



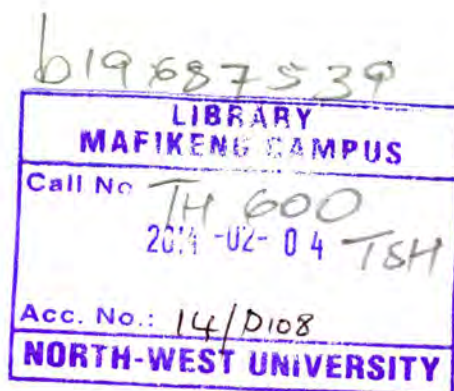
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**Acceptance model and use of technology in the Science and Technology
domain**

M V Tshivhase

Mini-dissertation submitted in partial fulfilment of the requirements for the degree Master
in Business Administration at the Mafikeng Campus of the North-West University



Supervisor: Prof N Mavetera

November 2012

DECLARATION

I, **Tshivhase Makondelele Victor** declare that the mini-dissertation hereby submitted in partial fulfilment of the Master's Degree in Business Administration is my own work and has not been previously submitted by me for any degree at any University. It is my own work in design and execution. The material contained herein has been duly acknowledged.



Signature

November 2012

Date

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I would like to thank my supervisor Assoc. Prof. N Mavetera for his guidance throughout this study.

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I wish to express my love and gratitude to my beloved family for their understanding and endless love throughout the duration of this study.

ABSTRACT

The research is intended to develop the Technology Acceptance Model (TAM) in the science domain and determine whether it could provide enough explanation of the acceptance in terms of perceived usefulness and perceived ease of use, and attitude towards use and intention of use in the science and technology domain. The study has investigated the contribution to technology acceptance by examining a research model that integrates age, gender, technology competency and the difference in the acceptance and use of technology and research equipment across the fields of science, engineering and technology. This study has analysed how age, gender and technology competency influence perceived ease of use, perceived usefulness, attitude towards use and intention of use in the science and technology domain. The study has revealed that age in relation to perceived usefulness and intention to use is not a factor. Gender in terms of perceived usefulness and attitude towards use is also not a factor. From this survey the technology competency factor was neither proved nor rejected, because in two of the survey questions respondents agree while in the other two they disagree. Therefore further study with a larger sample (much more than 40) is recommended to shed more light on this question. The full scope of research envisages that scientists, engineers and technologists form the sample of the respondents. However, there was difficulty in finding the two other groups, namely engineers and technologists. Therefore the conclusions drawn about difference in the acceptance and use of technology and research equipment across the fields of science, engineering and technology would be of limited applicability.

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Appendix A.

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AFFIRMATION

I hereby affirm that I have edited the mini-dissertation of MV Tshivhase, Acceptance model and use of technology in the Science domain, which he submitted in the partial fulfilment of the requirements for the degree Masters of Business Administration at the North-West University, Mafikeng Campus.

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Date: 2 December 2012

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Chapter 1

Overview

1.1 Introduction

The researchers and practitioners in the fields of Nuclear Engineering, Nuclear Science and Nuclear Technology use different types of technology to perform their research and daily work respectively. The hardware technologies in these fields range from the ancient Nuclear Instrumentation Methods (NIM) established in 1964 to the latest hand-held monitors and the software technology ranges from the Virtual Address Extension (VAX) based to the latest Windows software.

The purpose of the research is to develop the Technology Acceptance Model (TAM) and determine whether it could explain adequately the acceptance in terms of perceived usefulness, perceived ease of use, attitude towards use and intention of use in the science and technology domain.

1.2 Background and context

Nuclear technology plays an important role in medicine, industry, science, food and agriculture, as well as in power generation. Nuclear research has benefited mankind in many ways. Nevertheless, today the nuclear industry faces huge and very complex issues. The greatest challenge is how the risk factor of nuclear waste can be minimised. The future will depend on advanced engineering, scientific research, and the involvement of an enlightened citizenry.

In the quest to answer these and many other questions, researchers in the fields of nuclear sciences, nuclear engineering, and nuclear technology use specialised pieces of equipment to detect particles and perform research. The software and hardware designated for these tasks are used as interface between equipment that analyse the signal and the detectors. The hardware technologies range from the 1964 NIM standard to the latest hand-held monitors, and the software technology ranges from the VAX Virtual Memory System based on the latest Windows software. In most cases

researchers and practitioners have to use certain software or hardware because it is the only compatible technology.

The challenge is whether or not there is a single model in Science, Engineering and Technology (SET) for the acceptance of the various technologies. In the case where the reliability of technology equipment has to be validated, is there an accepted model to perform the task?

1.3 Structure of the dissertation

This document consists of five chapters. The overview of the study is presented in Chapter 1, which includes the following sections: Introduction to the study, background of the study that explains how the problem was discovered, the problem statement in which the issues to be investigated are presented, the research objectives in which the objectives of the study are presented, and the research questions in which the specific research questions posed in the study are presented. Chapter 2 presents the literature review that is relevant to the acceptance model, and the methodology followed in this study is discussed in chapter 3. The data analysis is presented in chapter 4, while the conclusion and recommendation of this study will be discussed in chapter 5.

1.4 Problem statement

The theory of acceptance model

According to Davis *et al.* (1989) and Dillon and Morris (1996), the theory of acceptance model is based on the theory of reasoned action from which Davis developed the TAM which deals more specifically with the prediction of the acceptability of an information system. The purpose of this model is to predict the acceptability of a tool and to identify the modifications which must be applied to the system in order to make it acceptable to users. This model suggests that the acceptability of an information system is determined by two main factors: perceived usefulness and perceived ease of use.

Statement of research problem

The following search engines; Google scholar, Web of science, LexisNexis and EBESCO, were used to search for the keywords: Technology Acceptance Model, Perceived usefulness, Perceived ease of use, user acceptance, usability, theory of reasoned action, innovation diffusion theory and information technology. The snapshot of the results from one the search engines is attached in figure 1.1.

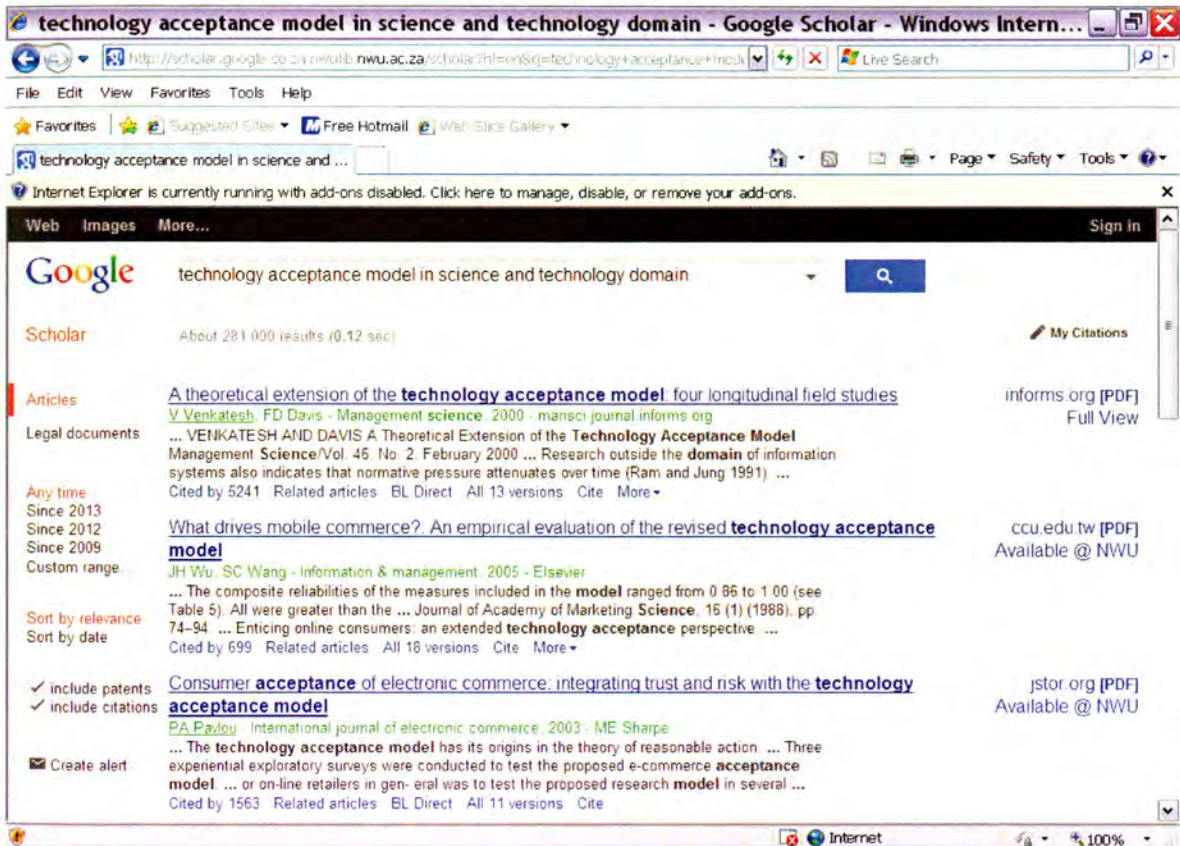


Figure 1.1: The snapshot of the results from the Google scholar search engine.

At the moment there appears not to be an acceptance model in Science, Engineering and Technology (SET) for the review in documents of acceptance of technology and the validation of equipment. Reviews of generated data and documents within different SET companies, research and academic institutions are not standardised.

Technology normally forms part of practical work in SET. However, the use of technology is not well accepted in some instances where people are forced to use it. This is especially true in the case where experiments have to be validated or information quality has to be accepted. In this case, there is no general way of specifying what is or is not acceptable, therefore there is a need to develop an acceptance model to address the above-mentioned problem.

To develop the acceptance model, data will be collected by means of the structured questionnaire among the participants in the field of SET. The questionnaire is presented in Appendix A.

1.5 Research objectives

The objectives of the study are to establish

1. whether or not age difference is a factor in the acceptance and use of technology and research equipment;
2. whether or not gender difference is a factor in the acceptance and use of nuclear technology and research equipment;
3. whether or not technology competency is a factor in the acceptance and use of nuclear technology and research equipment; and
4. whether or not there is a difference in the acceptance and use of technology and research equipment across the fields of science engineering and technology.

1.6 Research questions

The specific research questions to be examined are listed as follows:

1. Is age difference a factor in the acceptance and use of technology and research equipment?
2. Is gender difference a factor in the acceptance and use of nuclear technology and research equipment?
3. Is technology competency difference a factor in the acceptance and use of nuclear technology and research equipment?

4. Is there a difference in the acceptance and use of technology and research equipment across the fields of science, engineering and technology?

1.7 The research model

This research proposes a model for explaining and predicting the acceptance of technology in science engineering and technology fields. Based on the theories of TPB and TAM, the proposed model includes constructs and relationships which may prove to be important in the context of SET. The individual factors include three demographic characteristics of the professionals in SET (i.e. age, gender, and technology competency), attitude towards technology, ease of use of technology, usefulness of technology, and intention to use it.

1.8 Research scope and delimitation

The full scope of research envisages that scientists, engineers and technologists form the sample of the respondents. However, there is difficulty in finding two of the groups, namely engineers and technologists. Therefore the conclusions drawn will be of limited applicability.

1.9 Ethical requirements

Ethics statement

This research does not deal with issues of human behaviour or animals and it does not require ethics clearance.

1.10 Summary

This summary gives a brief overview of chapter 1. In this chapter the introduction to the study was presented in the following order: The background of the study that explains how the acceptance model problem was discovered; the structure of the dissertation that maps out the structure of the final report of the study; the problem statement in which the issues to be investigated are discussed; the research objectives section that outlines objectives of the study; the research questions which present the specific research questions posed in the study; the research model; the research hypotheses; the research scope and delimitation section in which the limitations of the study are

discussed; and finally the section, ethical requirements, in which the ethical statement of the study is presented.

Chapter 2

Literature review

2.1 Overview

Davis (1985) proposed the original TAM, in which the system use is a response that is related to the user motivation, which in turn is also related to the external stimuli, and the system's features and capabilities. TAM was developed by Fishbein and Ajzen in 1975 and evolved from the influence of the Theory of Reasoned Action (TRA), in which the actual behaviour of the person is directly related to the intention and beliefs about the given behaviour.

In this chapter the literature about topics related to TAM is reviewed under the following sections; technology acceptance model, perceived usefulness, perceived ease of use, user acceptance, usability, acceptability, theory of reasoned action, innovation diffusion theory, information technology and conclusion.

2.2 Technology Acceptance Model

In TRA the relationship between intention and actual behaviour is called the behavioural intention and was used to measure intention to perform behaviour. Davis (1985) then suggested that the motivation can be explained by perceived ease of use, perceived usefulness, and attitude toward using the system. In this case the attitude is influenced by the perceived ease of use and perceived usefulness. The perceived usefulness and ease are in turn directly influenced by the system design characteristics (Chuttur, 2009).

Holden and Karsh (2010) critically examined whether TAM is a fitting theory for health care. The objectives were to undertake a comprehensive, critical review of studies of TAM with respect to health Information Technology (IT) focusing on how technology is used in the health care context, to judge the efficacy of TAM and its worth as a theory of health IT acceptance and use, and also to propose avenues of change and extension to the theory in an effort to improve its usefulness to decision makers.

The findings were that TAM was a poor fit for physicians' acceptance of health IT, but it performed better in later tests. Holden and Karsh (2010) confirmed that there is interest in TAM in health care and ample opportunity for its success.

Flett *et al.* (2004) performed a study to determine whether the TAM model could give a better explanation about the adoption and use of dairy farming technologies. Their second aim was to determine the extent to which economic factors influence New Zealand dairy farmer decision making, technology adoption and use. They tested the TAM model with four different farming technologies to provide a representative view of farmer behaviour and to determine if the decision-making process varies with different farming technologies.

Flett *et al.* (2004) found that farmers evaluate the usefulness of technology, but also separately consider its ease of use. These results are consistent with the TAM that proposes that perceived usefulness and perceived ease of use are the two major casual pathways that determine user acceptance and usage behaviours.

Lai *et al.* (2010) studied the contribution to IT acceptance research by examining a research model that integrate Diffusion of Innovations and TAM in the context of Internet banking acceptance. They examined the validity of Diffusion of Innovations and TAM in the context of Internet banking acceptance. They also compared the performance of Diffusion of Innovations and TAM in explaining the variance of technology acceptance in their study context and finding out if the model integrated from the two could be extended to the theoretical capacity of each single theory.

The integrated model was found to be useful in explaining variances in Internet banking acceptance. Most of the independent and integrative paths proposed in the model were found to be highly significant in influencing, either directly or indirectly, the intention to use Internet banking.

Yi *et al.* (2006) performed the study to understand the determinants of IT professional users' intention to use a new IT from an integrative perspective of three related and robust theoretical paradigms. The acquired knowledge would help IT practitioners identify the essential building blocks of those conditions in which acceptance of

technology could be more effectively promoted and facilitated. It was found that IT is becoming an integral part of the work of professionals, marking the examination of factors critical to technology acceptance by professional users essential for its success.

Cheng *et al.* (2011) investigated whether the differences in gender, age, and occupation showed significance in the utilisation of mobile devices. They figured out whether the variation may influence the performance expectancy, effort expectancy and social influence to the behavioural intention or even to the behaviour of usage.

The study showed that social influence would have a positive effect on behavioural intention to the use of mobile-learning (m-learning). Their interpretation was that the more employees in the three major occupations in Taiwan are using mobile devices to access mobile learning, the more significant others thought that they could use the mobile device and the more they would have behavioural intention to use one (Cheng *et al.*, 2011).

Lu *et al.* (2009) used the Theory of Planned Behaviour (TPB), the TAM and the flow theory to examine Chinese users' acceptance of Instant Messaging (IM) products. It is a critical factor that can lead to a larger installed base of users and market share. Their study demonstrated that IM users are concerned about both extrinsic and intrinsic motivation. They not only expect a useful and easy-to-use IM platform, but also want to have fun and enjoy a flow experience. Additionally, flow as a comprehensive concept deserves more research attention in the Information Systems and e-commerce context.

The study by Kim *et al.* (2009) focused on the usage of groups of features, especially of Generalised Audit Software (GAS) for internal audit (IA) professionals. Audit staff require background in data analytic technologies to perform their audit tasks. It was found that there is a negative relationship between feature complexity and technology acceptance in the internal audit profession. It was also found that the perceived ease of use has more impact on the usage of advanced features than perceived usefulness.

In their study, Un Jan and Contreras (2011) investigated how to encourage students to use an Academic Administrative Information System (AAIS) which formulates and validates a model that explains behaviour of students in their daily work. Their study

confirmed that perceived usefulness influences attitude toward technology, behaviour intention, subjective norm influences on attitude toward technology, and attitude influences on the intention to use technology.

Chen *et al.* (2007) studied the critical antecedents of motorists' intention of electronic toll collection (ETC) service adoption by integrating the TAM and TPB perspectives. This research revealed that attitude, subjective norm, and perceived behavioural control could positively influence motorists' intention of ETC service adoption. It also emphasises that the impact of perceived behavioural control has the strongest effect on adoption.

According to Jones and Fox (2009), older adults in the United States are the fastest growing group of users of the Internet. The study by Chung *et al.* (2010), firstly, applied the TAM to the context of online community participation and tests its validity in an online application. Secondly, it examined the relationship of Internet users' age to perceptions of online communities and their future likelihood of participation. Thirdly, it extended the TAM by including age as a moderator and explored the moderating role of age in the process of predicting the intention of future participation.

In this study, Chung *et al.* (2010) applied the TAM model in the context of online communities and attempted to extend it with the moderator of age. It examined age differences in perceptions of online communities and the relative importance of the factors affecting future intention to participate in online communities. The results provided partial support for the propositions of the TAM, age differences in external variables, and the moderating role of age.

Chung *et al.* (2010) emphasised that the study replicated the key propositions of the TAM in the context of online communities, focusing on age differences and their impact on participants' future intention to take part in those communities. The study contributed to the literature on the TAM in two aspects: Firstly, they found no significant influence of PEOU on PU, in contrast to most TAM studies; and secondly, age, contrary to expectation, did not play a moderating role in predicting future intention to participate in online communities.

According to the TAM, perceived usefulness, perceived ease of use, institutional norms and organisational characteristics are powerful determinants of the usage of information systems at work (Davis, 1989). Both theories are repeatedly applied to examine the diffusion of new technologies in different social or institutional contexts. Few empirical studies have tried to incorporate them together to predict various types of intra-organisational adoption (Zhou, 2008).

Focusing on Internet adoption, Zhou (2008) established an integrated theoretical framework to compare the roles of different psychological, individual and institutional factors in organisational members' voluntary and forced adoption of information technologies. The study chose the Chinese journalists as research subjects because of the methodological conveniences of conducting the large-scale survey in the author's motherland. The main purpose of the study was not descriptive investigation but theoretical development; its findings were not confined to the Chinese journalistic context but could be applied to understanding the diffusion of the Internet (or other new technologies) in other occupations, as well as in other societies.

Qazi (2006) assessed the use of "Personal Computer Technology" in public organisations of developing countries in South Asia. In the related study, Hamner and Qazi (2009) expanded the TAM by adding additional external factors, such as Organisational Culture and Individual Factors and belief factors such as Perceived Personal Utility.

Financial compensation to employees was used as a control variable because preliminary data analysis showed that it explicitly differentiated results of the study between those employees who felt they were adequately rewarded and those who felt that they were not.

Alsajjan and Dennis (2010), proposed a revised TAM to measure consumers' acceptance of Internet banking, the Internet banking acceptance model (IBAM).

Data were collected from 618 university students in the United Kingdom and Saudi Arabia. The results suggested the importance of attitude in such a way that attitude and behavioural intentions emerge as a single factor, denoted as Attitudinal Intentions (AI). Structural equation modelling confirms the fit of the model, in which perceived usefulness and trust fully mediate the impact of subjective norms and perceived manageability on AI. The invariance analysis demonstrates the psychometric equivalence of the IBAM measurements between the two country groups.

At the structural level, the influence of trust and system usefulness on AI varies between the two countries, emphasising the potential role of cultures in Information System (IS) adoption. The IBAM is robust and parsimonious, explaining over 80% of AI (Alsajjan & Dennis, 2010).

Yanga and Yoo (2004) elaborated Davis *et al.*'s TAM by considering both the affective and the cognitive dimensions of attitude and the hypothesised internal hierarchy among beliefs, cognitive attitude, affective attitude and Information Systems (IS) use. Many earlier findings in TAM research were supported, but the mediating role of affective attitude between cognitive attitude and IS use was not confirmed.

Yanga and Yoo (2004) argued that their results cast doubts on the use of the affective attitude construct in explaining IS use and also found that cognitive attitude is an important variable to consider in explaining IS usage behaviours. Their results, Yanga and Yoo (2004), suggested that attitude deserves more attention in IS research for its considerable influence on the individual and organisational usage of IS.

Pavlou (2001) developed and empirically validated a model to predict intentions to transact by integrating trust in electronic commerce (EC) with the TAM. The impersonal nature of the online environment and the technological unpredictability of the Internet reduce consumer perceptions of control over their online transactions, making trust an inevitable component of EC. Since intentions to use a Web retailers' interface for transactions necessitate an element of trust, perceived risk is incorporated as a direct antecedent of intention to transact.

According to Pavlou (2001), following TAM, intentions to transact are also influenced by both perceived usefulness and perceived ease of use. The resulting research model was validated using data from 52 subjects and the results give substantial support for the proposed hypotheses, while explaining 76% of the variation for intention to transact in EC. This research validated TAM outside the workplace, suggesting that by including trust in EC, it could extend into consumer online behaviour.

According to Turner *et al.* (2010), the TAM was proposed in 1989 as a means of predicting technology usage; it is usually validated by using a measure of behavioural intention to use (BI) rather than actual usage.

Turner *et al.* (2010) examined the evidence that the TAM predicts actual usage, using both subjective and objective measures of actual usage. A systematic literature review based on a search of six digital libraries was performed, along with vote-counting meta-analysis to analyse the overall results.

The search identified 79 relevant empirical studies in 73 articles. The results show that BI is likely to be correlated with actual usage. However, the TAM variables perceived ease of use (PEU) and perceived usefulness (PU) are less likely to be correlated with actual usage (Turner *et al.*, 2010).

The review advised that care should be taken using the TAM outside the context in which it has been validated. E-readers, or devices designed primarily for reading e-books, are taking the world by storm. Several papers in library studies and education have examined e-book consumption for academic reading, argue Read *et al.* (2011). However, no previous marketing study has investigated consumers' adoption of e-readers for pleasure reading.

To address this gap Read *et al.* (2011) tested an extended version of the TAM with emotional attachment (TAME) in this context. Consumers' attachment to paper books was proposed as a barrier to their adoption of e-readers. Read *et al.* (2011) further

argued that this is a key deficiency of the TAM, being its focus on cognition at the expense of consumer emotion.

A three-phase study finds support for the TAME, with 64% of the variance explained in consumers' intentions to adopt e-readers (Read *et al.*, 2011). Emotional attachment to paper books is found to be weakly and negatively associated with consumers' attitude toward using e-readers. The qualitative findings suggest that e-reader adoption may not involve a binary choice between paper and e-formats.

Based on the belief–attitude–performance chain, Shih (2004), combined Davis's TAM and the information behaviour model, and developed an extended TAM for Internet use. The theoretical model was tested using questionnaire survey of 203 Taiwanese office workers (Shih, 2004).

The analysed results confirmed TAM and also showed that the relevance of information needs strongly determines perceived usefulness, perceived ease of use, user attitudes toward Internet use for information seeking, and individual performance during the use of information stage (Shih, 2004).

Shih (2004) argues that relevance has more positive effect on perceived performance and perceived usefulness for enterprise Intranet users than for simple/interactive Intranet users. Enterprise Intranet users have higher positive attitudes toward the Internet and greater positive perceptions of system effectiveness for supporting office tasks than simple/interactive Intranet users (Shih, 2004).

Perceived ease of use is the main determinant of user attitude toward Internet use in both enterprise Intranet and simple/interactive Intranet applications. The extended TAM explains the behaviour of enterprise Intranet users better than that of simple/interactive Intranet users (Shih, 2004).

Koufaris (2002), considered the online consumer as both a shopper and a computer user. The constructs were tested from information systems (Technology Acceptance Model), marketing (Consumer Behaviour), and psychology (Flow and Environmental Psychology) in an integrated theoretical framework of online consumer behaviour. The study examined how emotional and cognitive responses are related to visiting a Web-based store for the first time can influence online consumers' intention to return and their likelihood to make unplanned purchases. The instrumentation showed reasonably good measurement properties and the constructs were validated as a nomological network (Koufaris, 2002). A questionnaire-based empirical study was used to test the nomological network. The results confirmed the double identity of the online consumer as a shopper and a computer user because both shopping enjoyment and perceived usefulness of the site strongly predict intention to return.

According to Koufaris (2002), the results on unplanned purchases were not conclusive. Tests were performed on some individual and website factors that can affect the consumer's emotional and cognitive responses, namely product involvement, Web skills, challenges, and use of value-added search mechanisms. It was found that all have a significant impact on the Web consumer (Koufaris, 2002).

In the study Koufaris (2002), provided a more rounded, albeit partial, view of the online consumer and took a significant step towards a better understanding of consumer behaviour on the Web. Koufaris argued that the validated metrics should be of use to researchers and practitioners alike.

The continuous growth of the e-learning market stimulated discussion regarding effective e-learning methodology and the choice of media (Liu *et al.*, 2009). Liu *et al.* (2009) considered 'Streaming' as an effective method for providing e-learning, because it enables audio and video files to begin playing before the entire file has been downloaded, thus creating a more interactive learning environment (Liu *et al.*, 2009).

Liu *et al.* (2009) proposed an integrated theoretical framework for the user's acceptance behaviour of Web-based streaming media for e-learning. The research framework considered the e-learning user as both a system user and a learner. Concepts from information systems TAM and human behaviour and psychology (flow theory) were tested with reference to the adoption of Web-based streaming media for e-learning (Liu *et al.*, 2009). TAM was found to be the most widely accepted theory among information-system researchers for studying the system-acceptance behaviour of users. Liu *et al.* (2009) used flow theory to study the influence of user concentration on task activity. Their research framework exploits basic model of TAM and then integrates TAM with flow theory so as to predict the acceptance behaviour of learners (Liu *et al.*, 2009).

IT acceptance has been the subject of much research in the past two decades. Several theories have emerged that offer new insights into acceptance and use at both the individual and organisational levels. Among these theories, the TAM has received more attention (Plouffe *et al.*, 2001). A cumulative tradition has already been established in its research, especially in management and IS disciplines. However, according to Hu *et al.* (1999) the validity and applicability of TAM still need to be extended to incorporate different technologies, users, and organisational contexts.

The argument is also true when studying the e-banking system, where the technology settings and transaction environments are completely different from the traditional environment (Lai & Li, 2005). Lai and Li (2005) validated the TAM instrument in the context of Internet banking focusing on age, gender and IT competence factors.

The demographic variables were chosen because they may have effects on an individual's adoption decision. Literature, Lai and Li (2005), has suggested that these variables are critical factors. The instrument must be carefully validated to prove invariance to these demographic variables and confirm the hypothesised effects (Lai & Li, 2005).

The research addressed the inadequacy in the understanding of technology adoption by merging the TAM and PAD (the Pleasure, Arousal, and Dominance paradigm of affect)

models. The study examined an enhanced view of cognition (Kulviwat *et al.*, 2007). The product of the unified theoretical framework is known as the Consumer Acceptance of Technology (CAT) model. The results of a test provided empirical support for the model. The CAT model explained over 50% of the variance in consumer adoption intentions with a considerable increase compared to TAM.

The conclusions suggested that enormous improvement in the prediction of technology adoption decisions is possible by using the CAT model. Kulviwat *et al.* (2007) believe that marketers of high tech products are more successful when they take emotions into account during the marketing process of a product. Most prior technology adoption research has focused on cognition and ignored the potential role of the effect. The theories have highlighted what people believe about an innovation (Rogers, 2003; Davis, 1989).

The research developed and empirically tested a unified theory of consumer acceptance of technology. The primary objective was to incorporate the well-known PAD paradigm of affect into the TAM (Davis, 1989), the most popular model used for predicting technology adoption.

The research, in conjunction with other studies, that examined the role of affect in predicting adoption intention should serve as a caution to other consumer researchers that basing their behavioural predictions on cognition alone leads to significantly deteriorated prediction ability. The study concluded that comprehensive and integrative models of cognition and affect such as CAT provide useful explanations of technology acceptance (Kulviwat *et al.*, 2007).

2.3 Perceived usefulness

It is widely accepted that the use of IT/IS in the health care sector and in hospitals not only offers great potential for improving the quality of services provided and the efficiency and effectiveness of the personnel, but also for reducing the organisational expenses (Scott, 2007).

Aggelidis and Chatzoglou (2009) tested the applicability and effectiveness of Technology acceptance models TAM in the health care area in Greece and examined the way various factors affect the intention of public health institutions' personnel in using IT/IS. To achieve this goal, a modified TAM was developed and tested using the structural equation modelling (SEM) approach.

In this study it was found that the core constructs of TAMs (perceived usefulness, ease of use, social influence and attitude) significantly affect hospital personnel behavioural intention, which implied that the main aspects of TAMs apply to Greece as well (Aggelidis & Chatzoglou, 2009).

The importance of training for explaining behavioural intention is also highlighted. More specifically, training has a strong but indirect positive effect on behavioural intention (in contrast to what has been found by other researchers) through the mediators of facilitating condition and ease of use. These two moderators are the factors with the higher impact on behavioural intention (Aggelidis & Chatzoglou, 2009).

Chu and Chu (2011) studied a research model for explaining the relationships between intranet adoption and newcomers' organisational socialisation in the hotel industry. Data were gathered from 298 individual participants, who had only worked in a hotel for six months to one year, for a SEM analysis. The research results showed the mediation role of the perceived usefulness (PU) and perceived ease of use of the intranet. The SEM results also confirmed that usage of the intranet did increase the extent of an employee's socialisation into the organisation. The results revealed that PU has direct and indirect effects on socialisation. Measurements on gender and age differences were performed.

The analysis of the model showed that both genders demonstrated the same patterns in performing technology acceptance factors and socialisation, whereas different age groups demonstrated significantly different paths. The direct effect of PU was not significant for the newcomers aged over 35 (Chu & Chu, 2011).

Schepers and Wetzels (2007) examined the convergence or divergence of TAM relationships across different settings to make better claims on and give an objective picture of results of research using TAM in recent years. Since the field has been dominated by quantitative research approaches, Schepers and Wetzels (2007) conducted a meta-analysis on the literature, integrating a large volume of results to determine whether research findings were homogeneous. The study added to two previous metastudies. Ma and Liu (2004) also provided a quantitative meta-analysis, but only focused on three relationships, namely perceived usefulness with perceived ease of use, perceived usefulness with technology acceptance (use), and perceived ease of use with technology acceptance (use). Legris *et al.* (2003) performed a qualitative meta-analysis and concluded that TAM was a useful model, but had to include human and social change process variables (e.g. the subjective norm). To address their limitations, Schepers and Wetzels (2007) included the subjective norm in their analysis and additionally considered the impact of three types of settings as moderating variables. Schepers and Wetzels (2007) also used structural equation modelling to assess overall model fit and identified additional paths to improve the model.

Choi and Totten (2011) investigated the effects of cultural differences (individualism vs. collectivism) on the acceptance of mobile TV by identifying self-construal (independent vs. interdependent) as a possible antecedent of the TAM. Surveying 817 university students in Korea and the United States, the study found that TAM is consistently stable across countries, and that individual-level cultural orientation had significant effects on the model as a direct antecedent of TAM. Choi and Totten (2011) found that the relationships between self-construal and TAM variables were rather mixed. Hypothesised interdependence was more important for the Koreans' subjective norms and perceived usefulness, whereas independence was more important for the Americans' subjective norms. Unexpectedly, however, the direction was reversed in the case of perceived ease of use. Moderating effects of country culture appeared also in the relative effects of perceived ease of use and perceived usefulness on attitude. Perceived ease of use was more important for attitude in the US, while perceived usefulness mattered more in Korea. By adding self-construal as an antecedent variable, the study

effectively explains how users' individual value orientation shapes TAM. The approach can provide deeper understanding into the adoption of new technology and suggest to marketers better strategies for directly dealing with consumer characteristics in promoting mobile TV technology (Choi & Totten, 2011).

Venkatesh *et al.* (2003) worked and compared the variables in eight different models about users' technology acceptance including the TAM (Davis, 1989), and diffusion of innovation (DOI) (Rogers, 1983). Venkatesh *et al.* (2003) developed a unified theory of acceptance and use of technology (UTAUT), which consisted of four main determinants of acceptance/use and four moderating factors.

Im, Kim, and Han (2008) argue that although such models explain much of the variance, there seem to be two critical factors that are overlooked or have received inadequate attention—Perceived Risk (PR) and technology type. PR has been recognised as an important factor and was modelled as an antecedent of Perceived Usefulness (PU), and a sub-construct of others, such as trust (or as its antecedent) (Pavlou, 2003). However, PR was not considered in UTAUT.

According to Im *et al.* (2008), the decision to use a technology is affected by the technology type. According to the above argument the effects of PU and perceived ease of use (PEU) on behavioural intention (BI) would be similar for different technologies.

The study focussed on two moderating variables: PR and technology type, including the moderating variables in UTAUT and tested how these moderating variables moderate the effects of PU and PEU on users' intention to use a technology. The study demonstrated that the PR and technology type were moderating variables (Im *et al.*, 2008).

The study examined consumer acceptance of the Internet in different situations mainly as a dichotomy (adoption/non-adoption), thus ignoring the process underlying adoption

(McKechnie *et al.*, 2006). The aim was to provide insights into factors determining the extent to which an innovation is adopted.

The paper of McKechnie *et al.* (2006), reviewed the literature on the TAM, and justified the use of this model to explore the factors contributing to the extent to which consumers use the Internet as a distribution channel for financial services (FS). Data were collected through telephone interviews with 300 UK consumers responding to a questionnaire.

It was found that the application of the TAM model is helpful, but additional links need to be included. The key drivers of extent of use are past experience with the Internet as a purchasing channel (for non-FS) and attitudinal aspects, i.e. positive emotions towards the Internet as a distribution channel for FS. Insecurity about this channel does not appear to be an obstacle and perceived usefulness is not directly linked to extent of use but fully mediated via attitude towards the channel. Consumers with computer access from home, those with an active interest in FS, as well as consumers who have general online purchasing experience tend to find this channel easy to use, which, jointly with perceived usefulness, leads to a positive attitude toward this distribution channel (McKechnie *et al.*, 2006).

The study investigated students' acceptance of an Internet-based learning medium (ILM), by including a motivational perspective into the TAM. Lee *et al.* (2005) included extrinsic (perceived usefulness and ease of use) and intrinsic (perceived enjoyment) motivators for explaining students' intention to use the new learning medium.

Data collected from 544 undergraduate students were examined through the LISREL VIII framework (Lee *et al.*, 2005). The results showed that both perceived usefulness and perceived enjoyment significantly and directly impacted their intention to use ILM. Perceived ease of use did not have a significant impact on student attitude or intention towards ILM usage. Implications of this study are important for both researchers and practitioners (Lee *et al.*, 2005).

Organisations are always developing means to gain competitive advantage using systems like the ERP systems (Basoglu *et al.*, 2007). It was shown in previous studies that failures of ERP projects were due to the results of poor project communication (Somers & Nelson, 2004), lack of top management support (Al-Mashari *et al.*, 2003), existence of cultural differences (Yusuf *et al.*, 2004), low user acceptance levels (Amoako-Gyampah, 2007), inadequate integration of systems (Al-Mashari *et al.*, 2003), user dissatisfaction (Calisir & Calisir, 2004), inadequate training (Gupta, 2000), underestimation of resources needed for building a new ERP system (Granebring & Revay, 2005), and lack of buy in by employee in using the systems (Shih, 2006). The failure of the ERP systems continues to increase and this has prompted the search for new solution.

TAM is a model that can be applied to different technologies. It has been criticised for not providing sufficient information on individuals' opinions about novel systems (Moon & Kim, 2001). Calisir *et al.* (2009) propose that the constructs of TAM need to be extended by including more factors. The suggested technology, the users of technology and how it should be used is taken into account when choosing additional factors (Moon & Kim, 2001). Calisir *et al.* (2009) examined the research model in which TRA was incorporated into the TAM.

The growth of Weblogs (blogs), on the Internet has been phenomenal. Originally an online writing tool that helped its users keep track of their own online records, the blog quickly turned into a key part of online culture. The method provides an easy way for an average person to publish material of any topic one wishes to discuss in a website. With a popular issue, a blog can attract tremendous attention and exert great influence on society. Famous examples include "War on Terrorism" after the September 11, 2001 attacks; the fall of Trent Lott; the controversies of the Iraq war; the 2004 US presidential elections; etc. (JuiceeNewsDaily, 2005). The blog has become a new and significant way of information distribution. Blogs have grown in popularity (Hsu & Lin, 2008).

Hsu and Lin (2008) investigated why blog participants (bloggers and readers) participated. Blog participants need to be willing to use blogging tools provided by blog-hosting services. Hsu and Lin (2008) argued that since blogging is an act of sharing, a new form of socialisation, the study focused the investigation on the technology acceptance, knowledge sharing and social influence. Hsu and Lin (2008) found that ease of use and enjoyment appeared to be important variables in the context of blogs. Enjoyment was found to have the most significant influence on attitudes, with a coefficient much higher than others ($b = 0.67$). The perceived usefulness had no effect on the use of the blog. The results are in agreement with previous studies which argued that perceived usefulness played a critical factor only in work-related environments (Moon & Kim, 2001).

On the other hand, the intrinsic motivation such as enjoyment may be the most significant antecedent of attitude toward using IT. The findings of the study were that if users did not perceive blogging as enjoyable they were unlikely to contribute to it, which is hardly surprising. Ease of use was another essential factor. Indeed, an easy-to-use interface could influence a user's preference while difficulties can create user resistance, which reinforces the general beliefs that blog-hosting service providers should continue to develop tools that require minimum effort to learn and use. Only two factors, altruism and reputation, affected a user's attitude, while other knowledge-sharing motivation factors had no significant effect (Hsu & Lin, 2008).

People participating in blogs were motivated intrinsically to contribute knowledge to others because they enjoy helping others. Knowledge sharing in the context of task-oriented organisation, however, stressed the importance of external rewards such as a reciprocal benefit and anticipated reciprocal relationships (Hsu & Lin, 2008).

2.4 Perceived ease of use

Approximately 68% of American adults use the Internet and marketers are destined to reap the benefits associated with technology-based marketing strategies. However,

Internet usage rates associated with these demographic groups are lower than that of the general population (Lenhart *et al.*, 2003). Porter and Donthu (2006) studied why there are differential rates of Internet use, based on age, education, income and race.

The TAM suggests that perceived usefulness and perceived ease of use are beliefs about a new technology that influence an individual's attitude towards and use of that technology (Davis *et al.*, 1989). TAM has been applied in the context of online consumer behaviour (Lenhart *et al.*, 2003).

Porter and Donthu (2006) included perceived access barriers among the key beliefs about a technology that influence its use and added four key demographic constructs as external variables to the TAM (i.e., age, education, income and race). The model suggested that the TAM's belief variables are differentially relevant to consumers with different demographic profiles and serve to mediate the relationships between demographic variables and attitude toward the Internet.

The findings made several theoretical contributions (Porter & Donthu, 2006). First, it extended the basic TAM by adding (a) perceived access barriers as third belief about a technology that explains a consumer's attitude toward technology and (b) demographic variables as external variables, due to their importance in the context of Internet use. It was found that the three belief variables of our extended TAM (1) are differentially relevant to various demographic types and (2) mediate the relationships between demographic variables and attitude toward the Internet. The study found that demographic variables are external to, rather than moderators of, extended TAM (Porter & Donthu, 2006).

Amoako-Gyampah and Salam (2004) present an extension to the TAM and empirically examined it in an enterprise resource planning (ERP) implementation environment. The study evaluated the impact of one belief construct (shared beliefs in the benefits of a technology) and two widely recognised technology implementation success factors

(training and communication) on the perceived usefulness and perceived ease of use during technology implementation (Amoako-Gyampah & Salam, 2004).

Using data gathered from the implementation of an ERP system, the study showed that both training and project communication influence the shared beliefs that users form about the benefits of the technology and that the shared beliefs influence the perceived usefulness and ease of use of the technology (Amoako-Gyampah & Salam, 2004). The study provided empirical and theoretical support for the use of managerial interventions, such as training and communication, to influence the acceptance of technology, since perceived usefulness and ease of use contribute to behavioural intention to use the technology (Amoako-Gyampah & Salam, 2004).

In his study, Liu (2010) extended the TAM and empirically tested the new model with wikis, a new type of educational technology. Based on social cognitive theory and the theory of planned behaviour, three new variables, wiki self-efficacy, online posting anxiety, and perceived behavioural control were added to the original Technology Acceptance Model. A structural equation model was developed and the model was tested, using both qualitative and quantitative methods. The study found that wiki self-efficacy, perceived ease of use, perceived usefulness, and wiki use intention have direct and indirect significant impact on wiki usage in the classroom (Liu, 2010).

Wireless Internet via mobile devices (WMD) is leading the world into another spectrum of communications and means of conducting day-to-day business and life activities (Lu *et al.*, 2003). They developed a TAM for wireless Internet via mobile devices (TAM for wireless), a conceptual framework to explain the factors influencing user acceptance of WMD.

By revising the TAM to represent some unique features of the wireless system under study, TAM for wireless Internet, Lu *et al.* (2003) proposed that constructs such as individual differences, technology complexity, facilitating conditions, social influences, and wireless trust environment determine user-perceived short- and long-term

usefulness, and ease of using WMD. These, in turn, determined user intention and willingness to adopt WMD. Twelve propositions were developed to promote and facilitate future empirical research relating to WMD.

Lee *et al.* (2010) integrated Decision-Making Trial and Evaluation Laboratory (DEMATEL) into the theoretical extension of (TAM2) to evaluate users' behavioural intention to use while introducing a new etching plasma technology.

The study used a case of the Taiwan plasma etching manufacturing industry as the example, adopted DEMATEL to calculate the causal relationship and interaction level between the TAM2 variables, and at the same time, to use DEMATEL for finding the core variables of TAM2, providing the managers the important key for management or improvement while promoting a new technology to resolve the complicated problems in practical experience (Lee *et al.*, 2010).

The study found that adopting DEMATEL in the TAM2 method to find perceived ease of use, subjective norm and experience, is the key impact factor for the case study to decide the plasma etching TAM (Lee *et al.*, 2010). The study integrated e-shopping quality, enjoyment, and trust into a TAM to understand consumer acceptance of e-shopping (Ha & Stoel, 2008). Online surveys with college students (n=298) were conducted. E-shopping quality for apparel products consists of four dimensions: Website design, customer service, privacy/security, and atmospheric/experiential dimensions. A structural equation model revealed that e-shopping quality determines perceptions of usefulness, trust, and enjoyment, which in turn influence consumers' attitudes toward e-shopping (Ha & Stoel, 2008). Consumer perceptions of usefulness and attitude toward e-shopping influence intention to shop online, while perceived ease of use does not influence attitude toward e-shopping. Shopping enjoyment and trust play significant roles in consumers' adoption of e-shopping.

The study of Ha and Stoel (2008), provided important implications for e-tailers whose website developers must keep in mind that customers are not only Web users with

trust/safety and information needs, but also shoppers with service and experiential needs.

The rapid diffusion of the Internet has not only generated a renewed interest in the role of new information and communication technologies (ICTs) in higher education and learning (Dutton & Loader, 2002), but it has also affected the ways people teach and learn (DeLacey & Leonard, 2002; Radcliffe, 2002).

The study of Park *et al.* (2008) investigated the factors that influence behavioural intention toward and actual use of an electronic courseware system, using the framework of the TAM developed by Davis (1986). The findings generally supported hypotheses derived from the model and from earlier empirical studies. The study also found that there were other variables that played an important role in accounting for actual system use, as well as in behavioural intention to keep using the system.

The study confirmed that perceived ease of use had a significant impact on perceived usefulness, as the TAM suggested. Whereas the model suggested only an indirect effect of perceived ease of use on behavioural intention, the current study found that perceived ease of use had a substantial direct effect on behavioural intention as well. It was also found that perceived ease of use was channelled into actual system use through perceived usefulness and the evaluation of functions of the system (Park *et al.*, 2008). The direct effect of perceived usefulness on behavioural intention and the indirect effect of the variable on actual system use, both of which were suggested in the original TAM model, were supported.

Several limitations of this study should be noted (Park *et al.*, 2008); the single item measurement of three variables in the study design made validity of those variables, especially convergent validity, hard to achieve and the measure of behavioural intention to keep using the system may have inadequately captured the effect of current system use of electronic courseware on that variable.

IT has become a strategic tool for attaining competitive advantages in organisations. The hotel industry extensively relies on IT to improve employees' productivity and efficiency, as well as to improve customer satisfaction, since IT has been perceived to have notable advantages in competition (Ham *et al.*, 2005; Lam *et al.*, 2007).

Kim *et al.* (2008) investigated the relationship between antecedents and users' acceptance of Hotel Front Office Systems (HFOS) through the TAM framework, which is based on the survey of hotel frontline employees. The study demonstrated the acceptance of HFOSs from the perspective of hotel frontline employees through the information system quality and the perceived value as the external variables.

The achieved objectives are: (1) to investigate how information system quality can lead to the formation of perceived ease of use and perceived usefulness of HFOSs; (2) to explore the impact of perceived value on attitude towards use of HFOSs; (3) to assess the impact of perceived ease of use on perceived usefulness and attitude towards use of HFOSs; (4) to examine the impact of perceived usefulness on attitude towards use and on actual use of HFOSs and (5) to explore the impact of attitude towards use on actual use of HFOSs (Kim *et al.*, 2008).

2.5 User acceptance

Expert Systems are systems that mimic the human expert's behaviour in a narrowly defined problem domain (Turban, 1988). Vendors of these information systems are promoting their products by claiming that they deliver several-fold productivity gains (Liker & Sindi, 1997).

Liker and Sindi (1997) developed and tested a model that will improve understanding of user acceptance in the specific domain of Expert Systems (ES) and explored empirically implications of the Theory of Reasoned Action (TRA) for acceptance and use of information technology.

Ahn *et al.* (2007) investigated the effect of playfulness on user acceptance of online retailing and tested the relationship between Web quality factors and user acceptance behaviour. A survey of 942 users of Web-based online retailing was conducted to test the model. The study showed that playfulness plays an important role in enhancing user attitude and behavioural intention to use a site. It was found that Web quality, categorised into system, information, and service quality, had a significant impact on the perceived ease of use, playfulness, and usefulness, and consequently, that it encouraged website use in the context of online retailing.

The study provided a balanced and integrative framework for determining Web quality. It enhanced the knowledge of the effect of playfulness, which should help Web practitioners and researchers better understand user behaviour in Web-based online retailing (Ahn *et al.*, 2007).

With the growing reliance on computerised systems and increasing rapidity of the introduction of new technologies, user acceptance of technology continues to be an important issue (Yi & Hwang, 2003). Yi and Hwang (2003) extended the TAM by incorporating the motivation variables of self-efficacy, enjoyment, and learning goal orientation in order to predict the use of Web-based information systems.

One hundred and nine subjects participated in the study (Yi & Hwang, 2003), which was conducted in a field setting with the Blackboard System, a Web-based class management system. A survey was administered after a two-week trial period and the actual use of the system was recorded by the Blackboard System over eight weeks.

The study largely supports the proposed model, highlighting the important roles of self-efficacy, enjoyment, and learning goal orientation in determining the actual use of the system.

Information Technology (IT) has the potential to transform the means by which we learn and access information (Roca *et al.*, 2006). IT enables us to do many of the things we

already do faster, more flexibly, more efficiently and with greater access for all and IT enables us to do things that we cannot do now, or to do them in ways that are significantly different.

Theoretical models attempt to explain the relations between user attitudes, satisfaction and behavioural intention to use and system usage (Davis, 1989; Davis *et al.*, 1989). TAM is derived from the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980) and predict user acceptance based on the influence of two factors: perceived usefulness and perceived ease of use.

Roca *et al.* (2006) examined the effects of perceived usefulness, cognitive absorption, perceived ease of use and subjective norm on satisfaction, and the effect of confirmation on perceived usefulness, cognitive absorption and perceived ease of use. In this study, they provided a good explanation of users' satisfaction, and a significant amount of variance in e-learning satisfaction was explained (65%).

Selecting the appropriate mix of functional and/or interface characteristics to achieve user acceptance has proven to be a more challenging and difficult decision than expected. While numerous studies have shown that the TAM is useful for predicting acceptance, estimates of its structural weights are not consistent across studies. Using initial exposure data from 742 users of office suite applications (i.e., spreadsheet, database, word processing, and graphics), the research of Deng *et al.* (2005) illustrated the use of Multi-group Analysis of Structural Invariance (MASI) to test differences in structural weights across population subgroups for latent variables in TAM.

The study of Deng *et al.* (2005) argues that, for large sample studies containing latent variables, MASI may be a more appropriate test of differences for structural weights/regression coefficients than analysis of covariance. The managerial implications of the results in setting functionality and interface goals and allocating resources to continued development efforts are discussed.

Luo *et al.* (2006) developed and validated a theoretical model of the effects of intrinsic and extrinsic motivations on user acceptance of Internet-based information services. The research took several steps toward establishing a valid motivational model. The steps included:

- (1) Choosing U&G theory to formulate an integrated technology acceptance model with TAM;
- (2) developing and pre-testing the measures for the model's factors in two pilot studies;
- (3) conducting three rounds of data collection and analysing the data to prove that the integrated model is applicable to the present context;
- (4) reviewing literature in both information systems and mass communication to demonstrate that empirical support exists for various elements of the proposed model; and
- (5) using an advanced statistical technique, Partial Least Squares (PLS), to validate the model.

2.6 Usability

Research of Venkatesh (2000), has established that perceived ease of use is an important factor influencing user acceptance and usage behaviour in information technologies, but very little research has been conducted to understand how that perception forms and changes over time. Venkatesh (2000) tested an anchoring and adjustment-based theoretical model of the determinants of system-specific perceived ease of use.

The model proposes control, intrinsic motivation and emotion as anchors that determine early perceptions about the ease of use of a new system. With increasing experience, it is expected that system-specific perceived ease of use, while still anchored to the general beliefs regarding computers and computer use, will adjust to reflect objective usability, perceptions of external control specific to the new system environment, and system-specific perceived enjoyment (Venkatesh, 2000).

The proposed model was tested in three different organisations among 246 employees using three measurements taken over a three-month period. The proposed model was strongly supported at all points of measurement, and explained up to 60% of the variance in system-specific perceived ease of use, which is twice as much as our current understanding (Venkatesh, 2000).

Wolk (2007) determined the usefulness of deploying the TAM theory in an educational setting as an outcomes assessment instrument to assist in the accreditation process. The study of 131 college students found that the adoption of Internet usage is positively related to TAM constructs of perceived ease of use, perceived usefulness, behavioural intention to use, and the subject's attitude towards use. Negative attitudes were negatively related. External variables of gender, student major, full-time/part-time status, presence of four-year college graduate in family, and overall technology literacy all have impact on usage. The usage of the TAM instrument provides flexibility (Wolk, 2007).

Based on the expectancy disconfirmation theory, the study by Roca *et al.* (2006) proposed a decomposed TAM in the context of an e-learning service. In the proposed model, the perceived performance component is decomposed into perceived quality and perceived usability.

A sample of 172 respondents took part in this study. The results suggest that users' continuance intention is determined by satisfaction, which in turn is jointly determined by perceived usefulness, information quality, confirmation, service quality, system quality, perceived ease of use and cognitive absorption (Roca *et al.*, 2006).

Researchers and practitioners alike strive to understand individuals' unwillingness to accept systems that appear to promise substantial benefits. Davis, Bagozzi and Warshaw (1989) conclude that, "understanding why people accept or reject computers has proven to be one of the most challenging issues in IS research." This lack of understanding continues despite recent improvements in application usability and ease of use (Hasan, 2003). With employees seemingly accepting and rejecting systems

unsystematically, many organisations are failing to achieve the benefits promised to them by software manufacturers (McFarland & Hamilton, 2006).

The TAM is one of the most widely used models for describing IT usage behaviours (Igbaria *et al.*, 1995). The TAM asserts that IT behaviours are based largely on users' perceptions of a system's ease of use and usefulness. While the model "has been empirically proven to have high validity" (Chau, 1996), it "only supplies general information on users' opinions about a system" (Mathieson, 1991). Similarly, user evaluation measures, such as perceived ease of use and perceived usefulness, encompass many different user meanings and theoretical constructs (Chau, 1996; Moore & Benbasat, 1991; Segars & Grover, 1994). Goodhue (1995) concludes that "there are so many different underlying constructs, it is probably not possible to develop a single general theoretical basis for user evaluations." Cognitive psychologists support arguments opposing the mental averaging of an activity domain. Bandura (1997) argues that "combining diverse attributes into a single index creates confusions about what is actually being measured and how much weight is given to particular attributes in the forced summary judgment". The findings are consistent with social cognitive theory and the Theory of Reasoned Action (McFarland & Hamilton, 2006).

The study found that contextual variables significantly impacted the mediating variables, as well as the dependant variable, system usage. These findings are consistent with social cognitive theory, but they are in conflict with the TAM and TRA which posit that contextual variables only influence behaviour indirectly through mediating variables. The findings of this study suggest that researchers should not indiscriminately disregard or trivialise the role of contextual variables as they relate to IT behaviours. McFarland and Hamilton (2006) further argue that one's behaviour is a function of his or her characteristics and experiences as they relate to the specific situation.

2.7 Acceptability

Ziefle and Wilkowska (2010) examined the age-specific acceptance motives of medical assistive technologies assessing the general openness of using these technologies as

well as estimating potential barriers, which may impede a successful rollout. 122 respondents (20 - 80 years) participated in a survey, in which they were asked to evaluate the pros and cons of the usage of medical assistive technologies, acceptance motives and potential utilisation barriers. In order to understand the complex nature of acceptance, personal variables (age, technology, generation and gender) as well as participants' learning history with technology (technical experience, subjective technical confidence and general attitudes towards the usage of technologies) were related to each other.

Outcomes of the study showed that there is a positive motivation regarding the usage of medical technology, although the perceived usage barriers are weighted more decisively towards the acceptability of medical technology than the positively evaluated using motives. The study recommended that acceptance issues should be considered in order to proactively design a successful rollout of medical technologies (Ziefle & Wilkowska, 2010).

2.8 Theory of Reasoned Action

In the past decade the interest in using the Internet and World Wide Web in the classroom as part of the learning environment increased drastically. The value of online learning has become widely recognised and accepted. Recent developments have put pressures on businesses and academic institutions to integrate online course material into their environments (Saade' & Bahli, 2005).

In an attempt to study and explain individual attitudes and behaviours in using ILSs, Saade' and Bahli (2005), found several theoretical models that have been proposed, including the Innovation Diffusion Theory, the Theory of Reasoned Action, the Theory of Planned Behaviour, and the TAM. All generally agree that an individual's beliefs and perceptions of IT have a significant influence on their usage (Saade' & Bahli, 2005).

Saade' and Bahli (2005) studied an extended version of TAM, (Davis 1989) in which the concept of Cognitive Absorption (CA) was used. In this, CA is an antecedent to perceived ease of use and perceived usefulness. This construct involved three

dimensions: temporal dissociation, focused immersion, and heightened enjoyment (Saade' & Bahli, 2005).

The objective was to examine the influence of the three major cognitive absorption dimensions of the TAM constructs: perceived usefulness, perceived ease of use, and the behavioural intention to use ILSs. A secondary objective was to confirm the nature of the relationships between them in the Internet-based learning context (Saade' & Bahli, 2005).

The results of the empirical analysis provide a number of interesting insights and suggestions: (1) Cognitive absorption was shown to be an important antecedent to PU but less important to PEU; (2) TD did not load high on CA; (3) weak results were observed for PEU, however findings provided strong support for the PU-IUC component of the TAM model; and (4) CA seemed to play an important role in explaining intentions both directly and indirectly (Saade' & Bahli, 2005).

The TAM focuses on two specific beliefs—ease of use and usefulness and it was derived from the theory of reasoned action. It has been applied in the study of user adoption of different technologies, and has emerged as a reliable and robust model (Vijayasarathy, 2004). Researchers continued to incorporate additional constructs to the original model in their quest for increased predictive power.

Vijayasarathy (2004) attempted to explain consumer intention to use on-line shopping. The study included compatibility, privacy, security, normative beliefs, and self-efficacy are included in an augmented TAM. The test of the model, with data collected from 281 consumers, showed support for most research hypotheses.

Compatibility, usefulness, ease of use, and security were specifically found to be significant predictors of attitude towards on-line shopping, but privacy was not. Furthermore, intention to use on-line shopping was strongly influenced by attitude toward on-line shopping, normative beliefs, and self-efficacy (Vijayasarathy, 2004).

The approximately 60 million members of Generation Y are a major force in the consumer marketplace and represent a significant behavioural shift. To develop the broad, multifaceted advertising strategy necessary to reach them, more information is needed to characterise their purchase intentions (Belleau *et al.*, 2007).

The study of Belleau *et al.* (2007), determined whether the Theory of Reasoned Action can be used as a prediction tool in examining the purchase intention of a selected consumer group, Generation Y consumers, and product, fashion merchandise made of emu leather. Respondents' attitudes significantly influenced their purchase intention: The more favourable the respondent's attitude, the higher the purchase intention. Subjective norm and other external variables had no influence on this group's purchase intention.

The results partially supported the Theory of Reasoned Action as a prediction tool in examining purchase intention of a consumer product. This information is important to the emu leather industry, which may want to target Generation Y consumers (Belleau *et al.*, 2007).

Meta-analysis was used to quantify how well the Theories of Reasoned Action and Planned Behaviour have predicted intentions to attend screening programmes and actual attendance behaviour. Systematic literature searches identified 33 studies that were included in the review (Cooke & French, 2008). Across the studies as a whole, attitudes had a large-sized relationship with intention, while subjective norms and perceived behavioural control (PBC) possessed medium-sized relationships with intention. Intention had a medium-sized relationship with attendance, whereas the PBC–attendance relationship was small-sized.

Due to heterogeneity in results between studies, moderator analyses were conducted (Cooke & French, 2008). The moderator variables were (a) type of screening test, (b) location of recruitment, (c) screening cost and (d) invitation to screen. All moderators affected Theory of Planned Behaviour relationships.

Suggestions by Cooke and French (2008), for future research emerging from these results include targeting attitudes to promote intention to screen, a greater use of implementation intentions in screening information and examining the credibility of different screening providers.

Turner *et al.* (2010) investigated the findings of Straub *et al.* and assessed whether the TAM is an accurate predictor of actual usage when employing objective and subjective forms of usage measure.

Turner *et al.* (2010), investigated if other factors may influence the results of a TAM study, particularly mandatory technology usage or prior use of a technology. This will be achieved through conducting a systematic literature review (SLR) and using vote-counting meta-analysis to analyse the results.

The study of Turner *et al.* (2010) extended Legris *et al.*'s (2003), study of the relationship between TAM variables and actual usage. The study of Turner *et al.* (2010) has included data from 73 publications compared with their 22 and in addition it looked at the impact of different ways of measuring actual usage, i.e. subjective and objective measures. The study of Turner *et al.* (2010) is different to the meta-analysis undertaken by King and He (2006). The two studies have limited overlap in terms of primary studies and very different research goals.

2.9 Innovation Diffusion Theory

The research has shown that differences do exist in the way subjects in different cultures respond to standard usability measurement techniques (Cleary, 2000; Evers, 2002), Standard Human-Computer Interaction (HCI) measurement tools have been shown to have cultural differences that can be missed if they are not carefully evaluated and considered (Shimaneni & Dunckley, 2005). HCI has often relied on cultural models to help explain differences found in various aspects of usability and interaction.

Technology acceptance, people's attitude to the uptake and use of different technologies, were found to be the best candidate for cross-cultural validation of HCI tools. The earlier research has undertaken some work to cross-culturally validate and culturally extend technology acceptance models, such as the TAM, (Day 1996; Evers and Day 1997; Straub *et al.*, 1997).

The Unified Theory of Acceptance and Use of Technology, UTAUT (Venkatesh *et al.*, 2003), is a more recent instrument, which is a synthesis of eight existing models of technology acceptance — including TAM. UTAUT also integrates elements from: Theory of Reasoned Action, Motivational Model, Theory of Planned Behaviour (TPB), a combined TAM and TPB model, Model of PC Utilisation, Innovation Diffusion Theory, and Social Cognition Theory (Oshlyansky, *et al.*, 2007).

The unification of these models provides UTAUT with eight constructs: Performance expectancy, effort expectancy, attitude towards using technology, social influence, facilitating conditions, self-efficacy, anxiety, and behavioural intention to use the system (Venkatesh, *et al.*, 2003). UTAUT has already been validated and applied in the field in English-speaking countries (Anderson and Schwager, 2004; Venkatesh, *et al.*, 2003). The present paper provides a cross-cultural validation. The finding is useful, as it enables HCI researchers and practitioners to use the tool in an international context without concern for its cross-cultural validity (Oshlyansky, *et al.*, 2007). The findings indicate that the UTAUT tool will uncover cultural differences at least in the constructs it measures.

The rapid development of modern wireless communication technology, coupled with the increasingly high penetration rate of the Internet, is promoting mobile commerce (MC) as a significant application for both enterprises and consumers.

Insufficient user acceptance has long been an obstacle to the successful adoption of new information systems (IS) and information technologies (IT). While mobile technologies and applications are rapidly and widely developed for MC; it is extremely

important to understand consumer MC perceptions and acceptance (Wu & Wang, 2005). With accelerated business competition and the popularity of Internet and mobile device use, there is an urgent need to understand the factors that would entice users to use MC. Comprehending the essentials of what determines user MC acceptance can provide great management insight into developing effective strategies that will allow enterprises to remain competitive and hold their market.

Wu and Wang (2005) adopted the extended (TAM2), and integrated it with the Innovation Diffusion Theory (IDT) perceived risk, and cost and validated the factors that determine consumer MC acceptance,

The study of Wu and Wang (2005) showed that perceived usefulness and perceived ease of use all indirectly influence the actual usage through behavioural intention to use which is consistent with work of Venkatesh and Davis. The study stressed that the most important determinant for using behavioural intention is compatibility, also supported by Plouffe *et al.* (2001). In their study, the constructs of perceived characteristics of innovations explained a higher proportion of the variance than TAM.

The findings suggested that MC providers and managers should improve their compatibility with various user requirements, past experience, lifestyle and beliefs in order to fulfil customer expectations (Wu & Wang, 2005).

2.10 Information Technology

Companies are increasing their investment in technologies to enable better access to information and to gain a competitive advantage. Global competition is driving companies to reduce costs and enhance productivity, increasing their dependence on IT (Jones, *et al.*, 2010). It is critically important to understand what causes users to understand, accept and to follow the organisation's information systems security measures so that companies can realise the benefits of their technological investments.



Jones *et al.* (2010), studied the factors that affect employee acceptance of information systems security measures.

The objective of the study was to propose and test a research model to evaluate employee acceptance of information systems security measures (Jones *et al.*, 2010). The parsimonious model was used and customised to suit the context of information systems security.

Information Systems (IS) implementation is costly and has a relatively low success rate. Since the seventies, IS research has contributed to a better understanding of this process and its outcomes. The early efforts concentrated on the identification of factors that facilitated IS use. This produced a long list of items that proved to be of little practical value. It became obvious that, for practical reasons, the factors had to be grouped into a model in a way that would facilitate analysis of IS use (Legris *et al.*, 2003).

In 1985, Fred Davis suggested the TAM. It examines the mediating role of perceived ease of use and perceived usefulness in their relation between systems characteristics (external variables) and the probability of system use (an indicator of system success) (Legris *et al.*, 2003).

More recently, Davis proposed a new version of his model: TAM2. It includes subjective norms, and was tested with longitudinal research designs. Overall the two explain about 40% of system use. Analysis of empirical research using TAM shows that results are not totally consistent or clear. This suggests that significant factors are not included in the models (Legris *et al.*, 2003).

The study concluded that TAM is a useful model, but has to be integrated into a broader one which would include variables related to both human and social change processes, and to the adoption of the innovation model (Legris, *et al.*, 2003).

The proliferation of business-to-consumer e-commerce activities has created a need to understand how and why people participate in e-commerce (Klopping, 2004). The study treats consumer e-commerce as a technology adoption process and evaluates the suitability of two popular adoption models. The research of Klopping, (2004), supports the use of the TAM to predict online shopping activity, both the intention to shop online and actual purchases. Two minor alterations are made to the traditional use of TAM-perceived ease of use: It is not linked to perceived usefulness, and perceived usefulness is directly linked to actual use. The research also found that the task-technology fit (TIF) model is a valuable addition to TAM for online shopping tasks (Klopping, 2004). A Web-based survey of 263 undergraduates was used.

The recent development of e-Government services has opened new opportunities to deliver information and services more conveniently and cost-effectively to the general public. However, one of the main problems associated with the digital divide is whether or not people have equal capacity to use the new IT (Wang & Shih, 2009). The risk is that some social groups without adequate access to or knowledge of IT will be under-represented in the public information access and policy formation processes.

This would violate the equality principles of democracy (O'Hara & Stevens, 2006). Also, the purpose of e-Government development and implementation is to promote people's information literacy, alleviate the digital divide, and ensure that e-Government systems can be widely utilised. Thus, it is important to explore how to alleviate the digital gap between e-Government system adopters and non-adopters (Wang & Shih, 2009).

The research investigated factors influencing the use of information kiosks from the citizens' perspectives. The findings of the research also provided several important implications for the practice and research of information kiosks. Although the study has been conducted with methodological rigour, the findings should be used with caution (Wang and Shih, 2009). The study only examined the acceptance of information kiosks using a sample of willing respondents in Taiwan. The results may not be generalised to other e-Government systems and cultural areas. Additional research efforts should be

conducted to validate the proposed model and findings in other settings (Wang & Shih, 2009).

The advent of the Internet in the twenty-first century has led to remarkable changes in several aspects of people's lives. This advanced technology has become an essential tool of communication and information, thus offering unique advantages to both educators and students. Despite a recent educational revolution in Saudi Arabian educational systems, the issue of access to higher education still remains one of the more enduring challenges. The need for more delivery modes that take education to learners wherever they are, and not within the boundaries of the campus, is thus a necessity. E-Learning could dramatically increase access to tertiary education and training, especially for those learners who were once denied learning opportunities for any reason, such as health, distance or the like. Yet, successful implementation of e-learning requires an understanding of the issues that promote the effective use of the technologies (Al-Harbi, 2011).

The article of Al-Harbi (2011), discusses the factors that influence e-learning in Saudi higher education through analysing the perceptions and attitudes of Saudi university students (n=531). It reports the results of a survey conducted to investigate the acceptance of e-learning in a Saudi higher education institution as perceived by university students.

The findings demonstrated that attitudes toward e-learning, subjective norms, perceived behavioural control as well as e-learning-systems attributes were critical determinants of students' behavioural intention to use e-learning. By explaining students' behavioural intentions, the findings of this study of Al-Harbi, (2011) will help to provide insight into the best way to promote e-learning acceptance among students.

Valid measurement scales for predicting user acceptance of computers are in short supply (Davis, 1989). Most subjective measures used in practice are not validated, and their relationship to system usage is unknown. Davis (1989) developed and validated

new scales for two specific variables, perceived usefulness and perceived ease of use, which are hypothesised to be fundamental determinants of user acceptance.

In the past decades, there have been large investments in information technology; in 1999, for example, the IT budget of Federal Express was reported to be US\$ 1.4 billion (Agarwal, 2000). If companies are to make a return from their IT investments, the new systems must be utilised effectively. Unfortunately, countless systems are never used to their full potential; many simply remain “unexplored, rejected, or forgotten” (Orlikowski, 2000). Understanding the determinants of system use is therefore a cornerstone of IS research (DeLone & McLean, 2003).

The objective of this research was to provide theoretical and empirical evidence of the role of external variables and usage measures. The objective of the study of Burton-Jones and Hubona (2006), was to test a key tenet: that each construct in the chain from external variables to usage mediates prior constructs in the model. TAM uses two belief constructs: perceived usefulness (PU) and perceived ease-of-use (PEOU). However, early tests found that attitude did not fully mediate PU.

The objective of the study was to contribute to the continued improvement of models of technology acceptance. The study investigated two aspects of TAM (external variables and usage measures) that have received little attention. TAM and TRA proposed that the effect of external variables is completely mediated by users' beliefs. The study tested this proposition and found that the full-mediation hypothesis is overstated. The results also suggested that the nature of the relationship should not be considered full or partial mediation, but a contingent mediation, depending on the nature of the technology and external variable considered. The results also highlighted the different (and poorer) results that occur with more complex measures of usage (Burton-Jones & Hubona, 2006).

2.11 Conclusion

The literatures about topics related to TAM were reviewed under the following topics: Technology Acceptance Model, perceived usefulness, perceived ease of use, user acceptance, usability, acceptability, Theory of Reasoned Action and Innovation Diffusion Theory. In conclusion it was found that the technology determines perceived usefulness, perceived ease of use, and user attitudes toward technology use, as well as strongly influencing individual performance during the technology usage stage.

The results of the study in the TAM in science, engineering and technology were not found in literature. The current study seeks to develop the TAM and determine whether it could provide enough explanation of the acceptance in terms of perceived usefulness and perceived ease of use or perhaps convenience of use of nuclear techniques and the next chapter describes the research methodology to develop TAM.

Chapter 3

Research methodology

3.1 Overview

The intention of this chapter is to present the research methodology that was followed during the research. The discussion includes the following topics: research hypotheses, data gathering, sample size and demographic location, data analysis, ethical consideration, limitations and the conclusion.

3.2 Research hypotheses

There is always a perception that if people perceive the technology to be easy to use they will use it often. If the technology is perceived to be useful the technology users develop positive attitude towards the use of the technology. The attitude towards use of technology also affects the intention of use of the technology and the actual usage (Lai & Li, 2005). Figure 3.1 shows the research constructs and the hypothesised relationships between them (Lai & Li, 2005). To study the relationship above the following hypotheses were developed:

H₀₁. Perceived usefulness has a positive effect on technology acceptance by scientists, engineers and technologists.

H_{1c}. The technology competency factor has a positive effect on perceived usefulness of technology acceptance by scientists, engineers and technologists.

H₀₂. Perceived ease of use has a positive effect on technology acceptance by scientists, engineers and technologists.

H_{2a}. The age factor has a positive effect on perceived ease of use of technology by scientists, engineers and technologists.

H_{2b}. The gender factor has a positive effect on perceived ease of use of technology by scientists, engineers and technologists.

H₀₃. Attitudes toward using technology have a positive effect on technology acceptance by scientists, engineers and technologists.

H_{3b}. The gender factor has a positive effect on attitudes toward using technology by scientists, engineers and technologists.

H₀₄. The intention to use technology has a positive effect on technology acceptance by scientists, engineers and technologists.

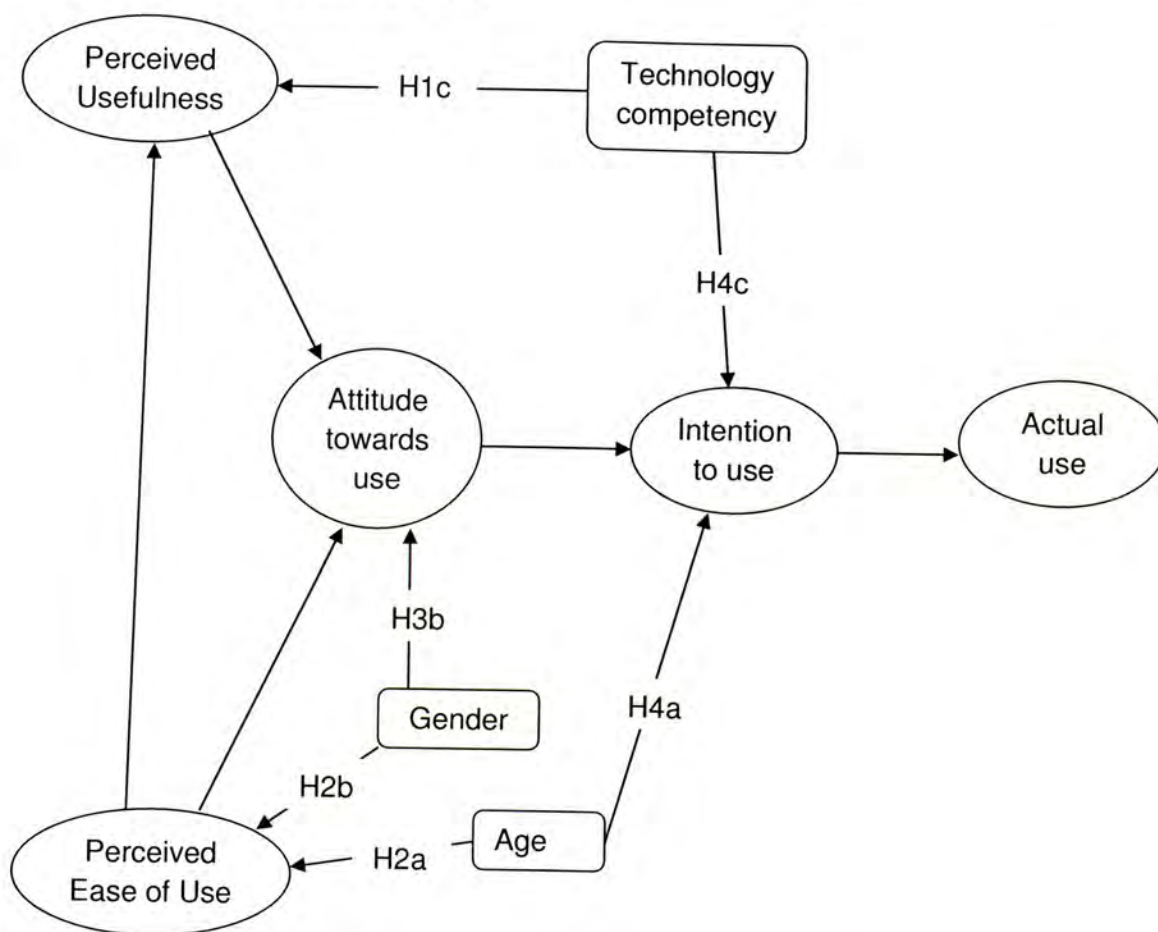


Figure 3.1 Proposed TAM in SET, (Lai & Li, 2005). The hypotheses H1c, H2a, H2b, H3b, H4a and H4c are defined in section 1.8.

H_{4a}. The age factor has a positive effect on the intention to use technology by scientists, engineers and technologists.

H_{4c}. The technology competency factor has a positive effect on the intention to use technology by scientists, engineers and technologists.

3.3 Data gathering

The questionnaire in appendix A was prepared to comply with the following criteria (Eiselen *et al.*, 2005) to collect primary data:

- The question should be short, simple and precise.
- The question should be clear and have one meaning.
- The question should indicate what is required.
- To avoid double negative the question should not be phrased in a negative form.
- Research participants should be asked to express their own opinions about their own views and not somebody else's opinion.
- The question should be phrased in such a way that it is not biased.
- The question should avoid to include emotional language.
- The question should not be asked in such a way that it plays on the guilt of the respondent.
- The question should not include the status of a person.
- The question should be accommodative of all possible answers.
- Only one response alternative should be mutually available.
- The question should be phrased in such a way that it does not make assumptions.
- The question should be free from hypothetical situations.
- The question should be asked on the highest level of measurement that would still make sense.

3.4 Size of sample and demographic location.

Forty questionnaires were distributed to scientists and technologists in the science and technology institutions, in South Africa.

The questionnaires were distributed via email to some professionals employed by the science and technology institutions, for an example Centre for Applied Radiation Science and Technology, Chemistry department, Physics department at North-West University (Mafikeng Campus), Centre for Science and Industrial Research and the Council for Geoscience and other industrial institutions.

3.5 Data analysis

Acquired data will be analysed using the SPSS. A correlation analysis and a series of multiple regression and hierarchical regression analyses will be performed to test the hypotheses. The following steps will be conducted for the analysis of hierarchical regression. The individual factors include three demographic characteristics of the professionals in SET (i.e. age, gender, and technology competency), attitude towards technology, ease of use of technology, usefulness of the technology, and intention to use.

First, for the dependent variable of perceived ease of use, external variables of this study: attitude towards technology, usefulness of the technology, and intention to use will be entered. For the dependent variable of perceived usefulness, the same external variables and perceived ease of use, but excluding perceived usefulness will be entered. Then age, gender and technology competency will be entered in order to see if they add any explanatory power over the external variables and perceived ease of use.

3.6 Ethical considerations pertaining to the study

Ethics statement

This research does not deal with issues of human behaviour or animals and it does not require ethics clearance.

3.7 Limitations

The full scope of research envisages that scientists, engineers and technologists form the sample of the respondents. However, there is difficulty in finding two of the groups, namely engineers and technologists. Therefore the conclusions drawn will be of limited applicability.

3.8 Conclusion

The research development and questionnaires preparation steps were outlined in this chapter. The developed questionnaire, appendix A, was compiled in accordance with the requirements listed in the chapter. The main requirements concerning the preparation of quality questionnaires listed above are the following: A questionnaire should be of

acceptable length and the questions asked should be phrased as per the questions' guidelines.

CHAPTER 4

Data analysis

4.1 Introduction

Data was collected using the questionnaire that was developed as prescribed in chapter 3. The sample was from the 40 scientists who are using different technologies in the government research councils as well as within the North-West University (Mafikeng Campus). The data collected was analysed using the statistical package in order to determine the relationship between variables and different factors.

The theme of the mini-dissertation is the acceptance model and use of technology in the science and technology domain. In this chapter the results of the analysis of the data collected are presented. The focus was on the three factors, namely: age, gender and technology competency, to determine if they influence acceptance of technology. The data were collected through self-administered questionnaires.

4.1.1 Demographics

The pie chart in Figure 4.1 shows that of the 40 respondents, 52%, 25%, 18% and 5% were between the ages of 20 and 30 years, 31 and 40 years, 41 and 59 years and 60 and above years respectively.



Figure 4.1 Ages of respondents

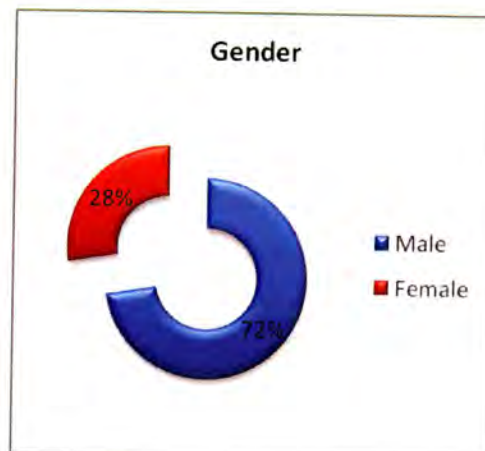


Figure 4.2 Gender of respondents

The pie chart in figure 4.2 shows that of the 40 respondents, 28% were female and 72% were male.

4.1.2 Job position

In Table 4.1 the job positions, number of respondents occupying a particular position, and the number of positions compared to the total respondents are presented in percent, valid percent, as well as cumulative percent.

Job Title	Frequency	Percent	Valid Percent	Cumulative Percent
Laboratory Technician	1	2.5	2.5	2.5
Manager	2	5.0	5.0	7.5
Research Technician	1	2.5	2.5	10.0
Senior Scientist (GIS and Remote sensing)	1	2.5	2.5	12.5
Technical Officer	1	2.5	2.5	15.0
Scientist	14	35.0	35.0	50.0
General Marketing Manager	1	2.5	2.5	52.5
Chemical Technologist	1	2.5	2.5	55.0
Radiological Safety Officer	1	2.5	2.5	57.5
Junior Researcher	2	5.0	5.0	62.5
Student	6	15.0	15.0	77.5
Administrative Officer	2	5.0	5.0	82.5
Lecturer	2	5.0	5.0	87.5
Professor	3	7.5	7.5	95.0
Intern	2	5.0	5.0	100.0
Total	40	100.0	100.0	

Table 4.1 Job position of respondents

4.1.3 Technology in use

In Table 4.2 the technologies, number of respondents using the technology, the percentage using a particular technology relative to the total number of technologies used by respondents are presented in percent, valid percent, as well as cumulative percent. The top five most used technologies are Microsoft Office, Arch GIS, Linux, Laptop and GIS Google Earth with 6, 5, 5, 4, and 4 users respectively.

4.1.4 Number of years in using the technology

The pie chart in Figure 4.3 shows that of the 40 respondents, 61%, 15%, 8%, 8%, and 8% have been using their respective technologies respectively for 0 - 5 years, 6 – 10 years, 11 – 15 years, 16 – 20 years and 21 years and above.

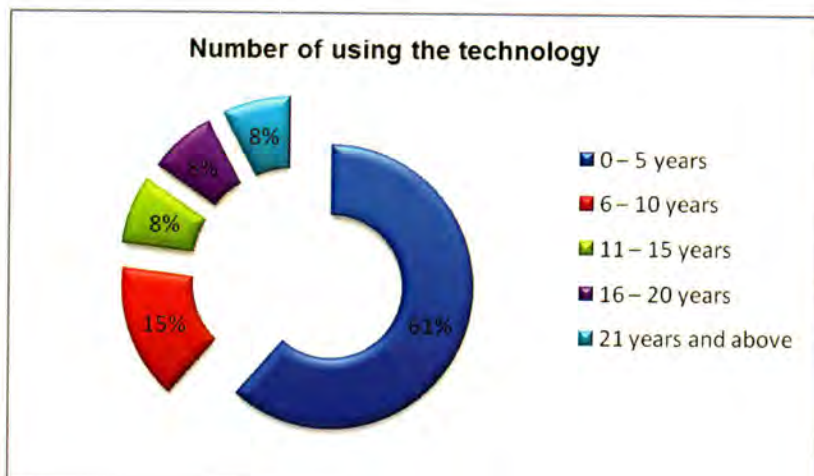


Figure 4.3 Number of years of respondents' using technology

Name of technology	Frequency	Percent	%Valid	%Cumulative
Linux	5	12.5	12.5	12.5
PC	1	2.5	2.5	15.0
Laptop	4	10.0	10.0	25.0
Erdas Imagine	1	2.5	2.5	27.5
GIS Google Earth	4	10.0	10.0	37.5
Geostatistical Analyst	1	2.5	2.5	40.0
Aspen Plus Software	1	2.5	2.5	42.5
Autotitrator	1	2.5	2.5	45.0
MCNPX	1	2.5	2.5	47.5
Arch GIS	5	12.5	12.5	60.0
Google	2	5.0	5.0	65.0
Microsoft Super Cross	1	2.5	2.5	67.5
Oracle	1	2.5	2.5	70.0
Microsoft Office	6	15.0	15.0	85.0
Mathcad	1	2.5	2.5	87.5
e-learning	1	2.5	2.5	90.0
Gamma Spectrometry	1	2.5	2.5	92.5
Refworks	1	2.5	2.5	95.0
GPS	1	2.5	2.5	97.5
Latex	1	2.5	2.5	100.0
Total	40	100.0	100.0	

Table 4.2 Technology in use by the respondents

4.2 Information about Technology Acceptance Model

This section discusses the relationships between the competency of the technology, age, gender, and the perceived ease of use, perceived usefulness and attitude towards using the technology.

4.2.1 Relationship between the technology competency of users and perceived usefulness of the technology

The general hypotheses concerning the technology competency of users are as follows:

H₀₁: The technology competency factor has no effect on perceived usefulness of technology acceptance by scientists, engineers and technologists.

H_{1c}: The technology competency factor has a positive effect on perceived usefulness of technology acceptance by scientists, engineers and technologists.

The first set of specific hypotheses concerning the technology competency of users is as follows:

H₀₁: Competency in using technology does not improve performance in doing a job.

H_{1c}: Competency in using technology positively improves performance in doing a job.

There is an association between technology competency and perceived usefulness, especially in relation to the 87.5% of the respondents who believe that when they use technology their performance in doing the job would improve.

		Using the technology would improve my performance in doing my job			Total
		Very much	Moderate	Little	
How competent do you think you are in using technology?	Very much	50.0%	2.5%		52.5%
	Moderate	37.5%	5.0%	2.5%	45.0%
	Little		2.5%		2.5%
Total		87.5%	10.0%	2.5%	100.0%

Table 4.3 Competency in using technology against performance in doing a job

The table below gives a significant observed probability of 0.027 as compared to 0.05 level of significance. Therefore being technologically competent would improve people's performance in doing their job.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	10.975 ^a	4	0.027
Likelihood Ratio	7.066	4	0.132
Linear-by-Linear Association	4.120	1	0.042
N of Valid Cases	40		

Table 4.4 χ^2 Tests for competency in using technology against performance in doing a job.

The second set of specific hypotheses concerning the technology competency of users is as follows:

H₀₁: Competency in using technology does not improve people's productivity.

H_{1c}: Competency in using technology positively improves people's productivity.

		Using technology at work would improve my productivity			Total
		Very much	Moderate	Little	
How competent do you think you are in using technology?	Very much	42.5%	7.5%	2.5%	52.5%
	Moderate	32.5%	10.0%	2.5%	45.0%
	Little		2.5%		2.5%
Total		75.0%	20.0%	5.0%	100.0%

Table 4.5 Competency in using technology against improvement in people's productivity

The 52.5% respondents concur they are very competent in using technology, 75% also concur that it will improve their productivity very much, and 20% agree that the improvement is moderate.

The observed probability of 0.340 in the chi square test above is less significant compared with 0.05. This confirms that technology does not really play a positive role in improving one's productivity.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	4.519 ^a	4	0.340
Likelihood Ratio	3.771	4	0.438
Linear-by-Linear Association	1.048	1	0.306
N of Valid Cases	40		

Table 4.6 χ^2 Tests for the competency in using technology against improvement in people's productivity.

The third set of specific hypotheses concerning the technology competency of users is as follows:

H_{01} : Competency in technology usage does not enhance people's effectiveness in their job.

H_{1c} : Competency in technology usage positively enhances people's effectiveness in their job.

		Using the technology would enhance my effectiveness in my job			Total
		Very much	Moderate	Little	
How competent do you think you are in using technology?	Very much	40.0%	12.5%		52.5%
	Moderate	32.5%	10.0%	2.5%	45.0%
	Little	2.5%			2.5%
Total		75.0%	22.5%	2.5%	100.0%

Table 4.7 Competency in technology usage against enhancement in people's effectiveness in their job.

The 52.5% of the respondents declared that they are very competent in using technology, 75% concur that it also enhances their effectiveness very much, whereas 22.5% agree that the effectiveness is moderate.

The observed probability of 0.814 in the chi square test above is less significant compared with 0.05. This confirms that technology does not really play a positive role in enhancing people's effectiveness.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	1.570 ^a	4	0.814
Likelihood Ratio	2.161	4	0.706
Linear-by-Linear Association	0.081	1	0.775
N of Valid Cases	40		

Table 4.8 χ^2 Tests for the competency in technology usage against enhancement in people's effectiveness in their job

The fourth set of specific hypotheses concerning the technology competency of users is as follows:

H_{01} : Competency in using technology would not enable people to accomplish their tasks more quickly.

H_{a1} : Competency in using technology would positively enable people to accomplish their tasks more quickly.

		Using the technology would enable me to accomplish my tasks more quickly				Total
		Very much	Moderate	Little	Not at all	
How competent do you think you are in using technology?	Very much	40.0%	10.0%	2.5%		52.5%
	Moderate	35.0%	5.0%	2.5%	2.5%	45.0%
	Little			2.5%		2.5%
Total		75.0%	15.0%	7.5%	2.5%	100.0%

Table 4.9 Competency in using technology against accomplishment of tasks performed more quickly

The table below gives a significant observed probability of 0.027 as compared to 0.05 level of significance. Therefore using technology would positively enable people to accomplish their tasks more quickly.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	14.265 ^a	6	0.027
Likelihood Ratio	7.502	6	0.277
Linear-by-Linear Association	1.863	1	0.172
N of Valid Cases	40		

Table 4.10 χ^2 Tests for the competency in using technology against accomplishment of tasks quickly

4.2.2 Relationship between the age of users and the perceived ease of use of the technology

The general hypotheses concerning age of users are as follows:

H₀₂: The age factor has no effect on perceived ease of use of technology by scientists, engineers and technologists.

H_{a2}. The age factor has a positive effect on perceived ease of use of technology by scientists, engineers and technologists.

The first set of specific hypotheses concerning the age of users is as follows:

H₀₂: The age factor has no effect on an individual's learning to operate the technology.

H_{a2}. The age factor has a positive effect on an individual's learning to operate the technology.

The 52.5%, 25.0%, 17.5% and 5.0% respectively of respondents are of the age groups 20-30, 31-40, 41-59 and 60 and above. Of them, respectively 20.0%, 15.0%, 7.5% and 2.5% concur that learning to operate the technology would be very easy for them,

		Learning to operate the technology would be easy for me			Total
		Very much	Moderate	Not at all	
Age group	20-30 years	20.0%	32.5%		52.5%
	31-40 years	15.0%	10.0%		25.0%
	41-59 years	7.5%	7.5%	2.5%	17.5%
	60 and above years	2.5%	2.5%		5.0%
Total		45.0%	52.5%	2.5%	100.0%

Table 4.11 The age factor against learning to operate the technology

The observed probability of 0.398 in chi square test below is less significant compared with 0.05. This confirms that the age factor does not have a positive effect on an individual's learning to operate the technology.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	6.233 ^a	6	0.398
Likelihood Ratio	4.985	6	0.546
Linear-by-Linear Association	0.075	1	0.785
N of Valid Cases	40		

Table 4.12 χ^2 Tests for the age factor against learning to operate the technology

The second set of specific hypotheses concerning the age of users is as follows:

H₀₂: The age factor has no effect on ease of using the technology.

H_{a2}: The age factor has a positive effect on ease of using the technology.

The 52.5%, 25.0%, 17.5% and 5.0% respectively of respondents are of the age groups 20-30, 31-40, 41-59 and 60 and above. 20.0%, 10.0%, 7.5% and 2.5% respectively concur that they would find it very easy to get the technology to do what they want it to do.

	I would find it easy to get the technology to do what I want it to do				Total
	Very much	Moderate	Little	Not at all	
20-30 years	20.0%	27.5%	5.0%		52.5%
31-40 years	10.0%	12.5%	2.5%		25.0%
41-59 years	7.5%	5.0%		5.0%	17.5%
60 and above years	2.5%	2.5%			5.0%
Total	40.0%	47.5%	7.5%	5.0%	100.0%

Table 4.13 The age factor against getting the technology to do what I want it to do
The observed probability of 0.273 in the chi square test below is less significant compared with 0.05. This confirms that technology does not really play a positive role in improving one's productivity.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	11.034 ^a	9	0.273
Likelihood Ratio	9.317	9	0.409
Linear-by-Linear Association	0.353	1	0.553
N of Valid Cases	40		

Table 4.14 χ^2 Tests for the age factor against getting the technology to do what I want it to do

The third set of specific hypotheses concerning the age of users is as follows:

H₀₂: The age factor has no effect on ease of becoming skilful in the use of technology.

H_{a2}: The age factor has a positive effect on ease of becoming skilful in the use of technology.

	It would be easy for me to become skilful in the use of technology			Total
	Very much	Moderate	Little	
20-30 years	27.5%	25.0%		52.5%
31-40 years	17.5%	7.5%		25.0%
41-59 years	10.0%	5.0%	2.5%	17.5%
60 and above years	2.5%	2.5%		5.0%
Total	57.5%	40.0%	2.5%	100.0%

Table 4.15 The age factor against skilful in the use of technology

The 52.5%, 25.0%, 17.5% and 5.0% of respondents are respectively of age groups 20-30, 31-40, 41-59 and 60 and above. 27.5%, 17.5%, 10.0% and 2.5% respectively concur that it would be very easy for them to become skilful in the use of technology, respectively.

The observed probability of 0.431 in the chi square test below is less significant compared with 0.05. This confirms that technology does not really play a positive role in improving one's productivity.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	5.935 ^a	6	0.431
Likelihood Ratio	4.721	6	0.580
Linear-by-Linear Association	0.024	1	0.876
N of Valid Cases	40		

Table 4.16 χ^2 Tests for the age factor against skilful in the use of technology

The fourth set of specific hypotheses concerning the age of users is as follows:

H₀₂: The age factor has no effect on ease of using technology.

H_{a2}: The age factor has a positive effect on ease of using technology.

		I would find the technology easy to use			Total
		Very much	Moderate	Not at all	
Age group	20-30 years	30.0%	22.5%		52.5%
	31-40 years	15.0%	10.0%		25.0%
	41-59 years	10.0%	5.0%	2.5%	17.5%
	60 and above years	2.5%	2.5%		5.0%
Total		57.5%	40.0%	2.5%	100.0%

Table 4.17 The age factor against finding the technology easy to use

The 52.5%, 25.0%, 17.5% and 5.0% respectively of respondents are of age groups 20-30, 31-40, 41-59 and 60 and above. Respectively 30.0%, 15.0%, 10.0% and 2.5% concur that it would be very easy to use the technology,

The observed probability of 0.535 in the chi square test below is less significant compared with 0.05. This confirms that technology does not really play a positive role in improving one's productivity.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	5.067 ^a	6	0.535
Likelihood Ratio	3.860	6	0.696
Linear-by-Linear Association	0.551	1	0.458
N of Valid Cases	40		

Table 4.18 χ^2 Tests for the age factor against finding the technology easy to use

4.2.3 Relationship between the gender of users and the perceived ease of use of the technology

The general hypotheses concerning gender of users are as follows:

H_{02b}. The gender factor has no effect on perceived ease of use of technology by scientists, engineers and technologists.

H_{2b}. The gender factor has a positive effect on perceived ease of use of technology by scientists, engineers and technologists.

The first set of specific hypotheses concerning the gender of users is as follows:

H_{02b}: The gender factor has no effect on learning to operate the technology.

H_{2b}: The gender factor has a positive effect on learning to operate the technology.

		Learning to operate the technology would be easy for me			Total
		Very much	Moderate	Not at all	
Gender	Male	32.5%	37.5%	2.5%	72.5%
	Female	12.5%	15.0%		27.5%
Total		45.0%	52.5%	2.5%	100.0%

Table 4.19 The gender factor against ease to operate the technology

Of the 72.5% respondents are male, 45% also concur very much that learning to operate the technology would be easy for them, 52.5% agree that it will be moderate.

The observed probability of 0.822 in the chi square test below is less significant compared with 0.05. This confirms that gender does not have a positive effect on perceived ease of use of technology by scientists, engineers and technologists.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	0.392 ^a	2	0.822
Likelihood Ratio	0.656	2	0.720
Linear-by-Linear Association	0.113	1	0.737
N of Valid Cases	40		

Table 4.20 χ^2 Tests for the gender factor against ease to operate the technology.

The second set of specific hypotheses concerning the gender of users is as follows:

H_{02b}: The gender factor has no effect on ease of using the technology.

H_{2b}: The gender factor has a positive effect on ease of using the technology.

	I would find it easy to get the technology to do what I want it to do				Total
	Very much	Moderate	Little	Not at all	
Male	25.0%	35.0%	7.5%	5.0%	72.5%
Female	15.0%	12.5%			27.5%
Total	40.0%	47.5%	7.5%	5.0%	100.0%

Table 4.21 The gender factor against ease to get the technology to do what I want it to do.

Of the 72.5% respondents who are male, 40% concur that they would find it very easy to get the technology to do what they want it to do for them, and 47.5% agree that it will be moderate.

The observed probability of 0.438 in the chi square test below is less significant compared with 0.05. This confirms that gender does not have a positive effect on perceived ease of use of technology by scientists, engineers and technologists.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	2.712 ^a	3	0.438
Likelihood Ratio	3.983	3	0.263
Linear-by-Linear Association	2.433	1	0.119
N of Valid Cases	40		

Table 4.22 χ^2 Tests for the gender factor against ease to get the technology to do what I want it to do

The third set of specific hypotheses concerning the gender of users is as follows:

H_{02b}: The gender factor has no effect on ease of becoming skillful in using the technology.

H_{2b}: The gender factor has a positive effect on ease of becoming skillful in using the technology.

The third set of specific hypotheses concerning the gender of users is as follows:

H_{02b}: The gender factor has no effect on ease of becoming skilful in using the technology

H_{2b}: The gender factor has a positive effect on ease of becoming skilful in using the technology

	It would be easy for me to become skilful in the use of technology			Total
	Very much	Moderate	Little	
Male	40.0%	30.0%	2.5%	72.5%
Gender Female	17.5%	10.0%		27.5%
Total	57.5%	40.0%	2.5%	100.0%

Table 4.23 The gender factor against ease of becoming skilful in the use of technology.

Of the 72.5% respondents who are male, 57.5% also concur that it would be very easy for them to become skilful in the use of technology, whereas 40.0% agree the learning will be moderate.

The observed probability of 0.768 in the chi square test below is less significant compared with 0.05. This confirms that gender does not have a positive effect on perceived ease of use of technology by scientists, engineers and technologists.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	0.529 ^a	2	0.768
Likelihood Ratio	0.792	2	0.673
Linear-by-Linear Association	0.371	1	0.543
N of Valid Cases	40		

Table 4.24 χ^2 Tests for the gender factor against ease of becoming skilful in the use of technology.

The fourth set of specific hypotheses concerning the gender of users is as follows:

H_{02b}: Gender factor has no effect on ease in using the technology.

H_{2b}: Gender factor has a positive effect on ease in using the technology.

	I would find the technology easy to use			Total
	Very much	Moderate	Not at all	
Male	37.5%	32.5%	2.5%	72.5%
Female	20.0%	7.5%		27.5%
Total	57.5%	40.0%	2.5%	100.0%

Table 4.25 The gender factor against ease in using technology.

Of the 72.5% respondents who are male, 57.5% also concur that they would find it very easy to use technology, and 40.0% agree that it would be moderate.

The observed probability of 0.448 in the chi square test below is less significant compared with 0.05. This confirms that gender does not have a positive effect on perceived ease of use of technology by scientists, engineers and technologists.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	1.606 ^a	2	0.448
Likelihood Ratio	1.891	2	0.389
Linear-by-Linear Association	1.515	1	0.218
N of Valid Cases	40		

Table 4.26 χ^2 Tests for the gender factor against ease in using technology.

4.2.4 Relationship between the gender of users and the attitudes toward using the technology

The set of general hypotheses concerning the gender of users is as follows:

H₀₃. The gender factor has no effect on attitudes toward using the technology by scientists, engineers and technologists.

H_{3b}. The gender factor has a positive effect on attitudes toward using the technology by scientists, engineers and technologists.

The first set of specific hypotheses concerning the gender of users is as follows:

H_{03b}: The gender factor has no effect on liking to use the technology.

H_{3b}: The gender factor has a positive effect on liking to use the technology.

		I like to use technology			Total
		Very much	Moderate	Little	
Gender	Male	60.0%	10.0%	2.5%	72.5%
	Female	17.5%	10.0%		27.5%
Total		77.5%	20.0%	2.5%	100.0%

Table 4.27 The gender factor against liking to use technology

Of the 72.5% respondents who are male, 77.5% also concur that they like to use technology very much, whereas 20.0% agree that they like it moderately.

The observed probability of 0.248 in the chi square test below is less significant compared with 0.05. This confirms that gender does not have a positive effect on perceived ease of use of technology by scientists, engineers and technologists.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	2.787 ^a	2	0.248
Likelihood Ratio	2.845	2	0.241
Linear-by-Linear Association	0.804	1	0.370
N of Valid Cases	40		

Table 4.28 χ^2 Tests for the gender factor against liking to use technology

The second set of specific hypotheses concerning the gender of users is as follows:

H_{03b}: The gender factor has no effect on pleasure in using the technology.

H_{3b}: The gender factor has a positive effect on pleasure in using the technology.

	It is pleasure for me to use the technology				Total
	Very much	Moderate	Little	Not at all	
Gender Male	50.0%	17.5%	2.5%	2.5%	72.5%
Female	17.5%	10.0%			27.5%
Total	67.5%	27.5%	2.5%	2.5%	100.0%

Table 4.29 The gender factor against pleasure of using the technology.

The observed probability of 0.747 in the chi square test below is less significant compared with 0.05. This confirms that gender does not positively have an effect on perceived ease of use of technology by scientists, engineers and technologists.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	1.226 ^a	3	0.747
Likelihood Ratio	1.730	3	0.630
Linear-by-Linear Association	0.044	1	0.833
N of Valid Cases	40		

Table 4.30 χ^2 Tests for the gender factor against pleasure of using the technology.

The third set of specific hypotheses concerning the gender of users is as follows:

H_{03b}: The gender factor has no effect on desire to learn to use the technology

H_{3b}: The gender factor has a positive effect on desire to learn to use the technology

		It is desirable for me to learn how to use technology			Total
		Very much	Moderate	Little	
Gender	Male	52.5%	15.0%	5.0%	72.5%
	Female	17.5%	10.0%		27.5%
Total		70.0%	25.0%	5.0%	100.0%

Table 4.31 The gender factor against the desire to learn to use technology

Of the 72.5% respondents who are male, 52.5% also concur that it is very desirable for them to learn how to use technology, and 15.0% agree that it will be moderately desirable.

The observed probability of 0.443 in the chi square test below is less significant compared with 0.05. This confirms that gender does not have a positive effect on perceived ease of use of technology by scientists, engineers and technologists.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	1.630 ^a	2	0.443
Likelihood Ratio	2.103	2	0.350
Linear-by-Linear Association	0.008	1	0.927
N of Valid Cases	40		

Table 4.32 χ^2 Tests for the gender factor against the desire to learn to use technology

4.2.5 Relationship between the age of users and the intention to use the technology

The set of general hypotheses concerning the age of users is as follows:

H₀₄. The age factor has no effect on the intention to use the technology by scientists, engineers and technologists

H_{4a}. The age factor has a positive effect on the intention to use the technology by scientists, engineers and technologists

The first set of specific hypotheses concerning the age of users is as follows:

H₀₄: The age factor has no effect on desire to unlimited access to the technology

H_{4a}: The age factor has a positive effect on unlimited access to the technology

	Assuming I will have unlimited access to the technology				Total
	Very much	Moderate	Little	Not at all	
20-30 years	20.0%	27.5%	5.0%		52.5%
31-40 years	12.5%	7.5%	5.0%		25.0%
41-59 years	7.5%	5.0%	2.5%	2.5%	17.5%
60 and above years		5.0%			5.0%
Total	40.0%	45.0%	12.5%	2.5%	100.0%

Table 4.33 The age factor against unlimited access to the technology.

The 52.5%, 25.0%, 17.5% and 5.0% of respondents are respectively of age groups 20-30, 31-40, 41-59 and 60 and above. 20.0%, 12.5%, 7.5% and 0.0% respectively concur that they will have unlimited access to the technology.

The observed probability of 0.421 in the chi square test below is less significant compared with 0.05. This confirms that age factor does not have a positive effect on the intention to use the technology by scientists, engineers and technologists.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	9.183 ^a	9	0.421
Likelihood Ratio	8.696	9	0.466
Linear-by-Linear Association	0.713	1	0.399
N of Valid Cases	40		

Table 4.34 χ^2 Tests for the age factor against unlimited access to the technology

The second set of specific hypotheses concerning the age of users is as follows:

H₀₄: The age factor has no effect on prediction of regular use of the technology

H_{4a}: The age factor has a positive effect on prediction of regular use of the technology

	I predict that I will use it on a regular basis in the future			Total
	Very much	Moderate	Little	
20-30 years	37.5%	12.5%	2.5%	52.5%
31-40 years	12.5%	7.5%	5.0%	25.0%
Age group 41-59 years	15.0%	2.5%		17.5%
60 and above years		5.0%		5.0%
Total	65.0%	27.5%	7.5%	100.0%

Table 4.35 The age factor against the prediction of using technology on a regular basis in future.

The 52.5%, 25.0%, 17.5% and 5.0% respectively of the respondents are of age groups 20-30, 31-40, 41-59 and 60 and above. 37.5%, 12.5%, 15.0% and 0.0% respectively predict that they will use the technology on a very regular basis in future.

The observed probability of 0.142 in the chi square test below is less significant compared with 0.05. This confirms that the age factor does not have a positive effect on the intention to use the technology by scientists, engineers and technologists.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	9.604 ^a	6	0.142
Likelihood Ratio	9.475	6	0.149
Linear-by-Linear Association	0.374	1	0.541
N of Valid Cases	40		

Table 4.36 χ^2 Tests for the age factor against the prediction of using technology on a regular basis in the future.

4.2.6 Relationship between the technology competency of users and the intention to use the technology

The set of general hypotheses concerning the technology competency of users is as follows:

H_{04c} . The technology competency factor has no effect on the intention to use the technology by scientists, engineers and technologists.

H_{4c} . The technology competency factor has a positive effect on the intention to use the technology by scientists, engineers and technologists.

The first set of specific hypotheses concerning the technology competency of users is as follows:

H_{04c} : Technology competency factor has no effect on desire to unlimited access to the technology

H_{4c} : Technology competency factor has a positive effect on desire to unlimited access to the technology

		Assuming I will have unlimited access to the technology				Total
		Very much	Moderate	Little	Not at all	
How competent do you think you are in using technology?	Very much	27.5%	20.0%	5.0%		52.5%
	Moderate	12.5%	25.0%	7.5%		45.0%
	Little				2.5%	2.5%
Total		40.0%	45.0%	12.5%	2.5%	100.0%

Table 4.37 Competency against unlimited access to the technology.

Of the 52.5% respondents who concur they are very competent in using technology, 40.0% also concur that they will have unlimited access to the technology, whereas 45.0% agree that access will be moderate.

The table below gives a significant observed probability of 0.000 as compared to 0.05 level of significant. This confirms that technology competency factor has a positive effect on the intention to use the technology by scientists, engineers and technologists.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	42.519 ^a	6	0.000
Likelihood Ratio	11.852	6	0.065
Linear-by-Linear Association	5.977	1	0.014
N of Valid Cases	40		

Table 4.38 χ^2 Tests for the competency against unlimited access to the technology.

The second set of specific hypotheses concerning the technology competency of users is as follows:

H_{04c}: The technology competency factor has no effect on prediction of use of the technology

H_{4c}: The technology competency factor has a positive effect on prediction of use of the technology

		I predict that I will use it on a regular basis in the future			Total
		Very much	Moderate	Little	
How competent do you think you are in using technology?	Very much	35.0%	15.0%	2.5%	52.5%
	Moderate	30.0%	10.0%	5.0%	45.0%
	Little		2.5%		2.5%
Total		65.0%	27.5%	7.5%	100.0%

Table 4.39 Competency against use of technology on a regular basis in future.

Of the 52.5% respondents who concur they are very competent in using technology, 65% concur that they will regularly use the technology in future, whereas 27.5% agree that their use of technology will be moderate.

The observed probability of 0.498 in the chi square test below is less significant compared with 0.05. This confirms that technology competency factor does not have a positive effect on the intention to use the technology by scientists, engineers and technologists.

	Value	df	Asymp. Sig. (2-sided)
Pearson χ^2	3.367 ^a	4	0.498
Likelihood Ratio	3.316	4	0.506
Linear-by-Linear Association	0.464	1	0.496
N of Valid Cases	40		

Table 4.40 χ^2 Tests for competency against use of technology on a regular basis in future.

4.2.7 Comments about the user of technology by the respondents

The respondents and users of the technologies gave a wide range of comments concerning the use of technology, listed in table 4.41, where f, p, V and C are the frequency, percent, valid percent and cumulative percent respectively.

Comments from the respondents	f	p	V	C
Technology makes work quick and easy. It improves creativity skills.	1	2.5	2.5	2.5
ArcGIS is the most useful package in my field.	1	2.5	2.5	5.0
Aspen Plus is used for the optimisation but it is short-lived if optimity has been reached.	1	2.5	2.5	7.5
e-Learning is difficult to access.	1	2.5	2.5	10.0
Gamma Spectrometry is not easy to use.	1	2.5	2.5	12.5
I have used excel for years and it is still working wonders.	1	2.5	2.5	15.0
I use excel to capture students' marks.	1	2.5	2.5	17.5
I use technology easily especially after being taught theory.	1	2.5	2.5	20.0
I would like to have an advanced knowledge of Microsoft.	1	2.5	2.5	22.5
I would like to have an advanced knowledge of using ArcGIS.	1	2.5	2.5	25.0
If autotitrator was fitted on an auto sampler and a network printer, the piece of equipment would improve my productivity and efficiency in doing my job.	1	2.5	2.5	27.5
It is important to approach technology with an open mind.	1	2.5	2.5	30.0
Latex is a must for Mathematicians.	1	2.5	2.5	32.5
MCA is a basis for analysis of nuclear spectroscopic data.	1	2.5	2.5	35.0

MCNPX is not easily accessible as it is in control of United States of American Los Almas Scientific Laboratory.	1	2.5	2.5	37.5
None.	17	42.5	42.5	80.0
Operation and maintenance of equipment is easy but the detection limits makes it to be time-consuming.	1	2.5	2.5	82.5
Technology keeps on changing and makes work easier. It tends to make people lazy.	3	7.5	7.5	90.0
Technology makes life easier in a sense that electronic gadgets such as laptops and tablets are mobile, making it easier to take work everywhere.	1	2.5	2.5	92.5
Technology software changes all the time and is also expensive.	1	2.5	2.5	95.0
Technology makes life easier.	1	2.5	2.5	97.5
Using technology for the first time is never easy but in time you get used to it and become perfect as you continue using it.	1	2.5	2.5	100.0
Total	40	100.0	100.0	

Table 4.41 Comments about the user of technology from the respondents

The technology makes work quick and easy; this is an example of the perception of users that use of technology will enhance their performance. Some users feel that their technologies are very useful and they will continue using them. The technology that they have been using for some time, they will continue using them because they are very useful. Certain technologies are very important for scientist to perform their duties successfully.

Chapter 5

Conclusion and recommendation

5.1 Introduction

The purpose of this study was to investigate the acceptance model and use of technology in the science and technology domain.

This chapter consolidates the research findings which are derived through statistical analysis and interpretation of data as presented in chapter 4. The research questions pertaining to influence of age, gender and technology competency on perceived ease of use, perceived usefulness, attitude towards use and intention of use are discussed.

This chapter is made up of the following sections, summary of study, response to research questions, proposed acceptance model and future research opportunities in this field of study. Conclusions of the study are drawn and recommendations are outlined.

5.2 Summary of study

The relationship between the technology competency of users and perceived usefulness of the technology was studied. The study analysed the relationship between the age of users and the perceived ease of use of the technology. It also analysed the relationship between the gender of users of technology and the perceived ease of use of the technology. The study revealed that age in relation to perceived usefulness and intention to use is not a factor.

The link between the gender of users and the attitudes of users toward using the technology, as well as the link between the age of users and the intention to use the technology was also investigated. The gender of technology users, in terms of perceived usefulness and attitude towards use is also not a factor.

Finally the relationship between the technology competency of users and the intention to use the technology was also investigated. The finding was that the technology competency factor does not have a positive effect on the intention to use the technology by scientists and technologists.

5.3 Response to research questions

The main findings of this study in relation to each research questions are discussed

1. Is age difference a factor in the acceptance and use of the technology and research pieces of equipment?

According to this survey the age factor does not have a positive effect on perceived ease of use of technology by scientists, engineers and technologists, and age factor does not have a positive effect on the intention to use the technology by scientists, engineers and technologists. The age of people, whether young or old, does not affect how one thinks about the ease with which one can use the technology and does not affect the intention to use the technology by scientists, engineers and technologists.

2. Is gender difference a factor in the acceptance and use of the nuclear technology and research pieces of equipment?

According to this survey the gender factor does not have a positive effect on perceived ease of use of technology by scientists, engineers and technologists, and the gender factor does not have a positive effect on attitudes toward using the technology by scientists, engineers and technologists. The gender of people, whether female or male, does not affect how one thinks about the ease with which one can use the technology and does not affect the attitude towards using the technology by scientists, engineers and technologists.

3. Is technology competency a factor in the acceptance and use of the nuclear technology and research pieces of equipment?

In relation to technology competency the following relationship was investigated. The technology competency factor has no effect on perceived usefulness of technology acceptance by scientists, engineers and technologists, and the technology competency factor does not have a positive effect on the intention to use the technology by scientists, engineers and technologists. The competency of use of technology of people, whether good or bad, does not affect how one thinks about the usefulness of technology and does not affect the intention to use the technology by scientists, engineers and technologists.

From this survey the hypothesis is neither proved nor rejected, because in two of the survey questions respondents agree while in the other two they disagree. Therefore further study with a larger sample (much greater than 40) would be needed to shed more light on this question.

4. Is there a difference in the acceptance and use of the technology and research equipment across the fields of science engineering and technology?

This variable in this study cannot be investigated because the engineers and technologists were absent in the data collected. A sample incorporating engineers and technologist would be needed to shed light on this factor.

5.4 Acceptance model

Acceptance model as reported by Lai and Li (2005) should not be altered according to the present study.

5.5 Future research

To address the question raised by the research question number 4, namely; is there a difference in the acceptance and use of the technology and research equipment across the fields of science engineering and technology, it requires a population sample that includes engineers, technologists and scientists.

5.6 Conclusion

According to the research carried out in this study acceptance model due to Lai and Li (2005) still holds.

Age in relation to perceived usefulness and intention to use are not factors. Gender in terms of perceived usefulness and attitude is not a factor. The technology competency factor does not have a positive effect on the intention to use the technology by scientists and technologists.

Therefore the model due to Lai and Li (2005) should not be altered according to the present study.

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Appendix A

Questionnaire for:

“Acceptance model and use of technology in the Science and Technology Domain”

Graduate School Of Business and Government Leadership,

North-West University,

Mafikeng Campus

Researcher: MV Tshivhase

Supervisor: Dr N Mavetera

Note to respondent

- We need your help to formulate the acceptance model and understand the use of technology in the Science and Technology domain.
- Confidentiality with respect to your responses is guaranteed.

How to complete the questionnaire

- In Questions 1, 2, 6 to 19, you can mark each response by making a tick or a cross, or encircling each appropriate response with a PEN (not Pencil)
- Complete Questions 3, 4, 5, and 20, with an appropriate response.

Permission to use my responses for academic research

I hereby give permission that my responses may be used for research purposes provided that my identity is not revealed in the published records of the research.

Initials and Surname:

Contact numbers: Cell:

Work:

Signature:.....

In this questionnaire the word technology refers to the tool that you use in the form of software and/or equipment for doing your work.

For an example

- Peter uses Microsoft Excel, then Peter will replace the word technology in the questionnaire with words Microsoft Excel.
- Simon uses ArcGIS, then Simon will replace the word technology in the questionnaire with word ArcGIS.
- Gudani uses Google Earth, then Gudani will replace the word technology in the questionnaire with words Google Earth.
- Ofentse uses the IPad, then Ofentse will replace the word technology in the questionnaire with the words IPad.
- Susan uses the Digital multimeter, then Susan will replace the word technology in the questionnaire with the words Digital multimeter.

1. Age

20 - 30	31 - 40	41 - 59	60 and above
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 years old

2. Gender

Male	Female
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3. Job Position.....

4. Technology in use.....

5. No of years using the technology

0 - 5 years	6 - 10 years	11 - 15 years	16 - 20 years	21 years and more
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6. How competent do you think you are in using your *technology*?

--	--	--	--

Very much

Moderate

Little

Not at all

Perceived usefulness statements

7. Using *the technology* would improve my performance in doing my job

--	--	--	--

Very much Moderate Little Not at all

8. Using *the technology* at work would improve my productivity

--	--	--	--

Very much Moderate Little Not at all

9. Using *the technology* would enhance my effectiveness in my job

--	--	--	--

Very much Moderate Little Not at all

10. Using the technology would enable me to accomplish my tasks more quickly

--	--	--	--

Very much Moderate Little Not at all

Perceived ease of use statements

11. Learning to operate *the technology* would be easy for me

--	--	--	--

Very much Moderate Little Not at all

12. I would find it easy to get *the technology* to do what I want it to do

--	--	--	--

Very much Moderate Little Not at all

13. It would be easy for me to become skilful in the use of *the technology*

--	--	--	--

Very much Moderate Little Not at all

14. I would find *the technology* easy to use

--	--	--	--

Very much Moderate Little Not at all

Attitudes toward using the technology statements

15. I like to use the technology

--	--	--	--

Very much Moderate Little Not at all

16. It is pleasure for me to use the technology

--	--	--	--

Very much Moderate Little Not at all

17. It is desirable for me to learn how to use the technology

--	--	--	--

Very much Moderate Little Not at all

Behavioural Intention to use statements

18. Assuming I will have unlimited access to the technology,

--	--	--	--

Very much Moderate Little Not at all

19. I predict that I will use it on a regular basis in the future.

--	--	--	--

Very much Moderate Little Not at all

20. Comments.....