

# Assessing the Need of Decision-making Frameworks to Guide the Adoption of Health Information Systems in Healthcare

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**Keywords:** Healthcare Information System, Decision-making Theories, Adoption Theories.

**Abstract:** Hospital Information System (HIS) is important in the healthcare industry as it supports a wide range of highly specialized health-care tasks, services and provide high-quality patient care. Adoption of HIS is one of the key decisions by hospital management, yet the function of hospital decision-makers within the area of new technology adoption, specifically the decision-making processes in the adoption of HIS remains unsupported. To investigate this phenomenon, this paper identifies HIS decision-making theories, their short-coming of adoption in healthcare organisations and decision-making facets that influence the adoption. These review will shed some light for future researchers to conceptualize, distinguish and comprehend the underlying HIS decision-making models and theories that may affect the future application of HIS adoption. A literature search was conducted to identify studies presenting HIS decision-making adoption theories/models in a healthcare environment. From synthesis of 26 studies, we identified five major facets that provides a structure to organize and capture information on the decision-making and adoption of HIS. The themes presented here provide a starting point in understanding the decision-making adoption theories, their major facets and their short-coming in adopting HIS. This will facilitate our future research on decision-making framework for the adoption of HIS.

## 1 INTRODUCTION

Healthcare information system (HIS) is defined by Lippeveld et al. (2000) as “*a set of components and procedures organized with the objective of generating information which will improve healthcare management decisions at all levels of the health system*”. HIS has the potential to address many of the challenges that healthcare is currently confronting. For example, it can improve information management, access to health services, quality and safety of care, continuity of services, and costs containment (Lippeveld et al., 2000). The adoption and use of HIS can play an important role in cost reduction and enhancing hospital performance (Sulaiman and Wickramasinghe, 2014).

Central to the adoption of any HIS is the decision-making process and frameworks to guide decision-making. Thus, following decision guidelines to support the adoption of (HIS) is vital to take full advantage of HIS. However, despite an accumulation of best practices and frameworks or research

identifying success factors, only 50% of HIS adoption projects succeed (Alipour et al., 2017). Indeed, there is ample evidence to suggest that despite the proposed benefits of HIS failing to adopt a suitable decision framework for the adoption of healthcare information system can exculpate costs and in some cases lead to the failure of HIS within a healthcare organisation (Ahmadi et al., 2017).

## 2 PROBLEM STATEMENT

Adoption of HIS is one of the key decisions by hospital management, yet the function of hospital decision-makers within the area of new technology adoption, specifically the decision-making processes in the adoption of a new technology remains unsupported (Yang et al., 2013).

Many interventions to improve the success of information systems (IS) decision-making and implementations are grounded in behavioural science, using theories and models to identify conditions and

determinants of successful use. However, models in the IS literature have evolved to address specific theoretical problems of particular disciplinary concerns, and each model has been tested and has evolved using restricted set of IS implementation procedures (Kim et al., 2016). Several theories have been suggested to describe how hospitals decide and adopt new technology, yet none of these perspectives alone has been able to satisfactorily explain technology adoption decisions (Kim et al., 2016, Sulaiman and Wickramasinghe, 2014).

### 3 RESEARCH QUESTIONS

There is an apparent lack of insight into what a decision-making adoption framework should capture, and what are its short-comings when applied for adoption of HIS. To address these gaps, we formulate the following research questions:

- *RQ1*. What are the current decision-making theories/models used for the adoption of HIS?
- *RQ2*. What are the short-comings of decision-making theories/models to support HIS adoption in the modern healthcare environment?

### 4 METHODOLOGY

To explore these questions, we undertook a structured literature review. A structured literature review may be described as appraisals of past studies conducted systematically, purposefully and methodologically (Armitage and Keeble-Allen, 2008, Petticrew, 2001). A structured literature review was done in accord with Preferred Reporting Items for Systematic Reviews and Meta-Analysis, or PRISMA guidelines for systematic review and meta-analyses given by Liberati et al. (2009).

In the research discussed in this article, a literature search was completed in the bibliographic databases (CINAHL, Embase, IEEE Xplore, ACM, Scopus, Springer Link and Web of Science) for relevant publications using the keyword search phrases ‘*decision-making*’, ‘*decision support*’, ‘*decision-making adoption frameworks*’, ‘*decision-making adoption models*’, ‘*technology adoption*’, ‘*information system adoption*’, ‘*healthcare*’, ‘*hospitals*’ and ‘*health information system adoption*’. Initially 4532 reference sources were found. 580 studies were removed by EndNote software as they

were duplicated. From the remaining 3952 studies, after screening titles and abstracts, 3789 were deemed not eligible. Out of remaining 163 research articles, 137 articles were screened out after applying the exclusion criteria on full text and 26 studies were selected as primary studies.

## 5 FINDINGS

### 5.1 Importance of Decision-making Frameworks in Healthcare

According to Baker et al. (2002) “decision-making is regarded as the cognitive process resulting in the selection of a belief or a course of action among several alternative possibilities”.

Technology adoption decisions in hospitals may occur through planned acquisitions or through uncontrolled changes in medical practice. They reflect a complex set of dynamics and incentives (Gelijns, 1992). Several theories (mentioned in table 1) have been suggested to describe hospital behaviour and adoption of new technology, yet none of these perspectives alone has been able to satisfactorily explain technology adoption decisions (Teplensky et al., 1995).

There have been a number of high profile and costly HIS failures within hospitals in recent years, leading to the importance of having a decision making framework to decrease the costs and failure rates (Ajami and Mohammadi-Bertiani, 2012).

### 5.2 Models Used to Support Adoption of HIS

We have looked into original versions of the theories rather than the modified ones. We chose this route as publications on HIS implementation are often based on case studies that report before-and-after outcomes and assessments of HIS as an intervention. Although they can provide rich detail on particular examples, they are often so focused on the specific aspects of the cases at hand that they are difficult to use as building blocks for constructing more generalizable theory. In addition, because of their focus on the process and impact of implementation, they offer limited insight into the underlying factors and conditions that shaped the outcomes (Ahmadi et al., 2015).

A range of models and theories are used to evaluate and test the adoption of HIS. The purpose of theories of adoption for HIS is to understand, explain, or predict how, why and to what extent individuals

Table 1: HIS decision-making related theories, its aim and theory facets.

HIS Decision-making Theories	Theory Description	Decision-making Characteristics	Corresponding theory facet
Technology diffusion (Ash, 1997)	Diffusion is the process for assimilating an innovation by the members of a social system over time and through certain communication channels. This theory explains how diffusion of an innovation/technology spreads across a social system, including individuals, groups and organisation.	The individual's decision to adopt HIS is influenced by five characteristics of innovation which include: relative advantage, compatibility, complexity, trialability and observability.	<ul style="list-style-type: none"> <li>• Environment</li> <li>• Human</li> <li>• Organisation</li> <li>• Technology</li> </ul>
Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975)	TRA is a social psychology theory which attempts to explain an individual's behaviour in acquiring such an innovation.	TRA defines the links to adopt HIS between the beliefs, attitudes, norms, intentions and behaviours of hospital individuals. An individual's decision adoption behaviour is determined by his/her behavioural intention, which is itself determined by his/her attitudes and subjective norms towards the behaviour of HIS.	<ul style="list-style-type: none"> <li>• Human</li> <li>• Environment</li> </ul>
Theory of planned behaviour (TPB) (Ajzen, 1991)	TPB was developed based on the TRA; however, TRA was related to voluntary behaviour which appears not to be 100% voluntary in certain circumstances. This resulted in the addition of another construct which is perceived behavioural control in TRA.	Perceived behavioural control is the individual's perception with regard to how easy or difficult a particular behaviour of HIS is to be performed. The decision-making intention of an individual to adopt HIS is determined by attitudes, subjective norms and perceived behavioural control.	<ul style="list-style-type: none"> <li>• Human</li> <li>• Environment</li> </ul>
Technology acceptance model (TAM) (Davis, 1989)	TAM is an IT theory that explains how people come to accept and use a technology. TAM is an adaptation of the Theory of TRA.	TAM posits two factors that determine an individual's decision-making intention for the adoption of HIS; these are Perceived Usefulness and Perceived Ease of Use. A personal behavioural intention to use HIS is directly influenced by perceived usefulness and perceived ease of use.	<ul style="list-style-type: none"> <li>• Human</li> <li>• Technology</li> </ul>
Unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003)	UTAUT was a result of a review and consolidation of eight theories that earlier studies had employed to explain technology usage behaviour like TRA, TAM etc. Its main aim was to explain users' intentions to use a technology and their subsequent behaviour. It deals with individual's perceptions of whether they have the ability to decide whether or not to adopt the technology.	UTAUT posits two main decision-making factors for adopting HIS including dependent variables (behavioural intention of and usage behaviour) and independent constructs (which are performance expectancy of HIS, effort expectancy, social influence, facilitating conditions, gender, age, experience and voluntariness of use). Simplifying the model by using age as the only moderating factor significantly increases the model's ability to predict HIS adoption	<ul style="list-style-type: none"> <li>• Human</li> <li>• Technology</li> </ul>
Task-technology fit model (TTF) (Goodhue, 1998)	TTF describes interaction of task and technology and how well technology fits within individuals.	TTF theorizes that HIS utilization depends on the degree to which a HIS assists an individual in performing the individual's tasks, i.e. the task-technology fit. The TTF framework adds new insight into decision-making of HIS adoption by incorporating the element of task and also the fitness of the task and HIS.	<ul style="list-style-type: none"> <li>• Human</li> <li>• Technology</li> </ul>

Table 1: HIS decision-making related theories, its aim and theory facets (cont.).

HIS Decision-making Theories	Theory Description	Decision-making Characteristics	Corresponding theory facet
Connected Health Evaluation Framework (CHEF) (Carroll et al., 2016)	CHEF enable hospitals to identify poorly designed healthcare solutions, assess performance requirements, monitors human interaction (end-user) and identify potential gaps within a business strategy.	CHEF offers first step towards employing evaluation to extend the evidence-based foundation for the decision-making of HIS through the assessment of best practice and by identifying interventions and opportunities for improvement. CHEF is comprised of four main layers for HIS decision-making assessment, broadly addressing clinical, business, users and systems with a view to determine how these co-create value.	<ul style="list-style-type: none"> <li>• Business</li> <li>• Environment</li> <li>• Human</li> <li>• Organisation</li> <li>• Technology</li> </ul>
Connected Health Delivery Framework (Kuziemy et al., 2018)	Connected Health Delivery framework identifies pain points, business model development, analytics, and evaluation as four main linkages between users (e.g. patients and providers) and technology.	The central point to Connected Health Delivery Framework is the use of the Design Thinking approach to understand the relationship between and explorative interplay between people, processes, technology and business needs.	<ul style="list-style-type: none"> <li>• Business</li> <li>• Human</li> <li>• Organisation</li> <li>• Technology</li> </ul>
HOT-fit (Yusof et al., 2008)	HOT-fit theory covers human perspective issues encountered by information technology staff in an organisation.	Yosof et al., (2008) proposed the Human, Organisation and Technology-fit (HOT-fit framework) which was developed from a literature review on HIS evaluation studies. The HOT-Fit has three decision-making aspects for HIS adoption linked with Human (clinical users), Organisation (healthcare organisation) and Technology (HIS functionality and characteristics).	<ul style="list-style-type: none"> <li>• Human</li> <li>• Organisation</li> <li>• Technology</li> </ul>
Precede-proceed model (Green and Kreuter, 1999)	Precede-proceed is a two-component conceptual model that is used extensively as the basis for planning health IT promotion programs.	Precede-proceed model is intended to guide the synthesis of more than one theoretical perspective for the purpose of developing effective multi-level interventions, providing a continuous series of phases that build logical links among multiple levels of causation for planning and adopting HIS. The goals of the model are to explain health-related decision-making behaviours and environments for the adoption of HIS.	<ul style="list-style-type: none"> <li>• Business</li> <li>• Environment</li> <li>• Human</li> <li>• Technology</li> <li>• Temporality</li> </ul>
Strategic triangle model (Pearlson and Saunders, 2006)	The Strategic triangle model explains importance for organisations of having an alignment between strategic perspectives.	The strategic triangle is a model used to establish the competitive position of healthcare organisation in relation to its competitors. It emphasises the importance for healthcare organisations of having an alignment between three strategic perspectives that play important role for decision-making adoption of HIS (business, organisation and information).	<ul style="list-style-type: none"> <li>• Business</li> <li>• Organisation</li> </ul>
TOE Framework and Fletscher, 1990)	TOE focuses on the process by which a firm adopts and implements technological innovations.	TOE identifies three aspects of healthcare organization's context that can influence HIS adoption decision making i.e., technological aspect of HIS, organizational context of health organisation, and environmental influence on the adoption of HIS.	<ul style="list-style-type: none"> <li>• Environment</li> <li>• Organisation</li> <li>• Technology</li> </ul>

or organizations will adopt and decide to deploy HIS. To look into underlying factors of decision-making adoption of HIS, we need to look into HIS applicability of these major theories and models that predict outcomes and to identify the important facets relating to success of adopting. Table 1 lists the theories, description, characteristics and major facets.

Based upon our understanding of the HIS field and the key theory-based components highlighted in Table 1, there are six major decision-making facets but we have included only five and excluded temporality facet as it is about diffusion and not about adoption. These five facets are:

**1. Business**—The business facet represents the consideration of business issues related to the HIS adoption decision. Business competition was found to stimulate HIS adoption as healthcare organizations strive to earn increased revenues by improving efficiency (Hsiao et al., 2009).

**2. Environment**—elements relating to the context influencing the decision-making and use of HIS. The environment facet captures categories that influence the implementation and use of the technology like regulation of use for HIS.

**3. Human**—elements capturing the decision-making and end results of the HIS in use by the user. Its importance can be explained by the following example: Physicians were told they had to use the Computerized Provider Order Entry (CPOE) systems and were not involved in the selection of the system or the development of order sets. When the system was implemented, many of the physicians did not use the predefined order sets, ordering took a significant time, and resistance dramatically increased when errors were discovered. There was no ownership or sense of responsibility to solve problems that arose, and the CPOE system was subsequently abandoned (Rippen et al., 2013).

**4. Organisation**—Decision-making elements relating to internal factors of healthcare organisations that are controlled by the organisation itself. The organisational factors refer to the decision-making characteristics and resources of hospital, including intra-hospital communication processes, hospital size and top management support within hospitals.

**5. Technology**—Decision-making elements relevant to the HIS functionality and characteristics like compatibility, complexity etc.

### 5.3 Short-comings from the HIS Decision-making Adoption Models and Theories

HIS decision-making adoption has largely been studied at two levels, the individual and the organisational. However, much of the HIS decision-making adoption research has focused on the individual by explaining what influences their decision to use HIS. The most used decision-making theories are the Technology Acceptance Model (TAM), Theory of Planned Behaviour (TPB), Unified Theory of Acceptance and Use of Technology (UTAUT). For the relatively fewer studies on organisation or group-level decision-making adoption, the important theoretical perspectives include the diffusion of innovation (DOI) theory, HOT-fit, CHEF and the technology–organisation–environment (TOE) perspective. Individually and collectively, these theories make valuable contributions by calling attention to the role of a range of key decision-making factors influencing the implementation and use of healthcare information systems beyond the features of the technology itself (Sulaiman and Wickramasinghe, 2014). While these theoretically driven approaches are broader and often richer than case studies, they are still highly focused, which allows them to deeply explore the impact of a limited number of factors. However, this prevents them from explaining the effects of others factors. Although, these are very widely used and implemented theories, there seems no single theory of decision-making that can be fitted to all the technology adoption in healthcare (Ahmadi et al., 2015).

#### 5.3.1 Short-coming from Individual Decision-making Adoption Theories

In 1975, Ajzen and Fishbein proposed the Theory of Reasoned Action (TRA), which mainly illustrates a person's behavioural tendency, for the purpose of predicting, changing and interpreting an individual's particular behaviour. TRA posits that individual decision-making is driven by behavioural intentions where behavioural intentions are a function of an individual's attitude toward the behaviour and subjective norms surrounding the performance of the behaviour. In this theory, attitude and subjective norms are independent of each other and they could each exert indirect influence on an individual's behaviour through behavioural intention.

In 1985, Ajzen proposed the Theory of planned behaviour (TPB). It is an extension of the TRA that

strived for a more appropriate prediction and interpretation of behavioural theory. The difference between TPB and TRA is that the former predicts decision-making under comparatively less controllable circumstances for adoption of HIS, while the latter predicts decision-making of HIS adoption based on the assumption that all behaviours and behavioural motivations are under control.

In order to explore the relationship between the perceived emotions factor and the use of technology, Davis developed the Technology Acceptance Model, TAM that shows how users decide to accept and use a technology and is based on the TRA and TPB. TAM assumes that there are two specified beliefs that determine HIS usage: perceived usefulness and perceived ease of use, eliminating subjective norms and normative beliefs.

Studies on TAM have generated conflicting findings and have led to the confusion over moderating and external variables (Chen and Tan, 2004). Hence, the TAM model should be generalized with caution. Further, TAM measures perceived adoption and self-reports on future behaviour rather than measurement of actual behaviour. TAM contains restricted constructs and thus cannot handle the issue of adopting new HIS services or solutions. Also, TAM is known for its limited possibility of explanation and prediction, triviality and lack of practical value (Kim et al., 2016). Venkatesh and Bala (2008) highlighted that TAM-based empirical studies do not produce totally consistent or clear results. Hence, significant factors are needed to be identified and included in the models especially for the adoption of HIS. The extensive focus of TAM on technology to the neglect of social and psychological parameters on the usage of HIS limits its explanatory and predictive utilities, and therefore demands its integration with other frameworks.

Venkatesh et al. (2003) reviewed and consolidated eight theories that earlier studies had employed to explain technology decision-making behaviour like TRA and TAM. They incorporated four key determinants (performance expectancy, effort expectancy, social influence and facilitation conditions) and four key moderators (gender, age, voluntariness and experience) in the UTAUT model. According to Bagozzi (2007), UTAUT might be a powerful model due to its parsimonious structure and higher explanatory power ( $R^2$ ) compared to TAM. However, the model does not examine direct effects which might reveal new relationships and important factors which were left out by subsuming under the existing predictors only. Kim et al. (2016) added that for HIS adoption, UTAUT lacks expansion in new

settings such as new technology, new users, and/or new culture. They also suggested that UTAUT lacks some constructs required for HIS adoption which is echoed by Bagozzi findings. Although these theories are well known and used for individual adoption, they may not be well suited for organisational level (Maillet et al., 2015).

Other perspectives, such as technology diffusion, seek to assess HIS decision-making in a broader context of the relationship of individuals, groups, organisational features and other elements to the technology. These perspectives underscore the complex, interactive, and often subtle range of influences that shape HIS decision-making and that must be considered in evaluating its adoption. Still other perspectives, such as PRECEDE/PROCEED underscore temporal dimensions as initial HIS implementation and use over time is affected by change over time in the environment or other factors.

Task-technology fit theory can be used to address task variables critical for successful implementation, but it will neither predict nor explain an implementation that fails because the technology does not work (e.g., shuts down unexpectedly or does not scale). In addition, many of the measures used to substantiate variables have not been validated in the HIS context (Kim et al., 2016).

### 5.3.2 Short-coming from Organisational Decision-making Adoption Theories

The TOE framework was developed by Tornatzky and Fleischer (1990) to examine firm-level adoption of various IS/IT products and services. It has emerged as a widespread theoretical perspective on IS adoption (Zhu et al., 2004). Inclusion of technological, organizational and environmental variables has made TOE advantageous over other adoption models in studying technology adoption, technology use and value creation from technology innovation (Zhu et al., 2004).

The TOE framework is consistent with the DOI theory, in which Rogers (1995) emphasized individual characteristics, and both the internal and external characteristics of the organization, as drivers for organizational innovativeness. These are identical to the technology and organization context of the TOE framework, but the TOE framework also includes a new and important component, environment context. The environment context presents both constraints and opportunities for technological innovation. The TOE framework makes Rogers' innovation diffusion theory better able to explain intrafirm innovation diffusion (Hsu et al., 2006).

But according to Dedrick and West (2003) the TOE framework is just a taxonomy for categorizing variables and it does not represent an integrated conceptual framework or a well-developed theory, hence, there is a requirement of a more robust framework to study organizational adoption. The TOE framework has been used to study the adoption of inter-organizational systems, but only from the perspective of a single focal firm. Extant research does not examine how decisions are made when multiple firms must collectively reach a decision about a new system. It was highlighted by Yang et al. (2013) that TOE framework is limited in its explanatory power of technology adoption as well as it can be seen in case of EHR adoption where around half of the percentages of EHR adoption variance remain unexplained. Wang et al. (2010) mentioned that TOE framework has limited major constructs and the variables of TOE framework may need to expand to cover human aspects especially in small or medium level organisations.

## 6 CONCLUSION

In this paper, we examine the literature on decision-making adoption theories for HIS. We also explore the short-comings of the current decision-making adoption theories used for HIS. Considering the broad and vast nature of investment and stake in HIS adoption in healthcare sector, we identify the key decision-making adoption theory facets (business, environment, human, organisation and technology) that stakeholders need to look into for the adoption of HIS.

There is no panacea for selecting any particular decision-making adoption theory for HIS. We have tried to explain short-comings of the HIS decision-making theories to enlighten the researchers about designing the new framework to cover these weaknesses to facilitate the development of more comprehensive frameworks for effective HIS implementation.

One limitation of this study is that we did not assess the extent to which proposed facets addressed decision-making adoption of HIS. The relative importance of each facet in specific HIS contexts remains to be explored by studies using prospective designs.

In this study, we focused on decision-making adoption in HIS by healthcare organisations, but we have to acknowledge that adoption of HIS in healthcare organizations is a multifaceted process since various stakeholders are involved (Menachemi

et al., 2004). Also, decision-making is just the first step to consider for the adoption of the HIS. As noted by Menachemi et al. (2009), it is important to consider the viewpoints of all key adopter groups, because resistance in any of these groups could slow the overall adoption and would not provide essential information for decision-makers.

## 6.1 Future Research

Although this review is preliminary, the five decision-making facets provide a high level checklist of decision-making for adoption of HIS to consider in healthcare environment. One of our future research topics will be to explore the interrelationship between the different facets.

We plan to undertake a structured literature review to synthesize evidence, consider the strength of evidence in assessing the extent to which factors addressed the decision-making adoption of HIS in healthcare organisations and implement these factors and facets for developing organisational framework to help decision-makers in adopting HIS.

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