

ASSESSING THE NEED OF DECISION-MAKING FRAMEWORK TO GUIDE THE ADOPTION OF HEALTH INFORMATION SYSTEMS IN HEALTHCARE

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Abstract: Technological advancements have accelerated the deployment of healthcare information systems (HIS) with the potential to enhance productivity, lower costs, reduce medication errors, and ease the manpower strain on the healthcare industry. Although HIS can provide various benefits to healthcare professionals and patients, there is a high occurrence (50%) of unsuccessful HIS projects and problems with initiating their adoption. To investigate this phenomenon, this paper identifies decision-making theories, their short-coming of adopting HIS 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 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). To put the importance of HIS in context, as part of the Irish e-health strategy, approximately €900 million is being invested in e-health technology. The UK has invested over £12.8 billion in their National Programme for Information Technology for the National Health Service. In addition, the Obama administration in the United States committed to a US\$38 billion investment over ten years for the implementation and meaningful use of electronic health records (Catwell and Sheikh, 2009).

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 healthcare information systems (HIS) is vital to protect such investments of public finances. However, despite an accumulation of best practices and frameworks or research identifying success factors, only 50% of HIS adoption projects succeed (Landrigan and Friedman, 2007). 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 (Nebeker et al., 2005).

2 PROBLEM STATEMENT

Adoption of a new HIS is one of the most important decisions in hospitals, 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 behavioral science, using theories and models to identify conditions and determinants of successful use. However, each model

in the IS literature has 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 (Kukafka et al., 2003). Several theories 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 (Kim et al., 2015).

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).

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 have been suggested to describe hospital behavior 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. 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.

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

Theory	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 adoption is influenced by five characteristics of innovation, including: relative advantage, compatibility, complexity, trialability and observability. Diffusion of an innovation occurs through a five-stage process including: knowledge, persuasion, decision, implementation and confirmation.	<ul style="list-style-type: none"> • Environment • Human • Organisation • Technology
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 between the beliefs, attitudes, norms, intentions and behaviours of 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.	<ul style="list-style-type: none"> • Human • Environment
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 is to be performed. The decision-making intention of an individual to adopt the technology is determined by attitudes, subjective norms and perceived behavioural control.	<ul style="list-style-type: none"> • Human • Environment
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 to use an innovation technology; these are Perceived Usefulness and Perceived Ease of Use. A personal behavioural intention to use a technology is directly influenced by perceived usefulness and perceived ease of use.	<ul style="list-style-type: none"> • Human • Technology
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 including dependent constructs (which are behavioural intention and usage behaviour) and independent constructs (which are performance expectancy, effort expectancy, social influence, facilitating conditions, gender, age, experience and voluntariness of use).	<ul style="list-style-type: none"> • Human • Technology
Task-technology fit model (TTF) (Goodhue, 1998)	TTF describes interaction of task and technology and how well technology fits within individuals.	TTF theorizes that technology utilization depends on the degree to which a technology 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 technology adoption by incorporating the element of task and also the fitness of the task and the technology.	<ul style="list-style-type: none"> • Human • Technology
Connected Health Evaluation Framework	CHEF enable hospitals to identify poorly designed healthcare solutions, assess performance	CHEF offers first step towards employing evaluation to extend the evidence-based foundation for the decision-making of HIS through	<ul style="list-style-type: none"> • Business • Environment • Human

(CHEF) (Carroll et al., 2016)	requirements, monitors human interaction (end-user) and identify potential gaps within a business strategy.	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"> • Organisation • Technology
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"> • Business • Human • Organisation • Technology
HOT-fit (Yusof et al., 2008)	HOT-fit theory covers human perspective issues encountered by information technology staff in an organisations.	The HOT-Fit has three decision-making aspects and different dimensions in every aspect. In technology aspect, there are three dimensions: (1) system quality; (2) information quality; (3) service quality. In human aspect, there are two dimensions: (1) system use; and (2) user satisfaction. In organization aspect, there are two dimensions: (1) structure; and (2) environment.	<ul style="list-style-type: none"> • Human • Organisation • Technology
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. The goals of the model are to explain health-related decision-making behaviors and environments. Five phases with levels of assessment include: Organizational needs and goals, IT specifications and match with goals, Behavior and environmental, Educational and organizational, and Points for system use. Evaluation phase includes: Implementation, Process evaluation, Impact evaluation, System evaluation and Outcome evaluation	<ul style="list-style-type: none"> • Business • Environment • Human • Technology • Temporality
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 the company in relation to its customers and competitors. The model is based on the premise that competitive advantage is determined by the decision-making ability to deliver greater value to customers at a lower cost than competitors. It emphasises the importance for organisations of having an alignment between three strategic perspectives (business, organisation and information)	<ul style="list-style-type: none"> • Business • Organisation
TOE Framework (Tornatzky and Fleischer, 1990)	TOE focuses on the process by which a firm adopts and implements technological innovations.	TOE identifies three aspects of an enterprise's context that influence the decision-making by which it adopts and assimilates a technological innovation: technological context, organizational context, and environmental context	<ul style="list-style-type: none"> • Environment • Organisation • Technology

Based upon our understanding of the health IS field and the key theory-based components highlighted in Table 1, we have identified five major facets of IS theories. These facets are:

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

2. **Environment**—elements relating to the context influencing the use of the technology. The environment facet captures categories that influence the implementation and use of the technology.

3. **Human**—elements capturing the end results of the technology in use by the user. The human facet covers the characteristics of 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**—elements relating to internal factors of an organisation that are controlled by the organisation itself. The organisational factors refer to the characteristics and resources of the firm, including linking structures between employees, intra-firm communication processes, firm size, and the amount of slack resources.

5. **Technology**—elements relevant to the specific technology. The HIS implementation literature often does not describe the technology in a detailed way. However, details relating to a technology can be critical to the success or failure of an implementation.

5.3 Short-comings from the HIS Adoption Models and Theories

HIS adoption has largely been studied at two levels, the individual and the organisational. However, much of the HIS adoption research has focused on the individual by explaining what influences their decision to use HIS. The most used 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 adoption, the important theoretical perspectives include the diffusion of innovation (DOI) theory, HOT-fit 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. 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 Theories

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

In 1985, Ajzen proposed the Theory of planned behavior, TPB. It is an extension of the Theory of Reasoned Action that strived for a more appropriate prediction and interpretation of behavioral theory. The difference between TPB and TRA is that the former predicts behavior under comparatively less controllable circumstances, while the latter predicts behavior based on the assumption that all behaviors and behavioral motivations are under control. TPB also adds the concept of perceived behavioral control as a third variable. It refers to an individual's perceived ease or difficulty of performing a particular behavior.

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 come to accept and use a

technology and is based on the Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB). TAM assumes that there are two specified beliefs that determine information system 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 behavior rather than measurement of actual behavior. 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.

In 2003, Venkatesh et al. reviewed and consolidated eight theories that earlier studies had employed to explain technology usage 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 use 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 use and that must be considered in evaluating its initial use and ultimate outcomes. 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 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 and models in health information systems. We also explore the shortcomings 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 shortcomings 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 health IS 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 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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