An Analysis of Executive Behavior with Hospital Executive Information Systems in Medical Centers

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Abstract — Existing Health Information Systems largely only support the daily operations of a medical center, and are unable to generate the information required by executives for decision-making. In this environment, executives must consider not only the best application of information technology, but also how to use this information effectively [1].

Building on past research concerning information retrieval behavior and learning through mental models, this study examines the use of information systems by hospital executives in medical centers. It uses a structural equation model to help find ways hospital executives might use information systems more effectively.

The results show that computer self-efficacy directly affects the maintenance of mental models, and that system characteristics directly impact learning styles and information retrieval behavior. Additionally, individual differences between executives and their locus of control impact the usefulness of scan-based information searches. Contextual factors and unstructured work characteristics also impact the usefulness of more focused information searches. Other results include the significant impact of perceived environmental uncertainty on scan searches; information retrieval behavior and focused searches on mental models and perceived efficiency; scan searches on mental model building; learning styles and model building on perceived efficiency; and finally the impact of mental model maintenance on perceived efficiency and effectiveness.

Keywords：Executive information system、Health Executive information system、Information Retrieval Model、Mental Model

Introduction

In recent years, increased demands for higher quality medical care, the growth of hospital organizations, and changes to health insurance policies have placed considerable pressure on hospital managers. These managers must balance rising volumes of services with rising medical costs, all while maintaining hospital competitiveness. Thus, it is now increasingly critical to understand how to use information technology to improve hospital efficiency and facility integration, as well as decision-making processes.

Due to the level of risk and investment costs of implementing executive information systems, research on these systems within various industries seems nearly endless. It is surprising then, that recent surveys on the development and planning of executive information systems find that about 60 percent of enterprises have experienced problems and failures in their management processes [2]. Fortunately, the troubles faced by other industries may not apply to the situation facing medical facilities; there are considerable differences between the organizational structure, goals, processes, and services of the medical industry and other enterprises. Thus, the unique case of the medical industry must be examined independently.

Corporate executives are responsible for their organization's survival. When they develop information technology strategy, they take appropriate actions to collect information for facilitating further decision-making and planning. Formulating strategy requires amalgamating internal and external information. Without access to the latest information, executives may misapply solutions that neither fit the entire enterprise nor accurately determine whether their enterprise can withstand internal problems or the external business environment [3].

Modeling is common in management research. For example, past scholars have used information retrieval models such as the one designed by Vandenbosch and Huff [3] as a base, combined with other theoretical frameworks, to explore the domestic banking and insurance sectors. This study hopes to do the same; use information retrieval model as a starting point for examining related issues and differences with other industries. The main research objectives of this study are as follows:

1. Explore the factors that impact hospital executive behavior when obtaining information through executive information systems.

2. Explore the factors that impact hospital executives in making decisions by using information systems.

3. Explore the factors that impact the results of hospital executive decision-making.

Literature Review

Executive Information Systems

The term “executive information system” was first proposed in 1982, and is defined as "providing competent information to improve management decision-making, monitor business conditions, [and perform] internal and external situation analysis of enterprise information-oriented computer systems" [4]. Executive information systems have attracted attention for three reasons. First, personalized analysis helps business executives better understand operations. Secondly, their flexibility helps meet individual needs. Lastly, these information systems can begin small. Since 1982, executive information systems have continued to be a hot topic among business managers, and researchers have supplied additional definitions. Turban [5] defined such systems as specific computer systems for obtaining information that executives need quickly, offering direct access to management reports, friendly graphical interfaces, drill-down analysis, online information services, and e-mail. Liang defined them as a data-driven computerized system used for quickly and accurately providing the most vital information to executives for decision-making.

Based on these definitions from the literature, this paper defines executive information systems as an information technology-based system that is flexible, easily adaptable and can offer information to executives quickly and instantly. The information provided is used to assist in decision-making, organizational management, information tracking, and analyzing situations related to internal and external organizations such as "critical factors."

Unlike other industries, hospitals have a special mission to "serve patients.” As a type of non-profit organization, the quality of health care is a common concern shared by both patients and administrators. Thus, in addition to focusing on information retrieval, executive information systems must also support the ultimate goal of improving the quality of medical services to patients.

Information Retrieval Model

One of the major goals of executives is successfully acquiring and using information from various sources and organizations that is helpful for decision-making and planning, which is why information tools like executive information systems are popular [6]. When organizations retrieve information, they can do so in two ways [7]:

(A) Scanning:

Scanning involves tapping into a wide range of organizations to detect and view information on the external environment, in order to understand future trends and accelerate an organization’s adaptation to change.

(B) Focused search:

A focused search involves a narrower search for internal or external information, in response to specific problems that may exist.

Focused Searches examine the results of work, or check specific information for solving specific organizational problems. Scanning, meanwhile, is used to understand business trends and changes in the external environment, or for stimulating answers to potential future problems. Scanning does not involve a specific need or problem [3].

While a Focused Search checks for specific directions or answers and Scanning casts a wider net, both methods are intended to help executives improve efficiency, effectiveness, and make the right decisions. Each behavior is affected by “individual differences," "organizational contextual factors," and "system characteristics," as shown in the model below.

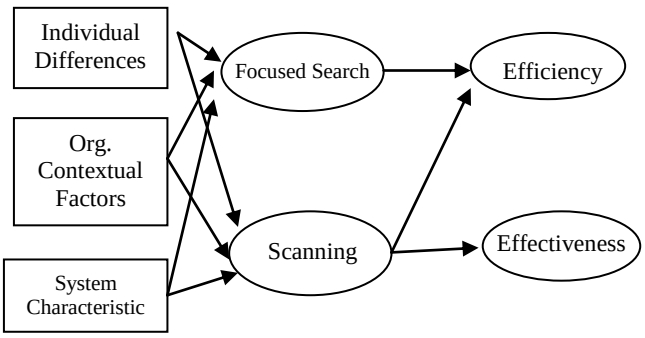

FIG.1 Information Retrieval Model [3]

Mental Model

Mental Models are often used by cognitive scientists, and they refer to how people’s daily life experiences and psychology impact their views and actions. “Mental” stems from the fact that these views exist within the minds of individuals, while the term “model” signifies how difficult it is to change or even detect these mental frameworks, because they are created through past experiences [8].

A more formal definition of a Mental Model is a dynamic representation or simulation of the world. Events outside us are automatically converted into our own internal frameworks, and as a whole they represent our interpretation of our surroundings. Based on this representation, people make inferences, choose actions, and respond to external affairs [9] [10]. A Mental Model can reflect how our personal experiences and understanding influence the way we use information and knowledge to achieve tasks. Mental Models also make the handling of new information more effective, as they help us group similar stimuli together, without having to reconstruct our required response from scratch. In this manner, Mental Models help fill information gaps between memories and facilitate Learning [11].

Cognitive scientists divide learning into two types: Mental Model Maintenance and Mental Model Building. Mental Model Maintenance identifies existing Mental Models used for properly handling situations involving new information. Mental Model Building is used to adapt to new environments or deal with unconfirmed messages, resulting in changes to the course of a Mental Model [11].

Performance Measures of EIS

In the management of information systems (MIS) field, many scholars consider usage, satisfaction, and performance as the main variables for measuring the successful use of information systems [6] [12] [13]. Here, the purpose of information systems is to improve organizational performance. Barnard divided performance into efficiency and effectiveness. Efficiency involves doing things correctly, while effectiveness refers to doing the right things [3]. Because health executive information systems are different from general executive information systems, this study defines decision outcomes as "the effectiveness and efficiency to health executives improve the medical quality."

Research Framework and Hypothesis

This study focuses on executives who use health executive information systems in hospitals. However, because EIS involves high costs and a developed information infrastructure, smaller hospitals may have little or no capacity to implement such a system. Li et al. consider that 80% of hospital medical centers have executive information systems. Therefore, medical centers are selected as cases in this study.

Liang states that an EIS provides services to not only executives, but also lower managers, and various departments within an enterprise at all levels of users. In some cases, the pool of users may involve as many as 150 individuals. This study however focuses primarily on executives in medical centers, including the president, vice president, president secretary and director of the administration office. It makes use of questionnaires to gather, analyze, and compare the ways executives use EIS.

This framework is based on Vandenbosch and Huff's (1997) information retrieval model. Their original model finds that executives who use EIS, influence organizational performance through three dimensions: "individual differences," "system characteristics," and "organizational contextual factors." This study combines their approach with the concept of Mental Models, and discusses the relationship between information retrieval behavior and the two types of learning behavior: Mental Model Maintenance and Mental Model Building. Particularly, this paper examines how this relationship directly and indirectly influences organizational performance (Figure 2). The hypotheses generated from this framework are shown as follows.

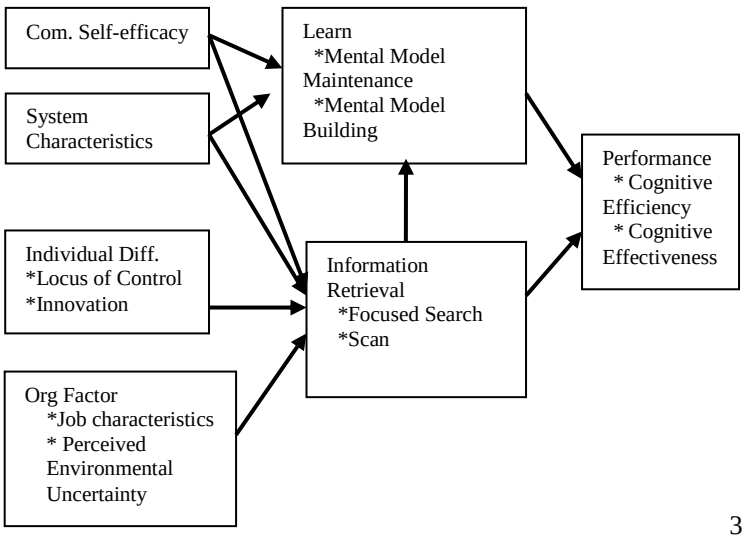

FIG.2 Research Model

H1: Hospital executives' "computer self-efficacy" will positively affect their "Mental Model Building."
H2: Hospital executives' "computer self-efficacy" will positively affect their "information retrieval behavior."
H3: Differences in "System characteristics" will lead to significant differences in the way hospital executives "learn."
H4: Differences in "System characteristics" will lead to significant differences in the "information retrieval behavior" of hospital executives
H5: The "individual differences" of hospital executives will lead to significant differences in "information retrieval behavior."
H6: Differences in "organizational factors" will lead to significantly different "information retrieval behavior" among hospital executives.
H7: Hospital executives' "information retrieval behavior" will positively affect their capacity to "learn."
H8: Hospital executives' "information retrieval behavior" will positively affect their "performance."
H9: Hospital executives' ability to "learn" will also positive influence their "performance."

Data Analysis

Measurement Model Analysis

This study randomly distributed a total of 101 questionnaires, recovering 34 (32 valid questionnaires), with a response rate of 32%. For information analysis, this study used SPSS 12.0 and SmartPLS 2.0 as statistical analysis tools.

In these samples, the majority of respondents were directors and the majority of medical centers were education institutes (65.6%). Most respondents had an educational background in management and medical care. The frequency and amount of computer use while working was "work every day" and "76% to 100%" for most respondents, respectively.

This study selected a partial least squares (PLS) model for its data analysis, using Smart PLS 2.0 Software. PLS is a structural equation modeling (SEM) analytical technique, developed by Herman Wold in 1960. It is based on standard regression analysis, and nowadays has become a powerful tool in studies with multi-dimension reconstruction for causal models.

The PLS measurement model mainly includes the following test of the reliability and validity of its dimensions:

(1) Reliability of individual questions: the reliability of individual questions is tested by question-loading, which examines how individual questions measure a particular dimension. To test loading presented by an individual can ask key dimensions to measure the extent to which if the loading threshold value of 0.7 or above, it means that the question items with individual reliability. In cases where our data contained items with less than a score of 0.7, this data was removed.

(2) The internal consistency of dimensions: Chronbach's alpha reliability coefficients were computed to determine internal consistency of all research constructs. A Cronbach's alpha above 0.7 means high reliability, between 0.7 and 0.35 signifies ordinary reliability, while less than 0.35 suggests low reliability. Analysis should remove lower related dimensions, until the reliability improves. Composite reliability must also be greater than 0.7 [14]. The data is in Table 1, where all values are greater than 0.7. This indicates the dimensions of this study have internal consistency, and their reliability is acceptable.

(3) Some scholars suggest that the individual dimensions of the average variance extracted (AVE) by the extraction volume must be at least greater than 0.5[15], and that convergence of dimensions is enough. This study used the recommendations of its threshold value as indicators of the data in Table 1, and found that in all dimensions AVE was greater than 0.5. This suggests an acceptable degree of convergent validity.

The path coefficients of this research test the relationship between dimensions, analyze the significance of path coefficients, and test the research hypotheses. Because the PLS path coefficients do not provide a significant test of the p-value to estimate their significance, Boolen and Stine [16] proposed a boot strapping method used to estimate t-values and p-values, in order to test coefficient significance and thus whether or not an hypothesis is correct.

In this study, the path coefficient test was used. The SmartPLS software default test method is BootStrap, and the model's predictive power estimation is used to determine the R^2. The path coefficients represent the strength of the relationship between variables and their direction. Here the path coefficients are related to the actual variable coefficients; a positive (or negative) path coefficient signifies that the variable has a positive (or negative) effect on the dependent variable measure. **and the observable variables and latent variables causal model to do hypothesis testing, and we can obtain the relevant data after testing, and use it to determine whether the path was significant, and estimated assuming the results are justified.**

Here, R^2 can help represent the overall predictive power of our model. R^2 is a percentage that ranges between 0 and 1, and depicts the overall percentage of the variance within the data that our model explains.

TABLE1. The Dimensions of Reliability and Validity

	AVE	Composite Reliability	Cronbach's Alpha
COM	0.633305	0.931963	0.916761
SYS	0.56944	0.887232	0.848761
FS	0.62546	0.83264	0.703815
INN	0.655843	0.903754	0.938273
JC	0.767509	0.92942	0.899285
LOC	0.544233	0.792133	0.7209003
MMB	0.775617	0.91199	0.855188
MMM	0.802929	0.924307	0.876861
CEFE	0.759307	0.903866	0.838705
CEFI	0.745805	0.897553	0.837763
PEU	0.822316	0.932591	0.89342
SC	0.566211	0.781353	0.726138

Computer Self-efficacy --COM
Focused Searches--FS
Mental Model Building --MMB
System Characteristics--SYS
Mental Model Maintenance--MMM
Cognitive Efficiency--CEFI
Cognitive Effectiveness--CEFE
Perceived Environmental Uncertainty--PEU
Innovative --INN
Job Characteristics --JC
Locus of Control --LOC
Scan--SC

Research Framework Analysis

Path	Coefficient(β)	t value	p value
COM→FS	0.216	4.149	0.000***
COM→SC	0.024	0.335	0.739
COM→FS	0.018	0.257	0.798
SYS→MMM	0.216	2.066	0.047**
SYS→MMB	0.299	3.276	0.002**
SYS→SC	0.339	4.685	0.000***
SYS→FS	0.059	12.515	0.000***
LOC→SC	0.018	2.824	0.008**
INN→SC	-0.234	1.409	0.168
JC→FS	0.298	5.098	0.000***
JC→SC	0.059	0.731	0.470
PEU→SC	0.280	3.153	0.003**
FS→MMM	0.349	4.868	0.000***
SC→MMM	0.064	0.665	0.510
SC→MMB	0.219	2.781	0.009**
MMM→CEFI	0.586	8.940	0.000***
MMM→CEFE	0.666	8.939	0.000***
MMB→CEFI	0.079	1.063	0.295
MMB→CEFE	0.177	2.260	0.031*
SC→CEFI	0.147	2.673	0.013*
SC→CEFE	0.002	0.036	0.970
FS→CEFI	0.117	2.821	0.008**

*p<0.05; **p<0.01; ***p<0.001

After performing our analysis, several hypotheses were rejected.

H2: Computer self-efficacy will positively affect information retrieval behavior.

Executives retrieve information through information systems not only to better adapt to different environmental conditions, but also as an important resource for decision-making [17]. Here, the more computer-literate the executive, the better he or she understands how to use a computer system appropriately in every case. Thus, there is little difference between computer self-efficacy and retrieval behavior.

H5.2: Individual differences between executives will positively impact Scan-type searches

Possibly due to users adaptation to new technology and each user's proficiency with using computers for

decision-making, individual differences among executives did not appear to affect the quality of their scan-based searches. It is possible that individual differences do impact the effectiveness of focused searches, but based on our results, it is clear there is little relationship between scan-based searches and the individual characteristics of executives.

H6.1b: Job characteristics that are unstructured will positively impact scan-type searches

Similar to Vandenbosch and Huff's [3] study, even if work is unstructured, it still contains some general direction. Executives may simply supply their own direction to searches, based on their own experiences. Thus, this hypothesis did not register significant results in our analysis.

H7.2a: Scan-type searches will positively affect Mental Model Maintenance

In the study by Vandenbosch and Higgins [18], although scan-type searches had a significant impact on mental model maintenance, they did not seem to have as strong a relationship with mental model building. This is possibly because when performing scan searches, executives are most interested in finding information that contracts their prior knowledge. Thus, information that confirms existing beliefs is easier to pass over, resulting in scan searches having limited impact on mental model maintenance.

H8: Scan-type searches will positively influence the results of decision-making

It is possible that hospital executives already have a wide understanding of information pertaining to hospital management, health insurance costs, and quality of care. Thus, a scan-type search on these topics may not likely produce a significant amount of new information that would impact the quality of decision-making.

H9.1b: Mental model building will positive effect cognitive efficiency

In the Vandenbosch & Higgins [18] study, mental model building was positively associated with competitive performance, but not exactly effectiveness or efficiency. It is possible that mental model building does help hospital executives think and rethink certain decisions, eventually leading to better decisions. However, this process may only happen over time, and thus in the short term, mental model building has no significant positive effect on decision-making effectiveness or efficiency.

Conclusions and Discussion

Despite the problems with the hypotheses listed above, the regression model does provide the following statistically significant results: computer self-efficacy directly affects mental model building; system characteristics directly impact our measurements of learning styles and information retrieval behavior; individual differences with the locus of control can impact scan-type searches; non-structural job characteristics in organizational contextual factors affect the focused searches; perceived environmental uncertainty affects scan-type searches; focused searches combined with information retrieval behavior directly affect the maintenance of mental models perceived effectiveness, while scan searches affect mental model building; mental model building in learning styles impacts on perceived efficiency, and lastly mental model maintenance impacts perceived efficiency and effectiveness.

The insignificant impact of scan-type searches on efficiency and effectiveness supports the results of Zhang and differs with those of Vandenbosch and Huff [3]. This result may be helpful for hospital executives wishing to avoid spending time on methods that will not lead to improved effectiveness and efficiency.

Mental model maintenance has a strong path coefficient with efficiency and effectiveness, which implies that when hospital executives make decisions, they must merge new information with past experiences and ideas through mental model building in order to obtain an optimal solution. Thus, if hospitals can maintain an integrated and comprehensive information system for their decision makers, decision-making effectives and efficiency should show some improvement.

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