

# A Review of the Technology Acceptance Model in Electronic Health Records

Al-Momani Ala'a<sup>1\*</sup>, T. Ramayah<sup>1,2,3,4,5,6,7</sup>

<sup>1</sup> School of Management, Universiti Sains Malaysia (USM)

<sup>2</sup>Department of Information Technology & Management, Daffodil International University, Bangladesh (DIU)

<sup>3</sup>Department of Management, Sunway University Business School (SUBS)

<sup>4</sup>Azman Hashim International Business School, Universiti Teknologi Malaysia (UTM)

<sup>5</sup>Applied Science Private University (ASU), Amman, Jordan

<sup>6</sup>University Center for Research & Development (UCRD), Chandigarh University (CU), India

<sup>7</sup>Faculty of Business, Economics and Social Development, Universiti Malaysia Terengganu (UMT), Malaysia

\*Corresponding Author: [dr.alaamohamad.2022@gmail.com](mailto:dr.alaamohamad.2022@gmail.com)

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**Abstract:** *Over the years, many theories and models have been proposed to explain and interpret behaviours related to the acceptance and usage of technology. The technology acceptance model (TAM), which has been tested in different technological applications, is the most well-known of these models. This article reviews previously published research on the application of TAM to electronic health records. According to the findings of this review, the original TAM was updated and extended to fit the dynamic healthcare service environment by absorbing and integrating variables from various theoretical frameworks as well as by adding variables in specific contextual settings. This demonstrates how the TAM model has been adapted and expanded to meet the specific demands of the healthcare industry, emphasising its usefulness in various settings.*

**Keywords:** TAM, technology acceptance model, EHR, review, perceived usefulness, perceived ease of use, behavioural intention

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## 1. Introduction

In the 21st century, where digital technologies connect everyone, Information and Communication Technology (ICT) plays an imperative role in improving the quality of several aspects of the business world and people's daily lives. As a result, various sectors are attempting to reap the full benefits of ICT by utilising new technologies to innovate existing systems and transform traditional business practises to enhance society's growth, well-being, and economy.

Electronic health records system (EHR) is a digital version of a patient's health record that was previously paper-based. EHR systems allow for the sharing of data with other healthcare organisations such as specialists, pharmacies, medical imaging facilities, laboratories, emergency facilities, and clinics. This provides better healthcare to patients by gathering information from all clinicians involved in their care (Tanwar et al., 2019).

One of the most successful models and theories used over past years to understand, explain, and predict how users accept and use new technologies is the Technology Acceptance Model

(TAM). TAM has a significant impact on users' attitudes toward technology acceptance due to its simplicity and understandability in explaining the attributes (Al-Qaysi et al., 2020; King & He, 2006). Chintalapati and Daruri (2017) identified parsimony, verifiability, and generalisability as features that should be fulfilled by any theory for understanding a difficult situation. Consequently, TAM has been widely applied since it meets these three features.

## 2. Origin of TAM Model

Venkatesh et al. (2003) suggested the fundamental concept of user acceptance models, as depicted in Figure 1. The core concept is that an individual's responses to technology use affect their intention of usage, which ultimately leads to the actual usage. As a result, actual usage is linked to an individual's responses to technology use.

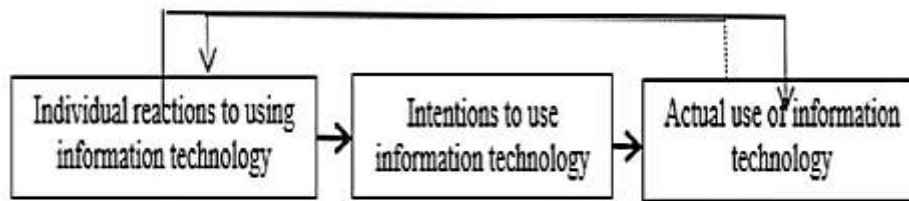


Figure 1: Basic Concept Underlying User Acceptance Models (Venkatesh et al., 2003)

According to Davis et al. (1989), the Theory of Reasoned Action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) has proven to be effective in explaining and interpreting individuals' behaviour in a variety of fields. Thus, they developed the TAM model from TRA to clarify and explain the behaviour of computer usage. TAM was developed to assess users' acceptance of technology, clarify the factors that impact the acceptance, and explain the users' attitudes towards various technologies. In other words, the primary goal of TAM was to establish a basis for measuring how external influences affect users' internal attitudes, beliefs, and intentions (Davis et al., 1989). Figure 2 illustrates the TAM model.

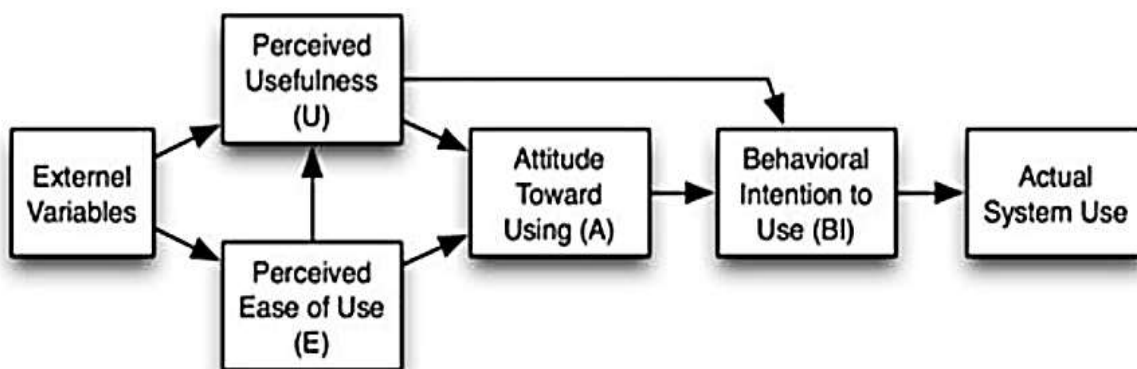


Figure 2: Original Technology Acceptance Model (TAM) (Davis et al., 1989)

Davis et al. (1989) defined perceived usefulness (PU) as the extent to which an individual believes that system usage would enhance his/her performance at the workplace. Perceived ease of use (PEOU) was defined as the degree of user's expectations that system usage would involve little effort (Davis et al., 1989). Original TAM had been modified in different models. For instance, Venkatesh and Davis (2000) proposed TAM2 by introducing additional constructs (see Figure 3).

Venkatesh and Bala (2008) developed an integrated model, TAM3, by merging TAM2 (Venkatesh & Davis, 2000) with the determinants of the perceived ease of use model (Venkatesh, 2000). This model outlines several factors that impact an individual's technology acceptance and usage. The TAM3 model comprises additional constructs, as illustrated in Figure 4.

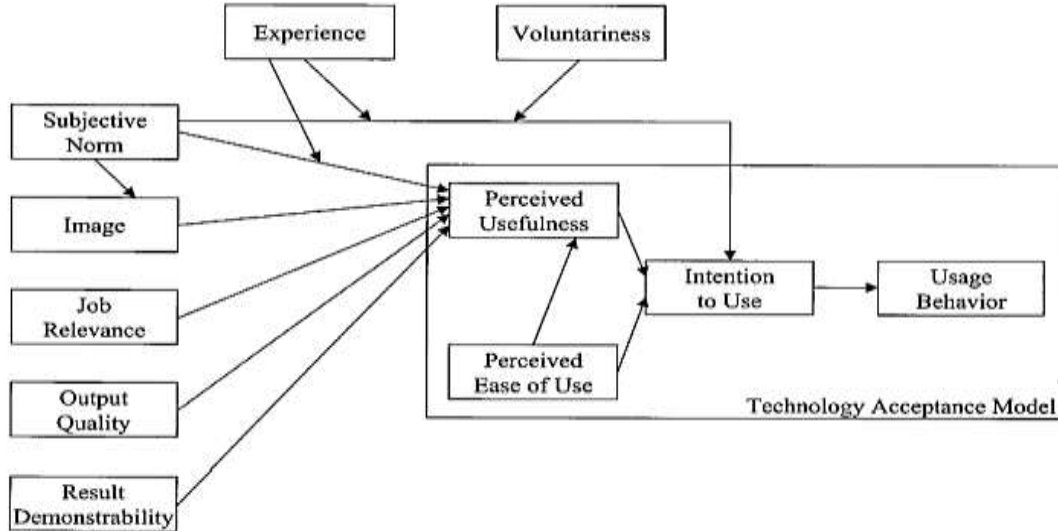


Figure 3: Proposed TAM2-Extension of the Technology Acceptance Model (Venkatesh & Davis, 2000)

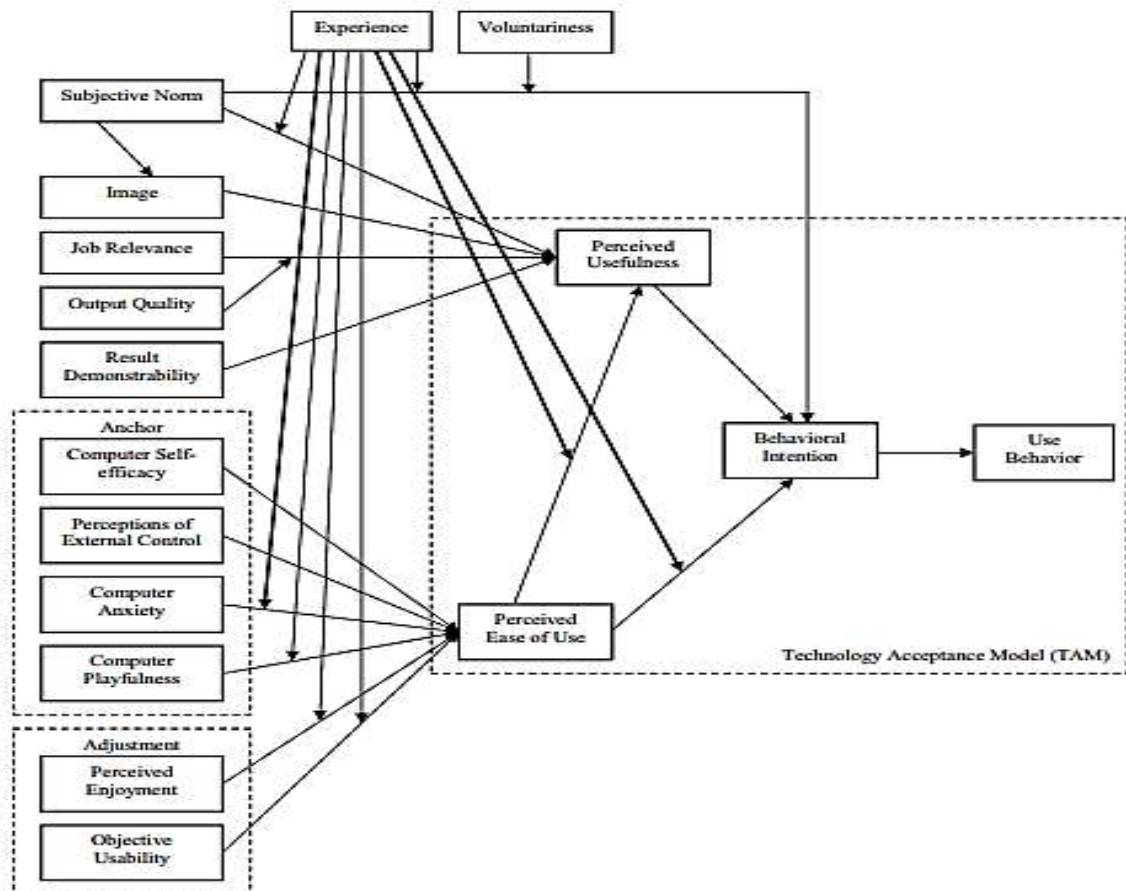


Figure 4: Integrated Technology Acceptance Model 3 (TAM3) (Venkatesh & Bala, 2008)

### 3. TAM Model and EHR in Previous Studies

According to Google Scholar, the article of Davis (1989) was cited 75,527 times to date (16 March, 2023). This statistic served as motivation to look at the role of the TAM model in the EHR setting. Table 1 summarises the prior studies of TAM model in context of EHR. It shows the model/theory, context, constructs, and results.

### 4. Discussion

As stated in Table 1, EHR technology has been studied in different contexts in developed and developing countries. Moreover, TAM model was extended with various external variables, which were deemed significant in some studies but not in others (see Table 2). Additionally, some studies did not incorporate any external variables at all. One explanation for this inconsistency can be attributed to the country where the research was conducted, as the usage of such variables can vary across different countries, therefore, they should be adapted to the context of countries. According to Straub et al. (1997), theories and models pertaining to technology users are not equally applicable in all contexts. Moreover, Sun and Zhang (2006) noted that the effects of certain characteristics on technology usage are inconsistent across studies.

In addition to that, most of these studies used TAM without integration with other theories. One justification for this issue might be that the TAM model is widely regarded as one of the most efficient models created for explaining an individual's adoption and usage of any technology. Due to its simplicity and understandability in explaining its attributes (Al-Qaysi et al., 2020; King & He, 2006).

### 5. Limitations of the TAM Model

According to Davis et al. (1989), TAM was developed specifically for computer usage behaviour. While, Davis (1989), in the initial TAM model, recommended investigating the influence of external factors on the primary constructs of TAM, which are perceived usefulness and perceived ease of use. Over the years, TAM has been extensively used in management information systems (MIS), and several modifications and adjustments have been proposed for TAM. This includes integrating factors from several theories and making adaptations that meet specific requirements.

The most common critique of TAM in context of Health Information Technology (HIT) is its oversimplification (Shachak et al., 2019). Although the simplicity of TAM makes it a tool for assessing the acceptability of the technologies usefully or assessing different needs of several groups of users, it reduces the model's explanatory and provide little penetration into the actual usage of HIT (Shachak et al., 2019). Moreover, several studies in HIT simplified the model to just three constructs: perceived usefulness, perceived ease of use, and usage intention.

**Table 1: Summary of Previous Studies of EHR Technology**

Authors	Theory	Context	Variables	Findings of the study
Egea and González (2011)	TAM	254 physicians in Southern Spain	<b>IV:</b> Trust (TR), Perceived Risk (PR), Information Integrity (INTG), PEOU, PU, Attitude <b>DV:</b> Behavioural intention (BI)	Attitude, TR, and PU determined physicians' intention to use EHCR; moreover, TR had a strong effect on PU, PEOU, and attitude; in addition, TR fully

				mediated the relation between PR and INTG
Terrizzi et al. (2012)	TAM	100 physicians and office staff in Pennsylvania	<b>IV:</b> Access to Shared Information (ASI), Trust (TR), PU, PEOU <b>DV:</b> Behavioural Intention (BI)	PU and ASI had a significant and positive impact on the intention to use HER; in addition, PEOU had significant and positive impact on PU
Gajanayake et al. (2013)	TAM	334 undergraduate and postgraduate students of medical, nursing, and other staff in Australia	<b>IV:</b> PU, Attitude <b>DV:</b> Behavioural Intention (BI)	PU and attitude were positively related to the BI to adopt HER; attitude partially mediated the effect of PU on the intention to adopt EHR
Gagnon et al. (2014)	TAM	157 physicians in Canada	<b>IV:</b> PU, PEOU, Computer Self-Efficacy (CSE), Demonstrability of the Results (DR), Resistance to Change (RC) Information about Change (IC), Personal Identity (PI), Social Norm (SN), Professional Norm (PN), Computer Self-Efficacy (CSE) <b>DV:</b> Behavioural Intention (BI)	PEOU, PN, SN and DR predicted physicians' intention to use the EHR strongly; the impact of determinants on intention was affected by age, gender, prior experience, and area of expertise
Steininger et al. (2014)	TAM	307 physicians in private practices in Austria	<b>IV:</b> PU, Social Influence (SI), Experience, Privacy Concerns (PC), ATT <b>DV:</b> Behavioural Intention (BI)	PC, SI, and Experience had a significant impact on the PU; moreover, PU had a significant impact on attitude and BI
Al-Adwan and Berger (2015)	TAM	222 physicians in Jordan	<b>IV:</b> PEOU, PU, Perceived Threat (PTH), SI <b>DV:</b> Behavioural Intention (BI)	SI, PTH, PEOU and PU influence EHR adoption decision of physicians
Kowitlawakul et al. (2015)	TAM	212 nursing students in Singapore	<b>IV:</b> Self-Efficacy, PU, PEOU, Attitude <b>DV:</b> Behavioural Intention (BI)	All the hypothesis were accepted; attitude was the most influential factor for BI
Sintonen et al. (2015)	TAM and TPB	187 health professionals in south-eastern Finland	<b>IV:</b> System Characteristics (complexity, reliability), PU, BI, Perceived Behavioural Control (PBC) <b>DV:</b> Actual Use	Complexity and reliability significantly influenced PU; complexity and PU significantly influenced the BI; but reliability had no impact on BI; BI influenced actual usage; while, PBC had no influence on BI or actual usage of EHR
Steininger and Stiglbauer (2015)	TAM	307 physicians in Austria	<b>IV:</b> Privacy Concerns (PC), Social Influence (SI), HIT Experience, PU, Attitude <b>DV:</b> Behavioural Intention (BI)	SI, HIT experience, and PC had a significant effect on the PU; which in turn had an impact on attitude as well as the BI
Alipour et al. (2016)	TAM	172 physicians and nurses in Iran	<b>IV:</b> Image, Computer Skills (COMS), Subjective Norms (SN), PEOU, PU <b>DV:</b> Behavioural Intention (BI)	Image, COMS, SN, PEOU and PU affecting the acceptance of HIS by physicians and nurses; PEOU had no effect on the BI



Beglaryan et al. (2017)	TAM	233 physicians in Armenia	<b>IV:</b> External Predictors, Other factors, PEOU, PU, Behavioural intention (BI) <b>DV:</b> Actual Use	The external factors were identified as direct determinants of BI; other factors have an indirect influence on the BI through their impact on projected collective usefulness, PU, and PEOU
Hoque et al. (2017)	TAM	350 patients in Bangladesh	<b>IV:</b> PU, PEOU, Privacy, Trust, Behavioural Intention (BI), Gender <b>DV:</b> Actual Use	PEOU and PU and trust significantly influencing BI; while privacy was identified as a less significant factor
Tubaishat (2017)	TAM	1539 nurses in Jordan	<b>IV:</b> PU, PEOU, Behavioural Intention (BI) <b>DV:</b> Actual Use	Jordanian nurses demonstrated a positive perception of PU and PEOU, which affect nurses' acceptance to use EHRs
Vitari and Ologeanu-Taddei (2018)	TAM	1427 clinical employees	<b>IV:</b> Misfit, Data Security (DS), Computer Self Efficacy (CSE), Anxiety (ANX), Trust (TRS), PU, PEOU <b>DV:</b> Behavioural Intention (BI)	ANX, CSE, TRS influence PEOU; PU, misfit, CSE, DS impact PU; PU and PEOU contribute to BI
Zayyad and Toycan (2018)	TAM	465 healthcare professionals in Nigeria	<b>IV:</b> PU, Information Sharing (INFS), Staff IT Experience (ITE), Technical Infrastructures (TINF), Security (SEC), Attitude <b>DV:</b> Behavioural Intention (BI)	PU, belief, willingness, and attitude have a significant influence on the BI
Alsharo et al. (2020)	TAM	241 physicians, nurses, and pharmacists in Jordan	<b>IV:</b> Habit, PEOU, PU, Attitude <b>DV:</b> Intention to Continuous Usage	Habit significantly increases PU and PEOU, which improves physicians and nurses' attitudes
Dhagarra et al. (2020)	TAM	416 patients in India	<b>IV:</b> Privacy Concerns (PC), Trust (TR), PEOU, PU <b>DV:</b> Behavioural Intention (BI)	PU, PEOU, TR and PC directly predict patients' behaviour to accept technology
Kalayou et al. (2020)	TAM	384 healthcare professionals in Ethiopia	<b>IV:</b> PU, PEOU, Staff IT Experience (ITE), Technical Infrastructure (TI), Attitude <b>DV:</b> Behavioural Intention (BI)	PU, PEOU, TI and ATT had a significant influence on BI; while the effect of ITE on the BI was not significant
Ebnehoseini et al. (2020)	TAM3	244 EHR users in Iran	<b>IV:</b> Subjective Norms (SN), PU, PEOU, Image (IMG), Job Relevance (JR), Output Quality (OQ), Result Demonstrability (RD), Voluntariness (VLN), Computer Experience (CEXP), HIS Experience (SEXP), Self-Efficacy (CSE), Computer Anxiety (ANX), Perception of External Control (PEC), Perceived Enjoyment (PENJ) <b>DV:</b> Behavioural Intention (BI)	SN, JR, OQ, VLN, CEXP have significant impacts on PU; also, PEC and ANX were identified as having significant impacts on PEOU; PU did not mediate RD and BINT. PEOU mediate CSE and BINT, and PENJ

Cho et al. (2021)	TAM1, TAM2, TAM3	223 nurses in Korea	<b>IV:</b> PU, PEOU, Resistance to Change (RC), Perceived Value (PV), Colleagues' Opinions (CO), Self-Efficacy for Change (SE), Organaisational Support (OS), Experience (EXP) <b>DV:</b> User resistance behaviour (UR)	All seven factors were strongly linked to user resistance, either directly or indirectly
Pavlovic et al. (2021)	TAM	156 physicians in Serbia	<b>IV:</b> General Data (GD), Use of Computers (UC), Technical Performance Satisfaction (TPS), PEOU, PU, Attitude <b>DV:</b> Acceptance of System	GD, UC, TPS, EOU, PU, and attitude identified as determinants of system acceptance
Saare et al. (2021)	TAM	200 Doctor and nurse in Iraq	<b>IV:</b> Age, Gender, IT-Competency, PU, PEOU, Attitude <b>DV:</b> Behavioural Intention (BI)	There was a significant relationship between PEOU, PU, Attitude, and BI
Yoo et al. (2022)	TAM & UTAUT	346 clinical experts in Korea	<b>IV:</b> System Quality (SQ), Information Quality (IQ), Service Quality (SevQ), PEOU, Trend, Organisation (ORG) <b>DV:</b> Use	ORG and PEOU impacted the use of system; while SQ, IQ, SevQ and Trend did not affect system usage

**Table 2: Variables Supportation from Previous Studies**

IV	DV	Frequency of Supported effect	Frequency of not-supported effect
Perceived usefulness	Behavioural intention	8	2
Perceived ease of use	Behavioural intention	6	2
Perceived usefulness	Attitude	7	
Perceived ease of use	Attitude	5	
Perceived ease of use	Perceived usefulness	12	
Attitude	Behavioural intention	6	
Behavioural intention	Use	3	
Perceived ease of use	Use	1	
Biometric authentication	Perceived ease of use	1	
Single sign on	Perceived ease of use	1	
Multi-system access	Perceived ease of use	1	
System quality	Perceived ease of use		1
Information quality	Perceived ease of use		1
Service quality	Perceived ease of use		1
Organaisation	Use	1	
Trend	Use		1
Trust	Behavioural intention	1	2
Trust	Perceived usefulness	2	
Trust	Perceived ease of use	1	1
Trust	Attitude	1	
Privacy concern	Behavioural intention	3	
Privacy concern	Perceived usefulness	1	
Privacy concern	Perceived ease of use	1	
Privacy concern	Attitude		
Habit	Perceived usefulness	1	
Habit	Perceived ease of use	1	
Attitude	Intention to continuous use	1	
Perceived usefulness	Intention to continuous use	1	
Personal innovativeness	Perceived ease of use	1	

Personal innovativeness	Behavioural intention	1	
Related knowledge	Perceived ease of use		1
Related knowledge	Behavioural intention		1
Computer anxiety	Perceived ease of use	1	
Computer anxiety	Behavioural intention		1
Patient influence	Perceived usefulness	1	
Patient influence	Perceived ease of use		1
Patient influence	Projected collective usefulness	1	
Patient influence	Behavioural intention	1	
Resistance to change	Perceived usefulness		1
Resistance to change	Perceived ease of use	1	
Resistance to change	Projected collective usefulness		1
Resistance to change	Behavioural intention	1	
Organizational support	Perceived usefulness	1	
Organizational support	Perceived ease of use		1
Organizational support	Projected collective usefulness		1
Organizational support	Behavioural intention		1
Security	Perceived usefulness		1
Security	Perceived ease of use		1
Security	Projected collective usefulness		1
Security	Behavioural intention		1
Administrative monitoring	Perceived usefulness	1	
Administrative monitoring	Projected collective usefulness		1
Administrative monitoring	Behavioural intention		1
Professional relationships	Perceived usefulness	1	
Professional relationships	Projected collective usefulness	1	
Professional relationships	Behavioural intention		1
Organizational change	Perceived usefulness	1	
Organizational change	Projected collective usefulness		1
Organizational change	Behavioural intention	1	
Perceived ease of use	Projected collective usefulness		1
Perceived usefulness	Projected collective usefulness	1	
Behavioural intention	Projected collective usefulness	1	
Social influence	Behavioural intention	3	
HIT experience	Behavioural intention	2	
Social influence	Perceived usefulness	1	1
HIT experience	Perceived usefulness	2	
HIT experience	Attitude	2	
Demonstrability of the Results	Perceived usefulness	1	
System complexity	Perceived usefulness	1	
System reliability	Perceived usefulness	1	
System complexity	Behavioural intention	1	
System reliability	Behavioural intention		1
Perceived behavioural control	Behavioural intention		1
Perceived behavioural control	Use	1	
Computer self-efficacy	Perceived usefulness	1	
Computer self-efficacy	Perceived ease of use	2	
Perceived threat	Behavioural intention	1	
Perceived threat	Perceived usefulness	1	
Perceived threat	Perceived ease of use	1	
Social Norm	Behavioural intention	1	
Professional Norm	Behavioural intention	1	
shared information	Behavioural intention	1	
Perceived risk	Trust	1	
Information integrity	Perceived risk	1	
Information integrity	Trust	1	



Consequently, the outcomes usually oriented around intended or perceived use, rather than the actual use of the technology under examination (Shachak et al., 2019). Furthermore, TAM partially takes a limited perspective of ICT diffusion and use, focusing on a user and assuming a direct causal influence of intention on the user's actual behaviour (Shachak et al., 2019). In addition, not all factors that impact the intention to accept and use technology are covered by the TAM model (Mutahar et al., 2018). It only focuses on technological factors by proposing PU and PEOU and ignores other significant factors that affect technology usages, such as individual, organisational, task, and social factors.

Moreover, TAM disregards the assessment of IT evaluation factors, such as performance impact, which is used to evaluate the success of information systems (Isaac et al., 2017, Isaac et al., 2019). In addition, several studies have excluded the "attitude" variable from the final model of TAM due to empirical data, as attitude did not act as a mediator between the effects of PU and PEOU on intention (Davis et al., 1989).

## 6. Conclusion

The healthcare sector is continually adopting new technologies, including modern and innovative ICT. The use of technology has been demonstrated to enhance the quality of healthcare services, improve staff performance, ensure patient safety, and reduce organisational expenses. The TAM model is a well-established model used to interpret and explain technology acceptance by users. TAM has been expanded to include various external factors. However, some studies have used TAM in isolation without integrating other theories. Since the usage of these factors varies across countries, it is essential to adapt them to the specific context of each country.

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