A NOVEL EVALUATION MODEL OF USER ACCEPTANCE OF SOFTWARE TECHNOLOGY IN HEALTHCARE SECTOR

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Abstract: Effective evaluation of healthcare information systems is necessary in order to ensure systems adequately meet the requirements and information processing needs of the users and healthcare organisations. A number of studies have proposed evaluation frameworks to aid in evaluation work. However, some of them can be improved upon. This paper proposes a novel evaluation model to evaluate user acceptance of software technology within the healthcare sector. It describes the theoretical basis behind the development of the research model and methodology being employed to validate the model.

1 INTRODUCTION

Information systems play an increasingly important role in developing the structure and functions of healthcare industry. Almost a billion dollars are being spent on the procurement of new technology with the aim to improve organization performance as well as the quality of service delivered to the patient. Any new system implemented is estimated to take approximately 18 months to be fully operationalized (Lee et al., 2008). Although technology often brings benefits to an organization, sometimes implementations do fail due to low levels of user acceptance (Southon et al., 1999). Since the success or failure of system implementation largely depends on user acceptance of technology, much research has been carried out to identify those critical factors that influence user acceptance (Yusof et al., 2008; Shaw, 2002; Despont-Gros et al., 2005; Schaper and Pervan, 2007). Some authors have proposed frameworks to assist evaluation. However, we believe most of these frameworks can be improved upon. In this paper, we propose a novel evaluation model to evaluate user acceptance of technology. The theoretical significance of this work is that it will use well-established theory in information systems to inform the proposed model.

2 THEORETICAL BACKGROUND

In order to build the evaluation model, the following three-step methodology was adopted:

- A general review of existing information system models to provide a theoretical basis to the key dimension of user satisfaction or acceptance of technology.
- A general review of existing evaluation frameworks to identify strengths and limitations of each framework, if any, to identify improvements.
- A general review of information system evaluation studies in healthcare to highlight studied variables on user acceptance of technology.

2.1 Review of Theories of User Acceptance of Technology

There are a number of theories that focus on user acceptance of technology such as the technology acceptance model (Davis, 1989), the theory of reasoned action, the IS Success Model (DeLone and McLean, 2003), the diffusion of innovation theory, the Unified Theory of Technology Acceptance and Use of Technology (Venkatesh et al., 2003) and many other related theories. Here, we discuss three theories that we believe are relevant to our research problem.

2.1.1 DeLone and McLean IS Success Model

Since its introduction by (Delone and McLean, 1992), the model has been widely used, evaluated, validated and extended in various studies. In 2003, the IS Success Model was updated by inclusion of net benefits derived from intention to use and user satisfaction (DeLone and McLean, 2003). The IS Success Model illustrates clear, specific dimensions of success or effectiveness and the relationships between the factors. Dimensions suggested are system quality, information quality, service quality, intention to use, actual use, user satisfaction and net benefits. (Petter and McLean, 2009) in his paper has given a detailed description of each of the constructs. However, the limitation of this model is that it cannot provide explanation as to why the same IT system can be adopted in different ways, with different effects in various settings (Tsiknakis and Kouroubali, 2008).

2.1.2 Unified Theory of Technology Acceptance and Use of Technology (UTAUT)

(Venkatesh et al., 2003) proposed a more complete model for understanding the acceptance and adoption of information technology. The UTAUT model contains four core determinants of intention and usage, while also incorporating moderating variables, gender, age, experience and voluntariness of use, which may or may not have an influence on user acceptance of technology. A description of the constructs defined by the model are as follows:

- Performance expectancy — "The degree to which an individual believes that using the system will help him or her to attain gains in job performance. Measured such as accomplish task quickly, improve job performance, increase productivity, enhance effectiveness."
- Effort expectancy — "The degree of ease associated with the use of system. Measured such as interaction with system clear and understandable, flexible to iteract, easy to use, etc."
- Social influence — "The degree to which an individual perceive that important others believe he or she should use the new system."
- Facilitating condition — "The degree to which an individual believes than an organization and technical infrastructure exist to support the use of a system."

The UTAUT model is a relatively new model and to our knowledge it has not been widely used in the healthcare domain. Thus, this model will be utilized in understanding user acceptance of technology in healthcare domain.

2.1.3 Task-technology Fit (TTF)

Task-technology fit model was developed by (Goodhue, 1995). TTF theory holds that information technology is more likely to have a positive impact on its individual performance and be used if the capabilities of the technology match the tasks that the user must perform. The importance of task fit and technology has been highlighted in many studies (Ammenwerth et al., 2006; Goodhue et al., 2000; Goodhue, 1995). The fit between attributes to accomplish certain tasks is more important that the individual attributes themselves. For example, a user with certain IT skills is not a sufficient requirement for the use of a new system; rather their skills must be match with the requirement of the IT system itself (system complexity). In addition to the fit defined by the model, we believe there must exist also a fit between the individual and the organisation. For example, if a particular individual does not possess the skill to use a new technology, the organisation needs to provide necessary training. This will eventually influence the user to accept the technology. Thus, other than the fit between individual and organisation, the fit between organisation and technology is also equally important and we include this additional fit in our model.

2.1.4 Observation and Recommendation

Both the IS Success Model and the UTAUT model by itself is an excellent model. Each is internally sound and based directly on well-tested attitude/ behaviour models. Both models define almost similar dependant constructs, where in IS Success Model it is called 'intention to use' or 'use', whereas in the UTATUT model it is called 'behavioural intention'. However, for this dependant construct, each model defines different independent constructs. For example, in the UTAUT model, behavioural intentions are determined by performance expectancy, effort expectancy and social influence. In the IS Success Model, intention to use or use is determined by information quality, system quality and service quality. We believe that, by combining all these independent factors, we can better represent factors that determine intention to use or behavioral intention of the user of the system. As observed also, the weakness of the existing models is in their lack of task focus (fit) between various constructs, which contributes to the mixed results in information technology evaluations studies (Dishaw and Strong, 1999). Thus, instead of proposing TTF as an alternative to the IS Success Model or UTAUT model, we propose to add the strengths of TTF models to the IS Success Model and UTAUT model to produce an integrated model which incorporate both

attitudes toward information technology and the fit between technology functionality and the characteristics of the tasks that users need to accomplish with the technology. We believe that these three models overlap in a significant way and, if integrated, it could provide a better explanation of information technology utilization by the users and also a stronger model than any stand alone model.

2.2 Observation on Early Study of Existing Evaluation Frameworks

In this section, we briefly analyze several existing evaluation frameworks. Most of the frameworks were developed based on influences from other disciplines (Chiasson et al., 2007).

- ICT and OTs: A model of information and communication technology acceptance and utilisation by occupational therapists (Schaper and Pervan, 2007). The framework was developed to examine acceptance and utilisation issues among health professionals and was based on the UTAUT model by (Venkatesh et al., 2003) and 'Technology Acceptance (TAM)' by (Davis, 1989). However, description of task charateristics is lacking in this model. We believe on the importance of task characteristics and skills that user possess will eventually influence users' usage of the technology and this must be evaluated when we address user acceptance of technology.
- Understanding IT: acceptance by individual professional: Towards an integrating view (Yi et al., 2006). The framework was based on the TAM model by (Davis, 1989), planned behavior and innovation diffusion. This research model was tested in the context of personal digital assistance acceptance by healthcare processionals. We believe that the important factor which is the fit between the technology and the task that the user needs to perform is important and this fit is lacking in this model.
- HOT-fit: An evaluation framework for health information systems: human, organization and technology-fit factors (Yusof et al., 2008). The proposed framework is constructed so that it is capable of being useful in conducting a thorough evaluation study and to help researcher and practitioners to understand the perceived complexity of health information system evaluation. The model was developed based on the IS Success Model and the 'IT-Organization fit model'. The strength of this model is inclusion of fit element. However, we believe more constructs from the UTAUT model can be incorporated into this model to better explain user acceptance of technology.
- FIIT: Fit between Individual, technology and Task by (Ammenwerth et al., 2006). This proposed framework was believed to provide better analyses on socio-organizational-technical factors that influence IT adoption during implementation. The model referred to the IS Success Model, the TAM model and the IT adoption model. Inclusion of several constructs from UTAUT model, including moderating factor, can (we believe) further enhance the applicability of this model.

Based on our early observations, we believe each of these frameworks can be improved upon to address the issue of user acceptance of technology.

3 THE PROPOSED INTEGRATED EVALUATION MODEL

The following proposed evaluation framework is developed after studying the existing models and theory of user acceptance of technology, and following critical appraisal of the existing evaluation frameworks. Three models were integrated to build this model as shown in Figure 1. The features of this integrated model are:

- Categorisation of all the independent constructs under Individual, Organizational and Technology context.
- The individual factors and their dimensions are performance expectancy, effort expectancy and social influence. These are constructs defined in the UTAUT model.
- The organisational factor and its dimension is facilitating condition, from the UTAUT Model.
- The technology factors and their dimensions are system quality, information quality and service quality. These are constructs defined in the IS Success Model
- Incorporation of fit between individual, organisational and technology context. In the original TTF model, the fit is between task (individual) and technology. In addition to this, we include fit between individual and organisation, and between technology and organisation, which we believe are also equally important.

Table 1: Classification of the Factors Associated with the Adoption of New Technology.

Factors/Constructs	Measurement Variable	Sources
Performance Expectancy	Work Quicker, Improve Quality of work, Improve communication, will use if offer advantages, save time, information exchange, clear interaction and understandable, easy to use, multi-tasking, improved work effectiveness, etc.	1, 2, 3, 4, 6, 11
Effort Expectancy	Clear, easy to remember, always available, easy to use, usability, has knowledge to use, improve job performance, enhance job effectiveness, increase job productivity, user-friendly etc.	3, 4, 5,6, 7, 8, 9, 10
Social Influence	Perception of other, usage benefits social factors, social words, atmosphere, etc.	7, 11
Information Quality	Relevance and usefulness, efficiency, conciseness and completeness, reliability, observability and result demonstrability, accurate information, content, format	10,11, 12
Service Quality	Helpdesk support, user documentation, quality of hotline, support, speed to repair	5, 7
System Quality	Speed, response time, provide security, downtime, response time, require multiple update, stability and usability, data accuracy, data availability, flexibility, reliability, functionality, connection time, system function, content design and device accessibility, etc.	3, 5, 6, 8, 9, 11, 12, 13
Facilitating Condition	Management support, training, provision of computer support (hardware, software), system availability, network infrastructure, security, compatibility of technology or technical issues/ appropriateness of technology implemented, helpdesk, maintenance, support from IS department, support from vendor, technical support, induction, etc.	2, 5, 6, 7, 8, 9, 13, 14, 15
User Satisfaction	Task-support satisfaction, quality of work-life satisfaction, interface satisfaction, decision-making satisfaction, software satisfaction, satisfaction with system components	2, 12
Net Benefits	Improve task performance, efficiency and effectiveness (goal achievement), error reduction	12
Moderating Factors	Experience, age and gender	2, 6, 9, 11, 14, 15

3.1 Classification of Factors: Individual, Organizational, Technology

According to (Chau and Hu, 2002), technology acceptance has three dimensions:

1. characteristics of the individual;
2. characteristics of the technology; and
3. characteristics of organisational context.

Several evaluation frameworks categorise factors under these three wide categories (Schaper and Pervan, 2007; Yusof et al., 2008; Lorenzi, 1999). Organisation factors need to be evaluated because introduction of new information technology changes the services, operation and also the structure of the organisation itself. Technology needs to be evaluated because it becomes part of the system within the organisation in which it operates. The user or individual is mainly subjective because they imply how people conceive their relationship with the technology, and individual also needs to be evaluated (Southon, 1999).

3.2 Validation of Proposed Evaluation Model: Phase 1 (Literature Review)

In phase one of our research, in order to validate the proposed model, we conducted a literature review to identify factors associated with the adoption of new technology. All these factors are collected and classified according to the constructs defined in our model to test if our defined constructs can incorporate these factors and we managed to classify the identified factors. Table 1 shows the classification of the factors identified from this review. This indicates that most of the factors associated with user acceptance of technology can be represented by our model. This demonstrates the strength and applicability of our proposed model.

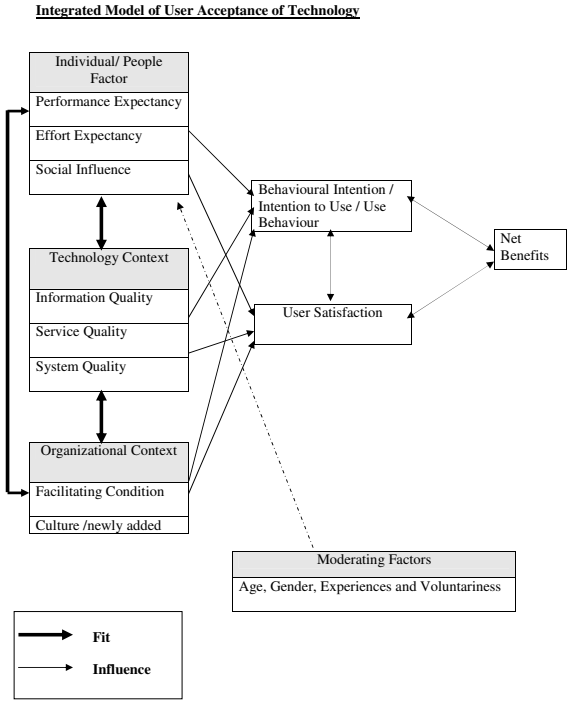

Figure 1: Proposed Evaluation Model of User Acceptance of Technology.

Table 2: Reference to Sources.

Key	Sources
1	(Otieno et al., 2008)
2	(Despont-Gros et al., 2005)
3	(Tsiknakis and Kouroubali, 2008)
4	(Yi et al., 2006)
5	(Shaw, 2002)
6	(Garfield, 2005)
7	(Martens et al., 2008)
8	(Sicotte et al., 2006)
9	(Ammenwerth et al., 2006)
10	(Chiasson et al., 2007)
11	(Lee et al., 2008)
12	(Yusof et al., 2008)
13	(Heeks, 2006)
14	(Mahmood et al., 2000)
15	(Goodhue et al., 2000)

3.3 Validation of Proposed Model: Phase 2 (Case Study Strategy)

In phase two of our study, in future, a case study strategy will be employed. The case study will serve two purposes:

1. to evaluate the adoption factor of new technology in the context of the phenomena under study;
2. to validate the proposed evaluation model.

A case study will be conducted within the clinical setting with research students from the Breast Cancer Pathology Research Group, based in the Queen's Medical Centre, Nottingham. This research centre has recently purchased a new piece of software known as Distiller (SlidePath, 2008). The model will be used as a guideline in the evaluation of this software. During the evaluation process, we will interview the users, observe their use of the system and also perform document analysis.

4 CONCLUSIONS AND FUTURE WORK

In this paper, we have proposed an evaluation model to evaluate user acceptance of software technology in the healthcare sector. Our proposed model integrates three very well-known theories of information systems to represent factors that influence user acceptance of software technology. In first phase of the study, we conducted a literature review to identified factors associated with the user acceptance of the technology. These factors were then classified according to the constructs proposed in our model. Through this process, we demonstrated that our model can better represent factors associated with technology acceptance. As future work, in order to further validate our model, we will test the model in clinical settings with research students by means of a case study. Findings from fieldwork will (hopefully) be used to further improve and refine the model. Identifying what are the factors that influence successful implementation of new software technology among the users is vital since the success and failure of any new systems to operate in a new environment depends largely on the acceptance of the users of the system.

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