hypothesis 3b: The effect of age on ESS utilization will be mediated by perceived usefulness.

(2) Education

The amount of formal education (e.g., undergraduate, graduate) has been found to be positively associated with IS-related behaviors (Jarvenpaa and Ives, 1991; Lucas, 1978). In addition, the innovation studies

have reported that education is positively related to receptivity to innovation (Dutton et al., 1987; Kimberly and Evanisko, 1981). For example, Kimberly and Evanisko (1981) found that technological innovation is positively affected by an adopter's education. Based on a meta-research of past studies on IT diffusion, Dutton et al. (1987) concluded that formal education is a strong factor in explaining the adoption and use of new IT. Lucas (1978) found that more educated individuals possess more positive perceptions and attitudes toward information systems than individuals with less education. Jarvenpaa and Ives (1991) argued that executives, who are highly educated and therefore more inclined to use IT vocabulary and be receptive to new technologies, are likely to have very positive perceptions and attitudes toward IT. Therefore, from these findings and TAM, the following set of hypotheses is presented.

Hypothesis 4: The executive's education will be positively related to the ESS utilization.

Hypothesis 4a: The effect of education on ESS utilization will be mediated by perceived ease of use.

Hypothesis 4b: The effect of education on ESS utilization will be mediated by perceived usefulness.

(3) Cognitive Style

Many researchers have studied the impact of cognitive style differences on a variety of IS-related behaviors (Fuerst and Cheney, 1982; Harrison and Rainer, 1992; Lucas, 1978; Taylor and Benbasat, 1980). However, the results on these studies are mixed. For example, Lucas (1978) found that individuals with different cognitive styles have different levels of IS use, perform different analyses of data, and take different actions based on the information. In contrast, Fuerst and Cheney (1982) found that an individual's cognitive style is not a significant factor in determining DSS use. With regard to mixed results, Taylor and Benbasat (1980) identified three possible reasons from a review of the literature: 1) inadequately developed theory of cognitive styles, 2) multitude of measuring instruments with inadequately established psychometric properties (e.g., reliability and validity), and 3) imperfect research designs used in empirical investigations of cognitive styles. Based on such criticisms, among various dimensions of cognitive style such as systematic-heuristic, analytic-heuristic, analytic-intuitive, sensing-thinking and intuition-feeling, the adaptive-innovative typology is selected for this study due to the following two reasons. First, there is a growing research

base with using a well-established adaption-innovation theory. Second, the Kirton Adaption-Innovation Inventory (KAI), which measures the adaptive-innovative dimension of cognitive style, has reasonable reliability and validity (Kirton, 1976; Foxall and Bhate, 1991; Foxall and Hackett, 1992). The adaption-innovation theory introduced by Kirton (1976) posits a continuum of styles of creativity, decision-making, and problem-solving. According to this theory, some individuals tend to be adaptors who solve problems within existing frames and do things better, while others tend to be innovators who change the frameworks of problems and do things differently. The characteristics of adaptors and innovators are shown in Table 1. Some studies have empirically tested the relationship between adaptive-innovative cognitive style and personal behaviors in computing, suggesting that the innovative cognitive style has more positive impacts on the behaviors. For instance, Harrison and Rainer (1992) found that individuals with innovative cognitive style exhibit higher levels of computer skills than those with adaptive cognitive style. Also, Foxall and Hackett (1992) reported that managers with innovative style demonstrate higher use of the system than those with adaptive style. Therefore, based on the above findings and TAM, the following hypotheses are proposed.

(Table 1) Behavior Descriptions of Adaptors and Innovators (Adapted from Kirton, 1976)

Adaptor	Innovator
<p>Characterized by precision, reliability, efficiency, methodicalness, prudence, discipline, conformity.</p>	<p>Seen as undisciplined, thinking tangentially, approaching tasks from unsuspected angles.</p>
<p>Concerned with resolving problems rather than finding them.</p>	<p>Could be said to discover problems and discover avenues of solution.</p>
<p>Seeks solutions to problems in tried and understood ways.</p>	<p>Queries problems' concomitant assumptions; manipulates problems.</p>
<p>Reduces problems by improvement and greater efficiency, with maximum of continuity and stability.</p>	<p>Is catalyst to settled groups, irreverent of their consensual views; seen as abrasive, creating dissonance.</p>
<p>Seen as sound, conforming, safe, dependable.</p>	<p>Seen as unsound, impractical; often shocks his opposite.</p>
<p>Liabile to make goals of means.</p>	<p>In pursuit of goals treats accepted means with little regard.</p>
<p>Seems impervious to boredom, seems able to maintain high accuracy in long spells of detailed work.</p>	<p>Capable of detailed routine (system maintenance) work for only short bursts. Quick to delegate routine tasks.</p>
<p>Is an authority within given structures.</p>	<p>Tends to take control in unstructured situations.</p>
<p>Challenges rules rarely, cautiously, when assured of strong support.</p>	<p>Often challenges rules, has little respect for past custom.</p>
<p>Tends to high self-doubt. Reacts to criticism by closer outward conformity. Vulnerable to social pressure and authority; compliant.</p>	<p>Appears to have low self-doubt when generating ideas, not needing consensus to maintain certitude in face of opposition.</p>
<p>Is essential to the functioning of the institution all the time, but occasionally needs to be "dug out" of his systems.</p>	<p>In the institution is ideal in unscheduled crises, or better still to help to avoid them, if he can be controlled.</p>
<p>When collaborating with innovators: supplies stability, order and continuity to the partnership.</p>	<p>When collaborating with adaptors: supplies the task orientations, the break with past and accepted theory.</p>
<p>Sensitive to people, maintains group cohesion and cooperation.</p>	<p>Insensitive to people, often threatens group cohesion and cooperation.</p>
<p>Provides a safe base for the innovator's riskier operations.</p>	<p>Provides the dynamics to bring about periodic radical change, without which institutions tend to ossify.</p>

Hypothesis 5: The executive's innovative cognitive style will be positively related to the ESS utilization.

Hypothesis 5a: The effect of cognitive style on ESS utilization will be mediated by perceived ease of use.

Hypothesis 5b: The effect of cognitive style on ESS utilization will be mediated by perceived usefulness.

(4) Computer Experience

A person's computer experience may positively influence his/her perceptions and attitudes toward IS and system usage, by reducing or eliminating any existing fears of computer. Most of the previous studies have showed a significant correlation between computer experience and IS-related outcomes (Arndt et al., 1983; DeLone, 1988; Guthrie, 1974; Howard, 1986; Kasper and Cerveny, 1985; Loyd et al., 1987; Montazemi, 1988; Thompson et al., 1994; Yaverbaum, 1988). Yaverbaum (1988) reported an increase in the internal motivation to use computers as the number of years of computing experience grew. In a study of the effect of computer experience on attitudes toward computers, Loyd et al. (1987) found that increased computer experience reduced anxiety and augmented positive perceptions and attitudes. A similar conclusion was reached by Arndt et al. (1983) and Howard

(1986), who found significant negative correlation between experience and anxiety. On the other hand, Guthrie (1974) explored the determinants of attitudes and concluded that previous experience with information systems was an important factor shaping managers' attitudes. Kasper and Cerveny (1985) investigated the impact of computer experience on DSS usage patterns. The results of this study showed that users with significant computer experiences were more likely to develop their own applications than those who had little experience. In a study of critical success factors for computer usage in small business, DeLone (1988) found that chief executive knowledge of computers resulted in IS success. From the analysis of data collected in a two-phase study of 83 small business firms with 164 end-users, Montazemi (1988) found that end users with computer experience were more at ease participating in IS activities and end-user satisfaction and appreciation were positively correlated with end users' level of computer literacy. Thompson et al. (1994) conducted a study that investigated influence of prior experience on personal computer utilization. In this study, they found that experience influenced utilization directly and had an intervening effect on the formation of attitude, which in turn influenced utilization. Therefore, from these findings and TAM,

the following hypotheses are presented.

Hypothesis 6: The executive's computer experience will be positively related to the ESS utilization.

Hypothesis 6a: The effect of computer experience on ESS utilization will be mediated by perceived ease of use.

Hypothesis 6b: The effect of computer experience on ESS utilization will be mediated by perceived usefulness.

III. THE MEASURES

Based on a literature review in IS and related areas, this study adopted the previously developed and validated instru-

ments with minor changes. By doing so, the study will add to the systematic approach needed in the IS field to relieve the confounding that plagues many streams of IS (Ives and Olson, 1984). Each of the measures used in the study is discussed below.

3.1 Perceived Attributes of Systems

Perceived attributes of systems (ease of use and usefulness) are measured by using Davis' instruments. Originally, Davis (1989) 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). Given the six items per construct (see Table 2),

<Table 2> Questionnaire Items for Perceived Ease of Use and Perceived Usefulness

Ease of Use:

1. Learning to operate an ESS would be easy for me.
2. I would find it easy to get an ESS to do what I want it to do.
3. My interaction with an ESS would be clear and understandable.
4. I would find an ESS to be flexible to interact with.
5. It would be easy for me to become skillful at using an ESS.
6. I would find an ESS easy to use.

Usefulness:

1. Using an ESS in my job would enable me to accomplish tasks more quickly.
2. Using an ESS would improve my job performance.
3. Using an ESS in my job would increase my productivity.
4. Using an ESS would enhance my effectiveness on the job.
5. Using an ESS would make it easier to do my job.
6. I would find an ESS useful in my job.

the respondents are asked to assess, on a five-point scale, the degree of their agreement or disagreement concerning perceptions of ESS. The overall score for each construct is formed by averaging the re-

spective six items.

3.2 Personal Characteristics

Age and education are measured by single

<Table 3> Cognitive Style Questionnaire Items

KAI	Item Loading	Item #
Originality Subscale:		
Generate original ideas	-0.77	1
Proliferate ideas	-0.74	2
Am Stimulating	-0.64	Not used
Cope with several new ideas at the same time	-0.60	3
Will always think of something when stuck	-0.52	4
Would rather create than improve	-0.52	5
Have fresh perspectives on old problems	-0.51	6
Often take risk by doing things differently	-0.47	7
Like to vary set routines at a moment's notice	-0.37	8
Prefer to work on one problem at a time	-0.36	9
Can stand out in disagreement against the group	-0.34	10
Need the stimulation of frequent changes	-0.33	11
Prefer changes to occur gradually	----	12
Efficiency Subscale:		
Am thorough	0.77	13
Master all details painstakingly	0.75	14
Am methodical and systematic	0.74	15
Enjoy detailed work	0.63	16
Am a steady plodder	0.48	17
Am consistent	0.35	18
Impose a strict order on matters within own control	----	19
Conformity Subscale:		
Fit readily into "the system"	0.75	20
Conform	0.68	21
Readily agree with the team at work	0.60	22
Never try to bend or break the rules	0.57	23
Never act without proper authority	0.54	24
Am prudent when dealing with authority	0.51	25
Like the protection of precise instructions	0.48	26
Am predictable	0.44	27
Prefer colleagues who never "rock the boat"	0.36	28
Like bosses and work patterns which are consistent	0.34	29
Work without deviation in a prescribed way	0.30	30
Hold back ideas until obviously needed	----	31

<Table 4> Computer Experience Questionnaire Items

1. Using microcomputer packages such as spreadsheets, word processing, or data management.				
2. Use of a fourth generation computer language or query language, such as Focus, SQL, etc.				
3. Building models (finance, statistics, organizational flowcharts, simulation, etc.) on a micro-computer or mainframe system.				
4. Programming in a computer language such as COBOL, FORTRAN, PASCAL, C++, etc.				
5. Participated in non-technical design of computer systems such as feasibility studies and requirement analyses.				
6. Participated in technical design of computer systems such as system analysis, design and implementation.				
7. How do you rate your computer skills?				
Novice		Intermediate		Expert
①	②	③	④	⑤
8. How do you rate your keyboard skills?				
Novice		Intermediate		Expert
①	②	③	④	⑤

questions with consisting of each 10 and 8 multiple items. The respondents are asked to check the degree of their own age and education. The adaptive-innovative cognitive style is measured using thirty-two items developed by Kirton (1976). The 32 items consist of three independent subscales, which measure Originality, Efficiency, and Conformity. For the construct validity test, Kirton carried out the principal factor analysis, showing that the items loaded on three subscale factors (see Table 3). The Originality subscale (13 items) indicates a creative, threatening, and unsettling individual. The Efficiency subscale (7 items) reflects a person who is methodical, precise, and reliable. The

Conformity subscale (12 items) identifies a bureaucratic individual who respects authority and rules. However, in this study, one item ("Am Stimulating") of the Originality subscale was deleted from the original 32 items due to ambiguity in its meaning. Two experts in the IS area reviewed these items and suggested minor modifications. Based on this feedback, the remaining thirty-one items are utilized in the study. The respondents are asked to indicate, on a five-point scale, the degree of ease or difficulty in performing various types of adaptive and innovative behaviors over time. The Efficiency and Conformity subscales are reverse scored, and an overall score for each respondent is computed. On

the other hand, computer experience is measured by using eight items developed from Pavri (1989). 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 (see Table 4). These scores are averaged to obtain an overall computer experience score for each individual.

3.3 System Utilization

System utilization is measured by using two questions regarding actual time spent in ESS and frequency of ESS use, which are adapted from Pavri's (1988) study. The first asks the respondents to specify how much time they normally spend each working day using their ESS. The second asks the respondents to indicate how frequently they use their ESS. These scores are averaged to provide an overall system utilization score.

IV. DATA COLLECTION AND ANALYSIS

The mail survey method was employed to collect data. Because there was no list of

organizations and individuals with an ESS, contacts with many ESS vendors were made by telephone to identify potential users. Most of the vendors rejected their cooperation, primarily citing company policy or possible loss of business. One company, Michigan, U.S.A., which is a leading-edge ESS vendor, agreed to assist with this study. However, the company 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 packet with 400 questionnaires was delivered to the company representative for distribution. The packet contained the research questionnaires with a cover letter describing the purpose of the study and a stamped return-addressed envelope. The respondents were assured complete confidentiality and were offered the summary results. Each respondent was requested to fill out the research questionnaire and to send it back to the researcher. Out of the 400 questionnaires distributed, 112 were completed and returned, representing a gross response rate of 28 percent. Since nine of the respondents did not use the ESS, and an additional six did not complete all of the questions, these fifteen respondents were removed. Thus, the final responses for analysis were 97, showing a net response rate of 24.3 percent. Of the 97 respondents, 72 (74.2%) were male and

25 (25.8%) were female. The primary age group of the respondents was from 41 to 50 (46.4%). 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. Most of the respondents (92.7%) held corporate high-level positions such as CEO, president, VP operations, CIO, CFO, etc., which indicated that the ESS were primarily used by high-level management.

The reliability of a measure examines to its stability over a variety of conditions (Nunnally and Bernstein, 1994). The Cronbach alpha coefficient is widely used for estimating the internal consistency of a measure. Although there is no definite value in IS studies, an alpha coefficient above 0.7 is recommended (Nunnally and Bernstein, 1994). The alpha coefficients for cognitive style, computer experience, perceived ease of use, perceived usefulness, and system utilization are 0.87, 0.77, 0.89, 0.94, and 0.91, respectively. This result was expected as all the measures employed in this study are extracted from prior well-established instruments with high reliability scores. On the other hand, the construct validity evaluates the quality of correspondence between a theoretically-based construct and its operational mea-

sure (Babbie, 1995). In general, a factor analysis is used for testing construct validity (Kerlinger, 1986). If all items in the variables are factor analyzed and load in accordance with priori theoretical expectations, then significant aspects of construct validity have been assessed (Nunnally and Bernstein, 1994). The factor analysis for this study was conducted by a varimax rotation on the construct items of the study variables (cognitive style, computer experience, perceived ease of use, perceived usefulness, and system utilization). The results showed that all the constructs loaded onto single factors in accordance with priori expectations.

V. RESULTS

All hypotheses of this study regarding direct and indirect effects on ESS utilization are tested in this section. In addition, a correlation matrix is employed to analyze the degree of relation or association among variables. More detailed procedures are discussed below.

5.1 Correlation Matrix

A correlation matrix provides some insights into the relationships among

(Table 5) Matrix of Correlations Among Study Variables

Variables	Mean	S.D.	1	2	3	4	5	6	7
1. Age	4.77	1.45	1.00						
2. Education	4.96	1.21	.26*	1.00					
3. Cognitive Style	3.19	0.40	.25*	.17	1.00				
4. Computer Experience	3.58	0.74	.07	.04	-.06	1.00			
5. Perceived Ease of Use	4.04	0.71	.00	.04	.10	.25*	1.00		
6. Perceived Usefulness	4.15	0.70	-.07	-.03	.11	.05	.10	1.00	
7. Utilization	4.42	0.52	-.08	-.01	.24**	.12	.29**	.39**	1.00

Note: ** $p \leq 0.01$. * $p \leq 0.05$. N = 93.

independent variables (i.e., multicollinearity or intercorrelation) as well as the correlations between a dependent variable and the independent variables. A high correlation between an independent variable and a dependent variable stands for strong association between them, and therefore the independent variable can be designated as a good predictor of the dependent variable. However, a high multicollinearity leads to imprecise estimation of regression coefficients, hence adverse effects on tests of their statistical significance (Pedhazur, 1982). Table 5 presents descriptive statistics for each variable, including mean and standard deviation, and the pairwise zero-order correlations among the study variables with their significance. The significance of each correlation was evaluated by a two-tailed test. As shown in Table 5, some correlations among independent variables were statistically significant (i.e., age and education, age and cognitive style,

computer experience and perceived ease of use). However, the correlations for any pair of independent variables did not exceed the multicollinearity criterion (0.9 and above) suggested by Hair et al. (1995). Based on the above result, it can be concluded that there exists no multicollinearity among the independent variables.

5.2 Direct Effects on ESS utilization

A multiple regression analysis was conducted to investigate the direct effects of the six independent variables (age, education, cognitive style, computer experience, perceived ease of use, and perceived usefulness) on ESS utilization. ESS utilization was regressed on all of the independent variables by using a stepwise method. The regression results are presented in Table 6. As shown in Table 6, three independent variables (cognitive style, perceived ease of use, and perceived use-

〈Table 6〉 Regression Results of Direct Effects on ESS Utilization

Variables	R ²	Incremental in R ²	p-Level
Perceived Usefulness	0.158	0.158	0.001
Perceived Ease of Use	0.269	0.112	0.01
Cognitive Style	0.349	0.081	0.05
Computer Experience	0.368	0.019	Not significant
Education	0.376	0.008	Not significant
Age	0.376	0.000	Not significant

fulness) on ESS utilization are statistically significant at the 0.05 level. Thus, hypothesis 1, 2, and 5 are respectively supported. However, hypothesis 3, 4, and 6 are not statistically supported.

5.3 Indirect Effects on ESS utilization

This study hypothesized that personal characteristics (age, education, cognitive style, and computer experience) would influence ESS utilization via perceived ease of use and perceived usefulness. These hypotheses were examined by adopting the procedure suggested by Wall et al. (1978), who 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: (a) the intervening variables should account for sizable proportions of the variance in the dependent variable; (b) the independent variables should add little

to this when considered in the same analysis; (c) the independent variables alone should account for relatively little of the dependent variable variance; and (d) the intervening variables should add considerably to this when considered in the same analysis. The first two criteria were analyzed by introducing the intervening variables (perceived ease of use and perceived usefulness) into a regression equation as primary predictors of the dependent variable (ESS utilization). Then, the four independent variables (age, education, cognitive style, and computer experience) were added as secondary predictors. In addition, the last two criteria were analyzed by introducing the independent variables into a regression equation as primary predictors and then adding the intervening variables. The results of the regression analyses are presented in Table 7. As shown in Table 7, all four criteria for age, education, and computer experience were satisfied. How-

(Table 7) Regression Results of Indirect Effects on ESS Utilization

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 Intervening Variables to the Independent Variables
Age	Perceived Ease of Use	0.006			
	Perceived Usefulness	0.113**	0.119*	0.006	0.113**
Education	Perceived Ease of Use	0.158***	0.161**	0.002	0.156***
	Perceived Usefulness	0.009			
Cognitive Style	Perceived Ease of Use	0.113**	0.123*	0.009	0.115**
	Perceived Usefulness	0.158***	0.165**	0.008	0.159***
Computer Experience	Perceived Ease of Use	0.084*			
	Perceived Usefulness	0.113**	0.196**	0.032*	0.109**
Computer Experience	Perceived Ease of Use	0.158***	0.212***	0.026*	0.149***
	Perceived Usefulness	0.021			
Computer Experience	Perceived Ease of Use	0.113**	0.127*	0.009	0.106**
	Perceived Usefulness	0.158***	0.176**	0.011	0.154***

Note: *** $p \leq 0.001$. ** $p \leq 0.01$. * $p \leq 0.05$.

ever, cognitive style was not simultaneously satisfied with these criteria. Cognitive style makes a noteworthy incremental contribution for two intervening variables (see the fifth column in Table 5) and accounts for substantial variance in the dependent variable ($R^2=0.084$, $p \leq 0.05$), which violated the second and the third criterion, respectively. Based on the above results, perceived ease of use and perceived usefulness were found to fully mediate the relationships between age and ESS utilization, between education and ESS utilization, and between computer experience and ESS utilization. Therefore, hypothesis 3a, 3b, 4a, 4b, 6a, and 6b are statistically supported. However, there was no evidence of mediation

for cognitive style on ESS utilization. Thus, hypothesis 5a and 5b are not statistically supported.

VI. FINDINGS

The results of multiple regression analyses showed that the users' cognitive style, perceived ease of use, and perceived usefulness had direct effects on ESS utilization. Additionally, the users' perceptions of ease of use and usefulness of the ESS fully mediated the relationships between age, education, computer experience, and ESS utilization. Thus, among a total of 14

hypotheses, nine were statistically supported. A summary of the hypotheses and support for those hypotheses is presented in Table 8. More specific analysis for each hypothesis is discussed below.

6.1 Perceived Attributes of Systems

Consistent with previous findings, perceived attributes of systems, perceived ease of use and perceived usefulness, are significant predictors of ESS utilization. This finding implies that executives are likely to use the system if they believe that it is easy to use and that using it will increase their performance and productivity. In particular, one of the more revealing results is the relative strength of the perceived usefulness-utilization relationship ($R^2=0.158$) compared to the perceived ease of use-utilization relationship ($R^2=0.113$). This result suggests that the motivation to use a system is driven by the functional advantages offered by the system, rather than how difficult or easy it is to get the system to perform those functions. Thus, IS designers and developers must consider usefulness thoroughly as one of the most important factors for the ESS success, when attempting to design or implement the system.

6.2 Personal Characteristics

Hypothesis 3, specifying a direct effect of age on ESS utilization, was not supported. However, hypothesis 3a and 3b, proposing an indirect effect of age on ESS utilization through users' perceptions of ease of use and usefulness, were supported. This finding indicates that younger executives are apt to perceive the ESS to be more useful and easier to use in their work activities than older counterparts, which in turn results in greater use of the system by the younger executives. Hypothesis 4, exploring a direct effect of education on ESS utilization, was not supported. However, consistent with hypothesis 4a and 4b, the effect of education on ESS utilization was fully mediated through perceived ease of use and perceived usefulness. This finding suggests that executives with high education perceive the ESS as easier to use and more useful than those with low education, resulting in greater use of the system. Hypothesis 5, proposing a significant effect of innovative cognitive style on ESS utilization, was statistically supported. This finding suggests that executives with innovative cognitive style are more likely to use the ESS than those with adaptive cognitive style. However, hypothesis 5a and 5b, investigating an indirect effect of cognitive style on ESS utilization through

(Table 8) Summary of Results

HYPOTHESES	RESULTS
〈H1〉 The ease of use, as perceived by the user, will be positively related to the ESS utilization.	Supported
〈H2〉 The usefulness, as perceived by user, will be positively related to the ESS utilization.	Supported
〈H3〉 The executive's age will be negatively related to the ESS utilization.	Not Supported
〈H3a〉 The effect of age on ESS utilization will be mediated by perceived ease of use.	Supported
〈H3b〉 The effect of age on ESS utilization will be mediated by perceived usefulness.	Supported
〈H4〉 The executive's education will be positively related to the ESS utilization.	Not Supported
〈H4a〉 The effect of education on ESS utilization will be mediated by perceived ease of use.	Supported
〈H4b〉 The effect of education on ESS utilization will be mediated by perceived usefulness.	Supported
〈H5〉 The executive's innovative cognitive style will be positively related to the ESS utilization.	Supported
〈H5a〉 The effect of cognitive style on ESS utilization will be mediated by perceived ease of use.	Not Supported
〈H5b〉 The effect of cognitive style on ESS utilization will be mediated by perceived usefulness.	Not Supported
〈H6〉 The executive's computer experience will be positively related to the ESS utilization.	Not Supported
〈H6a〉 The effect of computer experience on ESS utilization will be mediated by perceived ease of use.	Supported
〈H6b〉 The effect of computer experience on ESS utilization will be mediated by perceived usefulness.	Supported

users' perceptions of ease of use and usefulness, were not supported. Contrary to Hypothesis 6, computer experience had no significant effect on ESS utilization. However, hypothesis 6a and 6b, proposing an indirect effect of computer experience on ESS utilization through users' perceptions of

ease of use and usefulness, were supported. This result indicates that executives with much computer experience perceive the ESS to be more useful and easier to use than those with less computer experience, subsequently resulting in greater use of the system.

VII. CONCLUSIONS

Under an assumption of a positive relationship between IT use and individual and/or organizational performance, many IS researchers have investigated a number of variables to identify important factors influencing IT usage behavior. However, most studies have generally examined only direct relationships of personal characteristics, users' perceptions, and other variables with IS usage. The indirect linkages among these variables have been largely unexplored. Furthermore, there is very little empirical research on topics related to ESS in the IS literature. From these perspectives, this study investigated the factors that contribute to ESS usage and the relationships between these factors. The research model was developed on a basis of relevant IS literature. The model was empirically tested with data gathered from a number of ESS users. All hypotheses were advanced based on the research model. The results showed that cognitive style and perceived attributes of the ESS were significant predictors of ESS utilization. These results emphasize that organizations need the efforts to positively influence executives' cognitive style and perceptions regarding ease of use and usefulness for promoting more extensive use of ESS

technology. In addition, a test of the mediating model showed that executives' age, education, and computer experience influence the ESS usage indirectly through perceived attributes of the system. This indicates that the individual's perceptual formation of the system is anchored by the individual's age, education, and computer experience. Other hypotheses developed for the study were not statistically supported.

This study provides some contributions for IS researchers and practitioners. More specifically, the study can contribute to IS researchers, who are interested in understanding the determinants of IT use and building a cumulative tradition of studies on the successful implementation of IS. This was accomplished by providing a framework for ESS utilization, identifying several factors that are critical for ESS utilization, and empirically testing the proposed relations. In addition, the study can provide IS practitioners with general guidelines for the success of ESS. By identifying the important factors of ESS utilization and understanding the executives' usage behaviors, IS developers and managers are able to plan their courses of action more effective and establish a better environment for more productive use of the system.

Although this study provides interesting insights into the IS community, the results

must be interpreted cautiously. First, it should be noted that the model variables explained 37.6 percent of the variance on ESS utilization. The fact that 62.4 percent of the variance was unexplained suggests the need for additional research including potential unmeasured variables in the present study. Second, because of the difficulty in obtaining data, this study was conducted with the assistance of an ESS vendor located in Michigan, U.S.A. The resulting selection of participants may have brought in some bias. Third, the total number of responses seems to be somewhat small for external validity or generalizability of the study, although the gross response rate (28.0%) was reasonable. Fourth, this study employed the self-report scales to measure the study variables, which might be subjective and inaccurate. In addition, more refined instruments for the ESS utilization, which was measured by using a two-item scale in the present study, may be necessary for accurate its measurement. Finally, due to time and resource limitations, this study was conducted by 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.

From this study, a number of future research areas can be derived. First, this study tested a number of hypotheses in the context of ESS. In view of a wide range 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 ESS usage. The implicit assumption of this study is that higher usage of ESS will result in better individual and organization performance. However, this may not always be true. Some evidence of usage leading to poorer performance by managers has been found in the IS literature.

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