

ISSUES FOR SUCCESSFUL IMPLEMENTATION OF KOREA'S HOSPITAL  
INFORMATION SYSTEMS

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## ABSTRACT

Hogene Chae

### ISSUES FOR SUCCESSFUL IMPLEMENTATION OF KOREA'S HOSPITAL INFORMATION SYSTEMS

This study identifies key management issues in hospital information systems in Korea and critical success factors in management. The evolution of management issues in Korea between 1999 and 2006 was analyzed using secondary analysis, and it is determined if tertiary hospitals follow Nolan's growth stage theory. Moreover, the critical success factors (CSF) influencing hospital information systems from a management perspective were identified by analyzing the relationship between the above management issues and user satisfaction. The results showed that the top key management issue that was consistent with the 1999 study was "top management support," and other important issues were "aligning the IS department within organizations," "PACS," "disaster recovery system," "information strategy planning," "standardization," "EMR related regulations," "security and control of information resources," "EMR," and "training of IT specialists." In addition, tertiary hospitals were grouped into stages based on Nolan's stage theory in order to examine how management issues varied according to the growth stages (i.e., beginning year of implementing CPOE). Hospitals that were categorized into the third stage had the highest user satisfaction with the above key management issues. In summary, three management issues are found to be important issues for achieving successful implementation of hospital information systems: adequate support from top management, proper user training, and effective use of outsourcing are recommended.

## INTRODUCTION

### Background

Hospital information systems are being rapidly developed as the field of information technology evolves, and the effective use of hospital information systems brings cost reduction and better patient care to the healthcare industry. Korea's hospitals are increasingly being digitized and equipped with hospital information systems such as Computerized Physician Order Entry System (CPOE), Electronic Medical Records (EMR), Picture Archiving and Communication System (PACS), insurance claims by Electronic Data Interchange (EDI), Admission/Discharge/Transfer (ADT) system, and so on since late 1980s. According to the nationwide survey on HIS development (Chae et al., 2005), almost all tertiary hospitals are nowadays equipped with CPOE, PACS, insurance claims by EDI, and administrative systems. Hospital information systems have greatly contributed to reducing the waiting time for outpatients and length of hospital stay, and improving the productivity of hospital employees. Revenues for Korean hospitals have increased as the result of the implementations of the information systems (Park et al, 2003).

Table 1 Comparison of Hospital Information Systems in Korea (Unit: %)

Hospital Information Systems	1999	2005
Outpatient CPOE	81.8	97.6
Inpatient CPOE	81.8	97.6
Pharmacy	83.3	100
Laboratory	83.3	97.6
Radiology	83.3	97.6
Admission/Discharge/Transfer (ADT)	100	100
Accounting	91.7	100
Insurance claims by EDI	100	100
PACS	16.7	90.5
EMR	16.7	19.1
Enterprise Resource Planning (ERP)	-	14.6
Groupware	-	43.9
Data warehouse	-	14.6
Knowledge management system (KMS)	-	7.5

\* Chae et al. (2005) Survey on information systems development in Korea. Health Insurance Review Agency.

On the other hand, information technology has also created many management issues for Korean hospitals. For instance, IT has changed the workflow processes, such as delivering paper orders and films, keeping paper based medical records, etc., and thus, resulted in reducing many jobs, creating new ones, and changing roles of key players such as physicians, nurses, medical record librarians, and administrative staffs. Especially, when physicians and nurses have to enter all of their orders into the systems, problems occur due to lack of proficiencies. For such reason, management is often faced with resistance from those who are not familiar with the systems to adapt to the new system. In addition from Van Der Meijden et al.'s (2003) analysis, dissatisfaction was strongly correlated with perceptions of a



negative impact of the system on patient care. Thus, it is critical to spend some time analyzing the existing environment before thinking about how to implement such systems.

Hospitals are experiencing more demand than ever to create optimized settings for both better quality patient care and hospital management. Accordingly, the hospital management is shifting to utilize information systems to acquire a higher place in the competitive market of hospitals. Effective use of hospital information systems for better quality patient care and administrative operations has become the standard to measure success in hospital management. As hospital information systems advance and hospitals increase their dependency on the system, healthcare professionals are faced with issues regarding ways to achieve objectives with the use of hospital information systems, such as management issues on building competitive advantage over other hospitals.

From the early 1980s, the Society for Information Management (SIM) has been presenting achievements, uses, and research guidelines by analyzing changes in management issues with information system every three years (Brancheau & Wetherbe, 1987; Brancheau et al., 1997). In addition, numerous related research has been conducted based on the SIM's surveys. For instance, Louis (2000) presented the top five common issues that result in changing of management priorities by

comparing and analyzing common interests and characteristics of US, Taiwan, and Australia with Hong Kong's. Xia and Adams (2004) also conducted a research study to classify key management issues based on Importance and Persistency. They concluded that management issues were shifting from focusing on information technology toward concentrating more on business aspects of management of information technology.

The importance of identifying such major management issues was also recognized in Korea, and researchers have been conducting related studies from early the 1990s. Ryu (1991) but not since then analyzed current states of information systems for Korean companies, and provided data that recommended the Korean companies to effectively utilize information systems. Han et al. (1996) selected key management issues from the manager's point of view in order to analyze how these categories affected selection of different types of information systems, and provided vital standards for IT professionals when selecting key management issues. Furthermore, Kim et al. (2002) conducted a research study, and identified key management issues for Korean hospital information systems by targeting hospital IT managers using three-round Delphi survey. While several Korean researchers have been conducting short-term research on management issues of information systems implementation in Korea consistently over the past two decades, there has not been an

actual follow up of these studies since the study by Kim et al. in 1999.

It is widely accepted that information systems are greatly affected by information technology changes. According to Lee and Kim's (2001) research on a stage model of organizational knowledge management, Gibson and Nolan (1974) categorized the stages of growth of information systems into four stages from initiation to maturity as information technology changes. And they recommended application areas as well as the related management issues for each stage. By examining the changes in management issues for each stage, this study may be able to identify and help better forecast future management issues in Korea's hospital information system.

### Significance

It is widely known that management issues vary according to different IT environments. This study is the first attempt to examine how management issues have changed between 1999 and 2006, and how those issues have changed according to Nolan's growth stages, which hospitals are categorized based on the year of initiation of CPOE in the Korean hospital setting. Of management issues obtained from 2006 survey, important management issues influencing the user satisfaction of outpatient CPOE and ADT system users are identified. While most of the previous

studies on user satisfaction were based on the mixed type of users, this study separated two types of users (i.e. medical staffs for CPOE and administrative staffs for ADT) because they are working under different environment and tend to have different attitude toward the system. These results can be used in developing successful implementation strategies for hospital information system managers.

### Purpose

The purpose of this study is to identify key management issues in hospital information systems in Korea and to identify critical success factors in management.

Specific purposes are as follows:

1. To compare existing top management issues in hospital information systems in Korea between 1999 and 2006 in order to examine how management issues evolve as information technology improves
2. To examine how management issues change according to the growth stages suggested by Nolan
3. To identify the significant management issues influencing user satisfaction to outpatient CPOE and ADT system.

## THEORETICAL BACKGROUND

Health Information System Implementation Issues in the U.S.

There have been numerous efforts to successfully implement health information systems in the U.S., and one of the major efforts was in 2004 when the U.S. Department of Health and Human Services released a strategic framework that calls for the creation of Regional Health Information Organizations that would provide local leadership for the development, implementation, and application of secure health information exchange across care settings (Overhage et al, 2005). Despite such efforts, many HIS implementation projects have failed for reasons such as conflicting organizational missions, data ownership issues, lack of financing, and deep-seated professional and institutional resistance. According to Sciotte et al. (2006), fundamental risks are classified into following segments: technological risk, human risk, usability risk, managerial risk, and strategic / political risk. Technological risks include hardware and software complexity issues and standardization issues including issues with network infrastructures. There can be a time where the project team needs to outsource certain parts of the project to close the gap for in-house resource shortage, in terms of level of expertise.

One of the major human risk factors is resistance to change. Previous IT research has revealed that the major concerns include the users' openness to change, users' attitudes toward the new system, and users' expectations (Gibson, 2003; Jiang et al., 2001; Yi et al., 2006; Battacherjee, 2001; Paré & Elam, 1999). Physicians and

healthcare professionals have long been accused of being reluctant to use computer-based information systems, and they should be recognized as having major influence on implementation risks. It must be stressed that all the physicians agreed to participate in the implementation stage on a voluntary basis.

Usability risk is defined as the “degree to which a person believes that using a particular system would enhance his or her job performance” (Venkatesh & Davis, 2000), and it is dependent on information validity, context, and user friendly interface (Sicotte et al, 2006). The complexity of interface development and ineffective process redesign are main barriers to widespread diffusion of the health information systems because they can result in time consuming activities for the healthcare professionals that use the systems.

Adequate user-involvement is of paramount importance to foster ownership of the system by the future users, and to allow the implementation of systems that will actually match work processes, current and future. It is not enough to include just a few potential users in the project group. The project group needs to have them negotiate system specifications, discuss implementation plans, and fit them into meetings once very so often. User involvement should be much more extensive and literal (Mul et al., 2004; Hartswood et al., 2000, Shah & Robinson, 2006).

For managerial risk, it is critical to have a clear mindset to lead the

implementation project, such as power to lead the change effort and encouraging the group to work together as a team. Team leaders must create a vision to guide the project, and develop strategies to achieve the set goals. According to Berg (2001), this vision, “which should be first and foremost about the future of the organization should be both robust enough to frame and direct the IS implementation process, yet it should be open-ended enough to be adaptable to newly upcoming challenges, in part deriving from the IS implementation process itself.” Also, upper management support represents a meaningful factor that can also diminish managerial risk (Baird et al., 2007).

Lastly, large scale projects, like health information system implementation projects, pose numerous difficulties regarding setting strategies, collaborating with different groups of professionals and organizations, and dealing with political factors. However, a strategic stance is needed so the project may pursue common objectives (Sciotte et al, 2006).

Thus, the development of health information systems remains very complex and their implementation highly risky. Thus, it is important that risks be identified, understood, and managed. Success of health information systems lies in the capability to put in place a series of proactive strategies that minimize the potential impact of the various risks that are specific to a particular project (Sicotte et al, 2006).

## Determinants of Successful Health Information System Implementation

There are many ways to determine the success of health information system implementation. According to Paré (2002), success requires a proactive stance where implementation challenges are anticipated as early as possible and that a good implementation plan should start with the issues and challenges to be overcome rather than the actions to be taken and decisions to be made. Berg (2001) states that success of information system is “decided on the work floor, by the middle management, by top managers – and it is the outcome of all these interactions that in the end settles the system’s fate,” and Van Der Meijden et al. (2003) state that the determination of success depends on the setting, the objectives, and the stakeholders. According to Berg (2001), it is not possible to list a definite set of ‘success’ and/or ‘failure factors’ that will provide a certain recipe towards implementation success or failure because it is due to each implementation project’s unpredictability.

Given this unpredictability, an implementation strategy that was successful in one organization will not always be successful in another. Healthcare professionals, therefore, should be aware that no matter what is done and how good the strategy is, there is always the possibility that something unexpected will happen. However, the better the implementation plan, the less likely something unexpected will happen. Thus, rather than solely focusing on the tactics or strategies to be adopted to ensure



success, more efforts should be devoted toward understanding the complex nature of the implementation phenomenon by identifying the most common issues and challenges encountered in IT implementation projects (Paré, 2002).

In addition, such ‘success’ concept contains various dimensions, and not all parties of the organization may agree about which dimension should be the most relevant. For example, when a physician order-entry system was introduced in a US Academic Medical Center, management realized that direct substantial savings were not to be expected. Rather, the very restructuring of the professional’s work processes was seen as an important success. In this case, ‘quality of care’ and ‘being a state-of-the-art Academic Medical Center’ became the more important criteria for success than the originally projected cost-savings that were a major factor in the decision to acquire the system (Massaro, 1993). This case implies that managing towards a ‘successful’ implementation involves careful attention to what success parameters are used, whether the different parties involved in the implementation process share these goals, and how the inevitable evolution of the criteria of ‘success’ will be handled (Checkland & Holwell, 1998).

Pizziferri et al (2005) has evaluated user satisfaction, and found out that overall user satisfaction is one of the main determinants of user adoption. In addition, Delone and McLean in the field of management information systems aimed

at identifying determinants for system success, and through Van Der Meijden's analysis, the success dimensions identified for management information systems are valid for patient care information systems as well (Delone & McLean, 2003; Van Der Meijden et al., 2003).

Delone and McLean (2003) proposed six distinct categories to subdivide success measures of management information systems: (1) system quality, (2) information quality, (3) usage, (4) user satisfaction, (5) individual impact, and (6) organizational impact, which all have close relationships with the aforementioned user resistance issues. They also concluded that system quality and user satisfaction were the categories that attribute the most to the user resistance issue. System quality attributes included ease of use (record keeping time) and savings in documentation time and response time, while user satisfaction attributes were overall satisfaction, user friendliness, and user attitude toward the information system (Delone & McLean, 2003; Van Der Meijden et al., 2003). Information quality criteria are completeness, data accuracy, legibility, and timeliness; and usage criteria of an information system included number of entries, frequency of use, and duration of use (Van Der Meijden et al., 2003). Individual impact was comprised of five attributes: related to changed work practices, varying from a change in frequency of documentation to shifts in responsibilities for certain tasks, immediate benefits of

system use, changed documentation habits, and information use in daily practice (Van Der Meijden et al., 2003). Lastly, organizational impact attributes included effective communication and collaboration with other disciplines, direct or indirect impact on patient care, and costs (Van Der Meijden et al., 2003). Organizational issues are critical because technical difficulties can be the result of poorly managed development processes, and a well-functioning system exemplifies a match between the functionalities of the system and the needs and working patterns of the organization (Berg, 2001).

Table 2. Determinants of Successful HIS Implementation

Researchers	Determinants of Successful HIS Implementation
Paré (2002)	- A proactive stance where implementation challenges are anticipated - Implementation plan that starts with the issues and challenges to be overcome
Berg (2001)	- Right interactions of the work floor, middle management, and top management – and it is the outcome of all these interactions that in the end settles the system’s fate
Pizziferri et al. (2005)	- Overall user satisfaction as one of the main determinants of user adoption
Delone and McLean (2003)	- System Quality - User Satisfaction - Information Quality - Usage - Individual Impact - Organizational Impact

Thus, it is crucial to measure customer perception and satisfaction of their hospital’s information system, rather than evaluate technical aspects of the system and to listen to and implement the voice of customers more than the developers’ voices.

### Niederman et al.'s (1991) Research

Niederman et al.'s research in 1991 determined the most critical issues in IS management, and its analysis is very significant that it is still used in recent studies. The research analyzed how issues have evolved between 1986 and 1989, and the analysis focused on specific issues as well as emerging trends. This research was distinct compared to previous ones because issues were rated based on 10-point scale, and analyzed by categorizing them into four attributes. The results showed that issues related to strategic planning and alignment with IT organizations consistently stayed as top management issues, and issues that did not top ten, which was also significant were human resource management, software development, telecommunication system, and issues related with internal effectiveness.

### The Nolan Stage Model

In the corporate world, businesses are becoming more complex by adopting new technologies, systems, and strategies into their business models in order to increase profits while reducing costs. However, it is challenging for the corporations to recognize each stage of growth of IT and manage emerging issues accordingly because systems are increasingly used as a strategic tool for gaining competitive advantages. Nolan categorized four distinct stages in the growth of all information

system facilities. Each stage explains the underlying IT organizational forces at work and the related management issues. He stated the four stages of information system growth as follows: Initiation, Expansion, Formalization, and Maturity (Gibson & Nolan, 1974).

In stage one, *Initiation*, computers and information systems are introduced to the organization. The priority for the management is to fix any departmental responsibilities for the computers, such as deciding where the computer facilities should be located and whether an autonomous IT unit is to be created. One of the top issues is to minimize the disruption that results when high technology is injected into an organization (Gibson & Nolan, 1974). Anxieties among people may rise, and these fears can lead to open employee resistance. Thus, March and Simon (1958) state that the first step to managing this process of initiation to the new IT is to accept the fact that people's perceptions of reality and their views of the situation are what have to be understood and dealt with by key users, rather than some "objective" reality (March & Simon, 1958).

According to Gibson and Nolan (1974), stage two, *Expansion*, represents a steady, but steep, rise in expenditures for hardware, software, and personnel. It is a period of contagious and unplanned growth that is characterized by growing responsibilities for the information center director, loose (usually decentralized)

organization of the IT facility, and few explicit means of setting project priorities or crystallizing development plans for application systems (Gibson & Nolan, 1974). Thus, Gibson and Nolan (1974) stress the importance to acquire or develop middle managers, and to recognize the increasing demands for specialized personnel within the computer department.

In stage three, *Formalization*, managers begin to notice runaway computer budgets and try to get control over the resources. This calls for analysis and planning that sets forth clear and explicit objectives for exploitation of the computer resource vis-à-vis the user departments (Dearden & Nolan, 1973). Nolan (1974) suggests the following three management steps to resolve such crises: (1) centralize established complex operations and hardware that are less complex, (2) flag increasing impacts of computer applications for the top by introducing overseer and resource-allocation mechanisms at the general-management level, and (3) decentralize some parts of the systems analysis function and centralize other parts (Gibson & Nolan, 1974).

As all of the issues up to stage three become resolved, the computer resources will have reached maturity in the organization, and the corporations now have created a greater potential for continuation of monetary profit. Stage four, *Maturity*, is the ultimate stage of computing growth in organizations, and refers to a state where

information resources are fully developed. Contributions of resources can be seen, and the significant issue lies in the quality of communications between the information system manager and top manager, and between the information center and users (Gibson & Nolan, 1974).

## METHOD

### Data Sources

The secondary analysis of data from two surveys on management issues in 1999 (Kim, 1999) and 2006 (Kwak et al, 2007) for IT managers who work at Korean hospitals were used to compare management issues under different IT environments between two periods. Data from managers were collected via two data collection instruments, each serving different purposes: the open-ended questionnaires to obtain ideas from their experience in the first round of survey, the closed-ended questionnaires in the second round survey in order to select top 20 issues from the results of the first round survey, and a set of interview questionnaires in the third round in order to obtain professional opinion on the selected issues. The management issues in Korean hospital information systems from the 1999 and 2006 surveys were identified using the Delphi method.

In addition, a nationwide survey data on the status of hospital information

system was used to examine which management issues from 2006 survey influence user satisfaction. Such data were collected from the entire 42 tertiary hospitals in Korea in 2005 (Chae et al, 2005).

### Research Context

As seen in Figure 1, how the HIS development activities and management issues varied were analyzed according to the beginning year of HIS implementation in order to examine whether the Nolan's stage theory holds for hospital setting. Beginning year of HIS implementation was categorized into three stages: between 2003 and 2008 (stage 1), 1999-2002 (stage 2), and before 1999 (stage 3). Furthermore, the status of HIS was categorized into three groups according to advanced status: either "CPOE or PACS", both "CPOE and PACS", and implementing all three systems (CPOE, PACS and EMR).

In addition, the relationship among the status of HIS, management issues, and the user satisfaction from outpatient CPOE and ADT system were analyzed which are key success measures for information systems to identify the significant factors influencing the user satisfaction and to provide recommendations for successful implementation of HIS projects.



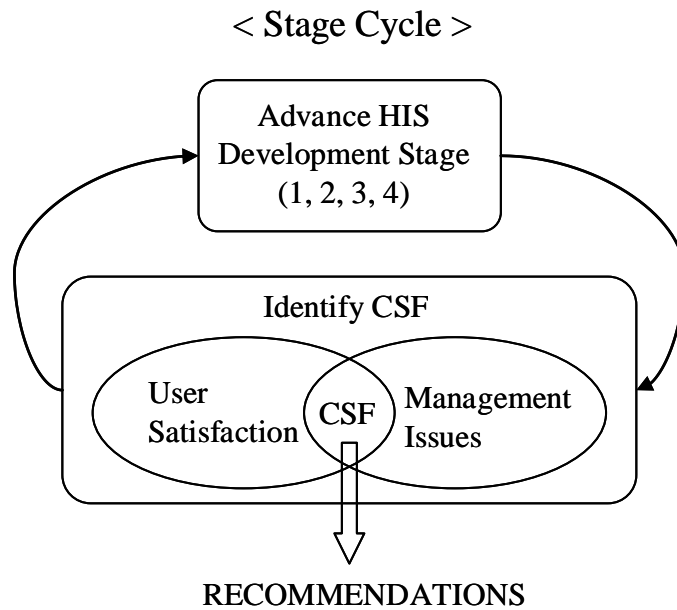


Figure 1. Research Framework

### Analysis of Management Issues

#### *Comparison of Management Issues between 1999 and 2006*

Throughout this thesis, management issues based on characteristics of Korean hospitals were analyzed, and comparisons were made on management issues using the results of the surveys conducted in 1999 by Kim (1999). In order to analyze major issues in hospital information systems with key issues in 1999, Niederman et al.'s (1991) analysis with classification was used: Business Relation (BR), Technical Infrastructure (TI), Internal Effectiveness (IE), and Technology Application (TA). Also, to identify what would be the key issues for hospital information system managers for future, 20 issues that were obtained through Kim's (1999) research were

used, and 10 more management issues were added based on recent literature reviews (Table 3). As shown in Table 1, total of ten key issues have been added since 1999 research on key management issues. “Telemedicine,” “Expanded IT Sourcing,” and “Improving IS Education System” were added to Business Relation (BR), and “Building a Responsive IT Infrastructure,” “Integrated HIS,” “Building a e-healthcare and u-healthcare infrastructure,” and “Enterprise Resource Planning” were added to Technical Infrastructure (TI) classification. “Law” and “IT improvement” were the only new issues that were added to Internal Effectiveness (IE), and “Standardization” and “Knowledge Management System” were added to Technology Application (TA) classification.

Table 3. Key Issues of Hospital Information Management Systems

Issues classification	Key issues in 1999(20)	New issues in 2006(10)
Business Relation	Top Management Support	Telemedicine
	IS/IT strategy and planning	Expanded IT Sourcing
	Making Effective Use of the Data Resource	Improving IS Education System
	Improving IS Strategic Planning	
	Rearranging of Organization for System Development	
Technical Infrastructure	Managing and Operating of IT Network	Building a responsive IT infrastructure
	Electronic Medical Record (EMR)	Integrated HIS
	PACS	Building a e-healthcare and u-healthcare infrastructure
	Developing of Laboratory Information System(LIS)	Enterprise Resource Planning (ERP)
	Developing and Managing Electronic Data Interchange(EDI)	
Internal Effectiveness	Building of Patient Information System	
	Aligning the IS Organization within the Enterprise	Law and IT improvement
	The Legacy of Electronic Medical Record	
	Educating of System Engineering	
	Improving the Effectiveness of Software Development	
Technology Application	Recruiting and Developing IS Human Resource	
	Advertising of HIS	
	Improving Information Security and control	Standardization
	Distributed System	Knowledge Management System (KMS)
	Collaborative IT Organization and Hospital	

\*Kwak et al.'s (2007) research on Key Issues of Hospital Information Management System

*Analysis of Relationship between Management Issues and Nolan's Growth Stages*

(1) Selection of Management Issues

Management issues were selected from the nationwide survey of healthcare managers in 2006 that was conducted. As seen from table 4, These were: “top management support” and “information strategy planning” from Niederman’s

business relation category, “user training,” “alignment of IS within the enterprise,” and “software development and outsourcing” from internal effectiveness, “status of HIS development,” and “disaster recovery system” from technical infrastructure, and “security and control of information resources,” and “standardization” from technology application (Kwak et al., 2007).

These nine issues are further divided into sub-issues and classified based on Niederman et al.’s (1991) analysis. Top management support contains a sub-issue that affect user satisfaction; human resource support. User training is selected to see how training on various information systems affects user satisfaction and the status of computerization within the hospital. Software development and outsourcing contains a sub-issue that affects user satisfaction within the hospital; development on software and hardware. Security and control of information resources is selected to determine how following sub-issues affect user satisfaction; having both security training and written oath, just security training, just written oath, or none. Standardization is to examine how following sub-issues affect user satisfaction within the hospital; whether hospitals equipped with standardization, not equipped, or planning to equip. Aligning the IS organization within the enterprise is selected to analyze how reputations within the hospital affect user satisfaction within the hospital. The status of HIS development is selected to determine how different types of

computerized environments within the hospitals can affect user satisfaction. Lastly, availability of information strategy planning is selected to examine how following sub-issues affect user satisfaction; hospitals which already implemented, currently implementing, planning to, or have no future plan.

## (2) Grouping of Hospitals by Growth Stages

To discover how management issues have evolved according to development stages based on Nolan's stage theory, Korea's tertiary hospitals are classified into three stages according to the year of HIS initiation:

Stage 1: from 2003 to 2008

Stage 2: from 1999 to 2002

Stage 3: before 1999

The reason for grouping hospitals in this way was to account for the years of HIS experience. That is, those hospitals which introduced CPOE before 1999 were assumed to advance HIS applications based on their longer experience compared with the hospitals which introduced CPOE after 2002. Of the three types of growth explained by the Nolan's stage theory (Gibson and Nolan, 1974) (a growth in computer applications, a growth in the specialization of EDP personnel, and a growth in formal management techniques and organization), this study focused on the last type of growth. Tertiary hospitals were grouped into one of the four growth stages (initiation, expansion, formalization, and maturity) based on the year of initiation of CPOE because CPOE has been considered to be the basic and initial hospital

information system implemented in Korea's healthcare environment. Tertiary hospitals that have recently initiated CPOE (between 2003 and 2008) fell into the Nolan's initial stage. Other hospitals that implemented CPOE between 1999 and 2002 were in the second stage, and other hospitals that implemented CPOE before 1999 are in the third stage. None of tertiary hospitals are yet near the fourth stage of Nolan's staging theory according to the analyzed data.

Relationships between the key management issues identified from the 2006 survey and the growth stages were analyzed by using cross-tabulation to examine how management issues varied according to the growth stages (or years of HIS experience). Also, any additional statistical analysis was not used such as the correlation analysis or the regression model because this section of the thesis is just to see how management issues are applied hospitals that are categorized into growth stages.

#### *Relationships between Management Issues and User Satisfaction*

Cross-tabulation was first used to analyze the relationship between management issues and user satisfaction of both outpatient CPOE and ADT system. Then, the correlation analyses were used to examine the relationship between these two. Coding for these analyses was done in opposite directions which resulted in opposite relationships: Yes as 1 and No as 2, 1 as very strong and 4 as very weak, etc.

Lastly, the regression models were used to identify which issues had the most significant relationships among others. User satisfaction was rated from one as the lowest to five as the highest, and these ratings were divided into 3 levels: 1-2 as low, 3 as middle, and 4-5 as high. From this analysis, important management issues influencing user satisfaction in medical and administrative field can be identified.

#### (1) User Satisfaction for Outpatient CPOE

High overall user satisfaction of hospital and administrative information systems from Korea hospital employees is shown in table 4. It presents that user satisfaction of each medical system (inpatient and outpatient CPOE, and EMR), medical support system (pharmacy, laboratory, radiology, and PACS), and administrative system (ADT, accounting, EDI, ERP, groupware, data warehouse, and KMS) vary, which indicates that comparison between each of system and management issue may lead to different results. However, the reason why outpatient CPOE is selected as the dependent variable to analyze the relationship between the management issues is because first of all, unlike EMR where the adoption rate is only 19.1% from tertiary hospitals, outpatient CPOE has the adoption rate of almost 100% (Chae et al., 2005).

Second of all, outpatient CPOE is the central platform that most hospitals implemented so far in Korea, and EMR, ERP, EDI, and ERP operate through this

system. Therefore, performance of these systems is largely depended on the accurate data entry of outpatient CPOE (Chin & Kim, 2002). Accordingly, hospitals have put great deal of efforts to increase of satisfaction of physicians, who are primary users of outpatient CPOE. Resistance to change by physicians has been also regarded as a major problem for successful implementation of CPOE in the United States (Kuperman & Gibson, 2003).

Table 4. User Satisfaction of HIS Unit: No. of Hospitals (%)

HIS	User Satisfaction		
	High	Medium	Low
Outpatient CPOE	23(85.2 )	3(11.1)	1(3.7)
Inpatient CPOE	23(85.2)	2(7.4)	2(7.4)
Pharmacy	19(70.4)	8(29.6)	0(0.0)
Laboratory	21(80.8)	4(15.4)	1(3.8)
Radiology	22(84.6)	3(11.5)	1(3.8)
ADT	22(81.5)	4(14.8)	1(3.7)
Accounting	19(70.4)	6(22.2)	2(7.4)
EDI for insurance claims	20(74.1)	7(25.9)	0(0.0)
PACS	21(84.0)	3(12.0)	1(4.0)
EMR	6(100.0)	0(0.0)	0(0.0)
ERP	2(66.7 )	1(33.3)	0(0.0)
Groupware	6(75.0 )	2(25.0)	0(0.0)
Data warehouse	3(75.0)	1(25.0)	0(0.0)
KMS	1(33.3)	2(66.7)	0(0.0)

## (2) ADT System User Satisfaction

The analysis with the user satisfaction of ADT system and the management issues is used to obtain more accurate results. For the reason that the outpatient



CPOE represents the user satisfaction of medical systems, ADT system is selected among administrative systems because it is the major component of the entire administrative systems. As seen from table 4, ADT received the highest user satisfaction among other administrative systems, and it is one of very first systems to get implemented when hospitals start implementing hospital information systems.

## RESULTS

### Comparison of Key Management Issues between 1999 and 2006

Key management issues of Korea's health information system were obtained through two round surveys, and they were compared with a related prior study done in 1999.

Five issues were no longer within the top ten key issues in 2006: "Managing and Operating of IT Network," "Recruiting and Developing IS Human Resource," "Building of Patient Information System," "Making Effective Use of the Data Resource," and "Collaborative IT system Organization and Hospital," and the last issue, "Collaborative IT system Organization and Hospital," has dropped nine ranks since 1999. Those five appeared to be critical issues considered when implementing hospital information systems.

Top ten key issues in 1999 that were consistent in 2006: "Top Management

Support,” “Information Security and control,” “Alignment of IS Organization within the Enterprise,” “EMR related regulations,” and “Developing IS personnel.” Costs for implementation and maintenance of hospital information systems have been consistently rising, and developments of hospital information systems have significantly been increased. However, the development curve is still gradual, and maturity of information systems is still lacking compared to corporate information systems. Thus, close attentions to “Top Management Support” in the healthcare industry is critical. The issues above are desired with not only implementation and development, but also maintenance of hospital information systems.

Three issues that joined the top ten in 2006 that were not part of the 1999 issues are “PACS,” “Developing IS Strategic Planning,” and “EMR.” PACS has gained significant considerations from many healthcare professionals because it does not require complex maintenance and has become the critical system for clinical cares. Throughout numerous researches in management information system field, the importance and effectiveness of developing IS strategic planning has never become more significant than before. Not many hospitals are equipped with EMRs yet; however, this system is becoming another critical system that enables telemedicine, integration of information systems, and ubiquitous healthcare environments.

Among the newly introduced key issues that bring close attentions to

healthcare professionals are “Disaster Recovery System,” “Standardization,” “Integrated HIS,” “IS/IT Strategy and Planning,” “Infrastructure for u-health,” “Development of Ubiquitous application system,” “Disaster Recovery System,” and “Standardization”. Healthcare providers have obligations to maintain patient health records for a set of period of time; therefore they must be equipped with disaster recovery systems to protect patients’ data. In addition, if standardization takes place within healthcare providers before information systems are implemented, the performance of the system and work processes will significantly improve. Standardization of healthcare system has been gaining much attention and there seems to be much to solve.

Almost all of newly introduced issues are related to Technical Infrastructure (TI) and Technology Application (TA) classifications. The other two newly introduced issues from Internal Effectiveness (IE) and Business Relation (BR), are not directly technology-related; however, they are closely related to “Development of Ubiquitous Application System” and “IS/IT Strategy and Planning.” As attention of information technology within healthcare increased during the 1990s, hospitals’ interests in hospital’s new applications have also increased. Great changes over a 6 year period in PACS (+15), ISP (+12), and EMR (+3) show such trend (Table 5).

Table 5. Comparison of Key Management Issues in 1999 and 2006

Key Issues	Rank		6-year Change	Issue Classification
	2006	1999		
Top Management Support	1	1	0	BR
Aligning the IS Organization within the Enterprise	2	4	+2	IE
PACS	3	18	+15	TI
Disaster Recovery System	4	-	NEW	TI
Developing Information Strategy Plan	5	17	+12	BR
Standardization	6	-	NEW	TA
EMR related Regulations	7	6	-1	IE
Security and control of Information Resources	8	3	-5	TA
EMR	9	12	+3	TI
Training of IT specialists	10	7	-3	IE
User training	11	5	-6	IE
Integrated HIS	12	-	NEW	TI
Building of Patient Information System	13	9	-4	TI
Strengthening planning and control function	14	-	NEW	BR
Making Effective Use of the Data Resource	15	8	-7	BR
Outsourcing	16	16	0	IE
Infrastructure for u-health	17	-	NEW	TI
Development of Ubiquitous application systems	18	-	NEW	IE
Collaborative IT system Organization and Hospital	19	10	-9	TA
Laboratory Information System(LIS)	20	14	-6	TI
Managing and Operating of IT Network	-	2	-	TI
Building a Responsive IT Infrastructure	-	11	-	TI
EDI System	-	13	-	TI
Effective Organization for System Development	-	15	-	BR
Marketing of HIS	-	19	-	IE
Management of Distributed System	-	20	-	TA

### Analysis of Management Issues with Growth Stages and User Satisfaction

#### *Top management support (Rank 1)*

The analysis showed that as the human resource support got stronger from the top management, the percentage of hospitals being more within the stage three groups increased. However, there was inconsistent and weak relationship when there was no support. Due to this inconsistent result, it appears the human resource support

has weak influence with growth stages.

Table 6. Top Management Support for Human Resource

Unit: No. of Hospitals (%)

Business Relation	Growth Stage			Total	
	1	2	3		
Human Resource Support	Very Strong	0	0	4(100)	4
	Strong	1(7.7)	3(23.1)	9(69.2)	13
	Normal	2(18.2)	3(27.3)	6(54.6)	11
	Weak	0	5(55.6)	4(44.4)	9
	None	0	0	1(100)	1
	Total	3	11	24	38

*Information System Department Influence (Rank 2 and 14)*

The majority of hospitals that were in the third stage responded the most on “medium” IS department influence within the hospitals compared to other hospitals that are in lower stages. The least number of responses came from hospitals in stage one. This result may be due to those hospitals being at the earliest stage. Table 7 shows the majority of IS departments have “high” and “medium” influence within hospitals.

Table 7. Information System Department Influence

Unit: No. of Hospitals (%)

Internal Effectiveness	Growth Stage			Total	
	1	2	3		
Very High	1(33.3)	0	2(66.7)	3	
High	0	7(46.7)	8(53.3)	15	
Medium	2(13.3)	3(20)	10(66.7)	15	
Low	0	1(25)	3(75)	4	
	Total	3	11	23	37

*Status of HIS Development (Rank 3, 9, 12, and 13)*

The relationship between the status of HIS development is shown in Table 8. The status of HIS development was categorized into three groups: either CPOE or

PACS (less developed), both CPOE and PACS (well developed), and implementing all three systems; CPOE and PACS and EMR (very well developed). The result showed that hospitals in the third stage had higher percentage of being equipped with these systems except for the comparison with “CPOE or PACS.” It appears because most hospitals in the third stage are better equipped than other stage hospitals.

Table 8. Status of HIS Development Unit: No. of Hospitals (%)

Technical Infrastructure	Growth Stage			Total
	1	2	3	
CPOE or PACS	0	1(50)	1(50)	2
CPOE and PACS	3(11.5)	8(30.8)	15(57.7)	26
CPOE and PACS and EMR	0	3(27.3)	8(72.7)	11
Total	3	12	24	39

#### *Disaster Recovery System (Rank 4)*

The relationship between the existence of disaster recovery systems with the Nolan’s stages is shown in Table 9. The number of hospitals that had already implemented disaster recovery system was twice as many number of hospitals than as the ones that do not. However, the percentage not having disaster recovery systems (69.2%) was slightly higher than the ones that do have the system (57.7%).

Table 9. Disaster Recovery System Unit: No. of Hospitals (%)

Technical Infrastructure	Growth Stage			Total
	1	2	3	
Yes	3(11.5)	8(30.8)	15(57.7)	26
No	0	4(30.8)	9(69.2)	13
Total	3	12	24	39

#### *Information Strategy Planning (Rank 5)*

The relationship between the information strategy planning (ISP) with the Nolan stage is shown in Table 10. Higher percentages of hospitals that have no plan for ISP were within the first and second stages; however, the third stage hospitals had higher percentage of having or have plan for ISP. It appears hospitals that started ISP from the early periods built up the know-how as users became more proficient utilizing it.

Table 10. Information Strategy Planning (ISP) Unit: No. of Hospitals (%)

Business Relation	Growth Stage			Total
	1	2	3	
Have or plan for ISP	0	6(26.1)	17(73.9)	23
No plan for ISP	1(10)	4(40)	5(50)	10
Total	1	10	22	33

### *Standardization (Rank 6)*

The relationship between standardization with the Nolan stages is shown in Table 11. The majority of hospitals that already have or planning for setting standardization are within the third stage. Even though standardization is critical to enhance interoperability and resolve data exchange issues many hospitals have not yet set it up. It appears changes in work processes and significant amount of development and customization processes are hindering this issue to be resolved.

Table 11. Standardization Unit: No. of Hospitals (%)

Technical Application	Growth Stage			Total
	1	2	3	
Yes or planning	2(10.5)	5(26.3)	15(68.2)	22
No	1(6.7)	5(33.3)	9(60)	15
Total	3	10	24	37

### *Security and Control of Information Resources (Rank 8)*

Table 12 shows hospitals in the third stage that do not have any security policies toward employees had higher percentage than third stage hospitals that do provide. However, hospitals that provided at least either security measure to employees were within the first and the second stage hospitals and had higher percentage than not providing at all. Thus, hospital staffs may lack proficiencies with hospital systems.

Table 12. Security and Control of Information Resources Unit: No. of Hospitals (%)

Technical Application	Growth Stage			Total
	1	2	3	
Security Training or Written Oath	2(8.3)	10(41.7)	12(50)	8
None	1(7.1)	2(14.3)	11(78.6)	14
Total	3	12	23	38

### *Training of Human Resources (Rank 10 and 11)*

Growth stage analysis showed that 31 hospitals provide training; however, the percentage of not providing user training was higher with hospitals within both second (37.5%) and third stage (62.5%). It was interesting to see one hospital that provides user training responded with “low” user satisfaction. Lack of qualified trainers or classes offers may be the cause.

Table 13. User Training Unit: No. of Hospitals (%)

Internal Effectiveness	Growth Stage			Total
	1	2	3	
Yes	3(9.7)	9(29)	19(61.3)	31
No	0	3(37.5)	5(62.5)	8
Total	3	12	24	39

### *Software Development and Outsourcing (Rank 16)*

Hospitals that outsourced development had higher user satisfaction (88.2%)



than hospitals that did not (80%), and accordingly, hospitals in the third stage that outsourced the development (68%) had a higher percentage than the ones that did not. It appears the majority of hospitals had outsourced and will be for the future development. In addition, most responses on all three categories of outsourcing came from hospitals that are at the third stage.

Table 14. Software Development and Outsourcing Unit: No. of Hospitals (%)

Internal Effectiveness		Growth Stage			Total
		1	2	3	
Development	Yes	2(8)	6(24)	17(68)	25
	No	1(8.3)	5(41.7)	6(50)	12
	Total	3	11	23	37

#### Analysis of Management Issues with ADT and Outpatient CPOE User Satisfaction

##### *Top Management Support (Rank 1)*

The analysis between user satisfaction of outpatient CPOE and human resource support from top management showed there was inconsistent and weak relationship between those two. In addition, the correlation coefficient was -0.002 with the p-value of 0.99 for this category. On the other hand, the user satisfaction analysis with ADT System and this management issue showed that as the support from the top management was stronger, the user satisfaction was higher with the ADT system as expected. Also, the correlation coefficient was -0.31 with the p-value of 0.14, thus showed that positive relationship between the issue and the ADT user satisfaction due to opposite coding scheme. It appears main users of the outpatient

CPOE who are physicians are less influenced by hospital's top management than administrative system users.

Table 15. Top Management Support

Unit: No. of Hospitals (%)

Business Relation		ADT System				Outpatient CPOE			
		Low	Medium	High	Total	Low	Medium	High	Total
Human Resource Support	Very Strong	0	0	3(100)	3	0	1(50)	1(50)	2
	Strong	0	1(10)	9(90)	10	1(9.1)	0	10(90.9)	11
	Normal	0	1(20)	4(80)	5	0	1(14.3)	6(85.7)	7
	Weak	1(14.3)	1(14.3)	5(71.4)	7	0	1(12.5)	7(87.5)	8
	None	0	0	0	0	0	1(100)	0	1
Total		1	3	21	25	1	4	24	29

### *Information System Department Influence (Rank 2 and 14)*

The analysis between user satisfaction of ADT system and the status of IS department within the hospital showed that as the position and the influence of the IS department was higher, the user satisfaction with the ADT system was higher. Also, the correlation coefficient was -0.6 (positive relationship) with the p-value of 0.001. The analysis between user satisfaction of outpatient CPOE and this management issue showed similar results; however, the relationship between those two were inconsistent and weaker than with the ADT system. The correlation coefficient for the outpatient CPOE and this issue was -0.12 (positive relationship) with the p-value of 0.56. It seems administrative system users are more affected with the status of the IS department since their daily operations are very closely related to IS specialists than physicians who are the main users of the outpatient CPOE.

Table 16. Information System Department Influence

Unit: No. of Hospitals (%)

Internal Effectiveness	ADT System				Outpatient CPOE			
	Low	Medium	High	Total	Low	Medium	High	Total
Very High	0	0	2(100)	2	0	0	2(100)	2
High	0	1(7.7)	12(92.3)	13	1(8.3)	1(8.3)	10(83.3)	12
Medium	0	1(12.5)	7(87.5)	8	0	1(11.1)	8(88.9)	9
Low	1(33.3)	2(66.7)	0	3	0	2(40)	3(60)	5
Total	1	4	21	26	1	4	23	28

### *Status of HIS Development (Rank 3, 9, 12, and 13)*

The user satisfaction analysis of HIS development status with ADT system and outpatient CPOE showed both consistent results. The analysis showed that the user satisfaction decreased from both administrative system users and physicians as the development of hospital information systems advanced. The correlation coefficient for the outpatient CPOE and this issue was -0.36 with the p-value of 0.05, and the correlation coefficient for the ADT system and this issue was 0.29 with the p-value of 0.15. It appears lack of proficiency and changes in work processes due to implementation of new hospital information systems caused such outcomes. Most of Korean hospitals redevelop CPOE when they develop EMR and therefore users have to learn the newly developed CPOE again.

Table 17. Status of HIS Development

Unit: No. of Hospitals (%)

Technical Infrastructure	ADT System				Outpatient CPOE			
	Low	Medium	High	Total	Low	Medium	High	Total
CPOE or PACS	0	0	4(100)	4	0	0	4(100)	4
CPOE and PACS	0	2(11.1)	16(88.9)	18	0	2(11.1)	16(88.9)	13
CPOE and PACS and EMR	1(12.5)	2(25)	5(62.5)	8	1(12.5)	2(25)	5(62.5)	8
Total	1	4	25	30	1	4	24	29

### *Disaster Recovery System (Rank 4)*

The analysis between user satisfaction of outpatient CPOE and the

availability of the disaster recovery system showed that users were more satisfied when the hospitals did not have the system implemented. The correlation coefficient for the outpatient CPOE and this issue was 0.19 (negative relationship) with the p-value of 0.33. On the other hand, the analysis between user satisfaction of ADT system and the disaster recovery system showed that the user satisfaction was higher when this system was implemented. The correlation coefficient for the ADT system and this issue was -0.2 (positive relationship) with the p-value of 0.32. This outcome showed the importance of having a reliable system for the ADT system users.

Table 18. Disaster Recovery System

Unit: No. of Hospitals (%)

Technical Infrastructure	ADT System				Outpatient CPOE			
	Low	Medium	High	Total	Low	Medium	High	Total
Yes	0	3(15.8)	16(84.2)	19	1(5.6)	3(16.7)	14(77.8)	18
No	1(12.5)	1(12.5)	6(75)	8	0	1(9.1)	10(90.1)	11
Total	1	4	22	27	1	4	24	29

### *Information Strategy Plan (Rank 5)*

The analysis between user satisfaction of ADT system and ISP showed that hospitals having ISP or at least having a plan for ISP had higher satisfaction than not having any plan for ISP. The correlation coefficient for the ADT system and this issue was -0.25 (positive relationship) with the p-value of 0.24. On the other hand, the analysis with outpatient CPOE showed the opposite result. The correlation coefficient for the outpatient CPOE and this issue was 0.15 (negative relationship) with the p-value of 0.46. Hospitals that have no plans for ISP had higher user

satisfaction than having at least plans for ISP. It appears administrative staffs see the importance of ISP more than physicians since their daily operations are more business related than physicians.

Table 19. Information Strategy Plan

Unit: No. of Hospitals (%)

Business Relation	ADT System				Outpatient CPOE			
	Low	Medium	High	Total	Low	Medium	High	Total
Have or planning ISP	0	2(11.8)	15(88.2)	17	1(5.9)	3(17.6)	13(76.5)	17
No plan for ISP	1(12.5)	1(12.5)	6(75)	8	0	1(12.5)	7(87.5)	8
Total	1	3	21	25	1	4	20	25

### *Standardization (Rank 6)*

Unlike the user satisfaction analysis between outpatient CPOE and standardization where the user satisfaction was lower when hospitals were at least planning for the implementation of standardization, the user satisfaction analysis with ADT system showed hospitals that already have standardization in place had the highest user satisfaction. The correlation coefficient for the outpatient CPOE and this issue was -0.04 with the p-value of 0.82, and the correlation coefficient for the ADT system and this issue was -0.3 with the p-value of 0.15. Thus, the result presented that standardization is more important to administrative operations than clinical care.

Table 20. Standardization

Unit: No. of Hospitals (%)

Technical Application	ADT System				Outpatient CPOE			
	Low	Medium	High	Total	Low	Medium	High	Total
Yes or planning	0	1(7.1)	13(92.9)	14	0	3(18.8)	13(81.3)	16
No	1(9.1)	2(18.2)	8(72.7)	11	1(7.7)	1(7.7)	11(84.6)	13
Total	1	3	21	25	1	4	24	29

*Security and Control of Information Resources (Rank 8)*

The analysis between user satisfaction of outpatient CPOE and security measures for employees did not show consistencies between them. The correlation coefficient for the outpatient CPOE and this issue was 0.05 with the p-value of 0.79. However, the analysis between user satisfaction of ADT system and the security measures for employees showed hospitals that have security measure had higher user satisfaction than hospitals that did not have any measure. The correlation coefficient for the ADT system and this issue was -0.2 with the p-value of 0.33. It appears ADT system users see the importance of security measures more than physicians because their operations deal much with financial data.

Table 21. Security and Control of Information Resources

Unit: No. of Hospitals (%)

Technical Application	ADT System				Outpatient CPOE			
	Low	Medium	High	Total	Low	Medium	High	Total
Security Training or Written Oath	0	2(12.5)	14(87.5)	16	2(8.3)	9(37.5)	13(54.2)	24
None	1(11.1)	1(11.1)	7(77.8)	9	1(7.1)	1(7.1)	12(85.7)	14
Total	1	3	21	25	3	10	25	38

*Training of Human Resources (Rank 10 and 11)*

The user satisfaction analysis of outpatient CPOE and ADT system users with user training showed consistent results that user were satisfied when hospitals provided user trainings to employees. The correlation coefficient for the outpatient CPOE and this issue was -0.13 with the p-value of 0.49, and the correlation coefficient for the ADT System and this issue was -0.35 with the p-value of 0.08.

As hospitals implement various hospital information systems, it appears both physicians and administrative users see the importance of being proficient with the systems they use.

Table 22. Training of Human Resources Unit: No. of Hospitals (%)

Internal Effectiveness	ADT System				Outpatient CPOE			
	Low	Medium	High	Total	Low	Medium	High	Total
Yes	0	2(10)	18(90)	20	1(4.3)	2(8.7)	20(87)	23
No	1(16.7)	1(16.7)	4(66.7)	6	0	2(33.3)	4(66.7)	6
Total	1	3	22	26	1	4	24	29

### *Software Development and Outsourcing (Rank 16)*

The user satisfaction analysis of ADT system and outsourcing for development showed that administrative system users were more satisfied when hospitals developed on their own. It is because Korea hospitals have been developing and customizing ADT system on their own for a long time, and the development of ADT system is fairly simpler than other hospital or administrative information systems. The correlation coefficient for the ADT system and this issue was 0.24 with the p-value of 0.25. On the other hand, the analysis with outpatient CPOE showed that physicians were more satisfied when hospitals outsourced the development due to complexities of the system. The correlation coefficient for the outpatient CPOE and this issue was -0.02 with the p-value of 0.9.

Table 23. Software Development and Outsourcing Unit: No. of Hospitals (%)

Internal Effectiveness		ADT System				Outpatient CPOE			
		Low	Medium	High	Total	Low	Medium	High	Total
Development	Yes	0	3(17.7)	14(82.4)	17	1(5.9)	1(5.9)	15(88.2)	17
	No	0	0	7(100)	7	0	2(20)	8(80)	10
	Total	0	3	21	24	1	3	23	27

## Correlation Analysis between User Satisfaction and Management Issues

### *Correlation Analysis for ADT System*

In order to analyze which management issues had significant correlations with the ADT System user satisfaction, the correlation analysis was used. The correlations between pairs of variables are reported in table 24.

The result showed that IS department influence was the only issue that had a significant correlation coefficient with -0.60 at 5% significance level. The reason why the correlation coefficient showed the negative relationship was because the coding set one as the highest influence and four as the lowest. Due to this opposite coding scheme, the result showed the negative relationship between ADT user satisfaction and IS department issue. Almost all issues showed negative relationships with the ADT system user satisfaction except for outsourcing and status of computerization issues due to the coding scheme explained above. The correlation between each management issue was overall lower than 0.4, and the Pearson correlation analysis between user training and security issues had the highest correlation of 0.75 with the p-value of 0.000. The correlation between ISP and security issue showed the second highest correlation coefficient of 0.55 at 5% significance level with the negative relationship between them due to coding scheme. In addition, the correlation between ISP and status of HIS development issues showed



the third highest correlation coefficient with -0.49 (positive relationship) at 5% significance level.

Table 24. Correlation Analysis for ADT System

	ADT System	Outsourcing	IS Department	User Training	ISP
ADT	1				
Outsourcing	0.24	1			
IS Department	-0.6*	0.13	1		
User Training	-0.35	0.35	0.33	1	
ISP	-0.25	0.32	0.21	0.42*	1
Security & Control	-0.2	0.25	0.3	0.75**	0.55*
Top Management Support	-0.31	0.03	0.5*	0.18	0.3
Standardization	-0.3	-0.12	-0.17	0.16	-0.04
Status of HIS Development	0.29	-0.21	-0.37	-0.07	-0.49*
Disaster Recovery System	-0.2	0.26	0.41*	0.28	0.22

\*P < 0.05, \*\* P < 0.01

	Security & Control	Top Management Support	Standardization	Status of HIS Development	Disaster Recovery System
ADT					
Outsourcing					
IS Department					
User Training					
ISP					
Security & Control	1				
Top Management Support	0.12	1			
Standardization	-0.06	0.08	1		
Status of HIS Development	-0.35	-0.14	-0.1	1	
Disaster Recovery System	0.27	0.13	-0.01	-0.37	1

\*P < 0.05, \*\* P < 0.01

### *Correlation Analysis for Outpatient CPOE*

In order to analyze which management issues had significant correlations with the outpatient CPOE user satisfaction, the correlation analysis was used. The

correlations between pairs of variables are reported in table 25.

The result showed that the status of HIS development had the significant relationship with the user satisfaction for outpatient CPOE. Status of development had the correlation coefficient of -0.36 at 5% significance level with the user satisfaction. The correlation coefficient showed the negative relationship due to the opposite coding scheme explained above. Thus, the status of development and the user satisfaction had actually the positive relationship. For the correlation analysis between management issues, the relationship between ISP and security showed the highest correlation of 0.73 with the p-value of less than 0.01. There were several similar correlation relationships between management issues of around 0.45 at 5% significance level: between user training and ISP, between user training and security, and between ISP and status of HIS development.

Table 25. Correlation Analysis for Outpatient CPOE

	Outpatient CPOE	Outsourcing	IS Department	User Training	ISP
Outpatient CPOE	1				
Outsourcing	-0.02	1			
IS Department	-0.12	0.24	1		
User Training	-0.13	0.03	0.39*	1	
ISP	0.15	0.19	0.15	0.42*	1
Security & Control	0.05	0.15	0.28	0.47*	0.73**
Top Management Support	-0.002	0.14	0.35	0.09	0.32
Standardization	-0.04	-0.07	-0.2	-0.12	0.08
Status of HIS Development	-0.36*	-0.17	-0.19	-0.15	-0.46*
Disaster Recovery System	0.19	-0.02	0.39*	0.34	0.32

\*P < 0.05, \*\* P < 0.01

	Security & Control	Top Management Support	Standardization	Status of HIS Development	Disaster Recovery System
ADT					
Outsourcing					
IS Department					
User Training					
ISP					
Security & Control	1				
Top Management Support	0.1	1			
Standardization	0.04	0.25	1		
Status of HIS Development	-0.24	-0.23	-0.03	1	
Disaster Recovery System	0.21	0.08	-0.019	-0.23	1

\*P < 0.05, \*\* P < 0.01

### Multiple Regression Analysis for User Satisfaction

Five management issues were selected among nine management issues for multiple regression models on user satisfaction for ADT system that had p-value less than 0.2, and ran several multiple regression models using these issues as independent variables. The regression model with three management issues (IS department, user training, and standardization) presented the best results in terms of adjusted R square, F-value, and p-values for independent variables. As seen in table 26, IS department and standardization were significant issues influencing user satisfaction for ADT system (Adjusted R-square = 0.34, F = 4.01\*).

Similarly, four management issues were selected for the multiple regressions models on user satisfaction for outpatient CPOE that had p-value less than 0.5. The reason was because there was only one issue whose p-value was less than 0.2, and ran

several multiple regression models using these issues as independent variables. The regression model with three management issues (user training, IS department, status of HIS) presented the best results. As seen in table 26, the status of HIS development was the only significant issues influencing outpatient CPOE user satisfaction (Adjusted R-square = 0.1, F = 0.15).

Table 26. Multiple Regression between User Satisfaction and Management Issues

	ADT System	Outpatient CPOE
IS Department Influence	-0.36*	-0.08
User Training	-0.16	-0.14
Standardization	-0.36*	
Status of HIS Development		-0.35*
R Square	0.46	0.2
Adjusted R-Square	0.38	0.1
F Value (p-value)	5.61*	1.93

\* P < 0.05

### Use of Regression Model

#### *Regression model for ADT System:*

Predicted User satisfaction to ADT system = 4.4 - 0.36\*IS Department - 0.16\*User Training -0.36\*Standardization

This model implies that user satisfaction to ADT system for hospital may be predicted by computing the predicted value for user satisfaction by obtaining actual values for IS Department, user training, and standardization.

#### *Regression Model for Outpatient CPOE:*

Predicted User Satisfaction to CPOE = 3.93 - 0.08\*IS Department -0.14\*User Training - 0.35\* Status of HIS

This model implies that user satisfaction to CPOE system for hospital may be

predicted by computing the predicted value for user satisfaction by obtaining actual values for IS Department, user training, and status of HIS.

## DISCUSSION

### Explanation of Outcomes

The purpose of this study was to identify key management issues in hospital information systems in Korea by comparing existing top management issues in hospital information systems in Korea between 1999 and 2006. This was done by examining how management issues evolve according to development stages based on Nolan's stage theory. Also, to identify critical success factors in management influencing hospital information systems from a management perspective by analyzing the relationship between the above management issues and user satisfaction of both outpatient CPOE and ADT system. These two user satisfaction variables were used as success factors from the users who represent medical and administrative system.

In order to accomplish the first purpose of this research, previous survey data on Korea's management issues in hospital information system was used, and Korea's tertiary hospitals were segmented based on Nolan's staging theory for secondary analysis. In addition, several significant survey questions were selected to analyze

user satisfaction and management issues in order to propose successful management strategies.

The survey data showed several key management issues in Korea's hospital information system, which still take major roles compared to 1999 research; "top management support," "alignment of IS within the enterprise," "development of information strategy plan," "EMR related regulations," "security and control of information resources," "training of IT specialists," etc. Top management support was selected as the top management issue for both 1999 and 2006 research because top management support has a vital role in measuring not only the success of the entire HIS implementation processes, but also in maintenance and system maturity periods. According to Cheon (1994) who has not done any more recent study on this issue, top managers are willing to support hardware and invest more on applications in larger scopes as they recognize needs for IT. Ryu and Kim's (2002) research states that key factors for successful implementation of HIS include organizational factors such as top management support and system factors. Alignment of IS organization within the enterprise has become one of the key issues due to possible complications that HIS can bring to organizations. The participation of power users of the system during development stages of HIS is important. It is very challenging for organizations to maintain rapidly changing IT environments just by utilizing

internal employees. Thus, many of them are outsourcing various areas as one way to stay competitive in this industry (Kim, 2004), and this makes the “training of IT specialists” issue important. Security and control of information resources is also a very significant issue that is nowadays more focused on protecting privacy than technical aspects of security systems (Lee, 1996).

The following issues were examined for secondary analysis to determine how management issues evolve according to development stages based on Nolan’s stage theory: “user satisfaction,” “top management support,” “user training,” “software development and outsourcing,” “security and control of information resources,” “standardization,” “information system department influence,” “status of HIS development,” “availability of information strategy planning,” and disaster recovery system.”

Human resource support from top management analysis showed that “very strong” and “strong” support came from hospitals at the third stage, and this data showed consistencies with Park’s (2003) and Kim’s (2002) research stating that computerizations of hospitals are higher when top managers present enthusiasm for support. The user satisfaction analysis between ADT system and human resource support from the top management showed that as the support got stronger, the satisfaction went up. On the other hand, the analysis with outpatient CPOE showed

that there was weak correlation between the support from the top management. It appears hospital administration system users feel more sensitive with the support from the top management than physicians. This analysis showed consistent result with Aiken et al.'s (2002) study, which states that adequate management support for hospital staffs is the key to improving the quality of hospital operations.

The analysis of the IS department's influence showed that the highest percentage came from the third stage hospitals that had low influence on other departments within these organizations. IS departments did not have much authority within organizations in the earlier days, it seems the third stage hospitals still do not have much influence within organizations. In addition, it appears when there is a lot of authority, users tend to have the highest work satisfaction regardless of ADT or outpatient CPOE users. As cited from Reich and Benbasat's (2000) research, Neiderman et al.'s (1990) research on information systems management issues states that the effectiveness with which IS can support the enterprise is dependent on the IS function's position within the enterprise.

Status of HIS development showed that hospitals that implemented hospital information systems in early periods are well computerized, and the adoption rate of EMR was the highest. Overall, the user satisfaction was high with all systems; however, there were several hospitals where user satisfaction with both ADT and



outpatient CPOE had been reduced after the implementation of EMR. It can be concluded that users are not familiar with newly implemented EMR and work processes which lead to decreased user satisfactions. This finding is supported by Miller and Sim's (2004) research on barriers and solutions for use of EMR which states that underlying barriers include difficulties with technology, complementary changes and support, electronic data exchange, financial incentives, and physicians' attitudes.

Analysis on existence of disaster recovery system showed that twice as many hospitals were equipped with the system and the majority came from the third stage. It is imperative that hospitals protect and maintain patient records by being equipped with seamless disaster recovery system. Hospitals without the disaster recovery system showed higher user satisfaction from outpatient CPOE users; however, for ADT user satisfaction, it showed the opposite result. Given that the type of operation ADT system deals closely with financial transactions, it appears ADT users see the needs for the disaster recovery system more than physicians. According to Prather (2008), system users are seeing the importance of protecting sensitive data due to previous major natural occurrences.

As hospitals became more and more digitized, the importance of effective management of HIS projects has become one of the major issues. To achieve

successful HIS implementation projects, hospitals plan to maximize return on investments and become competitive in this industry. Kim and Park's (2004) research presents that it is very important to have adequate information strategy planning (ISP) when building information systems and planning for operations. As expected, the most developed hospitals, which are in the third stage, had the highest percentage of having ISP. However, the outpatient CPOE user satisfaction was the highest when hospitals did not have any plan for building ISP, and the opposite result came out for the ADT system user satisfaction. It appears hospitals that implemented HIS in the earlier periods tried using ISP during those times and realized they were ineffective in some cases which led to poor user satisfaction unlike prior studies on the importance of ISP.

As hospitals start to exchange data, several standards need to be set in advance as base infrastructures, such as terminologies, networking protocols, telecommunication technologies, etc. The analysis showed that hospitals in the third stage had slightly higher percentage of at least planning for the standardization than not having it at all. Furthermore, the percentage of ADT system user satisfaction was higher when hospitals were at least planning for standardization; however, the opposite results were retrieved for the outpatient CPOE. For the reason that standardization can bring seamless operations among other systems, ADT system

users were more satisfied even though it requires considerable amount of development and customizations. In addition, Kim's (2004) study stated that more hospital organizations are positively seeing the needs for standardizations on information systems and resources to better manage hospitals.

As patient records are being digitized in healthcare organizations, privacy on such data has become vulnerable so that patients potentially could face discriminations from insurance companies and employers are getting bigger. In spite of such research, the highest percentage of hospitals that were part of the third stage came from "no security measurements" category including the highest outpatient CPOE user satisfaction in this category. On the other hand, the ADT system user satisfaction was the highest when either security measure was provided. Since administration system users operate more with financial transactions, it seems they are more sensitive with security issues than physicians. Park's (2004) research presented that hospitals need to set strict security measures and adequate security training for users.

An issue of end user training has become one of the most vital key issues that determines successful implementation and operation of hospital information systems. Compeau and Higgins's (1995) study on computer self-efficacy was cited by Ryu and Kim (2002), and presented that it moderates organizational influences on an

individual's decision to use computers and it is important to the successful implementation of systems in organizations. In addition, Ryu and Kim (2002) stated that to maximize use of information systems, effective user training is critical to increase computer self-efficacy. The user training results showed that a slightly higher percentage came from the third stage hospitals that did not provide user training than the third stage hospitals that did provide it. However, the both user satisfaction from ADT system and outpatient CPOE came out higher with hospitals that did provide user training. It appears percentage for user satisfaction on hospitals that provide training will be higher than hospitals that do not including user satisfaction.

When organizations started outsourcing, the main reason was to reduce costs; however, nowadays it allows them to focus more on core businesses (Moon & Park, 2002). Hospitals at the third stage had higher percentage of outsourcing development than hospitals did not. Consistent with such results, hospitals that outsourced development received high user satisfaction from physicians; however, the opposite result came out with ADT system user satisfaction. Due to complex development of CPOE systems, physicians felt more comfortable outsourcing the development of this system. Accordingly, Kim and Park (2004) stated that it will be very challenging for internal employees to handle rapidly changing IT industry, and

more hospitals will be outsourcing IT related services.

The correlation analysis for the ADT system showed that there was only one management issue that had the significant relationship among others; IS department influence. Almost all management issues showed negative relationships with this user satisfaction due to the opposite coding scheme, and there were two significant correlations among issues: between user training and security, and between ISP and status of HIS development.

The correlation analysis for the outpatient CPOE showed that the status of HIS development was the only issue that had the significant relationship with this user satisfaction. This issue also showed the negative relationship between them due to opposite coding scheme. There was a very high significant correlation between ISP and security, and in addition, there were several more: between user training and ISP, between user training and security, and between ISP and status of HIS development.

Multiple regression model was used to identify significant management issues influencing two categories of user satisfaction. Among five management issues that had p-value less than 0.2, three management issues were selected for the multiple regression model with the ADT system user satisfaction: IS department influence, user training, and standardization. Among these issues, IS department influence and standardization were significant issues influencing user satisfaction for

ADT.

Similarly, three management issues were selected among four that had p-value less than 0.5: user training, IS department influence, and status of HIS development. Through the multiple regression model, the status of HIS development was the only significant issue influencing the outpatient CPOE user satisfaction.

By using the regression model, it is possible to predict each user satisfaction level without actually retrieving responses from users because these estimates tell the amount of increase in each user satisfaction that would be predicted by the management issues in the model.

#### Implication of Results of Outcomes

Following are recommendations for management strategies on successful implementation of hospital information systems based on the findings.

First of all, when implementing new information systems, setting up standardization, security measurements, and disaster recovery systems, etc. should be considered to eliminate any future risk and reduce costs. Also, consistent support in all areas including development and maintenance phases from top management is critical. Secondly, aligning the IS within organizations will maximize system

efficiency and user satisfaction to ADT system. This includes how much influence the IS department can have within the organization. Thirdly, it is critical to perform user training because many key management issues that influence outcomes of the success in HIS projects have low user satisfaction due to lack of proficiencies. Lastly, it is very challenging to keep up with the rapidly changing IT environment, and hospitals should outsource areas where they do not need to develop from scratch and only focus on core areas to become competitive in Korea's healthcare industry.

## CONCLUSION

Hospital information systems have been rapidly developing as the IT industry has advanced over time, and hospitals are competing with each other to provide better quality of care for patients and to be competitive in the healthcare industry. Hospital information systems have been one of the key elements that determine the success in hospital management. This study was to identify how existing key management issues apply with hospitals that are categorized based on Nolan's stage theory and user satisfaction in order to recommend management strategies for successful implementation of hospital information systems.

Tertiary hospitals were grouped into stages based on Nolan's stage theory: after 2002 (stage 1), 1999-2002 (stage 2), and before 1999 (stage 3). Then, SAS V8

was used to build contingency tables through cross-tabulation to analyze relationships between key management issues and tertiary hospitals including user satisfaction.

The top key management issue that was consistent with the 1999 study was “top management support,” and other important issues were “aligning the IS department within organizations,” “PACS,” “disaster recovery system,” “information strategy planning,” “standardization,” “EMR related regulations,” “security and control of information resources,” “EMR,” “training of IT specialists,” etc.

When hospitals were grouped and analyzed with key management issues, hospitals in the third stage were getting the highest user satisfaction from end users, and recommendations were given based on the following analysis.

Korea’s tertiary hospitals are being advanced by implementing new information systems, and as seen from these analyses, management issues are also evolving accordingly. Furthermore, various supports from top management, alignment of the IS departments within organizations, and training of IT specialists were found to be the most significant management issues that bring the high user satisfaction that lead to successful implementation of hospital information systems.

#### Limitations and Implication for Future Research

This research was based on a comparison with prior studies where targets were mainly managers in the healthcare industry. However, if targets were selected



from not only managers, but also from key end users (i.e. doctors and nurses), information system providers, consultants, professors, and researchers, this study could have made it possible to view future management issues in various aspects. In addition, tertiary hospitals were selected for this research because they are the most advanced hospital groups; however, if other types of hospitals such as general hospitals, community hospitals, etc. were selected, analyzing additional diverse management issues would have been possible.

There were risk factors due to analyses of inaccurate data because there were cases where employees who were part of initial HIS implementation projects that were not available to the 2006 survey, and current employees recalling what happened can cause inaccurate results. The survey did not make any limitations toward the subjects of the study for responses on user satisfaction, and this introduces lack of representation issues with user satisfaction of HIS.

The 1999 and 2006 survey data did not retrieve all responses from managers for each management issue that lead to variations in total number of responses. There were more missing values from user satisfaction categories than growth stage categories, and if majority of subjects who did not respond show low user satisfaction, this can change the results. Consequently, fully responded survey data could have lead to better results for correlation and regression analysis. Future research could

increase the number of respondents by including face-to-face interviews in addition to mail surveys.

Lastly, tertiary hospitals were categorized into different stages based on Nolan's staging theory. According to the theory, there are many areas to consider when dividing into stages; however, conditions that set various stages do not exactly fit in with current Korea's tertiary hospitals because the theory is based upon U.S. corporate settings in the mid 70s. Thus, more in depth research should be conducted to accurately segment those hospitals into stages.

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APPENDIX A: Survey Data

17. Availability of Disaster Recover plan	1. Yes 2. No
24. What would be the coverage for personal information security policy presently in operation?	(1) Security training and writing out security covenant(2) Only security training(3) Only writing out security covenant (4) No adaption
25. What would be the coverage for management information security policy presently in operation?	(1) Adaption of access control and use control (2)Adaption of access control(3) Adaption of use control (4) No adaption
30. Status of IS within the hospital	(1) Very highly evaluated (2) Highly evaluated (3) Normal (4) under evaluated (5) Very under evaluated
33. Mark O on the items concerning if there would be plan for enlargement of outsourcing in the future.(multi-answers)	(1) Plan
	(2) Development
	(3)Operation/ Maintenance
35. Availability of ISP?	(1) Yes (2) On going (3) In planning (4) No plan
36.Top management support: financial support, human resource support, organizational support	1. very positive 2. Positive 3. Normal 4. Negative 5. Very negative
	1. very positive 2. Positive 3. Normal 4. Negative 5. very negative
	1. Very positive 2. Positive 3. Normal 4. Negative 5. Very negative
37.Consideration of standardization for medical information when ISP would be established	1. Very yes 2. Yes 3. Normal 4. No 5. Very no
38-1 Outpatient OCS	1. Yes 2. No
	1. Self development 2. Outsourcing service 3. Purchase of package
	Development year in the use
	Satisfaction degree(5 points scale, 5 points is the highest)
	Plan of the future 1. In the development 2. Within 1 year 3. Within 3 years 4. Within 5 years 5.



	No plan	
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## CURRICULUM VITAE

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**MCKESSON PROVIDER TECHNOLOGIES**, Alpharetta, GA June 2007 – August 2007  
*Implementation Consultant Intern – Horizon Clinical Upgrades*

- Built a Financial Tracking Report for all the completed, active, and future projects
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**COMMUNITY HEALTH NETWORK**, Indianapolis, IN September 2006 – April 2007  
*Project Manager Support*

- Participate in GE Healthcare's Hospital Information System solution (Centricity Enterprise) implementation project (During school semesters)
- Support planning, designing current and future workflow assessment including gap analyses, data collection, and securing resources of Centricity Enterprise
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*Information System Site Director Support*

- Provide one-to-one technical solutions to physicians, nurses, and staff with hardware, and information systems (EMR, CPOE)

**REPUBLIC OF KOREA MARINE CORPS**, Republic of Korea April, 2004 – April, 2006  
*Corporal, Platoon Leader (15 men), Combat Swimming Instructor*

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**SYRACUSE UNIVERSITY, Computing and Media Services,**  
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