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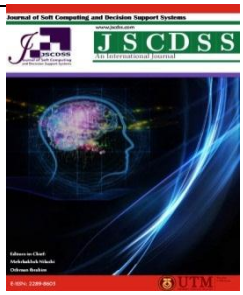

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Evaluating the Factors Affecting Adoption of Hospital Information System Using Analytic Hierarchy Process

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Abstract

The aim of this study is to provide more insight within the context of Malaysia to understand the potential factors that importantly driving or inhibiting the HIS adoption. In this study, an Analytic Hierarchy Process (AHP) model is developed to determine the most important factors among the four categories, which are based on the integrated Information System (IS) theories for HIS adoption in the context of Malaysian public hospitals. These factors are identified and compared by hospital experts and decision makers, who are fully familiar with HIS technology in the healthcare industry. Then AHP is applied to compute the weights of incorporated factors in the HIS adoption model. This can result at fostering the uptake of HIS and facilitating its reluctant trend by improving the decision of hospitals towards HIS adoption in Malaysia, however not limited to other countries.

Keywords: Public hospitals, HIS, Adoption decision, DOI theory, TOE framework, Institutional theory, HOT-fit model, AHP.

1. Introduction

According to Talmon et al. (Talmon et al., 2009), "health Informatics is a significant area of health systems investment, and potentially affects every professional and patient." Physicians and patients today encounter an extensive amount of pressure from the healthcare industry. From 'physicians' perspective, the pressure originates from various causes such as heavy responsibilities for patients, excessive managerial assignments, and loss of control over patients' decision on healthcare (Lee, Ramayah, & Zakaria, 2012). Along the same vein, patients also complain that more consideration should be provided for them during medical interaction (Kassirer, 2000; Sulaiman & Wickramasinghe, 2014). Unfortunately, the straggle in healthcare industry's technology adoption to support delivery of care has been strongly criticized (Menachemi, Burke, & Ayers, 2004; Stegwee & Spil, 2001; Suomi, 2001; Wager, Lee, & Glaser, 2005; Wickramasinghe, 2000). In this regard, a 2009 report showed that in the United States hospitals, only 17% percent of them have the equipment of Computerized Physician Order Entry (CPOE) (Menachemi et al., 2004). Therefore, there is an increase in patients' demand on electronic services to be dispensed by physicians.

In Malaysia, people can acquire a broad range of healthcare services at low prices. However, according to Lee et al. (Lee et al., 2012), "factors like changing pattern of death causing diseases from infectious diseases to chronic diseases, population structure, lifestyle, and healthcare service expectation from the people have distorted the status quo." Furthermore, this is compounded by an increasing rate of healthcare expenses in Malaysia annually. Hence, the Malaysian government faces an imposing pressure to enhance the healthcare quality and reduce patients' medical costs (H. W. Lee et al., 2012). In order to overcome these two major issues, the Malaysian government has embarked on several projects with the aim of promoting and maintaining the citizens' wellbeing, apart from providing additional access to healthcare information.

Consequently, in the quest to overcome and solve recent aforementioned challenges, the Malaysian government had initiated several medical care projects. One of the projects is the National Telehealth Policy (NTP) (Abdullah, 2008). NTP comprises four attractive schemes namely, Telemedicine, Mass Customised/Personalised Health Information and Education (MCPHIE), Lifetime Health Plan (LHP), and Continuing Medical Education (CME) (Abdullah, 2008; J. Li, 2010) which ultimately aim to promote Information System (IS) in the healthcare industry. Telemedicine is one of the domains that has been targeted

for radical improvement (Abdullah, 2008; H. W. Lee et al., 2012). Known as the Telemedicine Blueprint under the renowned Multimedia Super Corridor (MSC) Telehealth project, Telemedicine is a healthcare-reform initiative launched to reform the Malaysian healthcare system. Abidi et al. (Abidi, Goh, & Yusoff, 1998), concur that "MSC began in 1996 to emphasize on the national vision of 2020 which can assist Malaysia toward becoming a developed country in the year 2020 through particular objectives." In addition, the LHP is amongst the four key projects that concentrate on fostering a healthcare platform, whereby general hospitals can provide personal lifetime health plan to the general public. According to (Abidi et al., 1998; N. I. Ismail, Abdullah, Shamsudin, & Ariffin, 2013; Mohd & Syed Mohamad, 2005), under the LHP project, Hospital Information System (HIS) is introduced as an impetus to the healthcare industry's digitalization process.

Three types of HIS were introduced including Total Hospital Information System (THIS), Intermediate Hospital Information System (IHIS), and Basic Hospital Information System (BHIS) (Hassan, 2004; N. I. Ismail et al., 2013; H. W. Lee et al., 2012; Mohan & Razali Raja Yaacob, 2004). HIS decision applications are according to the number of beds that the particular hospital has. THIS gives an integrated system whereas BHIS is the lowest and limited system. Moreover, THIS implementation is for tertiary hospitals with over 400 beds. According to Kensing and Ismail et al. (A. Ismail et al., 2010; Kensing, Sigurdardottir, & Stoop, 2007), in Malaysia the intention of the Ministry of Health (MOH) on implementation of THIS is proven to be beneficial; even though, the task could be risky but the overall advantage of having extensive system is priceless. Despite all of these, according to (Ahmadi et al., 2015a; A. Ismail et al., 2010; N. I. Ismail et al., 2013; H. W. Lee et al., 2012; MOH-Malaysia, 2014; Sulaiman & Wickramasinghe, 2014), only 15.2% of the Malaysian public hospitals are referral hospitals equipped with either fully integrated or partially integrated HIS since the Telehealth project was launched more than a decade ago and almost 85% of public hospitals are delaying in adopting the HIS technology. Hence, this shows a very slow progress among Malaysian public hospitals on the trend of HIS innovation adoption.

2. The problem statement and our contributions

The questions in this study are shaped as: (a) what is the current situation of HIS adoption in Malaysia? (b) what factors significantly influence the organizational adoption of HIS in Malaysia? (c) what is the suitable theoretical model that can be proposed to facilitate the trend of HIS adoption in Malaysia? and (d) What Multi-Criteria Decision-Making (MCDM) model is suitable to weight the factors for HIS adoption in a public hospital?

The contribution of this study is three-fold. First, since the healthcare industry is a very institutionalized environment (Klöcker, Bernnat, & Veit, 2014; Mohr, 1992), it is relatively crucial to examine the effects of institutional pressures on hospital adoption of IT innovation. Nevertheless, to the best of our knowledge as of now, no study has sought the influence of institutional pressures on the process of hospital Information Technology (IT) adoption decision by using or applying the institutional theory. Additionally, several prior studies call for future study to be directed in seeking the effect of external pressures on IT innovation adoption with respect to the hospital organizations (Mohr, 1992; Klöcker et al., 2014; Currie, 2012; Jensen et al., 2009; Lin, 2012; Gagnon, 2004).

Second, according to (Fichman, 2000; Tornatzky & Klein, 1982), there is a paucity of theories specifically for specific types of innovation and for a particular adoption context such as healthcare, due to the lack of a generic theory of technology innovation (Fichman, 2000). This is more emphasized by Grover (Grover, 1993) who advocated the need to delve deeper into more than one innovation characteristic, which will lead to increase the relative predictive power of characteristics in evaluating the organizational adoption process. Hence, the current study makes an attempt to incorporate these statements as were suggested. Furthermore, according to (Fichman, 2000; Oliveira & Martins, 2011), since IT innovations possess two or more of the distinctive characteristics, and since there are theoretical overlaps amongst them, future study can be geared towards combining multiple theoretical streams into a more integrated view of IT innovation. Consequently, the explanatory power can be increased regarding the organizational adoption of IT innovation.

Third, to the best of our knowledge, no study up to now incorporated Diffusion of Innovation (DOI) theory, Technology Organization Environment (TOE) framework, institutional theory along with Human Organization Technology (HOT) fit model in order to provide a useful understanding of organizational factors influencing the HIS initiative adoption.

Thus, with these aims, the study at hand makes an effort to provide a richer insight and also introduce a new direction for future study in fulfilling the above voids regarding both the HIS innovation adoption in Malaysia and organizational IT adoption literature.

3. Literature review

3.1 Definition of HIS

Several definitions have been provided regarding the HIS. According to the National Library of Medicine (NLM) HIS is "the integrated, computer-assisted system designed to keep, manipulate, and retrieve information concerned with the administrative and clinical aspects of providing medical services within the hospital (Nlm, 2011)." According to Ismail et al. (N. I. Ismail et al., 2013), HIS is defined as a computer system by which the whole administrative and medical data of a hospital is managed to make the career of health experts more well-organized and operational. In another definition given by Kim (Kim, Lee, & Kim, 2002), HIS has been defined as "a designer computer system devised to enhance the clinical and

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administrative functions of a hospital." He further added that "HIS is required by the nature of its function to be integrated, and hence is referred as an integrated hospital information processing system." Furthermore, Peng and Kurnia (Peng & Kurnia, 2010) noted that although HIS has been defined variously in various researches, in most cases it refers to an integrated information system designed to manage administration, financial and clinical activities of the hospital. Referring to several definitions of HIS, the present study defines HIS as "a comprehensive, integrated information system designed to enhance all the clinical, financial, and administrative functions of a hospital."

3.2 The Malaysian healthcare context

Malaysia is an example of a developing country that is progressing in its electronic health (e-health) initiative with the healthcare information system being placed under the government's vision of 2020 plan (Mohan & Razali Raja Yaacob, 2004; Sulaiman & Wickramasinghe, 2014). Under the MSC project, the healthcare reform initiative known as Telemedicine Blueprint, has been launched since 1997 to reform the nation's healthcare system (Sulaiman & Wickramasinghe, 2014). Therefore, Malaysia's future focus on healthcare system will be on its citizens and services, whereby the use of technology will act as the main driving force to provide an accessible, integrated, high-quality and affordable healthcare system, recognized as one of the best globally (Mohan & Razali Raja Yaacob, 2004).

In line with Sulaiman's (Sulaiman, 2011) and Wickramasinghe's (Wickramasinghe, 2000) viewpoints, it is important for public hospitals to perform efficiently whilst providing excellent services to the public because revenues from general taxation have been used to subsidize health services (Chee & Barraclough, 2007). Three types of HIS was hence, introduced including THIS, IHIS, and BHIS (Ahmadi et al., 2015a; Ahmadi et al., 2015b; Ahmadi et al., 2015c; Hassan, 2004; N. I. Ismail et al., 2013; H. W. Lee et al., 2012). THIS has more complete set of HIS than IHIS and BHIS. The central objective of having THIS is to provide an integrated care delivery system capable of information sharing, automation of work processes, provide greater efficiency, better storage of data and use of data for relevant medical statistical or research purposes (Abdullah, 2008; Sulaiman & Wickramasinghe, 2014).

THIS project was first launched in Malaysia in late 1999 as a direct result of the Prime Minister's vision for Malaysia becoming a developed country by the year 2020 (Salleh, 2003). Hospital Selayang was the first hospital in the country to integrate THIS in the year 1999 (Dwivedi, 2011; H. W. Lee et al., 2012). The hospital implemented Electronic Medical Record (EMR) to improve their service delivery by focusing on patient, enterprise-wide information and management system in order to maximize the efficiency and utilization of their staff (H. W. Lee et al., 2012; Triantaphyllou, Shu, Sanchez, & Ray, 1998). Furthermore, hospital Putrajaya was the second hospital integrating HIS into the daily operations in the year 2000. In addition, the hospital integrated EMR into their medication administration (H. W. Lee et al., 2012).

3.3 Theoretical foundations

Since HIS is a new technology in Malaysian hospitals and is defined as a computerized hospital information system aimed at providing a paperless environment (2010, 2014), it is fundamentally organizational innovation. Hence the organizational innovation adoption theories can be potentially useful to our proposed new HIS adoption framework.

Therefore in the following, the more elaboration is paid to the organizational innovation adoption. Then, the suitable organizational IT adoption theories for this study will be discussed and justified and then the prior works of HIS innovation adoption with respect to the potential factors based on the respective theories will be determined out. Subsequently, our proposed conceptual research framework explaining organizational decision to adopt HIS will be presented and also demonstrated by reviewing the existing relevant literature.

3.3.1 Organizational innovation adoption

Commonly two main stages (consisting of different sub stages) are distinguished regarding the organizational innovation adoption, which are initiation and implementation. Moreover in between these stages, the adoption decision may be occurred (Damanpour & Daniel Wischnevsky, 2006; Rogers Everett, 1995; Zaltman, Duncan, & Holbek, 1973).

With respect to initiation stage, the organization recognizes a need, becomes aware of an innovation, forms an attitude towards it, and evaluates the innovation (Frambach & Schillewaert, 2002; Shanti Gopalakrishnan & Damanpour, 1997; Rogers Everett, 1995). During the implementation stage, the organization decides to purchase and make use of the innovation (Shanti Gopalakrishnan & Damanpour, 1997; Rogers Everett, 1995). However, it is argued that only at the beginning of implementation, organizational adoption decision takes place (Frambach & Schillewaert, 2002) due to the uncertainty on wide spread usage (Zhu, Kraemer, & Xu, 2006).

As it can be seen from Fig. 1, the adoption decision has been identified as an outcome. Therefore, adoption as an outcome will be obtained. Additionally, this has been mentioned as formal adoption decision or primary innovation-decision in which respective hospital would make the decision to purchase, adopt, and acquire HIS innovation (Fichman, 2000; Gallivan, 2001; Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004). With respect to the healthcare industry in particular the hospital setting as the most dominant in healthcare, a healthcare professionals are the integral players of using the HIS innovation. Nevertheless, their decision to adopt (use of) HIS innovation can be made only after the hospital has made an organizational adoption decision to purchase that

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HIS innovation. Hence, according to the background of this study, we focus on the adoption decision of HIS by Malaysian public hospitals.

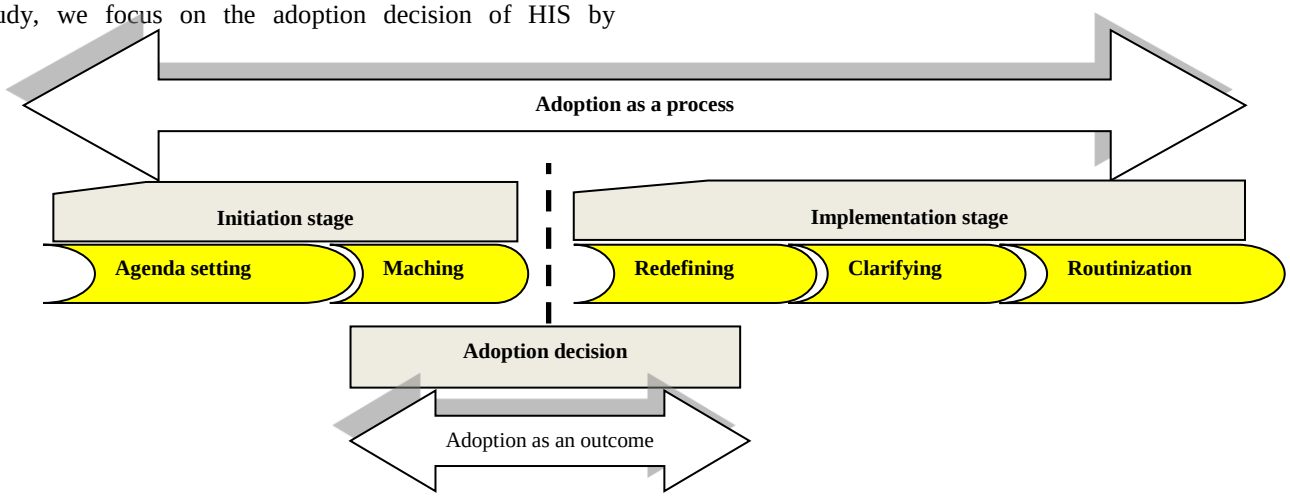

Fig. 1. Stages in the organizational innovation adoption process (Rogers Everett, 1995)

3.3.2 Diffusion of Innovation (DOI)

DOI developed by Rogers Everett (Rogers Everett, 1995) serves as a principle theoretical base for innovation adoption studies in different disciplines such as sociology, communications, marketing, education, and others (Shanthi Gopalakrishnan & Damanpour, 1994; Premkumar & Ramamurthy, 1995; Tornatzky & Klein, 1982). A recent review of IT innovation adoption studies (Jeyaraj, Rottman, & Lacity, 2006) shows that DOI is a dominant theory which has been widely used to examine organizational adoption of IT over the past twenty years. Within the context of DOI, an innovation is specified as a novel idea, practice, or object that is perceived as new by an individual or adoption team (Rogers Everett, 1995). Thus, HIS can be considered an innovation for hospital organizations, if the organization perceives HIS as new. The DOI theory is a theory that postulates how, why, and the speed of new ideas, technology, and process innovation expand in an organization, a society, or a country (E. Rogers, 2003). The DOI theory suggests that individual and organizational characteristics are rational predictors of an organization's innovativeness. In addition, the theory also posits that innovation characteristics, such as relative advantage, complexity, compatibility, observability, and trainability determine the diffusion of technology innovation (Yang, Kankanhalli, Ng, & Lim, 2013). Each characteristic boosts a prospective adopter's confidence in the perceived benefits of innovation adoption. Former studies found that compatibility, relative advantage, and complexity are critical factors of adoption in IS research (Jeyaraj et al., 2006; Tornatzky & Klein, 1982).

One of DOI's major contributions is in the innovation adoption decision process. Hence, innovation adoption is part of the innovation diffusion process (Rogers Everett, 1995).

In summary, DOI primary focuses on the impact of innovation characteristics on potential adopters (organizations and individuals). But less emphasized, DOI asserts that organizational adoption of an innovation can be influenced by leadership characteristics as well as internal and external characteristics of the organization. This is supported by TOE framework developed by Tornatzky and Fleisher (Tornatzky, Fleischer, & Chakrabarti, 1990). The TOE framework is explained in the next section.

3.3.3 Technology-Organization-Environment (TOE) framework

In order to study the adoption of general technological innovations, Tornatzky and Fleischer (Tornatzky et al., 1990) quest to study the adoption of general technological innovations, they developed the TOE framework. The framework identifies an organization's three contextual aspects that directly influence its technological innovations' adoption and implementation, namely external environmental context, technological context, and organizational context. Extant studies have demonstrated that the TOE framework can be highly versatile when applied in different technological, industrial, and national/cultural contexts. The TOE framework provides details on what a firm should consider when studying components that influence adoption of technological innovation.

Technological context comprises the internal and external technologies most applicable to an organization. In other words, current and prospective technologies to be adopted embody the technological context. The main focus is on how technological features can impact the adoption process (Tornatzky et al., 1990). Organizational context describes how an organization's attributes can either facilitate or constrain the adoption of technological innovations. Examples of organizational attributes include firm size, organization structure (centralization, complexity, and formalization), top management support and, the efficiency and incompetency of internal human resources. External environmental context denotes an organization's business operating domain, such as the

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industry it is situated in, its competitors, industrial regulations, access to resources supplied by others within the industry and, governments. External environmental context is the arena in which a firm conducts its business, such as the industry it belongs to, its competitors, regulations, access to resources supplied by others, and governments with which it interacts.

Recent studies on organizational adoption of IT innovation adopt institutional theory to better understand the impact of external pressure on organizational adoption of IT innovation; this is due to the significance of external pressure in organizational adoption of IT innovation (Gibbs & Kraemer, 2004; Jeyaraj, Balser, Chowa, & Griggs, 2004; Khoumbati, Themistocleous, & Irani, 2006; Son & Benbasat, 2007; Teo, Wei, & Benbasat, 2003; Zhu, Kraemer, & Dedrick, 2004). Institutional theory is described in the next section. In addition to external pressures, prior studies found other factors that pertain to the environmental context, including, customer readiness and vendor support.

In overall, the TOE framework is an appropriate and comprehensive theoretical guideline for studying the factors that affect organizational adoption of IT innovation.

3.3.4 Institutional theory

Institutional theory introduced by DiMaggio and Powell (DiMaggio & Powell, 1983) focuses on the extensive and more robust characteristics of the social framework. According to Currie (Currie, 2012), "institutional theory is a multi-level construct spanning the individual, organizational, and the organizational field levels of analysis." It recognizes the process of technological innovation in the organizational field (Deephouse, 1996; Jensen, Kjærgaard, & Svejvig, 2009). DiMaggio and Powell DiMaggio (1983) believe that three external institutional pressures lead firms that reside in the organizational field to increasingly resemble each other, resulting in institutional isomorphism. When organizations face such pressures, they are likely to conform by adopting processes, structures and strategies that others have already adopted (Deephouse, 1996; Jensen et al., 2009). This type of pressures is tolerated by organizations to organizational legitimacy achievable by them; hence it is guaranteed for them their survival for a long period (DiMaggio & Powell, 1983; A. D. Meyer & Goes, 1988). Organizational legitimacy is defined as credibility as well as acceptability in the external environment of an organization (Deephouse, 1996; Scott, 2000). Scott et al. (Scott, 2000) note, "organizations require more than material resources and technical information if they are to survive and thrive in their social environment."

Normative pressures, coercive and mimetic are three mechanisms of institutional isomorphic change. Mimetic pressures are those that cause organizations to imitate or copy the behavior of other organizations in their environment that are perceived to be similar (Porac, Wade, & Pollock, 1999); and are tightly associated by ties, consisting of board interlock, information and resources (Galaskiewicz & Bielefeld, 1998); with great prestige or status (Burns & Wholey, 1993); and with high degree of success (Kraatz, 1998). When this type of organizations adopts a practice, the rest of organizations will have mimetic pressures to be in the same condition too. This phenomenon can be defined as the bandwagon effect (Abrahamson & Rosenkopf, 1993). Another reason for having high degrees of mimetic pressures to imitate the practice by an organization is that the organization finds out a practice adopted by other organizations very successful or advantageous (Haveman, 1993).

Furthermore, mimetic pressures are exerted on potential adaptors when innovations that they consider adopting are uncertain and ambiguous (DiMaggio & Powell, 1983). Through imitating the behavior of other organizations, an organization both expects to be able to decrease the costs of experimentation and research to (reach) the lowest amount and gain organizational legitimacy, and; moreover first-mover risks will not threat such an organization (Cyert & March, 1963; Levitt & March, 1988; Lieberman & Montgomery, 1988). It has to be noted that competitors are main institutions, which would exert the pressure on the potential adopter (Klöcker et al., 2014).

DiMaggio and Powell (1983) introduced the second pressure named coercive pressure. This form of pressure can be imposed on organizations through the firms that those organizations closely rely on, as well as the society's cultural assumptions. Coercive pressure can be imposed by organization's stakeholders to fulfill their expectations or demands. Customers and suppliers are two groups of such stakeholders. Another big group are agencies that have been formally founded like trade associations, governments and those groups who are authorized to control firms by their regulatory power (Currie & Guah, 2007; DiMaggio & Powell, 1983; Klöcker et al., 2014; Srinivasan, Lilien, & Rangaswamy, 2002). Stakeholders can directly exert coercive pressure in different forms such as force, threats, persuasion, and invitation to adopt a certain innovation (Khalifa & Davison, 2006; Sahay, Monteiro, & Aanestad, 2009; Son & Benbasat, 2007). On the other hand, they can indirectly exert coercive pressures to adopt innovations as well (Son & Benbasat, 2007; Teo et al., 2003). In the context of healthcare, example of coercive pressure are government pressures, which enforce strict regulatory and legal requirements on health-care organizations, requiring them to conform to contemporary standards (Currie, 2012).

Normative pressure is the final institutional pressure. According to the Institutional theory, normative pressure is imposed on organizations to adopt new business practices while experiencing different types of entrepreneurial norms and values, including educational organizations, media, business partners, and professional, as well as trade organizations (Chiravuri & Ambrose, 2002; DiMaggio & Powell, 1983; Spell & Blum, 2005). Generally, organizations comply with normative pressures by employing business practices because they typically recognize adoption as most relevant (Scott, 1998).

According to the Currie (2012), Jensen et al. (2009), and Klöcker et al. (2014), the institutional pressures are

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contributed into the IS field as a lens of isomorphism and change specifically within the highly institutionalized organizational field of healthcare. Institutional theory has been long discussed regarding the big impact of different institutional stakeholders on the behavior of organizations or individuals to adopt the technological innovations (Currie, 2012; Currie & Guah, 2007; Gibbs & Kraemer, 2004; Klöcker et al., 2014; Mekonnen & Sahay, 2008; Miscione, 2007; Mohr, 1992; Sahay et al., 2009; Teo et al., 2003). Moreover, according to Klöcker et al. (Klöcker et al., 2014), the studies conducted before indicated that institutional pressure, especially in healthcare sector, have caused IS programs in to form in large-scale. Since these programs are complicated and multiple stakeholders are engaged in them, they are mostly expensive and lengthy. Furthermore, literature on health information system to date implies the theory which aims to explain the decision about IS innovation specifically in hospital context needs to consider multiple stakeholders within the related healthcare organizations which exert various institutional pressures. These stakeholders, amongst other institutions such as the government, patient, lead associations of both payors and providers or the medical technology industry exert institutional pressures. Up to date, some previous studies has explored and explained the role of institutional pressures in shaping individuals' opinion or behavior (physicians or doctors) on the new technology health information system (Currie, 2012; Jensen et al., 2009; Klöcker et al., 2014; Sahay et al., 2009). In addition, it is believed that institutional approach towards the research conducted on organizations resulted in very important point of concepts about how significant the institutional environments are to organizational structure and actions (Currie, 2012; Dwivedi, 2011; Mohr, 1992; Teo et al., 2003).

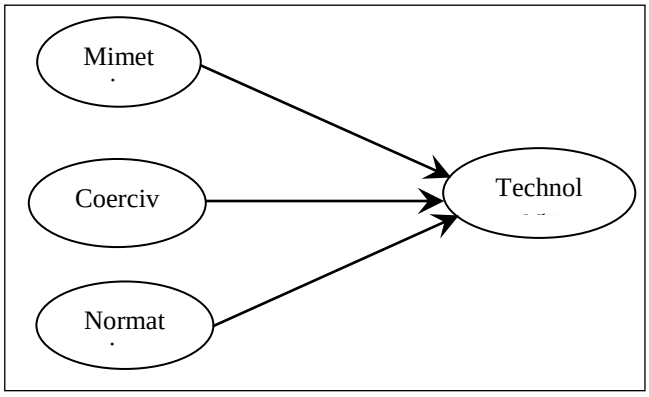

Fig. 2: Theoretical model of IS innovation based on institutional perspective (DiMaggio & Powell, 1983; Teo et al., 2003)

Therefore, the decision taken in the adoption of health information system in healthcare organizations, including hospitals have a complex nature and involve multiple stakeholders. Additionally, rather than being dependent solely on the characteristics of the technology, environmental influences emanate from institutional pressures play a crucial role in how organizations and individuals adopt and migrate to IS innovations with respect to the hospital setting (Currie, 2012; Gibbs & Kraemer, 2004; Jensen et al., 2009; Jeyaraj et al., 2004; Klöcker et al., 2014; Miscione, 2007; Mohr, 1992; Son & Benbasat, 2007; Teo et al., 2003). Therefore, in the complex nature of hospital organizations involving multiple stakeholders benefit from being informed by institutional perspective, institutional theory offers a highly suitable analytical framework for health information system adoption in healthcare industry including hospital organizations (Currie, 2012; Jensen et al., 2009). The theoretical model based on institutional perspective has been shown in Fig. 2.

Table 1 provides brief descriptions of prior studies which used institutional theory for adoption of innovation in the IS field in different level of analysis. In other words, each study according to its environmental context examined the effects of those institutional pressures on IS innovation adoption. As can be seen in Table 1, column one shows a set of previous research which examine the impact of institutional pressures on adoption of IS innovation. Column two displays types of IS innovation which have been studied. Third column presents the methodology and fourth column reveals the level of analysis that has been utilized in the research, respectively. The fifth column depicted what kinds of institutional pressures that were examined in previous available research. Finally, column six shows the institutions from which these pressures arise. As Table 1 displays, mimetic pressures with respect to all types of innovation seem to primarily arise from competitors or organizations of similar size. Coercive pressures with respect to healthcare information system innovation seem to primarily arise from government. Nevertheless, in non-healthcare information system innovation, coercive pressures have been arisen from customers and suppliers. At the end, it can be concluded that although professionals are the major source of normative pressure, with respect to the non-healthcare information system innovations customers and suppliers impose such pressure too.

3.3.5 Human-Organization-Technology (HOT) fit model

There are numbers of studies about the evaluation of Health Information Technology (HIT) adoption that point to the lack of fit between the context of technology, human and organization (Davis, 1993; Goodhue, Klein, & March, 2000; Marques, Oliveira, Dias, & Martins, 2011; Tsiknakis & Kouroubali, 2009). Recently, (Yusof, Kuljis, Papazafeiropoulou, & Stergioulas, 2008; Yusof, Papazafeiropoulou, Paul, & Stergioulas, 2008) conducted a rigorous evaluation of health information system to identify the important dimensions which can intensively affect the system adoption. Their assessment was performed based findings of the extant health information system and IS evaluation studies to finally develop a new framework incorporating the human, organization and technology dimensions.

There is a great overlap in this model with the TOE framework, except that it does not take into account the

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environmental context. On the other hand, the TOE framework does not have an explicit category "Human".

This proposed framework associated with a set of comprehensive dimensions and measurement of the health information system. They suggest that the more fit between technology, human, and organization, the more potential of the health information system can be realized.

Yusof et al. (Yusof, Kuljis, et al., 2008), provided a comprehensive, specific evaluation factors, dimensions and measures (HOT-fit model) which were applicable in evaluating the health information system. The use of such a framework is argued to be useful not only for comprehensive evaluation of the Fundus Imaging System (FIS) in healthcare environment (Yusof, Kuljis, et al., 2008), but potentially also for other general health information Systems (Yusof, Kuljis, et al., 2008; Yusof, Papazafeiropoulou, et al., 2008). According to Ahmadi et al. (Ahmadi et al., 2015a), the HOT-fit model is mainly focused on the adoption of healthcare information systems within the context of a hospital.

Hence, according to aforementioned discussion, HOT-fit model is deemed as a suitable model to be taken into consideration in this study.

Table 1

Research using institutional theory in IS domains with respect to healthcare

Author(s)	IS Innovation	Methodology	Level of Analysis	Types of Institutional Pressures	Institutions from which Pressures Arise
Son and Benbasat (Son & Benbasat, 2007)	B2B electronic marketplaces	Quantitative	Organization	Coercive*	Suppliers
				Normative*	Suppliers, professional and trade associations
				Mimetic*	Competitors
Khalifa and Davison (Khalifa & Davison, 2006)	IT	Quantitative	Organization	Coercive*	Customers
				Normative*	Employees
				Mimetic*	Competitors
Gibbs and Kraemer (Gibbs & Kraemer, 2004)	E-commerce	Quantitative	Organization	Coercive*	Customers, government
				Mimetic*	Competitors
Teo et al. (Teo et al., 2003)	Financial Electronic Data Interchange (FEDI)	Quantitative	Organization	Coercive*	parent corporation, customers and suppliers
				Normative*	Customers and suppliers, professional and trade associations, business bodies
				Mimetic*	Competitors
Tan and Fichman (S. Tan & Fichman, 2002)	Web-based transactional banking	Quantitative	Organization	Mimetic*	Organizations of similar size or Location
Silva and Figueroa (Silva & Figueroa, 2002)	ICTs	Quantitative	Organization	Normative*	Government
Currie (2012)	EHR system	Longitudinal	Organization-Individual	Coercive	Government
				Normative	Professionals
				Mimetic	Competitors
Klöcker et al. (2014)	E-health	Quantitative	Individual	Coercive*	Government regulation
				Normative	Medical technology providers
				Mimetic	Competitors
Currie and Guah (2007)	Health IT	Qualitative	Individual	Coercive	Governance agencies
				Normative	Professional groups
Jensen et al. (2009)	EPR system	Qualitative	Organization	Coercive	Government
				Mimetic	Competitors
Liang et al. (2007)	Enterprise Resource Planning (ERP) system	Quantitative	Individual	Coercive*	Regulations and government agencies
				Normative	Government agencies
				Mimetic*	Competitors

*institutional pressures that were statistically significant with respect to empirical studies

3.3.6 Factors related to HIS adoption based on selected theories

Table 2 presents the summary of studies of HIS adoption in healthcare. In this table, asterisks denote factors that were found statistically significant predictors of HIS adoption.

This table shows the prior empirical studies pertaining to HIS context that used DOI theory, TOE framework, institutional theory along with HOT-fit model to assess the

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effects of factors in those theoretical contexts on HIS adoption in the hospital setting. Thus, upon theoretically examining the empirical studies of HIS innovation in different study of adoption in the context of both Malaysia and other countries, it is believed that four dimensions including technology, organization, environment and human are potentially well suited and can be addressed for HIS adoption.

4. Our conceptual research framework

Based on theoretical foundation that in the last section was discussed, the conceptual research framework for this study is proposed which is shown in Fig. 3. As it can be seen, the model posits predictors for HIS within hospital's context that influence its adoption: technology, organization, environment and human. Factors that pertain to each context are identified based on DOI theory, TOE framework, institutional theory along with HOT-fit model with an attempt on reflection to the prior HIS adoption studies. The next section articulates and justifies the identified potential factors through detail pertaining to the TOEH context.

4.1. Decision to adopt HIS

The research framework proposes the decision to adopt HIS as a dependent variable. According to the meta analysis conducted by Jeyaraj (Jeyaraj et al., 2006), adoption decision has been used extensively in organizational adoption literature. The author has defined adoption decision as "whether an organization "hospital" is an adopter or a non-adopter of an innovation".

4.2. Independent variables

As has been presented in research model, independent variables are categorized in four contexts of TOEH: 1) Human 2) Technology 3) Organization and 4) Environment. As was mentioned earlier, variables associated with each context was identified based on reviewing of DOI theory, TOE framework, institutional theory along with HOT-fit model with respect to findings from prior HIS studies that have deployed those theories in their adoption context. The justification of the four contexts and corresponding variables in line with HIS innovation adoption studies have been presented in the following section.

4.2.1 Technological context

Technological context (Rogers Everett, 1995) describes innovation characteristics that have been used by various studies of prior IT innovation affecting the organizational adoption (Jeyaraj et al., 2006). Four innovation characteristics have been identified in the context of HIS adoption including relative advantage, compatibility, complexity, and data security. As discussed earlier, DOI suggests five variables regarding the innovation features that are composed of relative advantage, compatibility, complexity, observability, and trialability. Nevertheless, in an attempt to review the studies of HIS innovation adoption (see Table 2), this study specifically identifies three significant variables, namely relative advantage, compatibility, and complexity which frequently motivate the organization's decision to adopt HIS. Hence, based on Rogers' (Rogers Everett, 1995) suggestion, with the innovation characteristics and considering the prior HIS adoption studies, three characteristics for HIS were considered. In addition to the innovation characteristics, this study also adds another variable, which is data security. In prior HIS studies, various researchers had found that data security is a significant barrier that inhibits organizations from the adoption of HIS (Chang, Hwang, Hung, Lin, & Yen, 2007; Lian, Yen, & Wang, 2014; Lin, Lin, Roan, & Yeh, 2012; Luxton, Kayl, & Mishkind, 2012; Soliman & Janz, 2004).

4.2.1.1 Relative advantage of HIS

Relative advantage considers the useful perceptional level of an innovation as compared to its predecessor (Rogers Everett, 1995). Study conducted by Ahmadi et al. (Ahmadi et al., 2015a) emphasized that HIS technology act as an incentive for Malaysian public hospitals that can reduce the hospital operating cost and boost the care quality. This would encourage the decision makers to perceive HIS as a useful strategy to adopt (Ahmadi et al., 2015a).

Furthermore, Lin et al. (Lin et al., 2012) in his study of HIS, emphasized that Health Level Seven (HL7) would simplify the communication platforms which allow versatility among the diversified healthcare operations. According to Chang et al. (Chang, Hwang, Yen, & Lian, 2006), operating costs nowadays have become a big concern due to increasing competition among hospitals. Relative advantage pertains to conducting a check in ensuring that HIS adoption can lower hospitals' operating costs and consequently, obtain any corresponding hospital's operational benefits. DOI theory claims that an innovation's relative advantage will effectively lead to an organization's readiness in innovation adoption. The study of Premkumar and Roberts (Premkumar & Roberts, 1999) indicated that, relative advantages will drive and impact businesses in the adoption of new information technologies. Therefore, positive perceptions of IS benefits should provide an incentive as a useful business strategy to adopt the innovation (Thong, 1999). Chang et al. (Chang et al., 2006) found that HIS improves the quality of patient-care and also, increases hospital staff's productivity. Furthermore, study conducted by Hsiao et al. (Hsiao, Li, Chen, & Ko, 2009) on the Mobile Nursing Information Systems (MNIS) for nursing environment asserted that when medical record and information are promptly distributed, decision-making support can be inspired and hence, healthcare quality can be improved (Hsiao et al., 2009).

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Thus, in the study of both IT innovation and prior work associated with HIS adoption, it indicated the power of relative advantage that positively driving the decision of the organization to adopt the new technology.

4.2.1.2 Compatibility of HIS

DOI theory defines compatibility as how well an innovation is well-suited to prospective adopters' values, experience, and needs (Rogers Everett, 1995). According to Thong (Thong, 1999), compatibility is vital in an organization's commitment to adopt IT innovation. A high level of compatibility signifies an organization's ability to make nominal adjustments and progressive modifications. As a result, innovation adoption can be more receptive. In our review of HIS adoption (see Table 2), compatibility is acknowledged as the critical factor that directly impacts an organization's adoption of HIS innovative technology. Advent of today's evolutionary technologies has led to the vast design of more complex systems, such as more affordable technological software and hardware, highly dependable networking system, and standards (Tachinardi, Gutierrez, Moura, & Melo, 1993). Picture Archiving and Communication System (PACS), Radiology Information Systems (RIS), Clinical Information System (CIS), Laboratory Information System (LIS), Nursing Information System (NIS) and Pharmacy Information System (PIS) are several models of HIS sub-systems that are gradually being integrated into more comprehensive systems (N. I. Ismail et al., 2013; Tachinardi et al., 1993). In a study conducted by Lin et al. (Lin et al., 2012) on the adoption of HL7 innovation, a discord in hardware, software, applications and networks was noted in the HL7's implementation with its current IT frameworks. Hence, the integration of HL7 into the current practice was complex for the organizations' IS personnel. IS personnel's past experience is considered highly important in adopting the HIS and also for evaluating IT as an investment. Hence, it seems that compatibility is the crucial factor in the context of technology that affects its decision adoption.

4.2.1.3 Complexity of HIS

According to (E. Rogers, 1983; Tornatzky & Klein, 1982), complexity is the extent to which an innovation is perceived as relatively difficult to understand and use. An innovation could be considered as complex by some firms who lack associated knowledge and skill, nevertheless not complex by some firms who have the necessary knowledge and skill.

Public healthcare sector specially the hospitals has complex system and has more complex workflows than other healthcare providers (N. I. Ismail et al., 2013). The modern medical environment is now experiencing major transformation in its IT base with increasing in technological complexity and handling more patients with fewer resources, and resulting in higher demands on medical practitioners (Hajdukiewicz, Vicente, Doyle, Milgram, & Burns, 2001).

In many of IT innovations within prior studies, it was asserted that the perceived complexity of an innovation leads to resistance due to lack of skills and knowledge and also has been a key consideration in adopting decision process (Ahmadi et al., 2015a; Beatty, Shim, & Jones, 2001; Grover, 1993; Thong, 1999). Moreover, as depicted by Table 2, previous HIS adoption researches determined the negative effect of complexity on the adopting unit to use the HIS.

4.2.1.4. HIS security concern

Data security is one of the major concerns in adopting Information and Communication Technology (ICT) in the healthcare industry (Ting, Kwok, Tsang, & Lee, 2011; Tyrrell, 2002). According to Lin et al. (Lin et al., 2012), "medical behavior or process is closely related to a patient's personal life and safety, privacy, the healthcare provider should pay special attention to information security and accuracy, striving to rule out any possible errors."

Considering the IT innovation adoption, the reliability of network and information security are key factors (Ratnasingham, 1997; Soliman & Janz, 2004). Study conducted by Khoumbati (Khoumbati et al., 2006), has examined the factors influencing Enterprise Application Integration (EAI) in the context of healthcare. They note that security and confidentially are the issues that require immediate consideration.

Moreover, according to the case study conducted by the Sulaiman (Sulaiman, 2011) in the public hospitals of Malaysia, the level of security concern was high in HIS due to the fear of breach of patient's privacy. Luxton et al. (Luxton et al., 2012) highlighted that security problems are the most important issues in the context of a distribute environment; this is particularly true for hospitals because healthcare data requires a more secure environment for storage and retrieval. Hence, concern about security has been proved in prior studies as a big obstacle on the decision to organizational adoption of HIS (Chen, Jan, & Chen, 2005; Khoumbati et al., 2006; Lian et al., 2014; Ting et al., 2011).

4.2.2. Organizational context

Characteristics of an organization would affect the technological innovation of an organization (Tornatzky et al., 1990). According to the TOE framework, three contexts affecting the adoption of technological innovation with regard to organizational context (Tornatzky et al., 1990). Based on an attempt reviewing the HIS innovation adoption, three characteristics recognized as the most frequently important features of organizational context that positively influence the HIS adoption decision process (see Table 2). These features are presence of champions, IS infrastructure, and top management support.

4.2.2.1. Presence of champions

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A champion is defined as a person in the management level who is aware of the usefulness of an idea to the organization and drives the attention of authorities to lead resources for innovation throughout its development and implementation (M. Meyer, 2000). This factor has been more emphasized by Lee and Shim (C.-P. Lee & Shim, 2007) that studied the Radio Frequency Identification (RFID) innovation in the hospital setting. They stated that the characteristic of management who ultimately make the adoption decision is more important than any other factor in the adoption process. They found that presence of champions is the critical factor affecting the adoption of RFID.

In other hand, in prior IT innovation studies, it was consistently found that the presence of champion facilitated the adoption of a new technology by providing the necessary motivation and effort to initiate the adoption (Beath, 1991; M. Tan & Teo, 1998; Teo et al., 2003; Zmud, 1984). Hence, the existence of a champion has been found to be a significant factor in the successful adoption and implementation of IS.

According to Sulaiman (Sulaiman, 2011), in a public hospital context, the person who has more power is able to have control over the adoption and implementation of the HIS. She further stated that, it can be argued the champions who are a chief surgeon and the IT coordinator, are an integral player in the success of HIS adoption and implementation (Sulaiman, 2011).

4.2.2.2 IS infrastructure

IS infrastructure describes a firm's ubiquitous state-of-the-art telecommunication and database resources (Grover, 1993). The innovation in IT adoption as tabulated in Table 2 demonstrates that IS infrastructure was found to be the most significant factor which frequently affects the adoption decision process. Literature on IT innovation strongly proposes that a firm's technological capabilities determine its ultimate adoption of innovation (Hong & Zhu, 2006; Huang, Ou, Chen, & Lin, 2006; S. Lee & Kim, 2007; Maidique & Zirger, 1984; E. M. Rogers & Shoemaker, 1971).

IS infrastructure is made up of various tangible resources which includes, infrastructure components such as hardware and software. According to Ross et al. (Ross, Beath, & Goodhue, 1996), a shareable platform and technology is highly essential for integrating systems in organizations with IS infrastructure in order to make IS applications more cost-effective especially in the areas of operations and support. Furthermore, the increasing use of sophisticated IS infrastructure can lead to enormous advantage in clinical workflow (Bardach, Huang, Brand, & Hsu, 2009).

Public hospitals in developing countries often face infrastructural issues. According to Zhu et al. (Zhu et al., 2006), within the technological context of the firm, developing countries have less developed IS infrastructure. For instance, hospitals in Pakistan are facing the barrier of IT infrastructure in obtaining suitable software and hardware (Malik & Khan, 2009). Ismail et al. (N. I. Ismail et al., 2013) conducted a survey within some public hospitals in Malaysia to identify critical factors and barriers in adopting and implementing HIS. They found that infrastructure is one of the most critical issues in the country that need to be addressed. Additionally, Sulaiman (Sulaiman, 2011) determined that the infrastructure issue is a must that need to be enhanced in Malaysian healthcare system for successful HIS adoption.

4.2.2.3 Top management support

Top manager's support refers to whether or not the top managers understand the nature and functions of HIS innovation and therefore fully support the development of it (Lian et al., 2014). According to recent review of IT adoption literature by Jeyaraj (Jeyaraj et al., 2006), top management support has been one of the three best predictors of organizational IT innovation adoption. Furthermore, by reviewing the HIS adoption studies (see Table 2), top management support was found as one of the most frequently factor that has a positive effect to change the attitude of the organizations toward adopting the IT innovation.

In Taiwan, top management support was determined to be crucial for the introduction of PACS (Chang et al., 2006). The authors emphasized, top management support critically affects the decision for the PACS adoption. Further, in study of vital sign monitoring system, Yang and Lim (Yang et al., 2013) stated on the importance of top management in providing the adequate resources (financial and other sources) for the adoption of HIS. According to Thong and Yap (Thong & Yap, 1995), cited by (Hsiao et al., 2009; Y.-C. Li, Chang, Hung, & Fu, 2005), top managers' attitude would influence positively the adoption of an innovation technology, especially when they had certain IT-related knowledge or experiences and understood advantages and disadvantages of IT.

4.2.2.4 Hospital size

The hospital size effect has been asserted in the prior studies of organizational innovation adoption (Romeo, 1975; Zhu et al., 2006).

Ahmadi et al. (Ahmadi et al., 2015a) found that large and tertiary hospitals obtain more resources to change the business strategy, which lead to have more tendency in adopting the HIS more than smaller hospitals. Besides, Chang et al. (Chang et al., 2007) note that larger hospitals have more propensity to adopt e-signature more than smaller hospitals do. Hence, hospital size contributed a significant influence on decision to adopt innovative technology (Chang et al., 2007; Thong, 1999).

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4.2.2.5 Financial resources

Financial readiness refers to the financial resources available to pay for installation costs, implementation of any subsequent enhancements, and ongoing expenses during usage (Iacovou, Benbasat, & Dexter, 1995). Financial readiness is found to influence IT innovation adoption (Greenhalgh et al., 2004; Iacovou et al., 1995; Rogers Everett, 1995) Financial processes has been identified as one of the most salient characteristics of having HIS innovation in a hospital setting (Chong & Chan, 2012; Paré, Sicotte, & Jacques, 2006). Moreover, financial readiness has been a popular antecedent to IS diffusion (Iacovou et al., 1995; Zhu & Kraemer, 2005).

Furthermore, according to various researchers, sustainable funding (including funding plans) available for implementing and continuing (after pilot stage) an innovation is one of the strongest predictors for successful adoption and implementation (Aron, Dutta, Janakiraman, & Pathak, 2011; Chang et al., 2007; Jensen et al., 2009; Mekonnen & Sahay, 2008). According to the study conducted by Sulaiman (Sulaiman, 2011) within public hospitals in Malaysia, it was found that financial issues can be seen as one of the main causes of why the diffusion of HIS is slow and in many ways unsuccessful. Furthermore, the author emphasized that "in Malaysian public hospitals it is quite unacceptable when money or budget constraints have always been the reason to deny people's requests to try and improve and expand the functionality of the HIS; money should not have been an issue since the government's funding is based mainly on tax revenue.

4.2.3 Environmental context

According to Tornatzky and Fleischer (Tornatzky et al., 1990), factors that pertain to environmental context influence organizational adoption of technological innovation. By reviewing the organizational adoption of HIS studies, two dispositions in organizations external environment were found that consisting of the pressures from the organization's external environment (competitors, and government policy) and also support from the external environment (vendors) which are significant factors that affect adoption of HIS.

Recently a few prior IT studies use institutional theory to better understand the effects of external environmental pressures on organizational adoption of IT (see Table 1). These studies found that organizational adoption of IT can be influenced by three different types of external environmental pressures: coercive pressure, mimetic pressure and normative pressure (DiMaggio & Powell, 1983). According to Gagnon (Gagnon et al., 2004), among the theoretical models that have been used to investigate the characteristics influencing technology adoption by organizations, institutional theory (DiMaggio & Powell, 1983) proposes relevant concepts to analyze the relationship between hospitals' organizational structures and the process of Telehealth integration. In addition to that, Prasad and Prasad (Prasad & Prasad, 1994) underlined the predominant influence of the ideology of professionalism on the adoption of ISs by healthcare professionals. According to these authors, technology adoption in healthcare organizations is not only influenced by instrumental considerations such as efficiency, performance, and profitability. They have adopted an institutional theory perspective (DiMaggio & Powell, 1983), that has allowed for considering non-instrumental factors, such as symbolic, cultural and political aspects involved in the processes of work computerization in hospitals. Subsequently, (Gagnon et al., 2004; Lin et al., 2012) indicated the importance of institutional theory to improve the understanding of the HIS adoption. Therefore, it seems pretty crucial that external environmental pressures suggested by institutional theory (DiMaggio & Powell, 1983) can have a potential effects on HIS adoption decision within hospital setting. It should be noted that in prior studies (see Table 2), organizational HIS adoption refers to the two pressures outside the organization, consists of mimetic pressure by competitors and coercive pressure by government as the most frequently external pressures. Nevertheless, the normative pressure was not considered important since there was no any important relevancy or connection between normative pressure and those prior studies of HIS adoption.

In addition to environmental context, the review of organizational HIS adoption that has been conducted (see Table 2), found that vendor support frequently to be a significant driver and motivation for organizational adoption of HIS.

4.2.3.1 Mimetic pressure-competitors

Institutional theory proposes that mimetic pressures thrust organizations to imitate other organizations within the same industry (DiMaggio & Powell, 1983).

According to Haveman (Haveman, 1993), an organization faces mimetic pressures in two ways. First, an increase in other organizations within the same industry that have deployed similar action can directly cause mimetic pressures on a particular organization. In addition, mimetic pressures can also arise when an organization is inferior to the actions of other organizations within the same industry. Under this pressure, an affected organization will often follow suit as a strategy to demonstrate its competence to its stakeholders or competitors. This is because by following suit, it alleviates the doubt of an action. Therefore, the management of an organization believes in imitation as an approach to stay abreast with competition in the industry.

According to the institutional theory, an organization will emulate other similar organizations in their operational decisions to act. This is due to the other organizations sharing a common economic network in the industry, in terms of their respective goals, products, and challenges.

With respect to institutional theory, prior IT adoption studies find that mimetic pressures from competitors have a positive influence on an organization's decision to adopt IT. For example, Teo et al. (Teo et al., 2003) find that an

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organization's intent to adopt Financial Electronic Data Interchange (FEDI) is positively influenced by mimetic pressures from competitors. In that study, mimetic pressures are measured with extent of adoption among competitors and perceived success of competitor adaptors.

Furthermore, although prior studies in the context of HIS do not explicitly use institutional theory, several previous studies indicated that organizational adoption of the HIS is positively influenced by competitive pressures, which are similar to mimetic pressures exerted by competitors (see Table 2). For example, Kimberly and Evanisko (Kimberly & Evanisko, 1981) in study of HIS reported that organizations when see, the other hospitals in the same chain using the HIS in their operations, the hospital feels pressure to adopt HIS innovation.

Thus, according to institutional theory and prior HIS adoption studies, it is highly possible that potential adopters of HIS are subject to mimetic pressure from competitors.

4.2.3.2 Coercive pressure-government.

According to institutional theory, when an organization is dependent on its stakeholders (customers, suppliers and government regulatory bodies), the stakeholders can exert pressures on the organization to adopt new business practices. Such pressures are called coercive pressures (DiMaggio & Powell, 1983).

Yang et al. (Yang et al., 2013) stated that coercive pressures derive from legal mandates or influences that are exerted by structures on which the focal organization is dependent. In the context of organizational IT adoption, coercive pressures from government on an innovative technology promotion would significantly affect an organization's adoption of IT (Gibbs & Kraemer, 2004; Kuan & Chau, 2001; Moon & Bretschneider, 1997). Gibbs and Kraemer (Gibbs & Kraemer, 2004) examined the role of government policy factors included government promotion and legislation barriers on the decision to adopt and use of e-commerce. They stressed the importance role of government policy (promotions) from government. In line with prior studies of organizational HIS adoption, as was reviewed earlier (see Table 2), except few, the rest did not explicitly use the institutional theory. They found the government policy as a driving force or environmental pressure that positively influence the adoption of HIS in hospitals which is similar to coercive pressure related to institutional theory. According to Lee et al. (H. W. Lee et al., 2012), in Malaysia it can be foreseen that increased government pressure to provide major healthcare services to the society in the future will become a more pressing issue. In addition to that, government set related policies that covering different set of rules or promotion program or rewards to encourage HIS adoption which will result in the institutionalized adopted HIS hospitals (Chang et al., 2006; Hill, 2000; Klöcker et al., 2014; Lin et al., 2012).

4.2.3.3. Vendor support

Vendor support is interpreted in terms of external HIS vendors' or suppliers' ability to provide support (adapted from (Liu, 2011)). In the 1990s, there was an increasing number of participants in the vendor community who developed various clinical applications to make healthcare products more widely available and affordable (Friede, Blum, & McDonald, 1995). Vendor support has been discovered as one of the external environmental factors (Yang et al., 2013); by taking the perspective of TOE framework, many HIS innovation studies have been empirically supported in the imperative positive role of vendor support in organizational adoption of HIS (Ahmadi et al., 2015a; Chang et al., 2007; Hsiao et al., 2009; N. I. Ismail et al., 2013; Liu, 2011; Sulaiman & Wickramasinghe, 2014). Sulaiman (Sulaiman & Wickramasinghe, 2014) and Ismail et al. (N. I. Ismail et al., 2013), pointed out the apparent lack of vendor support in the public hospitals in Malaysia.

Chang et al. (Chang et al., 2007) emphasized that vendors dealing with healthcare technology in Taiwan consistently provide comprehensive services to their users. The solution-based services can range from providing accessibility to a tailored training or consultancy to building connections that bridge the new technology with IS users. As a result, hospitals in Taiwan can operate in a simple and manageable system. According to Hasiao et al. (Hsiao et al., 2009) and Liu (Liu, 2011), vendors also can provide various other services such as product installation, training or big-scaled business consultancy. Consistent support from vendors ensures an orderly and coherent adoption of HIS. Apart from vendors' support, Barlow et al. (Barlow, Bayer, & Curry, 2006) found that the successful adoption of Telecare hinges on building a master project proposal and mobilizing a highly qualified working team to implement the innovation proposal.

4.2.3.4 Intensity of Competition

It has long been empirically recognized that great intensity of competition in the adopter's industry can pressure organizations to adopt an innovation (Levin, Levin, & Meisel, 1987; Thong, 1999; Zhu, Kraemer, & Xu, 2003). In highly competitive markets, IT innovation adoption is necessary to maintain and achieve competitive advantage (Gatignon & Robertson, 1989).

The degree of competition is often directly associated with the adoption of new IT in healthcare organizations (Burke, Wang, Wan, & Diana, 2002). Moreover, competition increases the likelihood of innovation adoption (Burke et al., 2002; Hsiao et al., 2009) and adopting IS creates a competitive advantage by giving businesses new ways in which to outperform their rivals (Porter & Millar, 1985). Hence, intensity of competition leads to environmental uncertainty and increases both the need for and the rate of innovation adoption. As a result, business competition can be seen as a motivation for the adoption of HIS (Hsiao et al., 2009). In addition to study of Hsiao et al.

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(Hsiao et al., 2009) and Li et al. (Y.-C. Li et al., 2005), adoption of hospital information system with respect to the mobile nursing technology was highly associated with intensity of business competition.

4.2.4 Human context

According to the HOT-fit model human factor is central to the evaluation of health information system adoption and development (Yusof, Kuljis, et al., 2008; Yusof, Papazafeiropoulou, et al., 2008). Regarding the literature in HIS, most studies overlooked this concept in explaining the role of human context in behavior of hospital setting towards HIS adoption (Lian et al., 2014). According to Ahmadi et al. (Ahmadi et al., 2015a) and Marques et al. (Marques et al., 2011), the factors engaged in the human context need to be considered when adopting and implementing any technology innovation within the context of the hospital industry. Hence, taken from HOT-fit model, this study undertakes the analysis of human component with respect to perceived technical competence, employees' IS knowledge, clinical IT experts and Chief Information Officer (CIO) innovativeness in understanding the decision to adopt HIS in the hospital industry.

4.2.4.1 Perceived technical competence

Perceived technical competence refers to the capability of IS employees (Lian et al., 2014). According to Ross et al. (Ross et al., 1996), a valuable human resource can be distinguished by its IT team that consistently seek solutions to emerging business problems and capitalize on imminent opportunities using innovative technologies. In the context of IT innovation, IS employees' skills have been identified as having vital effect on the organizational adoption of IT innovation (Anand & Kulshreshtha, 2007; Hong & Zhu, 2006; S. Lee & Kim, 2007; Thong, 1999; Zhu et al., 2003).

According to prior studies of HIS, the levels of hospital staffs' technological adeptness directly affect a hospital's ultimate adoption of IT innovations (Ahmadi et al., 2015a; Lin et al., 2012; Liu, 2011). According to Lian et al. (Lian et al., 2014), IS personnel who are well-versed and skillful in adopting new IT will certainly boost confidence throughout the process of the particular hospital due to their critical capacity in adopting new IT implementations (Lian et al., 2014). Furthermore, Lin et al. (Lin et al., 2012) studied the HL7 integrated technology and discovered that a hospital with adequate IS staff and IS capabilities is more likely to adopt the integrated HL7 innovation. It is notable that in accordance to the HOT-fit model, studies are scarce to examine human context specifically the IS staff capabilities as can be seen in our review of HIS adoption (see Table 2).

4.2.4.2 Employees' IS knowledge

People (personnel or human resources) are the most valuable asset of an organization, and the proper management of the human resources has both strategic and legal importance for the organization to achieve substantial performance (Sulaiman, 2011). An organization that adopted an innovative technology successfully and gained benefits from it relied heavily on its staff having sufficient innovation knowledge or technology capability (Lin et al., 2012; E. Rogers, 2003; Thong, 1999). According to Hung et al. (Hung, Hung, Tsai, & Jiang, 2010), 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 of organizations have more knowledge of IS, then they will be more likely to adopt the ISs (Hung et al., 2010). Hence, as Ettlie (Ettlie, 1990) explained, staff must have some knowledge of IT innovation in order to use more innovative IT. Furthermore, Lin et al. (Lin et al., 2012) stated that staff's IS capability is a factor that frequently has been discussed through previous studies.

Sulaiman (Sulaiman, 2011) regarding the public hospitals of Malaysia, found that there are significant issues involving staff using the HIS. These issues are composed of poor medical record documentation, clinicians attitudes towards the HIS, human resource management of the government appointed healthcare staff and the lack of IS/IT exposure to medical staff. They further emphasized that in the HIS project initial stage and awareness, the clinicians' buy in process is critical (Sulaiman, 2011). Sobol et al. (Sobol, Alverson, & Lei, 1999) indicated that staff's IT knowledge and capability critically influenced medical computerized system implementation. In the case of investigating the critical factors for the integrated technology as for HL7 adoption, Lin et al. (Lin et al., 2012) found that staff's IS capabilities would help hospitals more likely to accept the hospital technology.

4.2.4.3 Clinical IT experts

In order to successfully adopt HIS at every stage, there is a need to have more people in the organization possessing both clinical and IS/IT skills (Sulaiman, 2011). In addition to ensuring that the technical support is well delivered, it is important that the people in the IT department have the attributes of strong technical competency and excellent customer service skills.

These attributes as discussed by Wager et al. (Wager et al., 2005), ensure the staff are able to execute their tasks well and demonstrate a sound understanding of the organization's needs, an ability to be good consultants and provide world-class support, and an undertaking to keep up to date with new techniques and technology that may improve the organization's IS/IT effectiveness.

Despite a number of clinical IS/IT issues, there is no doubt that the significant success of the HIS is due to the Hospital's people who possess both clinical and IS/IT knowledge (Sulaiman, 2011).

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4.2.4.4 CIO innovativeness

Kirton (Kirton, 1976) in his theory of innovativeness contends that everyone as located on a continuum ranging from an ability to do things better to an ability to do things differently in which he calls the two extreme ends of the continuum adopters and innovators, respectively.

According to Lian et al. (Lian et al., 2014), in the context of hospital the innovator CIO will play an important role in the adoption decision process. This is due to the fact that the hospital technology can be seen as one type of new IT innovation.

Thong et al. and his colleagues (Thong, 1999; Thong & Yap, 1995) believed that in small business, CIO's qualities are the determinants of the overall management style of the business. Hence, if the CIO can easily accept and conform to an innovative technology he/she will have/exert a positive attitude toward the adoption of that new hospital IT application (Lian et al., 2014).

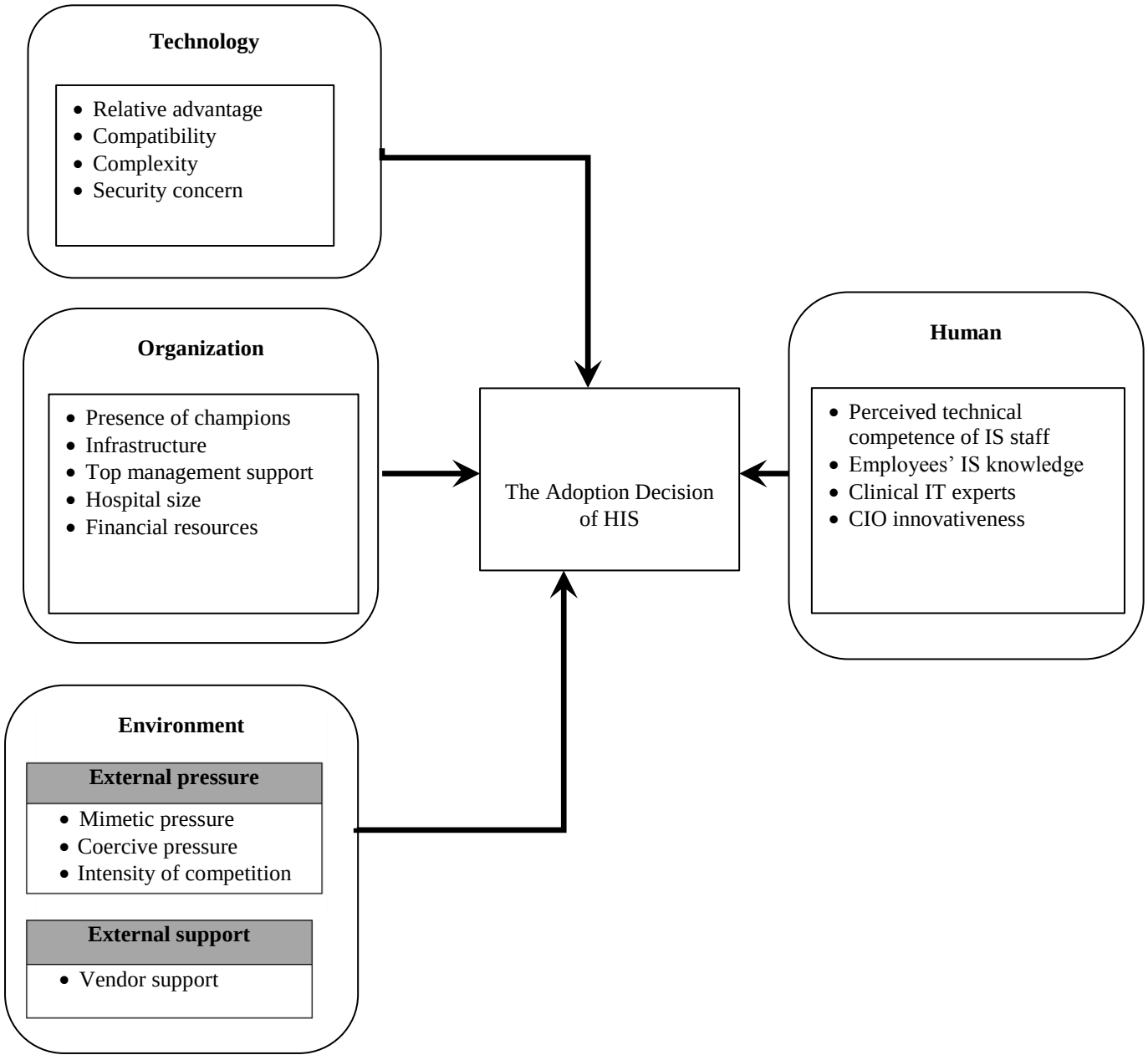

Fig. 3. Conceptual research framework

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Table 2
Summary of reviewed studies of HIS adoption in healthcare

Author	Hospital types of innovation	Theories/Models used	Contexts/Variables																
			Technology				Organization					Environment				Human			
			Relative advantage	Compatibility	Complexity	Data security	Presence of champions	IS infrastructure	Top management support	Hospital size	Financial readiness	External pressure-competitors	External pressure-government	Vendor support	Intensity of competition	Perceived technical competence	Employees' IS knowledge	Clinical IT experts	Chief information officer innovativeness
(Yang et al., 2013)	Vital Signs Monitoring System	DOI+TOE	√*	√*	√*				√*	√	√*			√					
(Hsiao et al., 2009)	MNIS	DOI+TOE		√			√		√			√*	√	√*	√*				
(Lin et al., 2012)	HL7	DOI		√*		√			√*	√*		√*	√*	√			√*	√*	
(Chang et al., 2007)	E-signature	TOE			√	√				√*	√*			√*					
(Hill, 2000)	Hospital Costing Systems	DOI+Institutional theory										√*	√*						
(Chang et al., 2006)	PACS	DOI+TOE	√*	√					√*				√*		√				
(C.-P. Lee & Shim, 2007)	Hospital Radio Frequency Identification	TOE (need pull & technology push)	√*				√*					√*							
(Lian et al., 2014)	Health Cloud Computing	TOE+HOT-fit	√*	√	√*	√*			√*		√*	√	√			√*			√*
(Gagnon et al., 2004)	Telehealth Adoption	Institutional theory										√*							
(Y.-C. Li et al., 2005)	Mobile Nursing Technology	DOI+TOE		√			√		√			√*			√*				
(Hung et al., 2010)	Hospital Customer Relationship Management System	DOI	√*		√			√*		√*							√*		
(Liu, 2011)	Telecare	TOE	√	√					√					√*					
(Marques et al., 2011)	Medical Records System	TOE+HOT-fit								√					√*	√*			
(Vest, 2010)	Health Information Exchange	TOE													√*				
(Klöcker et al., 2014)	E-health	Institutional theory										√	√*						
(Ahmadi et al., 2015a)	HIS	TOE+HOT-fit	√*	√	√			√	√	√*				√	√	√*			
Frequency			7	8	5	3	3	2	8	6	3	8	6	6	6	3	2	1	1

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5. AHP model

Multi-Criteria Decision Making (MCDM) is the most well-known decision making, and it is a branch of Operations Research (OR), which deal with decision problems under a number of decision criteria (Triantaphyllou et al., 1998; Nilashi and Ibrahim, 2014; Nilashi et al., 2012; Esfahani et al., 2015)

MCDM is a normative way of decision-making where there is one decision maker with multiple criteria problem. Its aim is to consider the way the decision maker looks at the multi-criteria problem. In order to do that, a mathematical model must be constructed, since the amount of information in multi-criteria problem is too much for a human to make the whole process. This can be best done by letting decision maker focus on smaller parts of the problem. The way the decision maker looks at the multi-criteria problem is also defined as the decision maker specific data (De Keyser & Springael, 2010).

In order to determine which methods are most appropriate for establishing the model of a decision, we should consider the kind and amount of the available information. An initial study identified the multi-criteria decision technique, known as the Analytic Hierarchy Process (AHP), to be the most appropriate for solving complex decision-making problems (Nilashi et al., 2014; Nilashi et al., 2015; Nilashi et al., 2011a; Nilashi et al., 2011b; Nilashi et al., 2011c; Nilashi et al., 2011d; Nilashi and Janahmadi, 2012; Ahmadi et al., 2014; Nilashi et al., 2011e; Ahmadi et al., 2013; Salahshour et al., 2015; Salahshour et al., 2014). AHP was first introduced by Saaty (Satty, 1980) and used in different decision-making process (Tolga, Demircan, & Kahraman, 2005). The basic assumption of AHP is the condition of functional independence of the upper part, of the hierarchy, from all its lower parts, and from the criteria or items in each level. Many decision-making problems cannot be structured hierarchically because they involve interaction of various factors, with high-level factors occasionally depending on low-level factors (Saaty, 1996). AHP maintains a unidirectional hierarchical relationship among decision level. Among MCDM techniques, AHP can also effectively handle both qualitative and quantitative data and it is easier to understand.

5.1. AHP

AHP is a systematic procedure for dealing with decision-making problems with many alternatives. AHP is based on a hierarchical structuring of decision-making elements using pairwise comparisons. This technique is fairly simple, practical, and can be performed using the steps as showed in Fig. 4.

In AHP, to assign judgment in comparing the pairs of alternatives in each level of the hierarchy, a scale of 1-9 (1- Equally Preferred; 5- Strongly Preferred; 9- Extremely Preferred) is recommended (see Table 3).

In addition, in AHP, to check the model for consistency a consistency index CI is calculated for each matrix comparisons as presented in Eq. (1). To calculate CI, first, multiply the priority vector by the original matrix. Then, compute the row totals of the new matrix and divide each row total in the column by the corresponding entry from the priority vector and average the outcome to acquire the principle eigenvalue.

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (1)$$

where n is the matrix size and λ_{max} is the acquired eigenvalue. If the CI does not exceed 0.10, then the matrix could be deemed consistent.

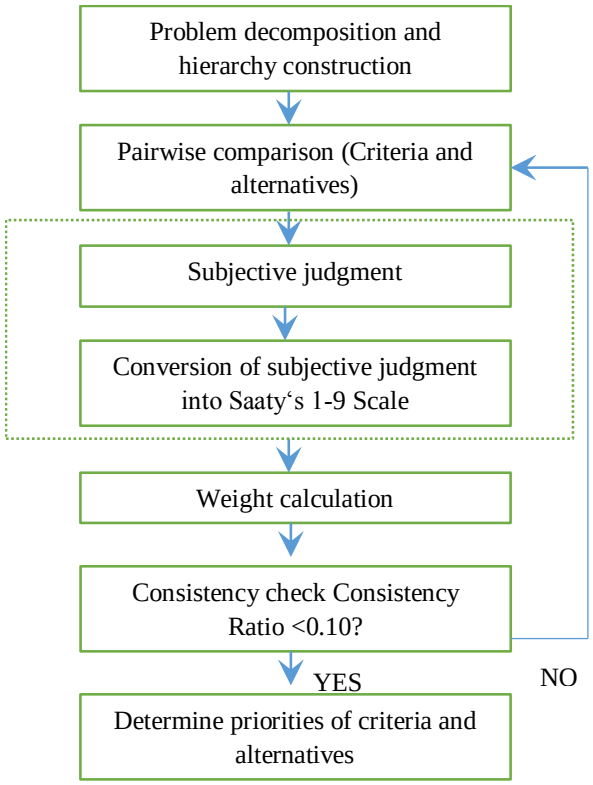

Fig. 4. Steps in the AHP method

We contacted individual experts separately to interview and obtain a completed questionnaire (see Table 4). For each expert, a questionnaire was developed which included comparison matrices along with explanations about components. Suppose that if there are m complete questionnaires (m=20) and n indicators which to be weighted by AHP, the expert could provide pairwise comparison matrix as:

$$A_e = \begin{pmatrix} a^e_{11} & a^e_{12} & \ldots, & a^e_{n} \\ a^e_{21} & a^e_{22} & \ldots, & a^e_{2n} \\ \vdots & \vdots & & \vdots \\ a^e_{n1} & a^e_{n2} & \ldots, & a^e_{nn} \end{pmatrix}$$

where, A_e is the pairwise comparison matrix completed by the expert e (e= 1…m), and a^e_{ij} indicates relative

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importance between indicator *i* (*i*=1,2,…,*n*) and indicator *j* (*j*=1,2,…,*n*) based on the judgment of expert *e* and comparison value $a_{ji}^{e} = \frac{1}{a_{ij}^{e}}$.

The pairwise comparison matrices are developed by the experts by using the scale given in Table 3 which are preference scale for pairwise comparisons recommend by Saaty. As an example, Site design and Transportation were compared under Site selection using the question ‘‘How important is Site design when it is compared with Transportation?” and the given answer by expert was ‘‘Moderately Preferred”, instead of the numerical value. Then we replaced corresponding numerical value of judgment in the relevant cell of comparison matrices (A_e). Following this procedure, the matrix of each expert's judgment was established and weight for each factors and sub-factors was calculated.

In order to calculate the rank of factors and sub-factors in AHP method, after collecting the pair comparison questionnaires, Expert Choice 2000 software was used. To obtain a collective judgment, geometric mean method was used to aggregate individual judgment. The geometric mean method for n element of x1, x2,…, xn is presented in Eq. (2).

$$GM = \sqrt[n]{\prod_{i=1}^{n} X_i} \quad (2)$$

6. Proposed MCDM model

The proposed MCDM model to determine the weights of critical factors incorporated in the conceptual framework is composed of following steps as shown in Fig. 5.

In this study to obtain the results, data was collected by questionnaire from 20 senior executives and clinicians with professional management and decision-making experience in the healthcare industry in particular hospitals. As was indicated by Ahmadi et al. (Ahmadi et al., 2015a), the study that survey the experts, hence the small sample size can be enough for data collection purpose and model validation. Table 3 provides the sample characteristics of the type of respondents for this study.

Step 1. In this step, 4 main factors and 17 sub-factors that have been determined from the literature review, are evaluated by the decision committee (decision makers) by means of a questionnaire. Three values 1, 2 and 3, corresponding to not important, somewhat important and very important, respectively, were used for the evaluation. From the evaluation, the decision makers responses were analyzed and arithmetic mean has been calculated which 16 of the factors in four main groups (with values above 2) were chosen to be used in the MCDM model for pair-wise comparisons. Thus, Presence of champions has been excluded from the MCDM model.

Step 2. In this step, the AHP model was formed by the factors and sub-factors determined in the first step is shown in Fig. 6. The proposed AHP model includes there stages. In the first stage of model, the goal of determining weights of sub-factor is determined. In the second stage of model, the main factors and in the third stage all sub-factors corresponding to main factors are presented.

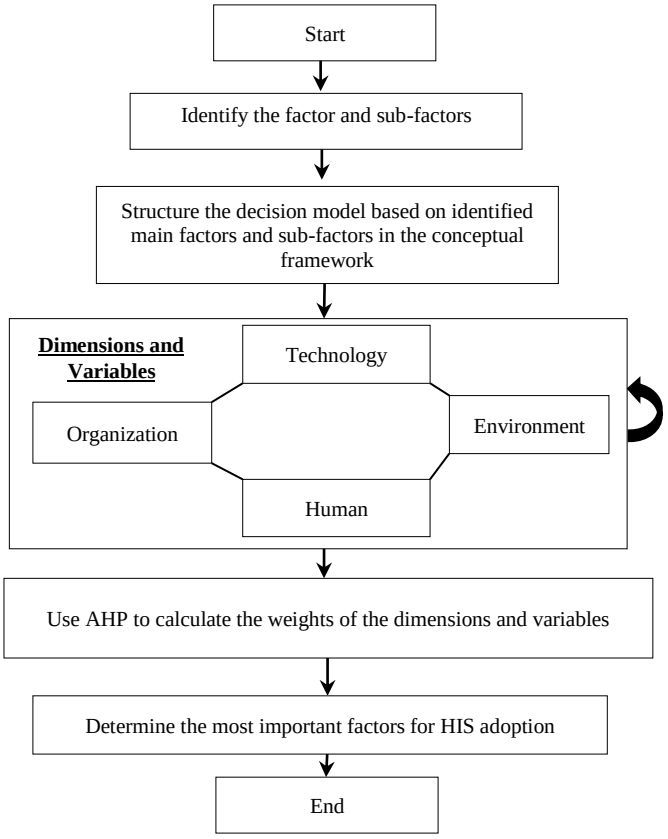

Fig. 5. Research flow for MCDM model.

Step 3. In this step, the sub-factors and factors local weights which take part in the third and second levels of AHP model, presented in Fig. 6, are calculated. Pairwise comparison matrices are developed by the decision committee by using the scale given in Table 3. As an example, Technology and Human Factors are compared using the question ‘‘How important is Technology Factors when it is compared with Human Factors?” and the given answer by expert is ‘‘Very Strongly Preferred”. Using this procedure, the evaluation matrices for each expert are produced. Then, AHP method is used to analyze the pairwise comparison matrices and determine local weights. For main factors, the local weights are calculated as presented in Table 5 and for sub-factors the Pairwise comparison matrices together with the local weights are given in Tables 6–9.

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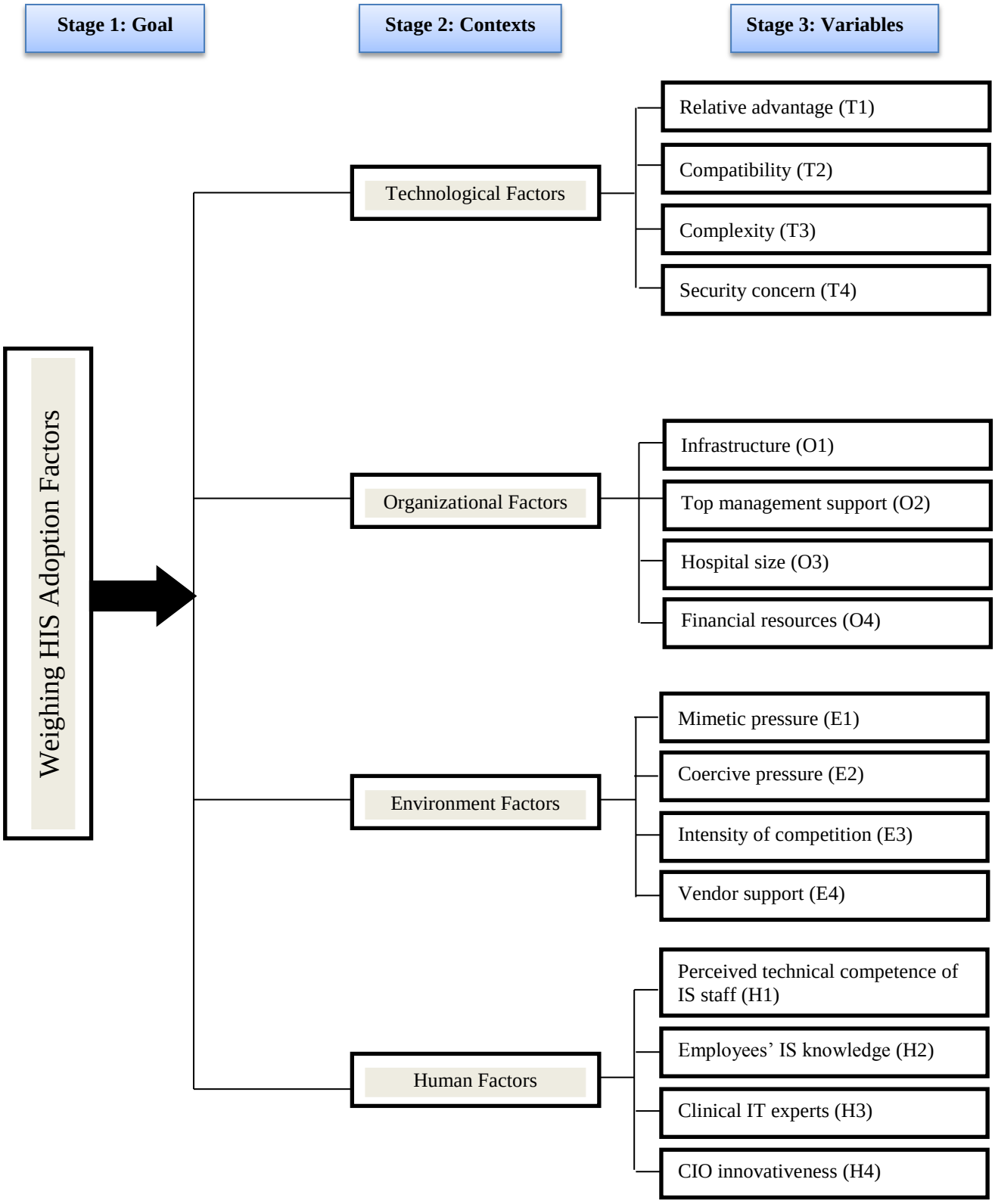

Fig. 6. AHP model to determine important factor for HIS adoption

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Step 4: In this step, global weights for the sub-factors are calculated using local weights of factors and sub-factors calculated in Step 3. By multiplying the local weights of the sub-factor with the corresponding interdependent weight of the factor, global sub-factor weights are calculated which the obtained values are presented in Table 10. According to the global sub-factor weights presented in Table 10, it can be seen that the eight most important sub-factors for the HIS adoption are "Hospital size", "Financial resources", "Coercive pressure", "Vendor support", ''Security concern", ''Mimetic pressure", ''Complexity" and "Compatibility".

Table 3

Preference Scale for Pairwise Comparisons

Linguistic Term	Numerical Value
Equally Preferred	1
Equally to Moderately Preferred	2
Moderately Preferred	3
Moderately to Strong Preferred	4
Strongly Preferred	5
Strongly to Very Strongly Preferred	6
Very Strongly Preferred	7
Very Strongly to Extremely Preferred	8
Extremely Preferred	9

Table 4

Pairwise comparison matrix of main factors and calculated local weights.

Factors	Technology	Human	Organization	Environment	Local weights
Technology	1	4	3	2	0.467
Human		1	1/2	1/3	0.095
Organization			1	1/2	0.160
Environment				1	0.277
C.R.	0.01				

Table 6

Pairwise comparison matrix and local weights of Technological factors.

Factors	Relative advantage	Compatibility	Complexity	Security concern	Local weights
Relative advantage	1	1/2	1/3	1/2	0.123
Compatibility		1	2	2	0.388
Complexity			1	2	0.299
Security concern				1	0.188
C.R.	0.05				

Table 7

Pairwise comparison matrix and local weights of Organizational factors.

Factors	Infrastructure	Top management support	Hospital size	Financial resources	Local weights
Infrastructure	1	1/3	1/4	1/4	0.079
Top management support		1	1/2	1/3	0.173
Hospital size			1	1/2	0.289
Financial resources				1	0.458
C.R.	0.03				

Table 8

Pairwise comparison matrix and local weights of Environmental factors.

Factors	Mimetic pressure	Coercive pressure	Vendor support	Intensity of competition	Local weights
Mimetic pressure	1	2	3	4	0.462
Coercive pressure		1	1/2	4	0.209
Vendor support			1	3	0.251
Intensity of competition				1	0.078
C.R.	0.08				

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Table 9
Pairwise comparison matrix and local weights of Human factors.

Factors	Perceived technical competence of IS staff	Employees' IS knowledge	Clinical IT experts	CIO innovativeness	Local weights
Perceived technical competence of IS staff	1	2	3	2	0.409
Employees' IS knowledge		1	3	2	0.289
Clinical IT experts			1	1/3	0.096
CIO innovativeness				1	0.205
C.R.	0.05				

Table 10
The local weights of factors and sub-factors along with global weights of sub-factors

Factors and local weights	Sub-factors	Local weights	Global weights
Technology (0.467)	Relative advantage	0.123	0.057
	Compatibility	0.388	0.181
	Complexity	0.299	0.140
	Security concern	0.188	0.088
Human (0.095)	Perceived technical competence of IS staff	0.409	0.039
	Employees' IS knowledge	0.289	0.027
	Clinical IT experts	0.096	0.009
	CIO innovativeness	0.205	0.019
Organization (0.160)	Infrastructure	0.079	0.013
	Top management support	0.173	0.028
	Hospital size	0.289	0.046
	Financial resources	0.458	0.073
Environment (0.277)	Mimetic pressure	0.462	0.128
	Coercive pressure	0.209	0.058
	Vendor support	0.251	0.070
	Intensity of competition	0.078	0.022

7. Discussion

By developing the integrated conceptual framework and analyzing the MCDM model using the evaluation method of AHP and based our data from 20 senior executive and clinicians with professional management and decision-making experience in the healthcare industry in particular hospitals, some findings from previous IS studies in identifying the important factors affecting the decision to adopt organizational IT innovation was confirmed. First, according to results gained from AHP, among four different dimensions, the most important one is "Technology" (0.467), followed by "Environment" (0.277), "Organization" (0.160), and finally "Human" (0.095). Hence, the hospital professionals considered technology and environment to be the most important dimensions. Thus, the two aforementioned dimensions should be taken into consideration when selecting a method to evaluate the HIS adoption decision process. Nevertheless, two other dimensions of organization and human are thought by professionals to have less effect than those of other dimensions.

Additionally, "Compatibility" is the most important variable for inducing HIS adoption in the hospital settings with the local weight of 0.388.

"Complexity" is identified as the second imperative variable in the technology dimension with the local weight of 0.299.

Some results obtained in previous studies are also supported by findings in present study. In this regard, "Compatibility" and "Complexity" have been identified as the critical factors influencing organization's decision about the innovative technology adoption or implementation (Dedrick & West, 2003; Gibbs & Kraemer, 2004; Grover, 1993; Lian et al., 2014; Premkumar & Roberts, 1999; E. Rogers, 1983, 2003; Thong, 1999; Tornatzky & Klein, 1982). This is simply because, HIS innovation with higher compatibility with existing systems, practices, working experiences and with lower complexity to implement, would be easier to be accepted by potential adopters and would enable the adoption of HIS as an innovative technology within hospitals.

Moreover, another most important variable in the dimension of technology is "Security Concern" with the local weight of 0.188.

It is notable that "Security Concern" is the most important issues in the context of a distribute environment (Luxton et al., 2012), and the HIS technology within hospital environment is certainly no exception. This is particularly true for hospitals because healthcare data requires a more secure environment for storage and retrieval. Hence, an adequate level of IT security needs to be ensured by the Malaysian public hospitals. This is because the deployment of HIS is heavily relied on the support of internet and other communication technologies; the guarantee of the security of the information flows is an important concern in the adoption decision among adopters.

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Following the technological variables is the factor of "Mimetic Pressure" within the environment dimension with the local weight of 0.462. In our study, we found that "Mimetic Pressure" has a significant effect on the decision to adopt HIS innovation. This might be due to the fact that developing countries (competitors) are implementing the health information system to gain more competitive advantage, to be perceived favorably by their patients and also by their external suppliers if any.

Furthermore, prior researchers presented that the pressure of competitors is a primary factor to drive hospital organizations in adopting HIS (Gagnon et al., 2004; Hsiao et al., 2009; Klöcker et al., 2014; C.-P. Lee & Shim, 2007; Y.-C. Li et al., 2005; Lin et al., 2012).

Also, the previous studies on various contexts of innovation adoption is no exception (Gibbs & Kraemer, 2004; Son & Benbasat, 2007; S. Tan & Fichman, 2002; Teo et al., 2003).

Furthermore, "Vendor Support" is demonstrated as the second most important variable in the context of environment with the local weight of 0.251. In this study, hospital professionals value the "Vendor Support" significantly. The possible reason may be that the experience for the development of HIS is yet to be achieved and thus, "Vendor Support" is perceived to be necessary by Malaysian public hospitals. In short, this finding confirmed the results in previous studies of HIS innovation adoption (Chang et al., 2007; Hsiao et al., 2009; Liu, 2011).

"Perceived Technical Competence of IS staff" is the most important variable within the human dimension with the local weight of 0.409. This is due to the fact that hospital organizations to successfully adopt an innovative technology and gaining benefits from it, require IS staff to have sufficient innovation knowledge or technology capability (Lian et al., 2014; Lin et al., 2012). Hence, capability of IS staff should be carefully assessed before any decision to adopt HIS is made. This also confirmed the results in the Ahmadi et al study (Ahmadi et al., 2015a).

With respect to organization dimension "Financial Resources" is the most important variables with the local weight of 0.458 connected to the organization dimension. Not surprisingly, this finding echoes the results of the most previous studies (Chang et al., 2007; Gibbs & Kraemer, 2004; Kuan & Chau, 2001; Lian et al., 2014; Yang et al., 2013).

In Malaysia, the revenues from the general taxation have been used to subsidize health services (Chee & Barraclough, 2007). However, hospitals are concerned more about the financial resources regarding the HIS adoption. According to Sulaiman (Sulaiman, 2011), "money should not have been an issue since the government's funding is based mainly on tax revenue." Hence, this factor is critical to the success of HIS adoption and need immediate consideration by hospitals policy makers.

Another important variable is "Hospital Size" with the local weight of 0.289 that fall under the organization dimension. The reason is that the resource advantages in terms of financial and technical resources, the larger hospitals usually initiate and adopt innovations. Hence, organization size (hospital size) influences significantly the adoption of technology innovation (Ahmadi et al., 2015a; Premkumar & Roberts, 1999; M. Tan & Teo, 1998; Thong, 1999; Zhu et al., 2003).

7.1 Overall

Again, it should be noted that, "Technology" and "Environment" are the most important dimensions for hospitals to make an adoption decision toward HIS innovation.

Moreover, "Compatibility" is an important consideration in hospital's HIS adoption decision. This is due to the fact that with a high level of compatibility with HISs, solely, the minimal adjustments and changes requires to be undertaken within hospital organization which implies less resistance to adoption. In other words, it is very crucial that applications are able to be integrated with HIS with respect to the technical specifications and complexity of integration.

The "Complexity" of HIS is another critical factor after system compatibility, since public healthcare sector specially the hospitals has complex system and has more complex workflows than other healthcare providers. This has become the most critical concern for adopting decision process of HIS in Malaysian public hospitals. Additionally, using the system will be perceived as time-wasting due to the complexity of the system. Therefore, an articulated vision and commitment should be provided by hospital management to create a positive environment for innovation.

Finally and surprisingly, another potential factor is the existence of "Mimetic Pressure" that is being exerted on public hospitals in Malaysia to adopt HIS innovative technology. Due to the various reformation plan that were outlined by the government in Malaysia with the ambition of being competitive with other developing countries (Siddiquee, 2006), and also having the Malaysian vision of 2020 plan for incorporating IS as the backbone of healthcare initiatives, the public hospital organizations are under a considerable pressure to be engaged successfully with the HIS adoption or implementation. Furthermore, this finding indicates a significant association of mimetic pressure impact, between other disciplines and IS discipline where Son and Benbasat (2007) noted that "although there is a cumulative body of the literature on mimetic isomorphism in other disciplines, relatively little attention has been paid to assess the role of mimetic pressures within the IS discipline, with the exception of empirical study by Teo et al. (2003)."

Comparing the results of this study with previous studies conducted in different countries, Chang et al. (Chang et al., 2007) found that for Taiwan hospitals to adopt HIS regarding e-signature, adequate resources, hospital size, vendor support, and government policy are the most critical factors. For Korean hospitals to adopt HIS with respect to EMR and Decision Support System (DSS), hospital size was found as the only significant factor associated with the

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adoption of EMR technology (Chae, Yoo, Kim, & Chae, 2011). In Malaysian healthcare industry with respect to public hospitals, the study of Ahmadi et al. (Ahmadi et al., 2015a) determined out the importance of relative advantage, hospital size, government policy, and perceived technical competence influencing the process of HIS adoption decision, in adopters setting.

In summary, it can be said, the relative importance of the seventeen variables may differ considering the confinement of each healthcare industry.

It is believed that "Relative Advantage" (Dedrick & West, 2003; Gibbs & Kraemer, 2004; Iacovou et al., 1995; Kuan & Chau, 2001; Nelson & Shaw, 2003; Thong, 1999; Wongpinunwatana & Lertwongsatien, 2003), "Infrastructure" (Bardach et al., 2009; Chau & Tam, 2000; Hong & Zhu, 2006; M. Tan & Teo, 1998; Zhu et al., 2003), "Top Management Support" (Beatty et al., 2001; Kambil, Kamis, Koufaris, & Lucas Jr, 2000; Premkumar & Roberts, 1999; M. Tan & Teo, 1998), "Employees' IS Knowledge" (Hung et al., 2010; Thong, 1999), and "Coercive Pressure" (Gibbs & Kraemer, 2004; Son & Benbasat, 2007; Teo et al., 2003) are key considerations for organizations deciding to adopt an innovation. Nonetheless, these five factors were not supported as the most important variables in this study which show some insights pertaining to the healthcare industry with respect to the Malaysia context. In addition, this study explored the critical factors for the adoption decision process of HIS innovation from non-adopters perception where these factors may behave differently compared to the adopters where also emphasis is more on expectations and assumptions of innovation (Ahmadi et al., 2015a; Khajeh-Hosseini, Greenwood, Smith, & Sommerville, 2010; Low, Chen, & Wu, 2011).

8. Conclusion

The TOE framework has been empirically tested by many studies and has been found useful in understanding the adoption of technological innovations. In particular, TOE perspective is suggested as a comprehensive lens to identify the imperative factors on HIS in the early stage of diffusion at the firm level by encompassing and focusing on the characteristics of technology, organization, and environment (Ahmadi et al., 2015a; Chang et al., 2007; Chang et al., 2006; Hsiao et al., 2009; Hung, Chen, & Lee, 2009; Lian et al., 2014; Liu, 2011).

Moreover, institutional theory is seen as a supplement for TOE which would help potentially in better explaining organizational innovation adoption. Furthermore, institutional theory discusses the environmental pressures that exist in the institutional environment which force organizations to follow the new action as others (isomorphism). This is more emphasized by Mohr (Mohr, 1992) in which the healthcare industry is a very institutionalized environment. Finally, with respect to HOT-fit model in the healthcare domain, Yusof et al. (Yusof, Kuljis, et al., 2008) recently developed a new model based on Human, Organization and Technology after having conducted a critical appraisal of the findings of existing health information system evaluation studies. This framework has great overlap with the TOE framework, except that it does not take into account the environmental context. On the other hand, the TOE framework does not have an explicit category "Human".

Oliveira and Martins (Oliveira & Martins, 2011) suggested for more complex new technology adoption in the organizational level, it is important to combine more than one theoretical model to achieve a better understanding of the IT adoption phenomenon. Hence, it can be concluded that organizational innovation adoption theories provide a strong theoretical foundation of new model for the current study to see in a valuable way, how HIS innovation can be adopted with respect to the early stages of innovation adoption process throughout the entire hospital organization.

Therefore, on the basis of TOE framework, this study introduced external pressures of the environment added to the environmental context of TOE and also introduced explicit human category into the TOE context in order to increase the level of variance explained on hospital information system technology adoption.

Hence, the present study on the basis of TOE framework known as a generic theory of technology diffusion proposed a new and suitable research framework relevant to the context of Malaysian public hospitals in successfully adopt the HIS innovation. Hence, this would give a better understanding of the HIS and address issues pertaining to its adoption as an outcome in the hospital level. Furthermore, the finding of this study presented that the integration of HIS in Malaysia is still in the early stage which indicates the slow rate of HIS adoption.

Four major contexts of Human, Technology, Organization, and Environment were highlighted to have significant effect on the overall adoption decision of HIS. In this study, external pressures were stressed as the crucial concept embedded in the environment of hospitals affecting the adoption of HIS innovation. These external pressures can be exerted from both the competitors and the government as two imperative parties, which influence the adoption of HIS innovation by hospitals. This is more emphasized by some prior studies in the context of healthcare technologies which found evidence that aforementioned external pressures may affect the rate of new technology diffusion. Thus, this study has shown the usefulness of the new proposed framework for identifying factors that influence organizational adoption of HIS as the TOEH framework compared to other adoption theories is a more relevant tool to classify all determinants of innovation adoption according to the four potential contexts and to explain organizational (hospital) innovation adoption.

Moreover, a hybrid MCDM model using AHP approach was applied as an effective method in IS literature. The potential factors related to the TOEH context was evaluated and determined influencing the adoption decision of HIS innovation. Hence, from the opinions of professional respondents who are qualified in the professional management and decision making experience, the context of "Technology" with respect to "Compatibility" and

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"Complexity" and as well as "Environment" context with respect to the "Mimetic Pressure" and "Vendor Support" are the most important which need to be evaluated, considered and treated cautiously during the adoption of HIS innovation by the decision makers and hospitals managers involved in acquiring and deploying of the HIS. Therefore, hospitals by adopting and implementing the HIS can provide many benefits including hospital data management, cutting down the waiting time for a patient, patient safety, and reducing treatment error can be achieved.

Thus, the combination of theories in this study along with the results obtained through the novel method of MCDM technique in the IS literature of medical area was tailored specifically to the hospital technology adoption in the healthcare setting, to enhance the delivery of healthcare services. Moreover, based on the study finding, it is wished that the proposed framework would contribute in fostering and motivating the trend of HIS innovation diffusion in public hospitals of Malaysia.

Additionally, as our study focuses on the primary innovation-decision of HIS adoption, therefore the post-adoption stage or later stage of implementation which occur after the adoption decision need to be concentrated by future researchers to accommodate the richer results of organizational innovation adoption process. Besides, significantly less attention has been paid to post-adoption stage in IS literature (Hsu, Kraemer, & Dunkle, 2006).

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