

Critical factors of hospital adoption on CRM system: Organizational and information system perspectives

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ABSTRACT

The recent rapid increase in the amount of medical information has pushed hospitals to confront an essential issue which is how to utilize healthcare information technology to improve healthcare services quality. Customer relationship management system (CRMS) is an innovative technology which facilitates the process to acquire, develop, and maintain customer relationships more efficiently and effectively. From the business perspective, patients represent the major customers of the hospital who receive and feel the healthcare services directly and realistically. Although the critical factors for the adoption of information systems have been identified in previous studies, few have specifically explored CRMS adoption in hospitals despite the fact that it has dramatic impacts on the quality of healthcare services and customer satisfaction. To fill this gap, this study proposes an integrated model that incorporates both organizational and system related factors as primary determiners of CRMS adoption in hospitals. A series of surveys were conducted with three levels of health institutions in Taiwan: medical centers, regional hospitals, and community hospitals. The results indicated that hospital size, IS capabilities of staff, innovation of senior executives, knowledge management capabilities, and relative advantage have significant influence on the CRMS adoption. The research results also reveal constructive suggestions to researchers, hospitals, CRMS vendors, and the government to increase the likelihood of adopting CRMS.

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1. Introduction

Improving quality of care and customer satisfaction are the key business drivers, and these will have the most impact on healthcare in the next 2 years as indicated by a research report from the Healthcare Information and Management Systems Society (HIMSS) [24]. In a recent investigation, the chief information officers (CIO) in hospitals ranked consumer considerations as the second most important business issue that has an impact on the healthcare sector [25]. The American College of Healthcare Executives (ACHE) [3], a renowned international professional society, identified the top issues confronting hospitals based on a survey among 1080 hospitals in 2007. CRM related issues (care for the uninsured, physician/hospital relations, and customer satisfaction) which most concern the chief executive officers (CEO) have been in the top-nine list for three consecutive years. In addition to the results in the United States, CRM has also become more important in the United Kingdom and Germany since a

series of interview investigations have discovered that a large proportion of customers feel dissatisfied with current healthcare services [30,44,45]. This dissatisfaction needs to be remedied through the use of CRM in hospitals.

Customer relationship management (CRM) for healthcare providers is an approach to learn all they can about their customers and prospects, to communicate relevant, timely information to them, and to track results to make program adjustments necessary [7]. From a non-profit organization's perspective, hospitals should provide quality medical services to those who are insured and not insured. In order to keep finance in balance, it is critical for hospitals to manage customer relationships, target those who can afford the health insurance, increase their loyalty, and generate more profits in order to cover the extra expenses of the uninsured. From the business perspective, patients represent the major customers of the hospital who receive and feel the healthcare services directly. Customer satisfaction is the key to maintaining hospitals' profitability since the customers' choice of a favorable hospital is frequently based on their inquiry into healthcare information and the experiences of their friends, family members, or colleagues. In the United States, customers who have medical insurance still have the right to choose a hospital from among several alternatives given by the insurance company. Thus, hospitals need to provide quality CRM to their customers in order to build a positive public image.

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Unlike the scenarios in most countries, the National Health Insurance (NHI) [46] system funded by the government in Taiwan covers almost the entire population because it is compulsory for all who have been granted citizenship for more than 4 months. They only pay a low access fee when visiting the doctor and are free to select a hospital of their choice for medical services regardless of the level and locality of the hospital. Under such conditions, price becomes less important. However, customers may anticipate a higher quality of customer service. Then, the uncovered medical services, such as cosmetic surgery, and health examination, are the other important type of financial source. These services critically need CRM to retain customer loyalty and improve brand image. For these reasons, the adoption of CRM is becoming an important trend in the healthcare industry of Taiwan.

The rapid increase in the amount of medical information has pushed hospitals to confront a critical issue, which is how to utilize information technologies to manage large amounts of customer information and then improve the quality of customer services. The adoption of a customer relationship management system (CRMS) thus is increased globally among hospitals. The percentage of hospitals which utilize Web sites for sales and marketing purposes has increased 2.47 times from 1995 (17%) to 2000 (59%) in the US [18]. A more recent study conducted by the American Hospital Association (AHA) [4] showed that nearly half of all responding community hospitals reported moderate or high use of health IT (HIT) for quality of care and customer safety in 2006, compared to a response of 37% in 2005. CRMS can be utilized in hospitals for enhancing customer satisfaction due to its ability to provide information about customer needs, satisfy their demands and improve ongoing service quality. Ultimately, it helps reduce cases of medical dispute and management costs.

A number of studies focused on exploring the factors affecting the adoption of CRMS in various industries, for example, financial servicing [32], fashion [34], and manufacturing industries [65]. Although they found some factors or characteristics, the applicability of these factors in the healthcare environment is questionable because the medical customer sometimes needs to be considered differently from a business client or customer since they expect to receive more care, for example, expecting doctors to remember their attitudes and expectations [43]. Payton and Zahay [49] examined a hospital and found that trust and quality play a crucial role in the adoption of data-warehousing technology for CRM applications, and that these two factors are correlated. Although this is a useful finding, that study focused only on the adoption of data-warehousing technology which is but one of many CRM technologies. The factors affecting the adoption of other technologies were not explored.

This study aims to identify the critical factors influencing the adoption of CRMS in hospitals from the perspective of the customer. Typically, insurance companies and healthcare providers are the parties negotiating the terms of agreement for payment schedules and services available in the healthcare system of the United States. It is different in Taiwan since the NHI is the major insurance company and covers most of the insurance business. As mentioned previously, the NHI lets its customers choose their hospital for medical treatment. Keeping a strong relationship with customers is thus far more important for hospitals than for the NHI, in Taiwan. In line with this perspective, patients are the major customers of the hospital, and direct receivers of medical services. Thus, this research will not focus on the factors affecting the adoption of CRMS in hospitals from the viewpoints of insurance companies or other stakeholders.

Because hospitals lag behind other industries in terms of IT adoption, it is more difficult for them to adopt CRMS. Although we have currently seen initiatives of CRMS adoption in a number of hospitals in Taiwan, the percentage of successful projects is quite low. A deep understanding of the critical factors of CRMS adoption therefore can provide substantial help and useful implications to

associate academics, potential CRMS adopters, the government, and CRMS vendors.

The rest of this paper is organized as follows. Firstly, it reviews the literature related to CRM, CRM supporting systems in healthcare, and antecedents of CRMS adoption from an IS innovation perspective. Secondly, a research model for investigating the adoption of CRMS is presented, followed by the research method, data analysis and results. Lastly, discussion of the research findings and implications for associated academics and practitioners is provided before the final section—the [Conclusion](#).

2. Literature review

2.1. Customer relationship management

Various definitions of CRM have been suggested. From a managerial perspective, Tiwana [61] believed that CRM is a process which manages relationships with current customers and selectively retains newer customers in order to enhance customer loyalties, and increase customer profitability. Swift [57] believed that CRM is an organizational method which is used to improve customer acquisition, customer retention, customer loyalty, and customer profitability through a meaningful way of communication that understands and influences customer behavior. From a strategic perspective, Kalakota and Robinson [31] treated CRM as an integrated framework, organizational strategy, or a process which provides customer demanded services that aim to sustain a long term relationship and fulfill ongoing dynamic customer needs.

Researchers also viewed CRM from both managerial and technological perspectives. Peppers and Rogers [50], from a narrower and IT-oriented perspective, believed that CRM is one-to-one marketing which utilizes computer technologies, such as database, interactive technologies, and mass production in order to develop and manage the learning relationship existing between customers and organizations. Through the tracking of customer response rate, interactive information, and historical transaction information, organizations are able to provide the products and services which are required by each individual customer. Ling and Yen [41] argued that CRM not only considers how to utilize customers effectively and identify high value customers from current and potential customers, it also considers how to optimize customer relationships from the customer's perspective and maximize the customer's profitability to the organization. This research adopts a balanced perspective, and defines CRM as: *A managerial strategy that helps organizations collect, analyze, and manage customer related information through the use of information technology tools and techniques in order to satisfy customer needs and establish a long term and mutually beneficial relationship.*

The CRM process includes four parts [57]. The first is “Knowledge Discovery” which involves the analysis of customer information in order to assure marketing opportunities and investment strategies. Knowledge Discovery provides detailed customer information that enables the sales department to make the best decision based on developed historical marketing records and analysis of customer attributes. The second is “Market Planning” which defines specific products, sales channels, time, and some related considerations to support the development of strategic communication plans or activities, such as pre-defined marketing types, preferences of channel, product development, and services. The third is “Customer Interaction” which includes the use of relevant and real time information through communication channels and front office applications, including customer service applications, sales applications, customer contact applications, and interactive applications to communicate with customers. The last is “Analysis and Refinement” which represents communicating with customers and continuously learning from them. Through the analysis of the interaction with the customer, organizations can adjust their communication model, product price,

and quantity. CRM consists of these four parts and is a continuous cycling process.

CRM has originated from relationship marketing. Over the past 50 years, marketing strategies and practices have changed dramatically, from public marketing to one-on-one marketing. Thus, the supporting IT applications have also been evolving. Organizations utilize a variety of technologies for CRM purposes, such as database management systems, Internet, data warehousing, online analytical processing (OLAP), data mart, data mining, and call centers. In order to sustain a long-term relationship with customers, Peppers et al. [51] believed that organizations should establish a long-term and continuous “learning relationship”. Supportive technologies include several kinds of interactive media, for example, telephone service centers, Web sites, sales automation, and automation at the point-of-sale, which allows customers to specify what types of services they desire.

2.2. CRM and supporting systems in hospitals

The operation of CRM in the healthcare industry needs to consider at least three characteristics. Firstly, customers have little power to decide how service or treatment will be provided. The medical service, which is a knowledge-intensive industry, is involved with a variety of professional medical service personnel. There is a great medical information asymmetry between medical service providers and customers. Customers rely totally on the service providers to supply medical information. Only medical staffs know precisely what kind of disease needs a particular treatment, and it seems that customers can only rely on the willingness and ethics of the medical staff to provide suitable treatment and medical services. These points show that medical service providers have the advantage of deciding how service will be provided.

Secondly, the use of information technology (IT) is a necessary condition for implementing CRM. An effective CRM requires a synergistic integration of the strategy, people and technology of an organization [55]. A customer knowledge database is the foundation for carrying out a customer demand analysis and forecast, active interaction, and marketing automation. Berry and Linoff [8] believed that data mining helps transform a large amount of data into useful information in order to target specified customers. Then, the organization can conduct one-to-one communication with the customer or potential customer to meet the demand.

With the implementation of a database, medical service providers particularly, need to access and control a large amount of customer information if they are involved with the NHI. Currently, most medical institutions are utilizing electronic mediums to declare their cost [11]. This shows that they must already possess IT hardware, software, and infrastructure. This equipment and stored information is the foundation of the medical health institutions adopting CRM.

The applications of CRMS can be seen throughout various kinds of organizations; however, hospitals' CRMS needs to be built upon the hospital information system (HIS) which integrates information generated from medical acts, such as electronic medical records (EHR), clinical decision support systems (CDSS), and telemedicine. The output of HIS can be then utilized by CRMS to strengthen and sustain the relationship between hospitals and customer [58]. Since the majority of data required for CRM comes from HIS, CRMS should be seamlessly integrated with HIS in order to release the potential of CRMS usage to the greatest extent. In addition, most medical institutions have already collected and stored customer-related data through the use of HIS. If all this data can be analyzed appropriately through data warehousing and multi-dimensional analysis technologies, medical institutions can provide closer relationships, personalized medical services, and two-way communication. This will result in understanding customers' needs and satisfying them more effectively.

Thirdly, the CRM in the healthcare industry seeks to obtain customer loyalty and provide lifelong value. In regard to customer loyalty, organizations which implement CRM consider two important effects. The first one is the effect derived from the number of customers. If the organization can increase customer retention rate, then substantial future revenue growth will occur from regular customers [9]. In the meantime, the organization can be released from the pressure of always having to gain new customers. The other is the effect caused by unit customer profits. The more loyal the customers are in each transaction, the less investment is needed by the organization. When losing a mature and stable customer, organizations often lose the ability to claim their investment back or create more profit. In medical institutions, loyalty indicators, such as the customer return rate, can show how satisfied and loyal the customers are [28]. So, like other types of organizations, the higher the customer's return rate, the more profits the hospital will have.

McDonald [42] believed that lifelong value includes two major items. The first is the core relationship which includes the number of uses (contact frequency), and loyal confirmation (customer commitment and emotion involved). The second is the “extended relationship” including product commercialization (the degree of how marketing communication tools influence the tendency of good purchasing), and the word-of-mouth effect (the effect of existing customers recommending the company's products and services to others). Hughes [27] pointed out that the following three aspects are commonly used by organizations to analyze customer lifelong value: recent date of the purchase (recency), purchasing frequency (frequency), and purchasing amount (monetary). From the perspective of the human life cycle, a person represents one who requires multiple healthcare services or products. Although the disease may have been cured this time, there is no guarantee that the customer will not become sick again. Moreover, some cases require continued treatment or follow-up rehabilitation. With some diseases, such as hypertension and diabetes, customers cannot be cured completely in one treatment, and need continuous tracking and treatment. Therefore, it is strategically and economically important for healthcare providers to recognize that a customer requiring multiple healthcare services or products can create lifelong value, and these providers should maintain a high-quality and long-term relationship with them.

2.3. Antecedents of CRMS adoption in hospitals

This study adopts an organizational perspective to explore the critical factors influencing the adoption of CRMS in hospitals. Organizational size often affects the adoption of innovative IT. Thong [60] believed that it is necessary to examine whether large and small environments affect the adoption of innovative IT. Large organizations are often subjected to many restrictions, and the effects of these restrictions are more significant for them than for smaller organizations. In addition, Thong [60] also believed that the characteristics of executives, innovation, and organization could affect the adoption of IT.

Kimberly and Evanisko [33] suggested that three factors affect innovative adoption: characteristics of the leaders of organizations, characteristics of the organization, and characteristics of the environment. Tornatzky and Fleischer [62] also held a similar view and believed that the background of technological innovation includes three major elements: organizational, technical, and environmental backgrounds. These factors affect the decision-making. Kwon and Zmud [36] believed that five factors affect IT innovation: characteristics of the user, environmental characteristics, organizational characteristics, technical characteristics, and characteristics of the mission. Fichman [19] believed that IT innovation may be at different levels because of varying loads of knowledge. Classical innovation theory also mentioned that innovation requires customization in

order to meet different organizational backgrounds. Rogers [56] defined innovation as an idea, event, or even an object. These ideas, events, or objects are perceived by an entity or adoption unit as a new item, that is, innovation. Rogers [56] also believed that the characteristics of innovation are important background factors for introducing IT.

A significant number of previous studies based on the technology, organization, environment (TOE) framework have already explored the critical factors for information systems adoption [11,13,35,67]. As organizational and information system contexts are playing a pivotal role in this study, it summarizes the factors which influence the adoption of innovative IT as characteristics of organization and characteristics of CRMS.

Government meddling is disregarded in this study since, currently, the Taiwanese administration has not established explicit assistance policies and a grant program for CRMS adoption. In addition, the external environmental context is not covered in this integrated model. The reason for this is that the study subjects of this research are hospitals ranked as medical centers, regional hospitals, and community hospitals. Since the competition among hospitals originates from the same rank of healthcare organizations, when the hospitals are from different ranks, the contexts of external competition will be explained differently. For example, medical centers are always compared with other medical centers or regional hospitals. In contrast, the perceived competition pressure in community hospitals is usually compared with the competition in medical centers and regional hospitals. Hence, the difference between healthcare ranks will moderate the perceived competition intensity, and the context of external competition is not covered in our study.

This study views CEO characteristics as a part of the internal organizational characteristics. Zhu et al. [67] proposed that the leadership characteristics can be viewed as specific internal organizational properties. In comparison with Thong's [60] research model, this model considers the variable of the innovation of senior executives as one type of organizational characteristics and has decided to disregard the variable of senior executives' IS knowledge. Regarding the information systems adoption in a hospital, CIOs normally have much stronger backgrounds in IS than the other managers in the hospital and have more opportunities to upgrade their IS knowledge after IS adoption. On the one hand, CIOs would surely be more suitable than other managers in responding to our questionnaire. On the other hand, letting CIOs evaluate the senior team's IS knowledge or IS capabilities objectively would likely be impossible. To avoid such a dilemma, this study disregarded the measure for the variable of senior executives' IS knowledge, and this variable is consequently excluded from organizational characteristics.

Through the review of the literature of IT adoption, we have found several possible antecedents of CRMS adoption in hospitals, which can be grouped into two dimensions: characteristics of organization and characteristics of CRMS. The next section will discuss our research model based on these two dimensions.

3. Research methodology

3.1. Research model

This research examined what critical factors affect the adoption of CRMS in hospitals. It summarized the factors which influence the adoption of innovative technology into two categories: characteristics of organization and characteristics of CRMS. Factors related to the characteristics of organization include size of organization, IS capabilities of staff, innovation of senior executives, and knowledge management capabilities. Factors related to characteristics of CRMS include relative advantage and complexity. The proposed model is shown in Fig. 1.

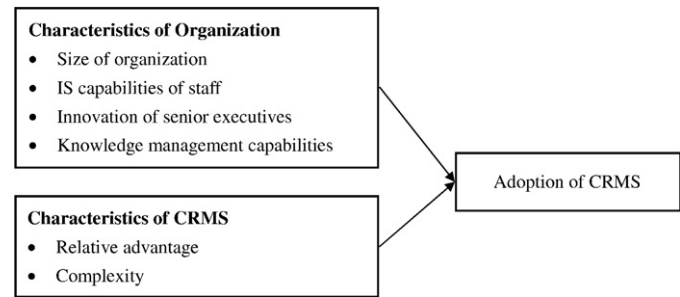


Fig. 1. Research model.

3.2. Research hypotheses

3.2.1. Size of organization

Dewar and Dutton [15] believed that a large-scale organization has more resources and infrastructure to promote innovation. Welsh and White [64] also argued that small businesses usually endure more restrictions, such as lack of resources, financial constraints, lack of experts, and management with short-term insight. Ein-Dor and Segev [16] suggested that small organizations face more obstacles when adopting IT and find it more difficult. Alpar and Reeves [2] also suggested that large organizations have more ability than small organizations to hire professionals, such as IT knowledge professionals. Lind et al. [40] indicated that large organizations have more potential than small ones in the use of information systems because of their large-scale operations. Thus, the size of organization is positively related to the adoption of CRMS. Therefore, we proposed a hypothesis for the adoption of CRMS in hospitals.

H1. The larger the size is, the more willingness for the hospital to adopt CRMS.

3.2.2. The IS capabilities of staff

Attewell [6] believed that innovation diffusion theory targets employees in small organizations. Small organizations usually lack professional IT knowledge and IT technical skills [20,38]. Neideman [47] believed that small European organizations failed because they lacked knowledge of information systems. Because of the obstacle lack of skill and technical knowledge required in the development process, many organizations delay innovation adoption, and tend to wait until they have sufficient technical expertise. Thus, if employees in small organizations have more knowledge of information systems, then they will be more likely to adopt the information systems. As Ettlie [17] explained, staff must have some knowledge of IT innovation in order to use more innovative IT. Yap [66] believed that organizations have different levels of information need in different sections, and there is more need to implement IS in information intensified sectors. Porter and Millar [53] suggested that the greater the information intensity, the greater the potential for the use of information systems. Thong [60] believed that greater information intensity in small organizations would lead to the senior executives believing that IS is a major competitive tool, and this would increase IS adoption. Based on these discussions, the IS knowledge of staff and the information intensity in the hospitals can be seen as the IS capabilities of staff. Therefore, we proposed a hypothesis for the adoption of CRMS in hospitals.

H2. The more IS capabilities the staff have, the more willingness the hospital will have to adopt CRMS.

3.2.3. Innovation of senior executives

Thong [60] believed that the characteristics of senior executives in organizations affect the adoption of IS. The positions and roles of senior executives have different effects on the organization's behavior

towards innovation. Some studies pointed out that the important actors in organizations should not be ignored. For example, Hage and Dewar [22] believed those who are in the higher levels and have the power to allocate organizational resources will influence the adoption of innovation. Senior executives in organizations are the critical persons to determine the organizational attitude toward innovation because these executives are usually owners and important policy-makers. The characteristics of senior executives will determine the style of the organization. Generally speaking, the change of an organization depends not only on its size and market factors, but also on the ability of senior executives, his or her preferences, and his or her readiness to change. It is senior executives who decide whether or not the innovation should be initiated. Therefore, we proposed a hypothesis for the adoption of CRMS in hospitals.

H3. The higher the level of innovation the senior executives have, the more willingness the hospital will have to adopt CRMS.

3.2.4. Knowledge management capabilities

The meaning of knowledge management capabilities is that organizations based on reliable information capture, manage, and transmit real-time customer product and service information in order to enable organizations to make rapid decisions and improve customer response [1,29]. In addition, researchers put forward three types of perceived abilities for managing knowledge [1,29]: (1) from the IT-based capacity point of view, the need to gain CRM information, client information, competitor information, product and market information, activity-based cost, human resources information, and the latest financial situation; (2) from the technology-based capacity point of view, the need to gain such things as bandwidth, e-mail, Web-based products, search engines, and information technology architecture; and (3) from the cultural capacity point of view, the need to gain such things as the practical guidelines for implementing knowledge management systems, and the advancement of organizational change and knowledge-sharing.

Cabena et al. [10] believed that the access to customer-related knowledge conducted by organizations can be divided into three stages: (1) database management phase including data sources, data warehouses, and data marts, which is the basis for information structure; (2) data analysis phase including database exploration, data mining, and the information found; and (3) business analysis phase including the information released, and decision support for the application of information. The growth of enterprises should be focused on customers, and data warehousing, data mining, and the integration of computer technology and explicit knowledge used in order to identify potential customers. Although previous researchers had various views on CRM, almost all mentioned the customer knowledge management processes and knowledge management infrastructure. These two aspects must be considered for the successful adoption of CRM. Organizations can immediately respond to customer demands if they have appropriate customer knowledge management. Therefore, we proposed a hypothesis for the adoption of CRMS in hospitals.

H4. The more knowledge management capabilities the hospital has, the more willingness it will have to adopt CRMS.

3.2.5. Relative advantage and complexity

Rogers [56] defined perceived characteristics of the innovation based on what affects the adoption of innovation of the organization implementing the innovation. The perception of IS from the potential implementing organizations is importantly used for judging whether IS will be implemented. According to the characteristics of innovation in the innovation literature, Tornatzky and Klein [63] identified relative advantage, compatibility, and complexity based on the

innovation characteristics of the attitude towards the use of IT innovation.

Innovation is broadly defined as individuals or other units adopting perceived new ideas, training, or objects. Diffusion means a process of adopting a specific innovation from introduction to acceptance by the members of the social system [56]. Rogers [56] defined innovation diffusion as the process of disseminating an innovative object through certain channels for a period of time, and then it is being accepted by the members of the social system. Innovation diffusion theory stated that any one of the innovations, over time, will spread into cases showing an S-shaped curve. Thus, it can reasonably predict the cumulative number of divisions adopted over a time period. The impact factors on innovation diffusion can be grouped into five categories including the perceived attributes of innovation, the type of innovative decision-making, communication channels, and the nature of the social system. The perceived attributes of innovation have five properties: relative advantage, compatibility, complexity, trialability, and observability. Therefore, we proposed two hypotheses for the adoption of CRMS in hospitals.

H5. The more relative advantages to the hospital, the more willingness it will have to adopt CRMS.

H6. The lower the complexity to the hospital, the more willingness it will have to adopt CRMS.

3.3. Definitions of variables and measurements

The definitions of the variables studied in this research and supporting references are listed in the following sections.

3.3.1. Size of organization

The size of organization was measured as the number of beds on seven levels. This variable was determined to be an appropriate measure of organization size, for example, the most common measure is the number of employees, total assets and revenue. To measure this variable the number of beds in a hospital was calculated. According to prior research [33], the predominant trend of hospital research studies is to use the same method to measure this variable.

3.3.2. IS capabilities of staff

IS capabilities of staff was measured based on the five-point Likert-type scale. The definition of this variable is the professional IS knowledge and technique capabilities that the staff have. The source of items was adopted from Thong [60].

3.3.3. Innovation of senior executives

Innovation of senior executives was measured based on the five-point Likert-type scale. The definition of this variable is the preferences of senior executives adopting different problem structures which are the solution to innovation. The source of items was adopted from Thong and Yap [59].

3.3.4. Knowledge management capabilities

Knowledge management capabilities was measured based on the five-point Likert-type scale. The definition of this variable is the abilities of retrieving, managing, and transmitting real-time customer information in order to enable timely responses to customers, and a shortened decision-making process. The source of items was adopted from Croteau and Li [14].

3.3.5. Relative advantage

Relative advantage was measured based on the five-point Likert-type scale. The definition of this variable is the advantage, such as economical benefits and better reputation, that the innovation can

bring to the organization. The source of items was adopted from Premkumar and Roberts [54].

3.3.6. Complexity

Complexity was measured based on the five-point Likert-type scale. The definition of this variable is the difficulties of understanding and utilizing the innovation. The source of items was adopted from Premkumar and Roberts [54].

3.3.7. Adoption of CRMS

Liang et al. [39] developed an instrument for measuring the dependent variable in their adoption model which is utilized to measure the degree of adoption of knowledge management in Taiwanese enterprises. Since this instrument is designed specifically for measuring the degree of adoption of innovation in the Taiwanese context, it is appropriate for this study to measure its adoption in the same country and culture.

Based on Liang et al.'s [39] instrument, hospitals were asked if they were currently adopting CRMS by selecting which stage of CRMS adoption that they were in: (1) fully implemented with profits earned, (2) implemented and promotion in progress, (3) partially implemented, (4) planning to implement, or (5) unimplemented. This study identifies hospitals in one of the first three stages as adopters, and the respondents who selected one of the last two stages are categorized as non-adopters.

3.4. Population and sampling method

The study subjects of this research were the hospitals ranked by the Department of Health (DOH) as medical centers, regional hospitals, and community hospitals. A sample source was achieved by using the roster of the Taiwan Bureau of National Health Insurance. A total of 508 health institutions were identified: 21 medical centers, 74 regional hospitals, and 413 community hospitals. Questionnaires were sent to the IS executives of these institutions (such as: Chief Information Officer and Vice President of MIS department, etc.).

3.5. Questionnaire design

This research utilized the closed question style, and the questionnaire was divided into two parts. One contains the questions eliciting the basic information of the participants and the hospital. The other part contains the questions used for studying the factors which the hospital is considering concerning the adoption of CRMS, and the current status of the CRMS which the hospital has implemented. After the completion of the draft questionnaire, three IS academics with earned doctoral degrees were asked to examine and help modify the content of the questionnaire. Subsequently, five high-ranking IS executives with practical experience in hospitals were invited to examine the questionnaire and to ensure that the content of the questionnaire was clear, and easy to understand. Some modifications were suggested. The final developed questionnaire is shown in Appendix A.

3.6. Questionnaire distribution and collection

In this study, questionnaires were posted to the 508 health institutions. The electronic address of the online questionnaire was given in case any participant preferred that method of response. Two weeks later, a collection process was conducted by calling or e-mailing these participants. If the questionnaire had been lost, another copy would be sent to the participant. This process was conducted over a period of one and half months.

4. Data analysis and results

4.1. Sample characteristics

This research sent questionnaires to 508 hospitals, with a total of 97 returned questionnaires showing a response rate of 19%. However, there were only 95 usable questionnaires since two incomplete questionnaires were eliminated. The usable response rate was 19% in this study. Table 1 summarizes the sample characteristics of the type of respondent and hospital. This table shows that 61% of the respondents currently have more than 4 years experience in their position, 72% of respondents have more than 5 years of seniority in the healthcare industry and 51% of respondents hold top-level positions in an IS department. These results show that respondents were capable of understanding the questionnaires. Furthermore, there was a wide distribution of hospitals, medical centers (14%), regional hospitals (33%) and community hospitals (54%), in terms of the sample characteristics. The distribution of hospital categories showed 48% from private hospitals; the others were divided into public hospitals (26%), non-profit hospitals (21%), and privately managed public hospitals (4%). The result shows that, in this study, 39 hospitals were adopters and 56 hospitals were non-adopters.

4.2. Analysis of construct reliability and validity

The construct reliability is assessed by Cronbach's alpha in this study. Reliability is the assessment of the degree of consistency between multiple measurements of a variable [23]. Table 2 presents

Table 1
Sample characteristics.

Hospital rank	Frequency	Percentage
Medical center	13	14%
Regional hospital	31	33%
Community hospital	51	54%
Category of hospital	Frequency	Percentage
Public hospital	25	26%
Private hospital	46	48%
Non-profit hospital	20	21%
Privately managed public hospital	4	4%
Title of responding executives	Frequency	Percentage
Chief information officer (CIO)	48	51%
Vice president of MIS department	15	16%
Other senior managers	32	34%
Seniority in current position	Frequency	Percentage
Above 10 years	16	17%
7~9 years	19	20%
4~6 years	23	24%
1~3 years	26	27%
Less than 1 years	11	12%
Responding executives' seniority in the healthcare industry	Frequency	Percentage
Above 26 years	5	5%
21~25 years	6	6%
16~20 years	11	12%
11~15 years	23	24%
6~10 years	23	24%
Less than 5 years	27	28%
CRMS adoption stage in hospitals	Frequency	Percentage
Fully implemented with profits earned	2	2%
Implemented and promoting	8	8%
Partially implemented	29	31%
Planning to implement	11	12%
Unimplemented	45	47%

Table 2
Construct reliability and validity analysis.

Variable	Item	Cronbach's α	Factor loading				
Innovation of senior executives	ISE_1	0.80	0.79	−0.19	0.21	0.11	−0.05
	ISE_2		0.92	0.03	−0.05	−0.01	0.02
	ISE_3		0.82	0.01	−0.19	−0.12	0.15
Relative advantage	RA_1	0.84	−0.10	0.81	0.00	0.21	0.08
	RA_2		0.05	0.87	−0.10	0.10	0.01
	RA_3		−0.08	0.82	−0.01	0.27	0.09
Complexity	COMP_1	0.86	−0.04	−0.13	0.91	−0.14	−0.10
	COMP_2		0.00	0.00	0.88	−0.20	−0.20
Knowledge management capabilities	KMC_1	0.87	−0.08	0.34	−0.19	0.69	0.24
	KMC_2		0.02	0.39	−0.05	0.80	0.14
	KMC_3		0.05	0.23	−0.11	0.84	0.20
	KMC_4		−0.03	−0.05	−0.05	0.83	0.15
IS capabilities of staff	ISCS_1	0.91	0.12	0.14	−0.04	0.24	0.86
	ISCS_2		−0.02	0.01	−0.09	0.20	0.91
	ISCS_3		0.03	0.08	−0.17	0.22	0.89

Factor loadings with bold emphasis are above 0.6.

the items used for Cronbach's alpha measuring. All the Cronbach's alpha values in this study are greater than 0.7 which is considered the minimum value for discerning whether the item is able to produce reliable measures.

In order to assess construct validity and discriminant validity, the 15 items used to measure the five constructs were subjected to principal components with quartimax rotation. The Kaiser–Meyer–Olkin (KMO) index of sampling adequacy was 0.76 confirming the appropriateness of the analysis. Five factors were extracted that cumulatively explained 79% of the variance, and are shown in Table 2. All the loadings of each observed indicator on its latent construct exceeded 0.6 and therefore good convergent validity was demonstrated.

4.3. Assumptions of discriminant analysis

The utilization of discriminant analysis, the assumptions of normality, multicollinearity and the equality of covariance matrices have already been tested in this study. All of the metric variables reflect a statistically normal distribution curve. The statistical significance of Box's M does not exceed the critical level (Box's $M = 20.82$, significance = 0.57) which means the equality of the covariance matrices is supported in this study.

The correlation matrix is useful for examining the multicollinearity problems between each construct. The correlation analysis is followed by the Pearson correlation matrix in this study. The results are presented in Table 3. In terms of the coefficients of correlation, these do not approach 0.7. This result indicates that each construct is not significantly multicollinear.

4.4. Hypothesis testing results

Discriminant analysis is utilized to identify the variables with greatest differences between the groups [23]. This study adopted discriminant analysis to test the research hypothesis, and the result

shows that the discriminant function is competent (Wilks' lambda = 0.82, Chi-square = 18.12, significance = 0.01). This result also indicates that this discriminant function can be used to discriminate between the adopters and non-adopters.

The discriminant loadings for each variable are shown in Table 4. Discriminant loading is used to measure the significance of the variables, and the common acceptable circumstance is that the value is greater than 0.3. Overall, the variables with discriminant loadings greater than 0.3 are the size of the organization, IS capabilities of staff, innovation of senior executives, relative advantage, and knowledge management capabilities which have significant leverage in recognizing the adoption between two groups. Only the variable "complexity" is insignificant to influence the adoption between the two groups. Furthermore, the accurate examination of classification is important to realize the effectiveness of the discriminant function. The overall classification accuracy is 68.4%. The separate correct classification rates for adoption and non-adoption are 66.7% and 69.6% respectively. The results show this discriminant function is appropriate for use in the study.

In order to determine if the classification accuracy of the discriminant model is more superior than the chance model, one approach is the t -test. This determines the level of significance for the classification accuracy [23]. The accuracy of the chance model was 51.6%, which is less than the discriminant model in this study. The result of the t -test was significant ($t = 3.277$, $p < 0.05$).

5. Discussion

5.1. Size of organization

Previous studies suggested that organizational size should positively influence organizations' capabilities to adopt innovations [63]. There are several advantages for larger organizations to adopt innovations, for example there are more resources to facilitate adoption, they will achieve economies of scale and they have more capabilities for bearing

Table 3
Pearson correlation matrix.

	Size of organization	IS capabilities of staff	Innovation of senior executives	Knowledge management capabilities	Relative advantage	Complexity
SO	1					
ISCS	0.39*	1				
ISE	0.19	0.37*	1			
KMC	0.19	0.45*	0.38*	1		
RA	0.23**	0.21**	0.29*	0.47*	1	
COMP	−0.35*	−0.32*	−0.08	−0.33*	−0.17	1

SO = size of organization, ISCS = IS capabilities of staff, ISE = innovation of senior executives, KMC = knowledge management capabilities, RA = relative advantage, COMP = complexity.

* Correlation is significant at the 0.01 level (2-tailed).

** Correlation is significant at the 0.05 level (2-tailed).

Table 4
Result of discriminant analysis and classification accuracy.

Variables	Discriminant coefficients	Discriminant loading	Group mean			
			Adoption		Non-adoption	
			Mean	S.D.	Mean	S.D.
Wilks' Lambda						0.82
Chi-square						18.12
df						6
Sig.						0.01
Size of organization	0.772	0.801*	3.82	2.00	2.46	1.62
IS capabilities of staff	0.278	0.615*	3.83	0.64	3.45	0.65
Innovation of seniorexecutives	0.393	0.587*	3.83	0.53	3.49	0.65
Knowledge management capabilities	0.074	0.392*	3.60	0.56	3.40	0.52
Relative advantage	0.083	0.360*	3.65	0.57	3.45	0.58
Complexity	0.224	−0.173	3.10	0.73	3.22	0.74
			Predicted group membership			Total
			Non-adoption		Adoption	
Actual group membership	Non-adoption		39 (69.6%)		17 (30.4%)	
	Adoption		13 (33.3%)		26 (66.7%)	

68.4% of original grouped cases correctly classified.

51.6% of chance accuracy.

* Discriminant loading above the 0.3 level.

the risk of innovation [67]. Also, increased size seems to have a positive influence on the willingness of adoption because of the increased availability of resources and specialized knowledge [37].

This study chose the number of beds to measure the size of the hospital. A hospital with more beds is larger in the scale in general and has more ability to set up additional assets, and therefore such a hospital is better able to afford the resources required for the adoption of CRMS. Moreover, the number of beds has a positive relationship with the number of customers that the hospital can handle. When dealing with a larger number of customers, a hospital tends to face more medical problems. Therefore, another reason for larger hospitals to adopt CRMS is to provide more timely information to customers and to respond to their requests efficiently in order to establish a powerful communication channel.

The relationship between organization size and innovation adoption did not vary across heterogeneous industries [48]. Previous innovation studies suggested that the positive relationship between organization size and innovation adoption was weaker for non-profit organizations [15]. Large organizations for profit may utilize their resources to extend their market competitiveness. The samples collected in this research are 48% privately owned hospitals, and this could be the major reason to explain why the results showed that hospital size influences the adoption of CRMS.

5.2. IS capabilities of staff

Thong [60] suggested that the higher IS capabilities the staff have, the higher their potential in the use of information systems, and thus the higher percentage of adopting IT. The literature also asserted that technical skills in an organization are critical for successful IS adoption [36]. The results of this study show that the hospital staff with higher IS capabilities are more likely to adopt CRMS. The degree of IS knowledge among healthcare workers in hospitals varies, despite most of them having adequate professional medical knowledge. Therefore, the key for adoption is not the medical knowledge, but the IS capabilities. When a hospital is aware that most of its staff have adequate IT knowledge, it will be inclined to adopt CRMS. In other words, the enhancement of information literacy of hospital staff and information technology capability will increase the possibility of adoption of CRMS.

5.3. Innovation of senior executives

If executives are willing to adopt innovative technology, this implies that the innovative management of their organizations is willing to bear the risks of adoption of innovations. The commitment in bearing risks is an important factor in adopting innovative technologies [26]. Regarding the results of the variable innovation of senior executives in this research, they are in line with the results generated from Thong's [60] study which discussed the adoption of information systems in small businesses and showed a positive relationship between the innovation of senior executives and the adoption of information systems. These matched results denote that the preferences of innovation among executives will increase the willingness in adopting CRMS.

In comparison with other industries, hospitals are far behind in the adoption of new information technology [5]. When hospital executives are familiar with the characteristics of innovation, the hospital reduces the uncertainty concerning the use of CRMS and increases the willingness of adoption. According to previous literature, hospital executives believed that most of the problems and challenges to be faced in the future will come from issues surrounding customer relationship. CRMS plays a crucial role in providing solutions to these challenges and problems in order to help hospitals.

5.4. Knowledge management capabilities

Knowledge management capabilities include the information technology infrastructure that is being utilized to capture technological advantage and collaborative knowledge about customers, products, and services [14]. In this study, knowledge management capabilities have a significant impact on CRMS adoption. This infers that a high level of knowledge management capabilities seems to support effective and efficient management of customer relationships in hospitals. Better knowledge management capabilities help hospitals utilize CRMS to deal with complex problems more easily.

Supporting CRM, knowledge management facilitates the integration of knowledge between departments and structures knowledge management processes to guarantee that all relevant knowledge is made accessible to the customer [52]. Hospitals can rely on the basis of high knowledge management capabilities and utilize CRMS to

better understand customer needs, to supply personalized medical records and relevant healthcare information, and to increase the interaction between the hospital and its customers.

5.5. Relative advantage

Thong [60] found that relative advantage is the benefit gained from adopting the innovation. According to a study on the adoption of PACS (Picture Archiving and Communication Systems) [12] conducted in the healthcare industry in Taiwan, both adopters and non-adopters agreed that the healthcare industry is competitive. Therefore, the adopter tends to utilize CRMS as a tool for increasing customer satisfaction and improving medical service quality in order to help the hospital gain relative advantage ultimately increase operation performance. The variable relative advantage discussed in this research showed a positive result concluding that the more benefits seen to be gained from adopting CRMS, the more willingness the hospital would have to adopt CRMS.

5.6. Complexity

Technological innovation is always considered a complex assignment and bewildering to the adopting department [21]. The results of this factor in this research are different from the results generated from past literature. The major reason is that IS vendors in Taiwan usually supply implementation solutions such as on-site training or consulting to link the emerging technology to the healthcare industry [11]. IS in hospitals is expensive and normally comes with manuals and supports. Therefore, adopters and non-adopters all perceived that the effect of CRMS complexity is not obvious. Furthermore, it is possible that no difference in operation is found between the CRMS and the current IS adopted by the hospital, and this has reduced the difficulties faced when operating CRMS. Another reason is that when a hospital considered adopting CRMS, the IS capabilities of its staff had already been considered as an important factor. Once a hospital adopts CRMS the IS capabilities are high enough, and therefore the effect generated from system complexity is relatively reduced.

6. Implications

Since few healthcare studies discuss the adoption of CRMS, the critical factors tested in our model and relevant discussion could provide implications for associated academics, practitioners, and governments. These implications are presented in the following sections.

6.1. Implications for researchers

This research has indicated several implications for academic research on CRMS adoption. First, it contributes to the IS adoption literature in the healthcare domain by empirically building an integrated model. Although this research provides the critical factors of hospital adoption on CRMS, sufficient explanations for justifying how these factors influence managerial decision-making are lacking. Therefore, we suggest that future research could use follow-up interviews with hospital CEOs to elicit explanations.

Second, the current study, based on surveys, indicated the factors which have direct influence on CRMS adoption by the healthcare industry. Further research can investigate whether other potential factors exist. Third, researchers can refine the current model to a better extent that can be used to explain CRMS adoption in the future. In addition, understanding the factors which influence the performance and implementation of CRMS is encouraged.

Lastly, it is encouraged that researchers would consider medical policies and information system security standards as perspectives on the adoption of CRMS in future studies. Customers are not the only ones driving change in healthcare. For example, in the United States, the

Health Insurance Portability and Accountability Act (HIPAA) sets a variety of security norms, standards, and restrictions on the deployment of healthcare information technology (HIT). Therefore, when hospitals deploy and use CRMS, they must be particularly careful to consider medical policies and the regulations of security restrictions.

6.2. Implications for hospitals

In more specific circumstances, this research has five implications for hospitals. First, CRMS can facilitate the customer relationship management by providing timely information and quick responses. Therefore, it is reasonable to infer that a larger hospital, with more beds, would have more need to utilize CRMS because of maintaining more complicated customer relationships and fulfilling more customer requirements. In line with this inference, the larger hospital should also explore the invisible advantages and potential of CRMS.

Second, this research provides lessons for the smaller hospitals. They will face the same situations that the larger hospitals are facing, such as more complicated customer relationships, when they are expanding and adopting CRMS. Therefore, they should enhance their system capability while expanding the scale of their business.

Third, limited IS capabilities of staff can be an obstacle for adopting CRMS. Since CRMS is a more complicated system, in order to enhance the capabilities of IS staff, senior management should provide more educational programs during the CRMS adoption than it provides when adopting conventional types of IS.

Fourth, the knowledge management capabilities have a positive impact on the adoption of CRMS. Therefore, senior executives should try to create knowledge management capabilities, such as undertaking business process re-engineering (BPR) to reform the hospital. Once the knowledge management capabilities are created, it will be easier for the hospital to adopt the CRMS. In contrast, hospitals can also utilize CRMS to support their knowledge management capabilities more efficiently and effectively. In a hospital, customer information is commonly required and thus stored in various databases or departments. For this reason, the hospital with a higher capability of managing knowledge becomes the one which has the stronger ability to centralize the scattered knowledge. The stronger ability of knowledge management helps reduce difficulties faced when a hospital needs to integrate scattered customer information in the process of CRMS adoption.

Finally, the results show that the innovative senior executives can stimulate re-engineering and change in organizations, and this has a positive effect on CRMS adoption. Thus, hospitals which intend to adopt CRMS should hire a senior executive with an innovative personality that will guide them toward innovation and growth. In order to diminish social barriers derived from the internal part, the hospitals should let their senior executives foresee that CRMS can enable customers to search for critical information and communicate with hospital staff in a timely fashion. Although CIOs can have a direct and positive influence in the adoption of an emerging technology, the major decision made in regard to IT adoption must be a consensus among the president and vice-presidents. Therefore, the CIO should negotiate with the president or vice-president who is partial to the innovation in order to increase the success rate of CRMS adoption.

6.3. Implications for CRMS vendors

This research provided four valuable insights for vendors of CRMS. First, the fact of hospital size (in terms of bed number) being positively associated with CRMS adoption gives CRMS vendors a clue to develop specific marketing strategies for identifying potential adopters. In addition, innovation is a major cause of the CRMS adoption. Hospitals with sufficient assets and financial resources have more inclination towards innovation. Smaller hospitals normally lack financial ability to cover the enormous cost of CRMS implementation. Purchasing a module of CRMS and fitting it in with their core organization functionality,

therefore, is an attractive solution for smaller hospitals because the module package can alleviate the pressure of financial expenditure and provide dynamic modification of the original CRMS. This study recommends that CRMS vendors can invest in the development of module packages of CRMS for smaller hospitals.

Second, the preparation for IS training by CRMS vendors for hospital staff can alleviate technological barriers in the adoption stage. This study suggests that if the adoption vendor could provide consultation or pre-training services to assist hospitals prepare related IS capabilities, then that would improve the willingness for CRMS adoption.

Third, CRMS vendors can provide training and coaching for the knowledge management capabilities of hospitals to make the planning of CRMS adoption run smoothly. If they possess superior knowledge management capabilities, this study suggests that vendors can supply the CRMS combined with KM applications to the hospitals. Overall, aside from paying attention to the research and development in CRMS technologies, vendors should also customize their products to the knowledge management capabilities of the hospitals.

Ultimately, the hospitals should perceive the relative advantages derived from the CRMS. CRMS vendors can include these findings in their marketing presentation materials to hospitals as an incentive for CRMS adoption. Vendors can also improve their marketing strategy for CRMS according to the degree of innovation of the senior executive's character. When vendors have prospective adopters for CRMS, they can promote the new applications to managers who have more potential innovative capacity.

6.4. Implications for the government

This research provides two implications for the government. First, smaller hospitals normally lack the resources for the adoption of innovative technology that will enhance the level of service quality. However, this cannot be the excuse for decreasing their service quality because customers being treated in smaller hospitals should be treated with the same quality of service as in larger hospitals. In order to ensure that every citizen receives quality medical services, this research suggests that assistance policies for smaller hospitals to adopt CRMS could be framed by the government. In addition, the government could help CRMS vendors develop cheaper CRM modules for smaller hospitals.

Second, the government could create an active and supportive environment to encourage senior executives to adopt CRMS. To achieve this, the government could hold exhibitions and conferences presenting the cases of the best practice of CRMS adoption and relevant experiences from the healthcare sectors.

6.5. Limitations of this study

The cross-sectional nature of this research restricts our full understanding of the decision-making of CRMS adoption. This research recommends that a longitudinal study is needed to identify the dynamics among the critical factors and decision-making. This research only considered the major characteristics of organization and CRMS, and thus may have ignored other undiscovered contexts. When possible, future research should attempt to conjoin additional theory-based contexts in order to enhance the explanatory ability of the model in CRMS adoption. Moreover, this research was based on data collected in Taiwan for understanding the critical factors of CRMS adoption in hospitals. The Taiwanese environment is somewhat different from other countries, for example, financial support systems of governments could be different in other countries. Thus, future research needs to be careful in interpreting the results of this research.

7. Conclusion

The purpose of this research was to identify the characteristics of organizations which would influence the adoption of CRMS in

hospitals. Theoretically, a review of prior IS innovation literature provided support for the proposal of an empirical model of CRMS adoption, and this model has been empirically verified by the results of a survey of 508 hospitals in Taiwan. The results showed that five factors; hospital size, IS capabilities of staff, innovation of senior executives, knowledge management capabilities and relative advantage, have significantly affected the CRMS adoption. The critical factors identified by this research can hopefully provide substantial aids and advices for academics and practitioners.

Appendix A. Questionnaire

Variables	Items
Size of organization	1. Number of beds in hospital
IS capabilities of staff	1. My employees were all computer-literate. 2. There was at least one employee who was a computer expert. 3. I would rate my employees' understanding of computers as very good compared with other small hospitals in the healthcare industry.
Innovation of senior executives	1. Senior Executives have original ideas. 2. Senior Executives would sooner create something new than improve something existing. 3. Senior Executives often risk doing things differently.
Knowledge management capabilities	1. The hospital is able to provide fast customer response because of integrated customer knowledge across several functional areas. 2. The hospital is able to provide fast decision-making due to customer availability. 3. The hospital is able to provide fast decision-making due to knowledge precision. 4. The hospital can provide authentic customer information for quick and accurate customer interaction. 5. The hospital can provide authentic product and services information for quick and accurate customer interaction. 6. The organization can generally predict future customers' expectations.
Relative advantage	1. The technology will allow us to better communicate with our hospital partners. 2. The technology will allow us to cut cost in our operation. 3. Implementing the technology will increase the profitability of our hospital. 4. Adoption of the technology will provide timely information for decision-making.
Complexity	1. The skills required to use these technologies are too complex for our employees. 2. Integrating these technologies in our current work practices will be very difficult.
Adoption of CRMS	1. Fully implemented with profits earned 2. Implemented and promotion is in progress 3. Partially implemented 4. Planning to implement 5. Unimplemented

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