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research paper   
  
the efficacy of technology acceptance model: a review of applicable theoretical models in information technology researches   
  
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abstract: this is a review of theoretical models most recently used in information technology adoption research. a literature review approach has been adopted. more than 25 literatures were reviewed in the area of   
  
information adoption covering the last 30 years. we identified the strengths and weaknesses of each of the theory used. it is found that technology acceptance model is by far the most used to underpin research work in   
  
this area follow by theory of planned behaviour.   
  
keywords: technology accepted model; theory of planned behaviour; theoretical models; behavioural intention; perceived usefulness   
  
 i. introduction   
 there are well known research models applied to information technology (it) system adoption such as the theory of reasoned action (tra) (fishbein, 1967; fishbein and ajzen; 1980); the theory of planned behaviour (tpb) (ajzen, 1991); and the technology acceptance model (tam) (davis, 1989; davis et al., 1989). in addition, recently, the diffusion of innovation (doi) (rogers, 1995) and the unified theory of acceptance and use of technology (utaut) (venkateshet al., 2003) identified factors that affect an individual‘s intention to use or actual use of information technology.   
  
―how and why individuals choose to adopt new technologies has forever been the focal point of information system (is) research,‖ (schaupp and carter, 2009). according to moody et al. (2010), ―the heart of   
  
any research field is its theories and the core theories of a field define its distinct identity‖. theory is also a necessary prerequisite for conducting research; collecting data without theory is not research but observation or reporting (dubin, 1978).   
  
a survey of commonly used theories in information technology research especially those associated with technology usage, is necessary to consider the merits and demerits of each of the theories used.   
  
 ii. theory of reasoned action (tra)   
 the theory of reasoned action (tra) was originally developed by fishbein (1967) and extensively refined and tested by fishbein and ajzen (1975). the theory of reasoned action defines relationships between beliefs, attitudes, norms, intentions and behaviour, as shown in figure 1 below. the theory of reasoned action   
  
predicts and understands an individual‘s behaviour by considering the effect of personal feelings (attitude) and perceived social pressure (subjective norm). the theory of reasoned action posits that beliefs influence   
  
attitudes, which in turn lead to intentions and then generate behaviour. ―the theory of reasoned action is one   
  
of the basic theories in psychology that has been utilized broadly to predict behaviour‖, (fishbein and ajzen 1975).   
  
  
  
fig. 1 theory of reasoned action (tra)   
source: ajzen and fishbein (1980)   
  
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the strengths and weaknesses of the theory of reasoned action (tra) are stated in table 1 below.   
  
author   
  
strengths   
  
weaknesses   
  
theory of reasoned action (tra) proposed by fishbein and ajzen (1975)   
  
1) strong predictive power of   
  
consumer‘s behavioural   
intention that has been   
demonstrated with a wide   
variety of consumer products 2) tra is a well-researched   
theory designed to explain   
virtually any human behaviour.   
  
1) consumers do not have   
complete control over their behaviour in some conditions.   
  
2) the direct effect of subjective norms on behavioural intention is difficult to isolate   
from the indirect effects of attitudes 3) did not include personality   
characteristics, demographic or   
social roles that influence   
behaviours   
  
 table 1: the strengths and weaknesses of the theory of reasoned action (tra) source: author   
  
 2.1: the theory of planned behaviour (tpb)   
 the theory of planned behaviour (tpb) was developed by ajzen (1985), and it extended the theory of reasoned action (tra) by incorporating an additional construct, namely perceived behavioural control (pbc) to account for situations in which an individual lacks substantial control over the targeted behaviour (ajzen, 1991; cited in wang, 2012), as shown in figure 2 below. it was proposed that, in addition to attitudes toward use, subjective norms and perceived behaviour control such as skills, opportunities and resources needed   
  
to use the system also influence behaviour. ―[the] theory of planned behaviour is one of the most influential models in predicting behavioural intentions and behaviours, and it has been comprehensively validated in the behavioural domain‖ (ajzen, 1991; ajzen and driver, 1991; madden et al., 1992; parker et al., 1995 and ajzen,   
  
2010). ―[the] theory of planned behaviour provides more specific information that guides development‖ (mathieson, 1991). ―theory of planned behaviour (tpb) posits that individuals make rational choices to engage   
  
(or not engage) in the behaviour of interest‖ (ajzen, 1991). the choices made are influenced by individuals‘ own beliefs about the outcome and the evaluation of the favourableness (or unfavourableness) of the outcomes   
  
from engaging in the target behaviour. according to smart (2013), ―these beliefs and expected outcomes underlie three conceptually distinct salient beliefs, which are central to the tpb model: behavioural beliefs (perceived beliefs about the likely outcomes from engaging in the target behaviour and the evaluation of the desirability of these outcomes); normative beliefs (perceived social pressure); and control beliefs (perceived ease or difficulty of engaging in a desired/undesired behaviour)‖. collectively, these elements influence   
  
individuals‘ intentions to engage in the target behaviour. according to chau and hu (2001), ―an individual‘s behaviour can be explained by his or her behavioural intention, which is jointly influenced by attitude, subjective norms and perceived behavioural control‖. ―[an] attitude variable can be regarded as the mediating variable which influences the behaviour intention and subjective norm (sn) is the social pressure exposed to the person or the decision maker to perform the behaviour‖ (benk and budak, 2011).tpb has been successfully applied to the understanding of individual acceptance and the use of many different technologies (harrison et al., 1997; mathieson, 1991; taylor and todd, 1995b).   
  
  
  
 fig.2 the theory of planned behaviour (tpb) source: ajzen (1985, 1991)   
  
the strengths and weaknesses of the theory of planned behaviour (tpb) are stated in table 2 below.   
  
authors   
  
strengths   
  
weaknesses   
  
theory of planned behaviour (tpb), proposed by ajzen (1985)   
  
1) a broader model compared to tra   
2) the theory has received   
substantial empirical support for predicting behaviour in   
information systems and other domains   
  
1) constructs are difficult to define and measure in the study.   
  
2) the model suffers from   
multicollinearity among the independent variables.   
  
 table 2: the strengths and weaknesses of the theory of planned behaviour (tpb) source: author   
  
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the next section discusses the technology acceptance model (tam).  
  
 2.2: technology acceptance model (tam)   
 the technology acceptance model (tam), developed by davis (1989), was adapted from the theory of reasoned action (tra) by ajzen and fishbein (1980) and theory of planned behaviour (tpb), developed by ajzen (1985) and tailored to the context of technology acceptance and usage. the final conceptualization of the technology acceptance model (davis, 1989; davis et al., 1989), unlike the theory of reasoned action, excludes the attitude construct in order to better describe intention parsimoniously. it has two constructs, which   
  
are perceived ease of use (peou) and perceived usefulness (pu), and these constructs determine a user‘s attitude towards use of that technology, which in turn, influences the behavioural intention to use technology.   
  
perceived usefulness (pu) is defined as the user‘s perception of the degree to which using the system will   
  
improve his or her performance in the workplace, while perceived ease of use (peou) refers to the user‘s perception of the amount of effort needed to use the system (using a particular system would be free of effort). the tam is illustrated in figure 3 below.   
  
  
  
 fig. 3 technology acceptance model (tam) source: davis (1989)   
  
alryalatet al.(2013) examined the role of usefulness, ease of use and social influence on jordanian citizens‘ intentions to adopt e-government. the study aimed at developing and empirically testing an extended technology acceptance model (tam) that integrates social influence with the tam constructs. the study used the survey method, since the study involves formulating and testing hypotheses (choudrie and dwivedi, 2005; galliers, 1992). the findings of the study revealed that all three independent constructs significantly affected jordanian citizens' behavioural intentions to adopt e-government. the literature review revealed that there has   
  
not been any study in the context of jordan which has attempted to empirically examine either citizens‘ or organisations‘ perspectives of e-government adoption. the findings from this research are likely to be useful for the jordanian government in terms of developing a user-friendly system that encourages citizen and organisational participation in e-government adoption.   
  
 2.2.1: external variables   
 a key purpose of tam is to provide a basis for tracing the impact of external variables on internal beliefs, attitudes, and intentions, and it suggests that perceived ease of use (peou) and perceived usefulness (pu) are the two most important factors in explaining and predicting system use (davis,1989).however, some scholars confirm that external variables are mediated by peou and pu and that any additional variable contributes little to the explanation of the variance in it systems. some scholars also say that the external variables provide a better understanding of what influences pu and peou, and their presence guides the actions required to influence greater use of it systems. table 3 presents the external variables considered by some scholars.   
  
author and date  
  
external variable  
  
park (2009)   
  
individual factor; social factor and organisational factor   
  
chuttur (2009)   
  
actual system‘s features and capabilities   
  
burton-jones and hubona (2006)   
  
system experience, level of education and age   
  
jackson et al. (1997)   
  
situational involvement, intrinsic involvement, prior use, argument of change   
  
igbariaet al. (1997)   
  
internal computing support, internal computing training, management support, external computing support, external computing training   
  
dishaw and strong (1999)   
  
tool functionality, tool experience, task technology fit, task characteristics   
  
agarwal and prasad   
  
role with regard to technology, tenure in workforce, level of education,   
  
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(1997)   
  
prior similar experiences, participation in training   
  
lucas and spitler (1999)   
  
quality perceived subjectiveness   
  
karahannaet al. [1999]   
  
compatibility, trainability, visibility, result demonstrability   
  
venkatesh and davis (1996)   
  
subjective norms, voluntariness, image, job relevance, output quality, result demonstrability   
  
venkateshand morris (2000)   
  
gender, experience   
  
chau (1996)   
  
implementation gap, transitional support   
  
davis et al. (1989)   
  
computer self-efficacy, objective usability, direct experience   
  
 table 3 external variables   
 source: adapted from legris et al. (2003)  
  
the strengths and weaknesses of the technology acceptance model (tam) are stated in table 4 below.   
  
authors   
  
strengths   
  
weaknesses   
  
technology of acceptance model   
(tam) proposed by davis (1989)   
  
1) numerous empirical studies have found that tam consistently explains a substantial proportion of the variance in usage intentions and behaviours with a variety of information technologies.   
  
2) the direct effect of subjective norms on behavioural intention has yielded   
mixed results in the past. this theory used perceived usefulness and perceived ease of use to replace the subjective   
norm.   
  
3) tam is a robust, powerful, and   
parsimonious model for predicting user acceptance of information technologies.   
  
4) it has been used in many empirical studies and proven to be of quality and statistically reliable.   
  
1) ignores some important   
theoretical constructs   
2) tam does not reflect the   
variety of user task environments and constraints   
  
 table 4. the strengths and weaknesses of the technology acceptance model (tam) source: authors   
  
in a related study, chen and huang (2006) predicted taxpayers‘ acceptance of online taxation use.the study proposed an extended model to predict users‘ acceptance of an online taxation system for their personal income based on tam and diffusion of innovation (doi). the findings revealed that taxpayers‘ attitudes toward using online taxation are strongly and positively correlated with users‘ acceptance. the empirical results confirm that peou, pu, compatibility, and perceived risk (pr) significantly influence taxpayers‘ attitudes toward using online tax systems (ots). it also confirmed the significant effect of peou of the ots on perceived usefulness. the findings also show that compatibility, pu, pr and the attitude toward using ots influence taxpayers‘ intentions to use an online taxation system.   
  
the summary of prior studies about understanding perceived ease of use (peou) in various contexts and the scopes of research are shown in table 5 below.   
  
author(s)  
  
research setting  
  
study   
sample(s)  
  
instruments /model  
  
key findings on perceived ease of use (peou)  
  
fu et al.   
(2006)   
  
taiwan   
  
individuals   
  
tam   
  
a manual taxpayer‘s decision to adopt e-tax method is influenced by perceived ease of use (peou) and social pressures. perceived usefulness (pu) was found to be the strongest determinant and   
explained most of the variance in behavioural intention (bi).   
  
ramayah (2006a)   
  
malaysia   
  
students   
  
tam   
  
this study on the subject of   
perceived ease of use (peou) of   
  
usms‘ digital ranked highest in the order of influence on ease of use, followed by organisational context and individual differences.   
  
ramayah (2006b)   
  
malaysia   
  
students   
  
tam   
  
interface characteristics were   
found to be strong predictors of perceived ease of use (peou). screen design was found to be a significant predictor of perceived   
  
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ease of use (peou). navigational clarity was only weakly correlated to peou. perceived usefulness (pu) was also found to be   
positively related to the intention to use online.   
  
gopi (2006)   
  
malaysia   
  
individuals   
trading in   
bursa saham, malaysia   
  
compared dtpb,   
itpb,tam and idtpb   
  
 perceived usefulness (pu) is the most significant factor in   
determining the attitude towards using internet stock trading   
compared to perceived ease of use (peou). there was a significant positive relationship of perceived ease of use (peou) towards   
perceived usefulness. the   
integrated dtpb model was   
concluded to be the better model.   
  
vennila   
(2006)   
  
malaysia   
  
college   
students   
  
social   
cognitive   
theory/tam   
  
canx has a negative effect on perceived ease of use (peou).   
  
personal innovativeness is   
positively correlated to perceived ease of use (peou). computer playfulness has a direct   
relationship with perceived ease of use (peou)   
  
ndubisiet al. (2005)   
  
malaysia   
  
malaysian   
entrepreneurs   
  
tam   
  
perceived ease of use (peou) has no direct relationship with usage. perceived usefulness has a strong   
  
influence on entrepreneurs‘ system usage.   
  
lu et al.   
(2003)   
  
usa   
  
students   
  
tam   
  
the attitude towards using is   
jointly determined by perceived near-term and long-term   
usefulness and perceived ease of use (peou). perceived near-term usefulness is also influenced by ease of use.   
  
jantanet al. (2001)   
  
malaysia   
  
smi   
  
tam   
  
 management support was found to be a determinant and have a   
positive direct influence on both perceived ease of use (peou) and perceived usefulness. external   
computing support has a positive direct influence on perceived ease of use (peou) only.   
  
venkatesh (2000)   
  
usa   
  
employees   
of three   
organisations   
  
tam   
  
determinants of system specific perceived ease of use (peou) as individuals evolve from early   
stages of experience to later stages of experience. with experience, general beliefs regarding the   
computer, perceived enjoyment and objective usability were   
important in perceiving the ease of use of a system. perceived ease of use influences behaviour   
intention.   
  
 table 5: peou in various contexts and the scopes of research source: authors   
the next section discusses the unified theory of acceptance and use of technology (utaut).   
  
 iii. the unified theory of acceptance and use of technology (utaut) the unified theory of acceptance and use of technology (utaut) model was developed by vankatchet al. (2003). it integrated the elements of eight prominent theories and models: including the theory of reasoned action (tra) (fishbein and ajzen, 1975), technology acceptance model (tam) (davis, 1989; davis et al., 1989), motivational model (mm) (davis et al., 1992, as cited in venkateshet al., 2003), theory of planned behaviour (tpb) (ajzen, 1991), combined tam-tpb (taylor and todd, 1995), model of personnel computer (pc) utilization (mpcu) (thompson, higgins, & howell, 1991), innovation diffusion theory (idt) (roger 1995) and social cognitive theory (sct) (bandura, 1986).   
  
the unified theory of acceptance and use of technology (utaut) is modelled in figure 4.below.   
  
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 fig. 4. the unified theory of acceptance and use of technology (utaut) source: venkateshet al. (2003)  
  
the unified theory of acceptance and use of technology (utaut) contain four core determinants of intention and usage: performance expectancy, effort expectancy, social influence and facilitating conditions (venkateshet al., 2003). the variables of gender, age, experience and voluntariness of use moderate the key relationships in the model.the utaut is able to account for 70% of the variance in usage intention – a considerable improvement over any of the original eight models and their extensions.  
  
 iv. the summary of other theoretical frameworks applied to it   
  
system adoption  
  
summaries of othertheoretical framework applied to it system adoption are stated in table 6 below.  
  
  
  
theory and author   
  
model and discussion   
  
core constructs   
  
social cognitive   
theory (sct)   
(compeau and higgins (1995b)  
  
sct is one of the most powerful   
theories of human behaviour (bandura, 1986). compeau and higgins (1995b) applied and extended sct to the level of computer utilization (compeauet al., 1999). although compeau and higgins (1995b) studied computer use, the   
nature of the model and the underlying theory allow it to be extended to the acceptance and use of information   
technology in general (venkateshet al., 2003)   
  
outcome expectations-  
performance   
outcome expectations-personal self-efficacy   
affect anxiety   
  
decomposed theory of planned behaviour   
(dtpb)   
(taylor and todd,   
1995)   
  
the decomposed theory of planned behaviour (dtpb) was derived from the theory of planned behaviour (tpb) and the technology acceptance model (tam) to a certain extent. empirical evidence suggests that dtpb is   
comparable to tpb but holds the   
advantage of providing a deeper   
understanding of acceptance. contrary to tpb but similar to tam, dtpb   
―decomposes, attitude, subjective   
norms and perceived behavioural   
control into the underlying belief   
structure within technology adoption contexts‖ (taylor and todd, 1995b).   
  
attitude toward behaviour   
subjective norm   
perceived behavioural control   
  
innovation diffusion   
theory (idt)|diffusion of innovation (doi)   
(rogers, 1995)  
  
the innovation diffusion theory (idt) has its roots in sociology and has been in use since the 1960s to study an array of innovations ranging from   
agricultural tools to organizational   
innovations. moore and benbasat   
(1991) adapted innovation   
characteristics presented in rogers   
(1995) and refined a set of constructs that could be used to study individual technology acceptance. agarwal and prasad (1998) explored the role of   
these characteristics in predicting   
acceptance and found that there was   
  
relative advantage   
ease of use   
image   
visibility   
compatibility   
results demonstrability voluntariness of use   
  
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modest support for the predictive   
validity of innovation characteristics. in terms of the overlapping constructs with other models, the relative   
advantage and ease of use of idt are similar to perceived usefulness and   
perceived ease of use of tam, and the compatibility of this model is similar to the one used in dtpb.   
  
  
  
extended technology acceptance model   
(tam2)(venkatesh and davis, 2000)  
  
―tam2 extended tam by including subjective norm as an additional   
predictor of intention in the case of mandatory settings‖ (venkatesh and davis, 2000).   
  
perceived ease of use perceived usefulness subjective norm   
  
is success model   
(delone and mclean, 1992 and 2003)   
  
the is success model as a taxonomy and framework for measuring the   
complex-dependent variables in is research. delone and mclean (2003) discussed many of the significant is research efforts that have applied,   
validated, challenged, and proposed enhancements to their original model, and they then proposed an updated delone and mclean (2003) is   
success model   
  
information quality system quality   
service quality   
  
hofstede’s cultural   
dimensions (hofstede, 1980)  
  
hofstede‘s research on cultural   
dimensions provides a theoretical   
foundation for exploring the influence of cultural differences on the adoption and diffusion of it based innovations. hofstede (1980) proposed four widely cited dimensions of national culture. latter long-term orientation (hofstede and bond, 1988) was added as a fifth dimension.   
  
power distance   
individualism / collectivism masculinity   
uncertainty avoidance   
long-term orientation   
  
 table 6 summary of all thetheoretical frameworks applied to it system adoption source: adaptedfromrana et al.(2012)   
  
however, venkateshet al. (2003) developed the unified theory of acceptance and use of technology (utaut) model to consolidate previous tam related studies. utaut aims to explain user intentions to use an is and subsequent usage behaviour. utaut suggests four core constructs to explain and predict user acceptance of technology adoption, which are: performance expectancy (equivalent to perceived usefulness), effort expectancy (equivalent to perceived ease of use), facilitating conditions and social influence. these constructs explain up to 70% of the variance in usage intention. according to saliza and kamil (2012),―a unified model is being accepted and integrated in many studies of various fields, their results revealed some inconsistencies when applied in different areas or situations; in other words, there is no universal utaut that can explain all situations of acceptance”. it indicates thatthe utaut model of technology acceptance established in developed countries revealed some inconsistencies when applied in different areas or situations; in other words, there is no universal utaut that can explain all situations of acceptance”. it indicates thatthe utaut model of technology acceptance established in developed countries can only be transferred to developing countries with varying degrees of explanatory power. despite being predictive, utaut is more integrative; however, the utaut model is weak in explanatory ability. the utaut model is considered a reflection of an individual‘s internal schema of beliefs, where the external part is being ignored (brown et al., 2010). significantly, the utaut model successfully integrated 32 variables with four moderators, but the application is too general in terms of incorporating classes of technologies (venkatesh and bala, 2008).   
  
utaut is found to be deficient to the following extend:   
i) may not be useful to underpin sensitive and confidential studies that may attract the use of insignificant complex data collection.   
  
ii) the utaut model does not include cultural factors, which may be important in most countries of the world. efendiogluet al. (2005), cited in chiemeke and evwiekpaefe (2011), noted that, ―even though a developing country (like nigeria) government may make the necessary investments in infrastructure (as china has done to a significant degree), unless e-commerce industry participants understand and address cultural issues that are unique to that country and relate to off-site transactional process, the large scale diffusion and success of such   
  
endeavours will be greatly impeded‖.  
  
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 v. justification for popularity of the technology acceptance model (tam) and the theory of planned behaviour (tpb) the technology acceptance model (tam) and the theory of planned behaviour (tpb) are well established in the it arena and appear to be widely accepted. tam was chosen after considering merits and demerits of other possible models and theories that might be suitable for most research studies in technology acceptance and usage.  
  
 i) technology acceptance model (tam)   
 the main aim of tam is to find out what factors cause people to accept or reject an information technology. the technology acceptance model, has two determinants, which are perceived ease of use and perceived usefulness. since its introduction by davis (1989) and davis et al. (1989), the technology acceptance model has been widely used for predicting the acceptance, adoption and use of information technologies.  
  
―understanding…technology acceptance has been a priority for a couple of decades and several models have been proposed and suggested, but tam has been the most popular of these models‖ (chuttur, 2009; gefen and straub, 2000; taylor and todd, 1995).   
  
the technology acceptance model is more appropriately applied in online contexts in light of several advantages it offers:   
1) it is specific to information system usage in applying the concepts of ease of use and usefulness.   
  
2) it is more parsimonious (economical). additionally, it adopts the simplest assumptions when formulating or interpreting data.   
  
3) it is more robust in various information system applications.   
  
4) it is a robust but parsimonious theory and it is useful to explain a particular information system or technology.   
  
5) tam helps to understand and explain use behaviour in information system implementation.   
  
6) it has been tested in many empirical studies, and the tools used with the model have proven to be of quality and to yield statistically reliable results.   
  
7) tam has been the only model that has widely captured the attention of the information systems community. 8) tam is advanced theory derived from the theory of reasoned action (tra) and the theory of planned behaviour (tpb); it is expected that it should explain or predict actual behaviour more accurately than tra and tpb.  
  
9) tam could be useful in predicting end users‘ acceptance of an e-learning system in organisations (davis et al., 1989; wu et al., 2011).  
  
10) tam offers a basic framework to explain the influence of external variables towards   
10) tam offers a basic framework to explain the influence of external variables towards behavioural ideas (davis, 1989), and tam has been applied to different technologies such as word processors, email, the world wide web and hospital information systems.   
  
11) tam predicts it acceptance under different conditions, such as time and culture, with different control factors. the utaut model is less parsimonious than tam   
12) tam has been applied in different forms to explain technology adoption in a wide variety of contexts, ranging from individual to organisational technology acceptance.   
  
according to legrisaet al., (2003) ―tam has proven to be a useful theoretical model in helping to understand and explain use behaviour in is implementation, and it has been tested in many empirical studies. the tools used   
  
with the model haveproven to be of quality and to yield statistically reliable results‖. tam is superior to both the tra and the tpb for explaining the variance in actual behaviour and in terms of model fit.  
  
 the use extension of the technology acceptance model   
 however, the use extension of the technology acceptance model is an ongoing process to assess the modern technologies context, including mobile service, cloud computing applications, ubiquitous computing applications which are also applicable to this study. tam has arguably become the most influential theory in the is field; with the various extended tams, the structure and main assumptions of these models remain the same as the original technology acceptance model (tam).the new variables that were added to the technology acceptance model are shown in table 8 below.   
  
author and date   
  
the added construct   
  
agarwal and prasad (1998a, 1998b)   
  
compatibility   
  
dishaw and strong (1999)   
  
task-technology fit   
  
agarwal and karahanna (2000)   
  
cognitive absorption, playfulness and self-efficacy   
  
venkatesh and davis (2000)   
  
subjective norms   
  
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moon and kin (2001)   
  
world wide web   
  
chau and hu (2002)   
  
peer influence   
  
chiu et al. (2005)   
  
personal innovativeness   
  
gefenet al. (2003) and wu and chen (2005)   
  
trust   
  
walczuchet al. (2007) and lin et al. (2007)   
  
readiness   
  
lin et al. (2007)   
  
e-stock users‘ behavioural intentions   
  
stern et al. (2008)   
  
online auctions   
  
chen et al. (2009)   
  
self-service   
  
chen and chen (2009)   
  
automotive telematics users‘ usage intention   
  
lee (2009)   
  
perceived risk and perceived benefit   
  
muller-seitz et al. (2009)   
  
―security‖ to understand customer acceptance of radio frequency identification (rfid).   
  
 table 4.8 new variables added (extensions) based on the technology acceptance model source: author   
  
some scholars have stated that, ―tam posits that perceived usefulness is the strongest predictor of an individual‘s intention to use an information technology‖ (davis, 1989; venkatesh and davis, 2000; venkateshet al., 2003). tam suggests, ―perceived ease of use has a significant influence on perceived usefulness, behaviour   
  
attitude, intention, and actual use‖ (davis, 1989; mathieson, 1991; moore and benbasat, 1991). regarding perceived ease of use and perceived usefulness, davis (1989) suggests, ―from a causal perspective, the regression results suggest that ease of use may be an antecedent of usefulness, rather than a parallel, direct determinant of usage‖. ―the goal of tam is to offer a parsimonious explanation of the determinants of adoption of it ―(davis et al., 1989). venkatesh (2000) concludes that ―tam is the most widely applied research paradigm to understand user acceptance of technology and one of the most widely used in the information systems field‖. according to other scholars, ―tam is a valid and robust model of technology acceptance (king   
  
and he, 2006) across levels of user expertise‖ (gefen, 2002) and across various contexts including social networks (hossain and de silva, 2009), health it applications, online trading (lee, 2009) and software firewalls (kumar et al., 2008). tam was developed as an attempt ―to provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behaviour across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified‖ (davis, 1989: 985). according to azmiet al. (2010), ―tam is widely used and accepted to explain the relationship between perceptions and the use of technology and the two main constructs that influence   
  
behavioural intention are pu and peu; pu is defined as the user‘s perception of the degree to which using the   
  
system will improve his or her performance in the workplace and peu is defined as the user‘s perception of the amount of effort they need to use the system‖. past researchers have provided evidence of the significant effects of peu and pu on bi (venkatesh and davis, 1996; davis et al., 1989; agarwal and prasad, 1999). similar to davis et al. (1989), the attitude construct is dropped from this extended tam model because of its weakness in mediating the impact of beliefs on behavioural intention (cited in azmiet al., 2010). regarding predicting usage, tam models might be useful within and across organisations for evaluating applications or technologies or to make comparisons between user groups or applications (fu et al., 2006). according to moody et al. (2010),   
  
―there is a large gap between the technology acceptance model (tam) and the rest: it is more than 3 times as influential as the next most cited theory, the information systems success model (ism), was developed only 3   
  
years after tam, which makes it a clear choice as the leading paradigm in the information systems field‖. benbasat and barki, (2007) also confirmed that ―tam being the most influential information systems theory and the technology acceptance model (tam) is generally referred to as the most influential and commonly employed theory in information system which is also considered to be the only well-recognised theory in   
  
information systems field‖.  
  
 ii) the theory of planned behaviour (tpb)   
the theory of planned behaviour (tpb)was proposed by ajzen (1985) and is also widely accepted and adopted in management information systems (mis) research and has the following advantages: 1) the limitation of tam is that it does not reflect the variety of user task environment and constraints, but the theory of planned behaviour incorporates subjective norm and perceived behaviour control to predict behaviour intention for using the system. the theory of planned behaviour has also been widely used to understand individual acceptance and use of different technologies.   
  
2) many studies have applied the theory of planned behaviour to investigate behaviour prediction using attitudinal variables and found that tpb is one of the most influential models in predicting behavioural intentions and behaviours. it has been comprehensively validated in the behavioural domain (ajzen, 1991; ajzen and driver, 1991; madden et al., 1992; parker et al., 1995 and ajzen, 2010).   
  
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3) the theory of planned behaviour provides more specific information that guides development (mathieson, 1991).   
  
4) the researcher considers the theory of planned behaviour to be relevant to some aspects of studies in technology adoption as it involves human behaviour, technology, professional groups, organisations and general management.there is overwhelming support for the theory of planned behaviour model‘s ability to predict behaviour; researchers continue to call for additional variables to be added to the model in an attempt to further enhance the model‘s predictive capability (conner and armitage, 1998; lutz, 2011). the theory of planned behaviour explains and predicts all human behaviour and not just it usage behaviour. paul and john (2003) suggested that tam should combine a broader one which includes variables related to human and social factors which theory of planning behavioural incorporates.  
  
table 9 summarises the progress of technology adoption research using the technology acceptance model (tam) and the theory of planned behaviour (tpb).  
  
major areas of progress   
  
technology acceptance model (tam)   
  
theory of planned behaviour (tpb)   
  
  
  
key examples   
  
cites   
  
key examples   
  
cites   
  
influential models   
  
i)technology   
acceptance model:   
ii)theory of planned   
behaviour:   
iii)innovation diffusion theory:   
  
i)davis (1989);   
davis et al.(1989)   
ii)ajzen (1985,   
1991); mathieson   
(1991);   
iii)taylor and todd (1995a, 1995b)   
agarwal and prasad (1998)   
moore and benbasat (1991)   
  
i) for the purpose of the model:   
centric comparison   
  
i)theory of planned   
behaviour: ajzen (1985, 1991)   
  
replication and generalizability   
  
i)population:   
  
ii) countries:   
  
iii)technologies:   
  
iv)organizational   
  
systems—   
  
i)adamset al. (1992); hendricksonet   
al.(1993); mathieson (1991)   
ii)japan—straub et   
al. (1997); saudi   
arabia—abdulgader and kozar (1995)   
iii) email karahanna and straub (1999);   
calculator—  
mathieson (1991);   
spreadsheet—  
mathieson (1991)   
and venkatesh and   
davis (1996);   
iv) venkateshet al.   
  
(2003)   
  
i)cross-cultural examinations   
ii)goal-directed behaviours   
iii)health   
behaviours   
  
iv) weight loss   
  
i)godin et al. (1996); hanson (1999)   
ii)ajzen and madden (1986)   
iii)connor and sparks (1996)   
iv)schifter and ajzen (1985)   
  
predictive validity   
  
i)actual use:   
  
ii) choice:iii)intention:   
  
iv)self-reported use:   
  
i) straub et al.  
  
(1995); venkatesh and morris   
(2000);venkateshet al. (2003)   
ii) szajna (1994)   
iii) davis et al.  
  
(1989); mathieson   
(1991)   
iv) davis et al.(1989)   
  
i)blood donation ii)consumer   
behaviour   
 iii)household   
cycling of   
newspapers   
iv)negotiation   
v)rehabilitation   
  
i) armitage and conner (2001b)   
ii) east (1996); fortin (2000); notani (1998) iii) boldero (1995)   
  
iv) shapiro and watson (2000)   
v) blanchard, courneya, rodgers, daub, and   
knapik (2002); godin et al. (1996)   
  
competing models   
  
i)decomposed theory of planned behaviour:   
 ii) innovation diffusion theory:   
 iii) social cognitive   
theory:   
  
iv)triandis‘ model:   
  
i) taylor and todd (1995a, 1995b)   
  
ii) moore and   
benbasat (1991)   
iii) compeau and higgins (1995a,   
1995b)   
iv) thompson et al.  
  
(1991)   
  
i)health models   
ii)triandis‘ model: iii)volunteer   
motivation   
  
i) quine et al. (1998) ii) triandis (1977)   
iii) harrison (1995)   
  
theory base to study unique   
  
i)advertising:   
  
i) rogers and chen (2002)   
  
i)adherence to speed limits   
  
i) elliott et al. (2003)   
  
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problems   
  
ii)dairy farming:   
iii)green electricity:   
iv)information adoption: v)marketing:   
  
vi)trust:   
  
ii) flettet al. (2004) iii) arkesteijn and oerlemans (2005) iv) sussman and   
seigal (2003)   
v)dabholkar and   
bagozzi (2002)   
vi) gefenet al.  
  
(2003a, 2003b)   
  
ii)ethical decision making:   
iii) smoking   
cessation   
behaviour:   
 iv)technology   
adoption:   
  
ii) flannery and may   
(2000)   
iii) bennett and clatworthy (1999)   
iv) taylor and todd   
(1995a, 1995b);   
venkateshet al. (2000)   
  
temporal dynamics and other   
contingencies   
  
i)age:   
ii)gender:   
  
iii)higher-order   
interactions:   
iv)temporal dynamics:   
  
v)voluntariness:   
  
i) morris and   
venkatesh (2000)   
ii) gefen and straub (1997); venkatesh and morris (2000) iii) morris et al.  
  
(2005)   
iv) karahannaet al.  
  
(1999); taylor and   
todd (1995a);   
venkatesh and davis (2000)   
v)hartwick and   
barki (1994);   
venkatesh and davis (2000)   
  
i)age:   
ii)gender:   
  
iii)temporal dynamics:   
  
i) armitage et al. (2002) ii) armitage et al. (2002); taylor, bagozzi, and   
gaither (2001)   
iii) doll and ajzen (1992); conner et al. (2000);   
sheeran and abraham   
(2003)   
  
temporal dynamics and other   
contingencies   
  
i)age:   
ii)gender:   
  
iii)higher-order   
interactions:   
iv)temporal dynamics:   
  
v)voluntariness:   
  
i) morris and   
venkatesh (2000)   
ii) gefen and straub (1997); venkatesh and morris (2000) iii) morris et al.  
  
(2005)   
iv) karahannaet al.  
  
(1999); taylor and   
todd (1995a);   
venkatesh and davis (2000)   
v)hartwick and   
barki (1994);   
venkatesh and davis (2000)   
  
i)age:   
ii)gender:   
  
iii)temporal dynamics:   
  
i) armitage et al. (2002) ii) armitage et al. (2002); taylor, bagozzi, and   
gaither (2001)   
iii) doll and ajzen (1992); conner et al. (2000);   
sheeran and abraham   
(2003)   
  
determinants and   
other interventions   
  
i)determinants of   
usefulness and ease of use   
  
ii)training interventions   
  
i) karahanna and   
straub (1999);   
venkatesh (2000);   
venkatesh and davis (2000)   
ii) olfman and   
mandviwalla (1994); venkatesh (1999);   
venkatesh and   
speier (1999)   
  
i)cognitive   
behavioural   
therapy   
interventions   
ii)determinants of blood donation   
behaviour   
iii)determinants of condom use   
iv)determinants of exercise intention v) determinants of vegetable   
consumption   
  
i) fishbein and ajzen   
(2005)   
ii) armitage and conner (2001b)   
  
iii) albarracin et al. (2001) iv) blanchard et al. (2002) v) bruget al. (1995)   
  
construct   
refinement and alternative   
mechanisms   
  
i)expectation-  
disconfirmation:   
  
ii)habit   
  
iii)post-adoption:   
  
i) bhattacharjee   
(2001);   
bhattacharjee and premkumar (2004) ii) : morris et al.  
  
(2005)   
iii) jaspersonet al.  
  
(2005)   
  
i)behavioural   
expectation:   
ii)dimensionality of pbc:   
iii)habit:   
  
iv)refinement of pbc:   
  
v) role of self-identity:   
  
i) warshaw and davis (1985)   
ii) chan and fishbein (1993)   
iii) ouellette and wood (1998)   
iv) terry (1991, 1993) v) sparks (2000)   
  
synthesis   
  
gefen and straub (2000); lee et al.(2003); legriset al. (2003); venkateshet al. (2003)   
  
albarracinet al. (2001); armitage and conner (2001a); fishbein and ajzen (2005)   
  
 table 9 summary of the progress of technology adoption research using the technology acceptance model (tam) and the theory of planned behaviour (tpb)   
 source: adapted from davis and morris (2007)   
  
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mathieson‘s (1991) study compared the technology acceptance model (tam) with the theory of planned behaviour (tpb) and identified that: i) the technology acceptance model (tam) was specifically designed by davis (1986) to predict use of an is; ii) the theory of planned behaviour (tpb) was discussed by ajzen (1985, 1989); iii) the theory of planned behaviour (tpb) was designed to predict behaviour across many settings and can be applied to is use; and iv) these models were compared using three criteria: (1) how well do   
  
they predict the user‘s intention to use an is? (2) how valuable is the information provided by the model? (3) how difficult are the models to apply?   
  
 there are three differences between the technology acceptance model (tam) and the theory of planned behaviour (tpb), which are as follows:   
1.generality   
 the technology acceptance model assumes that beliefs about usefulness and ease of use are always the primary determinants of use decisions. its constructs are measured in the same way in every situation. the advantage of the theory of planned behaviour‘s approach is that all respondents are making the same comparison. it uses beliefs that are specific to each situation. the disadvantage of the approach is that this reference point may not apply to all individuals. tpb‘s items require an explicit behavioural alternative if they are to be as specific as possible. this theory is more difficult to apply across diverse user contexts than the technology acceptance model.   
  
 2. social variables   
 the technology acceptance model does not explicitly include any social variables. thus motivation is more likely to be captured by the theory of planned behaviour than by the technology acceptance model. the theory of planned behaviour incorporates social norms and perceived behaviour control.   
  
3. the models treat behavioural control differently.   
  
referring to the skills, opportunities, and resources needed to use the system, the only variable included in tam is ease of use (internal control factors), while the external control factors such as time, opportunities and cooperation of others were included in tpb.   
  
 7. findings and conclusions   
 we have covered well-established research theories and models that have contributed to the development of the conceptual framework of technology adoption such as the theory of reasoned action (tra) (fishbein, 1967, fishbein and ajzen, 1980), theory of planned behaviour (tpb) (ajzen, 1991), technology adoption model (tam) (davis, 1989, davis et al., 1989) and the unified theory of acceptance and use of technology (utaut) model. attempt was made to summarise other theoretical frameworks applied to it system adoption; suggested justification for choosing the technology acceptance model (tam) and the theory of planned behaviour (tpb) in most research work involving technology adoption. we identified three significant differences between tam and tpb.   
  
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[2].  
  
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[7].  
  
[8].  
  
[9].  
  
[10]. [11]. [12]. [13].