A RESEARCH MODEL TO IMPROVE UNDERSTANDING OF THE EXTENT OF USAGE OF ENTERPRISE RESOURCE PLANNING SYSTEMS IN A UNIVERSITY

by

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DECLARATION

I, Sherwin Mudaly declare that the thesis represents research work carried out by myself and that it has not been submitted in any form for another degree at any university or higher learning institution. All information used from published or unpublished work of others has been acknowledged in the text.

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ABSTRACT

This study reports on the development of a model for the improvement of understanding the extent of Enterprise Resource Planning system usage at the Durban University of Technology. Previous research revealed that university ERP systems are not fully utilized by end-users, resulting in low usage and institutional inefficiencies. Consequently this leads to stakeholders (particularly students and government) pressurizing universities to improve their efficiency and performance. To address the problem, this study developed a research model by adapting the TAM2 theoretical model with additional IT usage factors of training, management support, perceived behavioural control and technical support.

A dataset of 312 full time academics was generated by a survey method. Partial Least Square (PLS) technique was used to determine the predictive power of the developed research model which was then compared to other adoption and usage models to determine its superiority. The model was empirically tested and the findings demonstrated an improvement on the model predictive power as a result of the additional IT usage factors and the interaction effect of gender, age and experience. The predictive power comparison shows that the research model better explained 23% of the variability in ERP system usage compared to the original TAM2 model of 3.6% and the original TPB model of 5.2%. With the exception of management support, the additional IT usage factors of training, technical support and perceived behavioural control were found to have a significant relationship with ERP system usage. The test of gender, experience and age interaction effect revealed that gender and experience moderated the relationship between the independent factors of technical support and management support on the dependent factor of ERP system usage. In addition gender moderated the effect of perceived behavioural control on ERP system usage but not the effect of training which was however moderated by experience. Age did not moderate the relationship between the additional IT usage factors and ERP system usage. Consequently, the Durban University of Technology will have to address these additional IT usage factors and gender and experience interaction effect more precisely in its attempt to improve ERP system usage.

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CHAPTER 1
INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Enterprise resource planning (ERP) systems introduced in the early 1990s (Arif, Kulonda, Proctor and Williams, 2004; Swartz and Orgill, 2001) was coined to describe an emerging category of hardware and software solutions that expanded upon and extended the scope of traditional manufacturing resource planning (MRP) systems (Al-Mashari, 2003; Arif *et al*., 2004; Kvavik, Katz, Beecher, Caruso and King, 2002). ERP systems are organization-wide information systems designed to integrate information flows within organizations in order to control business processes in an integrated approach, thus enhancing efficiency and effectiveness (Davenport, 1998; Moon, 2007). The reliance and dependence on ERP systems has grown substantially and the purchase and implementation of ERP systems continues to be one of the fastest growing segments of the information technology sector (Lou and Strong, 2004).

In recent years, higher education has been strongly influenced by global trends, especially as a result of the call by governments for universities worldwide to improve their performance and efficiency (Allen and Kern, 2001). Consequently, the higher education sector has turned to ERP systems in the hope of helping them to cope with the changing environment (McCredie and Updegrove, 1999). As a result, existing management and administration computer systems have been replaced by ERP systems in these institutions (Pollock and James, 2004) to achieve more efficiency and accessibility for all members and to improve end users performance by providing better managerial tools (Kvavik *et al*., 2002).

Universities adopt ERP systems to conduct their day to day business functions of finance, human resources, payroll, financial aid, and student registration to name just a few (Graham, 2009). In addition, university ERP systems assist to improve customer services offered to students, faculty and staff (Judith, 2005), transform business processes, improve administration, increase operating efficiency, and adhere to regulatory compliance (King, Kvavik and Voloudakis, 2002). The bottom line is that all higher education institutions (HEIs) require access to accurate and timely data which can be utilized to make informed decisions with serious consequences for daily and future institutional operations, as well as for their structure and culture (Fowler and Gilfillan, 2003; Lou and Strong, 2004).

1.2 DEMARCATION OF THE PROBLEM

Universities are persevering in adopting and implementing ERP systems, but this does not guarantee that they are fully utilized by end-users (Yaseen, 2009). Low usage of installed ERP systems has been identified as a major challenge facing management of various organizations including HEIs (Venkatesh and Davis, 2000). In many cases, the users often only make use of a subset of available ERP system features resulting in low system usage (Boudreau, 2003; Jasperson, Carter and Zmud, 2005; Ross and Weill, 2002; Yi, Wu and Tung, 2006). This has a direct negative impact on the university and may lead to inefficiency in university operations such as unsatisfactory service delivery to university stakeholders, particularly students who are paying for better services (Beekhuyzen, Goodwin and Nielsen, 2002). An example in the past few years at the DUT is the aggressive student protests against poor service delivery such as book allowance payment allocations (DUT Homepage, 2012) which exerts pressure on the university to achieve greater system administrative efficiency in order to provide better services (Beekhuyzen *et al*., 2002).

In addition, other stakeholders such as government departments demand the meeting of deadlines and improvement in the university's business performance (Judith, 2005) in terms of accurate and timely information (Kvavik *et al*., 2002). Further consequences to low usage of the university ERP system is the high costs incurred in subsequent maintenance (Bajwa, Garcia and Mooney, 2004) and the large amount of resources required to support the system (Abugabah and Sanzogni, 2010). The DUT is no exception in terms of low usage of their ERP system. The researcher has nine years of experience supporting the university ERP system known as Integrated Tertiary Software (ITS) and is therefore aware that the ITS system is not fully utilized, and that it is mostly used by academics for student marks processing even then features that can improve this process such as class enrollment and student progress are not used. Among the non-academic departments, Human Resources (HR) use only a subset of features for personnel details but personnel verification reporting features are not extensively used.

Literature advocates that unused ERP system features could effectively lead to inefficiency in university operations (Fisher, 2006; King, 2002). Based on this and the researcher's experience with the ERP system at DUT, the researcher deemed it to be of paramount importance to investigate the factors that impact the use of the ITS system at the DUT. The purpose of this study therefore was to determine how ERP system usage can be improved at the university.

1.3 RESEARCH AIM AND OBJECTIVES

The aim of this study was to develop a research model to improve understanding of the extent of ERP system usage by university end-users toward enhanced service delivery and administrative efficiency of university operations. The following objectives were identified to be of paramount importance in helping to achieve the above aim:

- to adapt the TAM2 theoretical model through the integration of additional IT usage factors of training, management support, perceived behavioural control and technical support. The outcome of this objective is an integrated research model that can be used to improve understanding of the extent of ERP system usage at the university; and

- to demonstrate the superiority of the developed research model compared against the TAM2 model in improving understanding of the extent of ERP system usage and to find out the impact of the additional IT usage factors. The output of this objective is the model that better explains the variability in ERP system usage at the university.

1.4 RATIONALE BEHIND THIS STUDY

The motivation for carrying out this study was based on both a personal and scientific rationale.

1.4.1 Personal rationale

The researcher has been working at the DUT Information Technology Support Services Department for the past nine years. During his work experience as an ERP system support personnel, the system has been upgraded several times to offer end-users unlimited functionality for their work performance but this has not been realized as the ERP system is still not fully utilized. The researcher thus has personal interest in this research to: unpack the factors (such as training) that may improve end-users' work performance in extensively using the system; and to determine how to provide better ERP system support to the end-users thus contributing to his own professional development.

1.4.2 Scientific rationale

ERP systems are often the largest software application adopted by universities with significant funds being allocated to their implementation. However, little research has been conducted on ERPs in a university environment compared to other domains such as health and engineering (Holsapple, Wang and Wu, 2005; Katerattanakul, Hong and Lee, 2006). Existing studies on ERP in higher education focus on ERP system implementation success and failure factors in universities in Australia (Nielsen, 2005) and the United States of America (Parth and Gumz, 2003). To the best of the researcher's knowledge no studies have been conducted on factors that will improve understanding of post-implementation ERP system usage for HEIs in South Africa and abroad; this study will therefore address this gap.

1.5 CONTRIBUTION OF THE STUDY

This study will make theoretical contributions and will have practical implications for HEIs.

1.5.1 Theoretical contributions

In this study the TAM2 theoretical model is adapted to bring more insight into the adoption and usage of ERP systems in institutions of higher learning. The proposed research model in this study aims to improve understanding of the extent of ERP system usage by integrating additional IT usage factors that have been identified in the literature as having an effect on ERP system usage. This study will contribute to the open issue of gender differential in information technology usage by examining the effect of gender (as a moderator) on factors that improve understanding of the extent of ERP system usage. Contribution will also be made in terms of age and experience differentials in the context of ERP system usage. The evaluation of other existing related technology adoption and usage models to demonstrate the superiority of this study's research model will make further theoretical contributions.

1.5.2 Practical implications

The results of the study will inform university stakeholders and all interested groups about how to improve understanding of the extent of ERP system usage by end-users for their work performance. The methodology and the findings from this study can be generalized to other HEIs, and the methodology may be applied to studying ERP system usage in other HEIs. The factors impacting the improvement of understanding of ERP system usage identified in this study can be used in future system design targeting the higher education sector.

1.6 DEFINITION OF KEY TERMS

This section is aimed at clarifying terms used in this study:

1.6.1 Enterprise resource planning (ERP) system

ERP is a packaged software system that enables an organization to manage the efficient and effective use of resources (Nah, Zuckweiler and Lau, 2003).

1.6.2 Technology adoption and usage

Technology adoption and usage has been studied in many related disciplines such as information systems (IS), human-computer interaction (HCI), health, engineering and communication studies and many more. It is defined as the demonstrable willingness within a user group to employ information technology for the tasks it is designed to support (Wu, 2009).

1.6.3 Academic

An academic in this study refers to a full-time member of the instructional staff of a university and may mean, or be used interchangeably with the word lecturer or faculty member.

1.6.4 Information technology (IT)

IT is defined as the various technologies such as ERP systems which are used in the creation, acquisition, storage, dissemination, retrieval, processing, manipulation, interpretation, and transmission of information to accumulate knowledge and expedite communication in organizations (Moll, 1983).

1.6.5 Information systems (IS)

IS is defined as a system, whether automated or manual that comprises people, machines, and/or methods organized to collect, process, transmit, and disseminate data that represent user information (Chan, 2002).

1.7 OVERVIEW OF CHAPTERS

The dissertation is organized into five chapters namely:

Chapter 1: Introduction

This chapter provided a brief introduction to the background of the study along with the research problem. The chapter also outlined the research aim and objectives of this study together with the significance, contributions, key terms and the structure of the study.

Chapter 2: Literature Review

The focus of this chapter reviews available literature on ERP systems in higher education as the focus, leading to the theoretical framework for the research model, concluded by theoretical model comparisons.

Chapter 3: Research Methodology

A thorough rationale for this study's research model development, followed by the research methods employed to conduct this study are presented in this chapter. It discusses the nature of the study, the survey method, the instrumentation employed in data collection and the Partial Least Square (PLS) analytic modeling technique used for data analysis. Ethical considerations of the study are also discussed.

Chapter 4: Results and Discussion

The findings of the survey with an emphasis on statistical data analysis are discussed in this chapter. Hypotheses proposed in the methodology chapter are tested and the results are discussed.

Chapter 5: Conclusion and Recommendations

This chapter provides the research conclusions and a discussion of the empirical findings in light of the theoretical framework developed and the main research objectives. Recommendations for future research arising from this study and limitations of this study are presented.

CHAPTER 2
LITERATURE REVIEW

The preceding chapter provided the background of the study and outlined the research problem, aim, objectives, rationale, and contribution of the study and set out the structure of the dissertation. This chapter presents an analysis of literature on Enterprise Resource Planning (ERP) systems focusing on higher education, as well as a comprehensive review of technology adoption and usage models. An evaluation of extant technology adoption and usage models is also presented.

2.1 ERP SYSTEM EVOLUTION

It is important to understand the history and evolution of ERP systems within the broader enterprise applications concept in order to understand ERP system use and future development (Jacobs and Weston, 2007). ERP systems resulted from the need in large enterprises for the seamless integration of data, information transfer between stand-alone functional applications and for smoother co-ordination between business units resulting in higher efficiency (Davenport, 1998). The evolution of ERP systems has thus been a highlight in the information technology literature for several decades (Yaseen, 2009).

Since the early 1960's when the focus was just on producing as much as possible without considering the exact demand, software packages were being designed for handling inventory for a manufacturing setting (Chung and Snyder, 1999). Consequently, techniques of those days were focused on the most efficient way to manage large inventories (Umble, Haft and Umble, 2003). In the 1970's, companies could no longer afford the luxury of maintaining large quantities of inventory (Umble *et al*., 2003). Due to the need for software designed specifically for manufacturing operations, Materials Requirement Planning (MRP) systems which dealt with planning the product or part requirements according to the master production schedule, were introduced (Rashid, Hossain and Patrick, 2002; Umble *et al*., 2003). With the beginning of 1980's, the MRP system was extended from a simple MRP tool to the standard manufacturing resource planning system (MRPII) (Chung and Snyder, 1999). MRPII systems were introduced with an emphasis on optimizing manufacturing processes by synchronizing the materials with production requirements. MRPII included areas such as shop floor, distribution management, project management, finance, human resource and engineering (Rashid *et al*., 2002). These systems incorporated financial accounting systems and financial management systems along with manufacturing and materials management systems (Umble *et al*., 2003). However, the shortcomings of MRPII in managing a production facility's orders, production plans, inventories and the need to integrate new techniques led to the development of a rather more integrated solution called ERP (Chung and Snyder, 1999). Figure 2.1 and Table 2.1 shows the historical evolution of ERP in detail.

Figure 2.1: Evolution of ERP (Rashid *et al*., 2002)

The Gartner Group, an information technology research and advisory firm is credited for coining the term ‘Enterprise Resource Planning’ for a concept they developed in the 1990's for the next generation MRPII systems (Dahlen and Elfsson, 1999). Russell and Taylor (2001) describe ERP as an updated MRPII system with relational database management, graphical user interface and client-server architecture. In addition, Markus, Tanis and Fenema (2000) claim that ERP systems work essentially at integrating inventory data with financial, sales, human resources and allowing organizations to price their products, produce financial statements and effectively manage their resources of people, materials and money.

Types of Systems	Time	Purpose	Systems
Reorder point systems	1960s	Used historical data to forecast future inventory demand and when an item falls below a predetermined level additional inventory is ordered	Designed to manage high-volume production of a few products, with constant demand; focus on cost
Materials Requirement Planning (MRP) system	1970s	Offered a demand-based approach for planning manufacture of products and ordering inventory	Focus on marketing; emphasis on greater production integration and planning
Manufacturing Resource Planning (MRPII) systems	1980s	Added capacity planning; could schedule and monitor the execution of production plans	Focus on quality; manufacturing strategy focused on process control, reduced overhead costs, and detailed cost reporting
MRPII with Manufacturing Execution (MES) systems	1990s	Provide ability to adapt production schedules to meet customer needs; provide additional feedback with respect to shop floor activities	Focus on the ability to create and adapt new products and services on a timely basis to meet customers' specific needs
Enterprise Resource Planning (ERP) systems	Late 1990s and onward	Integrate manufacturing with supply chain processes across the firm; designed to integrate the firm's business processes to create a seamless information flow from suppliers, through manufacturing, to distribution to the customer	Integrates supplier, manufacturing, and customer data throughout the supply chain

Table 2.1: Historical evolution of ERP systems (Summer, 2005)

The concept of ERP seems to be growing and expanding. Moon (2007) asserts that companies have accepted ERP systems as a means of achieving organization integration. These systems provided what the organizations were looking for, that is, integration and optimization of various business processes (Mabert, Soni and Venkataramanan, 2001). At that time, as Davenport (1998) suggested, the organizations needed to make sound and timely business decisions and ERP systems offered this to them. It is not wrong to say that ERP systems gained importance as they arrived at a time when process improvement and accuracy of information became critical strategic issues (Yen and Sheu, 2004).

The 2000s saw a number of trends relating to extensions and method of delivery of ERP system functionality over hosted platforms such as the web and mobile platforms. Web-based and cloud-based ERP systems (Aalmink, Balloul, Glagau, and Gómez, 2010) became increasingly popular due to the proliferation of cloud computing and e-commerce (Shehab, Sharp, Supramaniam, and Spedding, 2004). ERP systems are being developed continuously and nowadays they can encompass all integrated information systems that can be used across any organization (Kumar, 2000).

2.1.1 Anatomy of ERP systems

Integration is the key to an ERP system. Before the introduction of ERP systems, companies usually used different software applications as separated systems to perform their business (Beheshti, 2006). To achieve the goal of integration, most ERP systems have to provide a minimum range of components and integrate them into one unified database (O'Leary, 1995). Today's ERP systems have a wide range of components such as Supply Chain Management (SCM), Customer Relations Management (CRM), manufacturing functions, Warehouse Management (WM), Human Resources (HR) and financials functions (Kevin, Vinod and Jeff, 2007). These key components as well as the interaction between the different components are illustrated in Figure 2.2 by Davenport's (1998) anatomy of an ERP system.

The functionality and components supported by an ERP system are generally designed to support best business practice (SAP, 2010), thereby ensuring a complete solution for the organization that uses the ERP system. In addition, software vendors are also adding value in the areas of data management, quality management, field service modules and internet capabilities (SAP, 2010). Davenport's anatomy has been adapted and expanded by many ERP vendors such as Oracle, SAP and PeopleSoft (Yaseen, 2009) for industries (Piturro, 1999) and universities (Chung and Snyder, 2000).

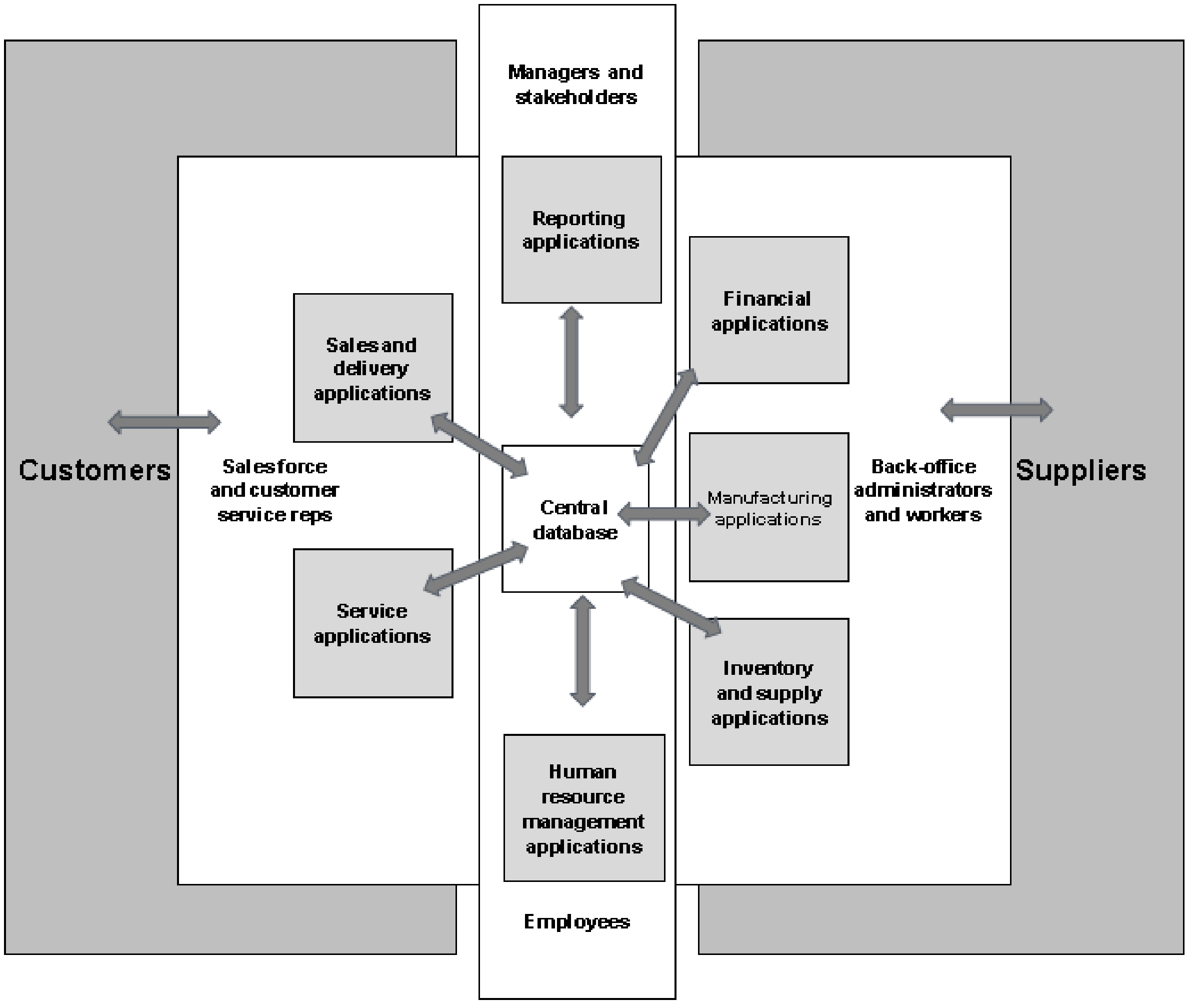

Figure 2.2: Anatomy of an enterprise resource system (Davenport, 1998)

2.1.2 Benefits and challenges of using ERP systems

Researchers (Bernroider and Leseure, 2005; Esteves, 2009) have documented the different tangible and intangible benefits, as well as the challenges and risks (Häkkinen and Hilmola, 2008; Verville, Bernades and Halingten, 2005) that ERP systems pose to users.

2.1.2.1 *Benefits of using ERP systems*

Bocij, Greasley and Hickey (2008) state that ERP systems can provide end-to-end automation and integration, thereby optimising functions, processes and workflows. ERP systems can leverage business processes and operations by facilitating improved quality of information, organization wide information sharing, substantial cost reductions, improved decision making, and an increase in productivity (Botta-Genoulaz and Millet, 2006; Marnewick and Labuschagne, 2005). It is also evident that communication and collaboration within and between stakeholders, both internal and external to the organization, is supported through the use of ERP systems (Esteves, 2009; Leung, Choy and Kwong, 2010). ERP systems are designed and developed to incorporate best business practices (Lim, Pan and Tan, 2005) thus enabling efficient and effective business operations.

2.1.2.2 *Challenges of using ERP systems*

ERP system integration and assimilation can be a complex, incompatible, and arduous undertaking as radical business process re-engineering and hesitant changes (organizational, managerial and cultural) are likely to follow (Akkermans and Helden, 2002; Bernroider and Leseure, 2005; Lim *et al*., 2005). However, according to Bernroider and Leseure (2005), this challenge may be experienced more by larger, established organizations rather than small organizations, smaller organizations tend to be more flexible than larger ones as their organizational structure is less rigid and can be changed more easily.

ERP systems are seen as rigid and inflexible (Olsen and Saetre, 2007) as they are unable to support all business processes of an organization, customization thus is needed. ERP system customization to fulfill unique and specific needs is a challenging and costly project (Quiescenti, Bruccoleri, La Commare, La Diega and Perrone, 2006) as ERP systems offer best practice solutions that may not necessarily align to the operations of the adopting enterprise (Kwahk and Ahn, 2010). Laukkanen, Sarpola and Hallikainen (2007) emphasize that customization also takes time and impacts on future upgrades of ERP systems. ERP system customization therefore presents a dilemma.

The question of customization to what is offered by an ERP system or development of an in-house (Olsen and Saetre, 2007) system to fulfill requirements (Huang and Palvia, 2001) poses a difficult decision for the organization acquiring and implementing an ERP system. ERP is a long-haul investment; it is therefore difficult to realize the return on investment (Davenport, 1998) within a short period of time.

Equey and Fragnière (2008) state that the benefits of implementing an ERP system far outweigh the challenges of implementation and use. Marnewick and Labuschagne (2005) similarly concur that the expectation of the benefits of using an ERP system is important in defining the purpose of the ERP system in organizations such as higher education institutions.

2.1.3 ERP systems in higher education

Environmental pressures for change on universities worldwide include continuing decline in per-student government funding and support, globalisation and global competition, continuing growth in student numbers, changes in the nature of academic work, increasing competition between institutions, government pressure to improve operational efficiency, and generally diverse and shifting expectations of stakeholders (McCredie and Updegrove, 1999; Rabaa'i, Bandara and Gable, 2010). These substantial and continuing shifts in the sector demand more efficient management processes (Pollock and Cornford, 2004) and improved administrative operations (Allen and Kern, 2001). In response to these pressures from governments to create administrative efficiencies (Allen and Kern, 2001; King, 2002), government policy changes, and unsatisfied students demanding better services (Anderson, Johnson and Milligan, 1999), universities have turned to IT as a core facilitator of new strategic directions.

Rowley, Lujan and Dolence (1997) suggest that given the fundamental activities of HEIs are significantly affected by ever advancing technologies, HEIs need to stimulate innovation in research, teaching, learning and management through the aggressive application and use of IT. IT vendors have responded with ERP system components tailored to this relatively new market of higher education with many universities, similar to large corporations, increasingly replacing their legacy administrative systems with ERP systems (Allen and Kern, 2001; Beekhuyzen *et al.*, 2002).

ERP systems have been implemented in HEIs to integrate different administrative functions into a more systematic and cost effective approach thereby gaining a strategic advantage in terms of improved institutional business processes (Mehlinger, 2006). The integration of administrative functions in the HE sector spans the integration of student administration, human resource management, facilities management, and financial management that have in the past been supported by separate legacy systems (Zornada and Velkavrh, 2005). These separate legacy systems were disparate and led to duplication of resources and services (Allen and Kern, 2001). ERP systems were implemented to resolve this as they: hold the promise of improving business processes and decreasing costs (Beheshti, 2006; Nah *et al*., 2003); facilitate communication and coordination, centralise administrative activities, improve ability to deploy new system functionality; and reduce system maintenance costs (Siau, 2004). Importantly a fully integrated system like an ERP allows data to be transferred between administrative processes and be accessible in real time with the use of up-to-date information approaches (web technologies, mobile phones, on-line services, etc.) not only for the administration within a higher education institution, but also for people who constantly interact with the institution (students, lecturers, researchers, etc.) (Murphy, 2004). HEIs have implemented ERP systems for: improved information access for planning and managing the institution; improved services for the faculty, students and employees; lower business risks; and increased income and decreased expenses due to improved administrative efficiency (King, 2002).

While ERP system implementation in HEIs is often described as difficult, expensive, risky and unsuccessful or ineffective (Beekhuyzen *et al*., 2002; Davenport, 1998; Markus *et al*., 2000), the implementation of ERP system solutions and its adoption across the tertiary sector has continued globally (Von Hellens, Nielsen and Beekhuyzen, 2005). This has given HEIs using ERP competitive advantage by improved administrative operations and more efficient management processes over the other institutions who have not implemented ERP systems (Murphy, 2004). Vitale (2000) concurs that the importance of an ERP system for the smooth, economical operation of a tertiary institution cannot be denied. This is the direction followed by many HEIs (franchising, distance education and on-line learning) in Australia (CAUDIT, 2001) and abroad (Swartz and Orgill, 2001) which makes wide accessibility and the retention of market position possible. Hence HEIs are making significant investments in ERP systems to improve institutional business processes (Mehlinger, 2006); this investment represents the biggest investment in IT for HEIs (Murphy, 2004). An ERP system with its associated components for a university environment is illustrated in Figure 2.3.

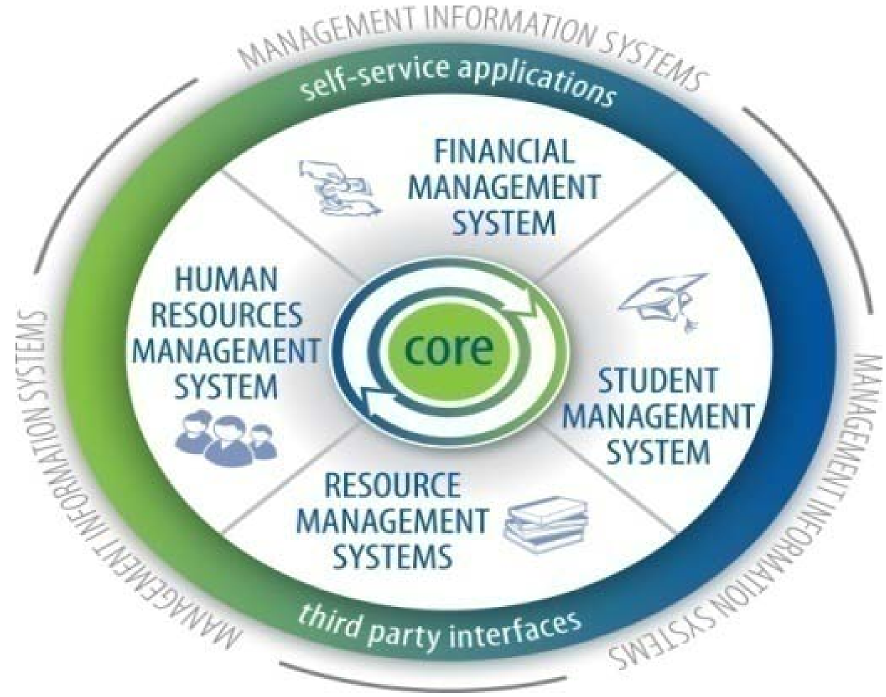

Figure 2.3: Components of an ERP system for a university environment (ITS Tertiary Software, 2012)

Management information systems: is a category of analytic applications that are part of the ERP system landscape to support strategic and operational activities (Moller, 2005) of the university by providing periodic or on-demand reporting to assist in decision-making (Chou and Tripuramallu, 2005; Elbashir, Collier and Davern, 2008; ITS Tertiary Software, 2012; Marnewick and Labuschagne, 2005).

Human resource management systems: involves maintaining employee related information including employee recruitment and appointment, leave management, performance evaluation, disciplinary action and skills development (ITS Tertiary Software, 2012) to ensure effective employee capacity planning (Worley, Chatha, Weston, Aguirre and Grabot, 2005).

Financial management systems: supports the financial aspects of the university operations (Scapens and Jazayeri, 2003; Shehab *et al*., 2004) that include the purchasing of stock and non-stock, payment of creditors, maintains records of assets within the university and the processing of remuneration of permanent, contract and temporary employees (ITS Tertiary Software, 2012).

In addition, the financial management system has the ability to permit university management to view complete financial information of the institution.

Student management systems: handles the core function of record keeping of all student and academic information for the management of qualifications, and subjects and modules within the curriculum. The student management system also allows for the identification of multiple campuses, full-time and part-time studies, defining flexible study periods and the linking of all qualifications and subjects to pre-and-co-requisites, as well as multiple class groups within one subject in the case of large class groups (ITS Tertiary Software, 2012).

Resource management systems: include sub-systems to supplement the core functions of the university ERP system which include a Meals Point of Sale sub-system that allows a student to purchase meals from vendors on campus with direct debiting to their student account, a Vehicle Reservation sub-system which allows staff to book company vehicles and an Equipment Reservation sub-system which allows for the pre-booking of media equipment for students and employees (ITS Tertiary Software, 2012).

The components of an ERP system function interdependently (Ranganathan and Brown, 2006) using data accessed from related components and this capability to integrate business functions is a vital benefit of an ERP system.

2.1.4 Previous studies on ERP systems in HEIs

Researchers have investigated which factors are important when implementing ERP in HEIs and which factors lead to success or failure. For instance, Mahrer (1999) investigated the factors for a successful ERP system implementation in a Swiss university and concluded that strong communication and coherence between the departments in the university was the main success factor. Watson and Schneider (1999) mentioned that staff training as a factor is very important when implementing ERP in higher education in order to reap more benefits from these systems. Vevaina (2007) investigated factors affecting the success or failure of the implementation process of Enterprise Systems in New Zealand higher education and found that factors such as change management, behaviour management emotions, communication and the implementation process approach; and system functionality had profound effects on implementation success. The study also discovered the effect of ERP system design on the usage of the system by the users, leading to the belief that system aspects must be taken into account when investigating ERP systems (Vevaina, 2007).

Judith (2005) investigated the impact of ERP systems on business processes and performance in higher education; the study addressed whether or not ERPs enhance performance process and concluded that ERP potentially improves business performance in higher education by enhancing services offered to students and staff. Fisher (2006) examined staff perceptions regarding issues that influence the implementation of ERP systems in three Australian universities. He identified the influences impacting on the outcomes of the implementations which formed the basis for the development of guidelines for the effective and efficient management of ERP implementations in Australian universities. The study also identified some important factors of resistance when applying new systems and recommend that poor staff co-operation should be addressed during ERP system implementation (Fisher, 2006).

ERP adoption in higher education has been a study of interest for many researchers. For example, Beekhuyzen *et al.* (2002) conducted a survey to research the rate of adoption and the status of ERPs in Australian higher education. They provided an increased awareness of the extent of the adoption of ERP technology by universities with the modules adopted being human resources, financials and student administration. In another study, Oliver and Romm (2002) examined the rationale employed by universities as ERP adopters and outlined the significance of ERP systems. The data used for the study took the form of documents published electronically on the internet by universities and identified the main reasons for adoption to be the modernization of systems, greater usability and flexibility, integration of data and systems, business process reengineering, an increase in the degree of electronic data interchange (including the provision of web-based interfaces to application systems), reduced maintenance, and risk avoidance (Oliver and Romm, 2002).

Researchers in the area of ERP systems in higher education have also investigated ERP in terms of cultural constraints to gain some knowledge about its importance regarding implementation success and failure issues. Thavapragasam (2005) investigated the cultural influences on ERP implementation in a large Australian University. The study concentrated on factors influencing the post-implementation stage of an ERP system life cycle project and identified the importance of cultural influences on user satisfaction with implementation. He found that during a technology's implementation, the management of human and organizational risk is not only more difficult than managing the technical risk, it is crucial to the success of the implementation thereof. Allen and Kern's (2001) study on four UK universities found that organizational cultural influences have significant effects on the implementation outcome of ERPs in higher education. McConachie (2001) examined the effect of sub-cultures on the implementation of ERPs in an Australian regional university; the results indicated that all sub-cultures except the academics themselves perceive that the academic sub-culture holds the power to influence the success or failure of change. He explained that many staff asserted that benefits from the ERP systems will be achieved not through autocratic leadership but through the management driving a common vision and empowering staff. He concluded that for change to be successful, the needs and values of sub-cultures must be recognized, or individuals will create barriers to change.

Despite a number of ERP systems being successfully implemented in higher education institutions, some cases of unsuccessful implementation are found in practice. Parth and Gumz (2003) and Madden (2002) have reported on factors that have limited the successful implementation of ERP system projects in the higher education sector such as the lack of system functionality where staff had problems accessing information, ERP system did not fit with the organisational processes, and the budget over ran because of unexpected costs. Mehlinger (2006) studied the impacts of leadership and culture factors on implementation of ERP systems in higher education and found that organizational culture has little impact on the success of ERP implementation and that the combination of leadership and culture factors was not associated with successful user performance. Research in Australian higher education have reported on complex of problems with ERP implementations that appear unique to universities (Nielsen, 2005; Von Hellens *et al.*, 2005) such as strong resistance caused by manpower reductions as university staff are on recess and the daily university business demands restrain staff from giving their full support. Such problems have been reported by Australian newspapers as being broadly characterized as ERP project failures (Madden, 2002) at the University of New South Wales

(UNSW), Adelaide University, and Royal Melbourne Institute of Technology (RMIT). Unsuccessful university ERP implementation was also reported in the United States (Parth and Gumz, 2003), where Cleveland State University considered legal action against the ERP vendor when their new system could only handle half of their transaction volume.

Having discussed previous studies conducted on ERP systems in HEIs globally, the following section reviews some of the models applicable to this study.

2.2 TECHNOLOGLY ADOPTION AND USAGE MODELS

In the past researchers have been intensively applying theories, frameworks and models in their studies either to guide their research or to test their theories and/or models used so that their findings can have sufficient rigor and be credible.

Extant evidence shows that organizational users employ only low levels of available features provided (Mabert *et al*., 2001), resulting in underutilization of the implemented systems. Consequently the problem of underutilized systems remains (Norman, 1993; Weiner, 1993). To address this issue of underutilized systems, various technology adoption and usage theoretical models (Taylor and Todd, 2001) have evolved over the years as a result of persistent efforts of model validations and extensions that took place during the period each was presented. Psychology research contributed the Theory of Planned Behaviour, TPB (Ajzen, 1985), which was extended to the Decomposed Theory of Planned Behaviour, DTPB (Taylor and Todd, 2001); Information Systems research contributed the Technology Acceptance Model, TAM (Davis, 1986), which has an extension TAM2 (Venkatesh and Davis, 2000) and the Unified Theory of Acceptance and Use of Technology, UTAUT (Venkatesh *et al*., 2003) which is an aggregation of eight models including the aforementioned. It is therefore important to study them individually, since it is expected that theoretical factors from these models will help to provide a sound basis for the development of this study's research model for the improvement of understanding of the extent of ERP system usage at the DUT.

2.2.1 Technology Acceptance Model (TAM)

TAM is the most commonly employed model of technology system usage, receiving considerable empirical support (Davis, 1989; Davis *et al*., 1989; Mathieson, 1991; Taylor and Todd, 2001). It was designed to explain system usage (Davis *et al*., 1989) and has been shown to be useful in predicting behavioural intention with respect to the adoption and usage of technology (Gefen, Karahanna and Straub, 2003; Moon and Kim, 2001). TAM postulates that perceived usefulness (PU) and attitude toward behaviour (ATB) are the main factors in explaining the behavioural intention (BI) to use systems (Umrani and Ghadially, 2008). Davis (1989) defined perceived usefulness as the degree to which an individual believes that using a particular system would enhance his or her job performance and defined perceived ease of use as the degree to which a person believes that using a particular system would be free of effort. ATB reflects the individual’s global positive or negative evaluations of performing a particular behaviour of system usage (Ajzen and Fishbein, 1980). In general, the more favorable the attitude towards system usage behaviour, the stronger should be the individual’s intention to perform it (Armitage and Conner, 2001). Behavioural intention (BI) indicates an individual's readiness to perform a given behaviour (Ajzen and Fishbein, 1980). TAM postulates that actual behaviour (i.e. system usage) is determined by BI to use the system, ATB and PU (Davis *et al*., 1989) as shown in Figure 2.4.

According to Davis *et al*. (1989), the direct path from PU to BI is that in work settings, intentions to use the system may be based on anticipated job performance consequences of using the system regardless of overall attitude. In other words, an employee may dislike a system (i.e. have a negative attitude towards it), but still use the system because it is perceived to be advantageous in terms of job performance. Davis *et al*. (1989) state that all other factors not explicitly included in the model are expected to impact BI and AB through PEOU and PU. They add that these external factors might include: system design characteristics; training; documentation and other types of support; as well as decision maker characteristics that might influence system usage. Thus, according to TAM, the easier a technology is to use, and the more useful it is perceived to be, the more positive one’s attitude and intention towards using the system. Correspondingly, the usage of the system increases (Taylor and Todd, 2001).

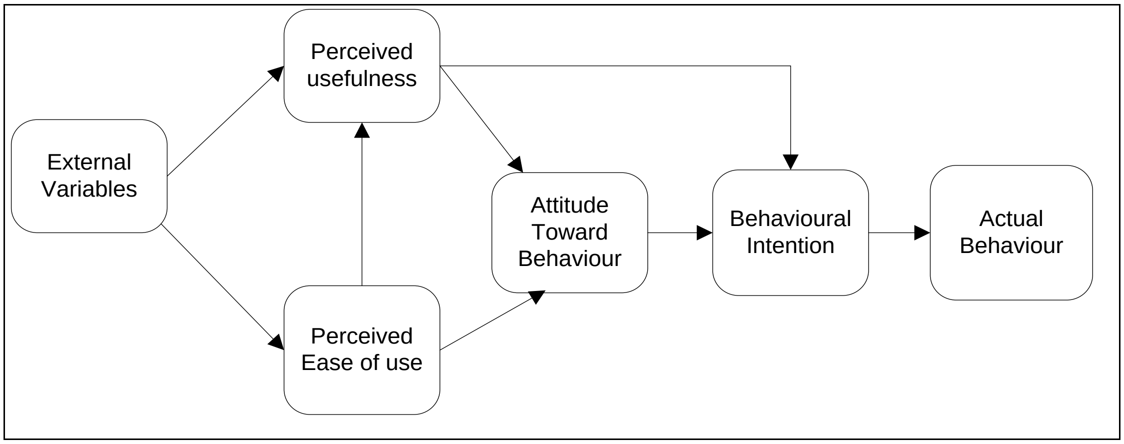

Figure 2.4: Technology Acceptance Model (Davis *et al.*, 1989)

Han (2003) pointed out that since its introduction, the TAM model was tested and adopted across a wide range of IT systems such as key office applications (e.g. Lotus 1-2-3, Word Perfect, Microsoft Word and Excel spreadsheets), communication technologies (e.g. email, voice mail, customer dialup system, and fax), database systems, microcomputers, workstations, telemedicine technologies and internet–related applications (e.g. online services, virtual workplace systems and digital libraries). Furthermore, several researchers have replicated Davis' original study to provide empirical evidence on the relationships that exist between PU, PEOU and system usage (Davis *et al.*, 1989; Hendrickson and Collins, 1996; Szajna, 1994). Much attention has been focused on testing the robustness and validity of the questionnaire instrument used in Davis' work (Adams, Nelson and Todd, 1992; Hendrickson and Collins, 1996; Szajna, 1994). Adams *et al.* (1992) demonstrated the validity and reliability of the questionnaire instrument and also extended it to different settings by using two different samples to test the internal consistency and replication reliability of the questionnaire instrument measurement scales. Hendrickson and Collins (1996) found high reliability and good test reliability of the questionnaire instrument. Szajna (1994) found that the instrument had predictive validity for intent to use, attitude toward use and system usage.

A drawback of the TAM is that it does not provide an in-depth explanation of how the factor PU is formed or how it can be managed to improve user behaviour towards system usage (Yousafzai, Foxall and Pallsiter, 2007). In an attempt to overcome such shortcomings, Venkatesh and Davis (2000) developed an extension of the Technology Acceptance Model (TAM2).

2.2.2 Extension of the Technology Acceptance Model (TAM2)

Venkatesh and Davis (2000) extended the original TAM model to include additional key factors that explain perceived usefulness and usage intentions in terms of social influence and cognitive instrumental processes, and to understand how the effects of these factors change with increasing user experience over time with the target system. The TAM2 retained the three core factors of TAM namely: PU; PEOU; and BI (Davis *et al*., 1989). The new model incorporates moderating factors (voluntariness and experience) and additional theoretical factors like subjective norm, image, job relevance, output quality, and result demonstrability (Venkatesh and Davis, 2000) as shown in Figure 2.5. Subjective norm (SN) is defined as a person's perception that most people who are important to them think they should or should not perform the usage behaviour (i.e. use of the system) (Ajzen and Fishbein, 1980). Voluntariness is defined as the extent to which potential adopters perceive the adoption decision to be non-mandatory (Agarwal and Prasad, 1998; Hartwick and Barki, 1994; Moore and Benbasat, 1991).

Moore and Benbasat (1991) define image as the degree to which use of a system is perceived to enhance one's status in the social system. Job relevance is defined as an individual's perception regarding the degree to which the target system is applicable to his or her job (Venkatesh and Davis, 2000). Output quality is defined by Venkatesh and Davis (2000) as the perception of how well the system performs tasks that match with job goals. Result demonstrability is defined by Moore and Benbasat (1991) as the tangibility of the results of using the system which directly influences perceived usefulness. Venkatesh and Davis (2000) further explain the role of social influences in an IT system usage context, whereby TAM2 theorizes that the SN direct effect on BI over PU and PEOU will occur in mandatory system usage settings. They add that the model posits voluntariness and experience as a moderating factor to distinguish between mandatory versus voluntary compliance with organizational settings. They state further that SN can influence BI through PU which is called internalization. In addition, they explain that TAM2 theorizes that internalization rather than compliance will occur regardless of whether the system usage context is voluntary or mandatory, that is, even when system usage is mandated by the organization, it is the user’s perception of a system’s PE through persuasive SN that will increase his/her intention towards system usage.

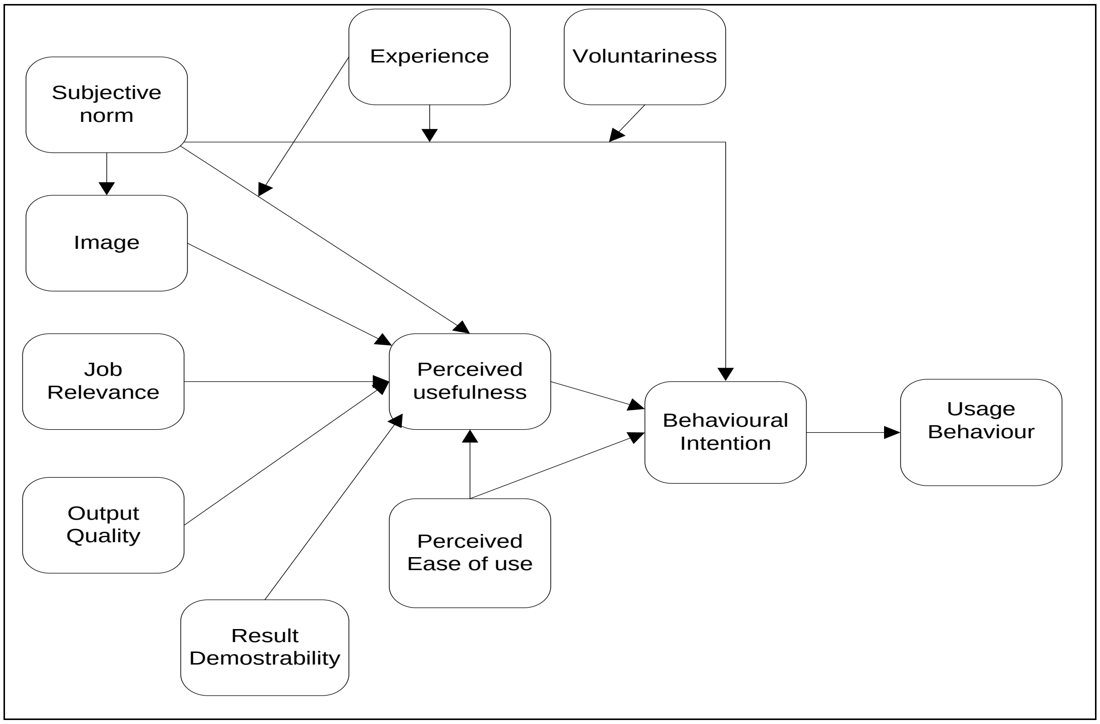

Figure 2.5: Extension of TAM - TAM2 (Venkatesh and Davis, 2000)

TAM2 was tested and adopted in various disciplines. For instance, in the health sector field, Chismar and Wiley-Patton (2003) tested the applicability of TAM2 to the acceptance of internet and internet-based health applications within 89 paediatric physicians. The results partially confirmed the model; however, a core factor of the model, that is PEOU, was not supported by the findings but PU was a strong factor of BI (Chismar and Wiley-Patton, 2003). Chismar and Wiley-Patton (2003) stated that in the medical context the important factors for BI to adopt the new system were: PU; job relevance; and the output quality which is sufficient for the completion of the daily tasks by use of the new system. In another study, Hart and Porter (2004) applied TAM2 to investigate how the factors of result demonstrability, output quality and job relevance influence the PU of on-line analytical processing technology (OLAP) in South Africa. The results showed that result demonstrability, output quality and job relevance does influence PU, as well as PEOU was significantly and positively correlated with PU (Hart and Porter, 2004).

A drawback of the extension of TAM, that is TAM2, is that it excludes the influence of personal control factor perceived behavioural control (PBC) which has been found to have a significant influence on user behaviour towards system usage (Mathieson, 1991; Moore and Benbasat, 1991; Taylor and Todd, 2001; Thompson, Higgins and Howell, 1991). PBC has been recognized as a key factor in the Theory of Planned Behaviour model (Ajzen, 1991).

2.2.3 Theory of Planned Behaviour (TPB)

TPB model was first introduced by Ajzen in 1985 who asserts that behaviour (i.e. system usage) is a direct function of intention and PBC, and that intention is formed by ATB which reflects users' feelings of favourableness or unfavourableness towards performing system usage. Ajzen (1985, 1991) adds that SN reflects perceptions that significant referents desire the user to perform or not perform a behaviour, and PBC reflects perceptions of internal and external constraints on system usage. Each of the factors towards intention, i.e. ATB, SN and PBC are in turn, determined by underlying salient belief structures (Ajzen, 2006). These are referred to as behavioural, normative and control beliefs which are related to ATB, SN and PBC respectively (Ajzen, 2006) as shown in Figure 2.6.

Ajzen (2006) summarized these salient beliefs as follows:

- behavioural beliefs are assumed to influence ATB, a behavioural belief is the subjective probability that the behaviour will produce a given outcome. Although a person may hold many behavioural beliefs in respect to certain behaviour, only a relatively small number are readily accessible at a given moment;
- normative beliefs refer to the perceived behavioural expectations of important influential referent individual(s) or group(s). It is assumed that normative beliefs in combination with the person's motivation to comply with different referents, determine the prevailing SN. This means that the motivation to comply with each referent contributes to the SN in direct proportion to the person's subjective probability that the referent thinks the person should or should not perform the behaviour in question; and
- control beliefs has to do with the perceived presence of factors that may facilitate or impede performance of behaviour; each control factor enjoys a certain power. This means that this perceived power contributes to the PBC in proportion to the factors present in a given situation calling for the performance of behaviour.

A comprehensive explanation of the salient beliefs (behavioural, normative and control beliefs) and its relationship with ATB, SN and PBC follows. ATB is equated with the behavioural belief that performing system usage will lead to a particular outcome, for example, an individual may believe that using the system will result in better job performance and may consider this a highly desirable outcome (Taylor and Todd, 2001). SN is formed as the individual's normative belief, for example an individual may believe that his/her colleagues think that one should use the system (Taylor and Todd, 2001). Interestingly the role of SN as a factor of system usage is somewhat unclear, neither Davis *et al.* (1989) nor Mathieson (1991) found a significant relationship between SN and BI. However, these results may have been due to the fact that there were no real consequences associated with system usage under study and little external pressure to use the system (Davis, I993; Davis *et al*., I992; Hartwick and Barki, 1994). Indeed, studies in organizational settings have found SN to be an important factor of intention towards system usage (Hartwick and Barki, 1994; Moore and Benbasat, l991).

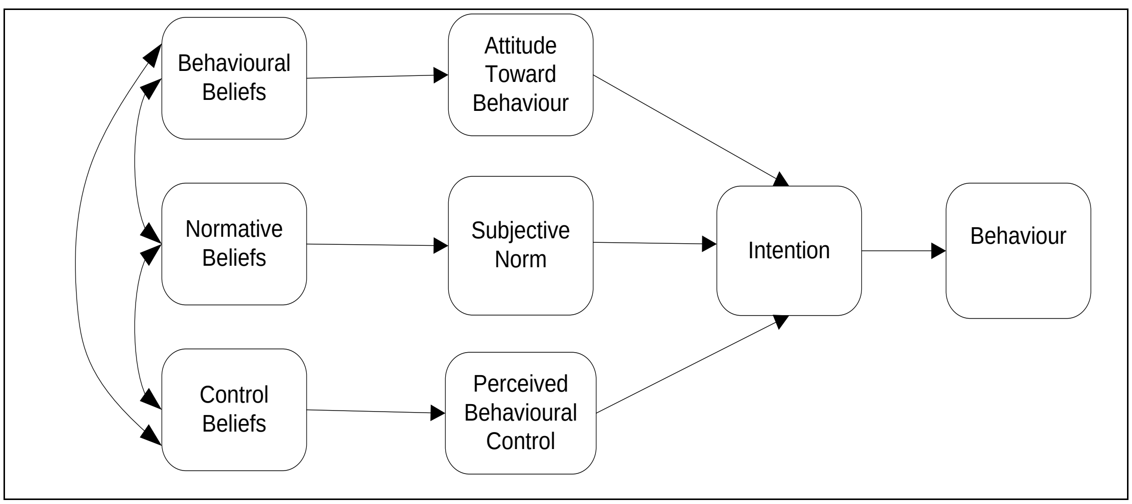

Figure 2.6: Theory of Planned Behaviour (Ajzen, 2006)

Hartwick and Barki (1994) concluded that in a setting where system usage with real consequences is studied, SN would be expected to be an important factor of intention towards system usage. PBC is formed as the sum of the control beliefs, for example, an individual may feel that he/she does not have the skill to use the system and that skill level is important in determining system usage (Taylor and Todd, 2001). According to Ajzen (1985, 199l), PBC reflects beliefs regarding access to the resources and opportunities needed to use the system, or alliteratively, to the internal and extemal factors that may impede system usage. This notion encompasses two components. The first component is facilitating conditions (Triandis, 1979) which reflects the availability of resources needed to use the system such as time, money or other specialized resources.

The second component is self-efficacy, that is, an individual's self-confidence in his/her ability to use the system (Bandura, 1997). PBC has received considerable attention in literature. Ajzen (1991) assumed that PBC is most compatible with Bandura's (1997) factor of self-efficacy which is concerned with the judgment of how well one can execute courses of action required to deal with prospective situations. Ajzen recognized that most of the knowledge about PBC comes from the systematic research program of Bandura and associates which showed that an individual's system usage is strongly influenced by their confidence in their ability to use the system thus leading to the conclusion that self-efficacy influences system usage (Bandura, 1997). Ajzen (1991) assumed that self-efficacy is synonymous with TPB although Armitage and Conner (2001) contradicted Ajzen in his assumption, taking proof from several studies suggesting that self-efficacy and PBC are not entirely synonymous. Other studies (Manstead and Eekelen, 1998; O'Leary, 1995) have provided support for the distinction between the two factors as well. Armitage and Conner (2001) stated that while self-efficacy and PBC account for equivalent proportions of variance in system usage, self-efficacy explains somewhat more of the variance in intention than does PBC, implying that self-efficacy should be the preferred measure of intention within TPB.

TPB has been used in numerous studies that have successfully predicted intention and subsequent system usage in a wide range of contexts (Taylor and Todd, 2001; Harrison, Mykytyn and Riemenschneider, 1997). In a study that investigated gender differences in the context of individual adoption and sustained usage of technology in the workplace using the TPB; it was found that the decisions of men were more strongly influenced by their attitude towards using the new technology. In contrast, women were more strongly influenced by SN and PBC (Venkatesh *et al*., 2003). Liaw (2004) applied the TPB to the study of behavioural intentions to use search engines as a learning tool. Other studies have modified the TPB to specific contexts such as consumers' adoption of broadband internet and basis of social influences in online environments (Bagozzi, 2006).

Taylor and Todd (2001) mentioned draw backs of TPB, stating that the model requires individuals to be motivated to carry out system usage; furthermore, TPB had one factor (PBC) as an answer to all non-controllable elements of system usage. According to Taylor and Todd (2001), beliefs behind the PBC factor were aggregated to create a measure for it and this aggregation has been criticized for not identifying specific factors that might predict system usage_and for the biases it may create. To address the aforementioned weaknesses, Taylor and Todd (2001) proposed the decomposed TPB model to provide a better understanding of system usage.

2.2.4 Decomposed Theory of Planned Behaviour (DTPB)

The Decomposed TPB (DTPB) was introduced by Taylor and Todd in June 1995 in their study titled Understanding Information Technology usage: A test of competing models. This model retains the original three core factors ATB, SN and PBC from TPB model and more completely explores them by decomposition into further factors (Taylor and Todd, 1995) as shown in Figure 2.7.

Taylor and Todd (1995) decomposed ATB into three more factors namely: compatibility relating to the fit between the individuals' work style and their use of the system (Moore and Benbasat, 1991), PU and PEOU that has been found to be consistently related specifically to behaviour (i.e. system usage). SN was decomposed into peer influence and superior's influence factors because each may have different views on system usage. For example, peers of the user may be opposed to the use of a particular system because they think it requires too much change in their work processes but superiors of the user may be encouraging the use of the system because they anticipate certain productivity payoffs (Taylor and Todd, 1995). Hence, SN has been decomposed into two factors peers and superiors because the expectations of peers and superiors may be expected to differ (Taylor and Todd, 1995). PBC was decomposed into three factors: self-efficacy, resource facilitating conditions and technology facilitating conditions (Taylor and Todd, 1995). Self-efficacy (Bandura, 1997) is related to perceived ability and it is anticipated that higher levels of self-efficacy will lead to higher levels of intention and system usage (Compeau and Higgins, 1995). The facilitating conditions factor provides two dimensions for control beliefs: one relating to resource factors (resource facilitating conditions) such as time and money and the other relating to technology compatibility issues (technology facilitating conditions) that may constrain system usage (Taylor and Todd, 1995). They add that the absence of facilitating resources represents barriers to system usage and may inhibit the formation of intention and system usage; however the presence of facilitating resources may not necessarily encourage system usage. Taylor and Todd (1995) in their study aimed at comparing the TAM, TPB and DTPB in terms of their contribution to understanding system usage, stated that DTPB model seemed to have more capability in explaining system usage although it is a less parsimonious model when compared to TPB and TAM model.

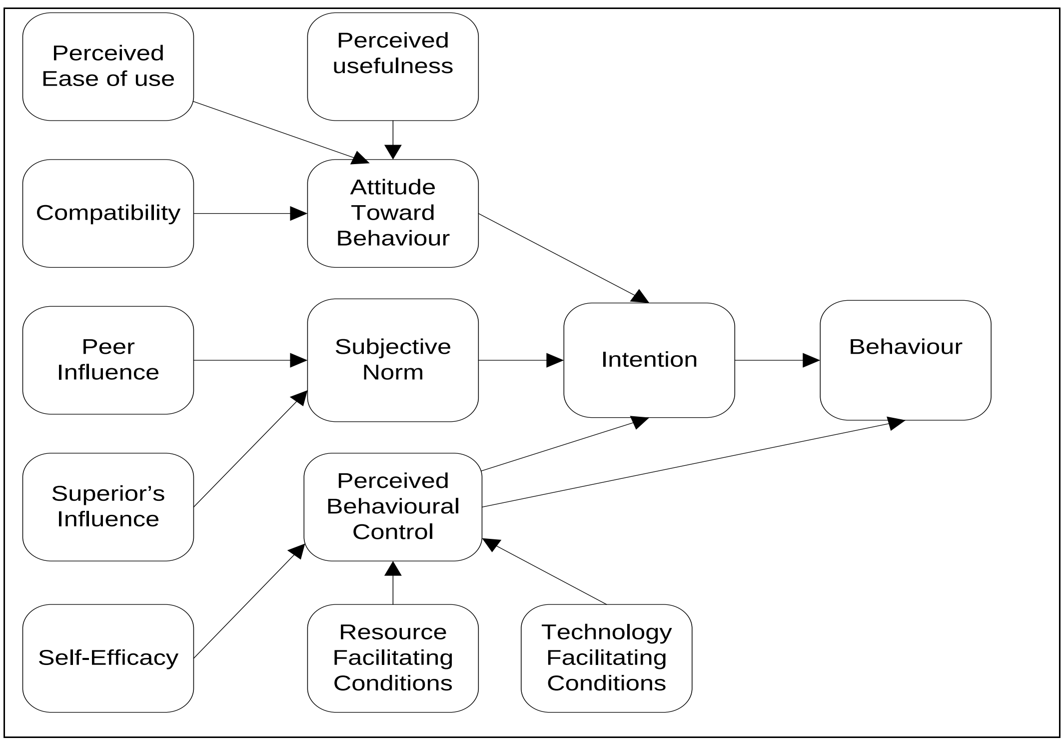

Figure 2.7: Decomposed Theory of Planned Behaviour (Taylor and Todd, 1995)

Upon review, Venkatesh *et al.* (2003) reported further limitations of prior models discussed and others in technology adoption and usage literature that included: the technologies studied were simple and individual-oriented as opposed to complex and sophisticated organizational technology; most participants in these studies were students except for a few studies; time of measurement was general and in most studies well after acceptance or rejection of the usage decisions so individuals' reactions were retrospective; the nature of measurement was in general cross-sectional; and most of the studies were conducted in voluntary usage contexts making it rather difficult to generalize results to mandatory settings.

In an attempt to overcome these limitations, Venkatesh *et al*. (2003) integrated the main competing technology adoption and usage theoretical models and formulated the Unified Theory of Acceptance and Use of Technology.

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

UTAUT (Venkatesh *et al*., 2003) is a more recent technology adoption and usage theoretical model that consolidates factors of eight older technology adoption and usage models. These models included TRA (Theory of Reasoned Action), TPB, TAM, C-TAM-TPB (Combined TAM and TPB), DOI (Diffusion of Innovation Theory), SCT (Social Cognitive Theory), MM (The Motivational Model) and MPCU (The Model of PC Utilization). UTAUT can explain up to 70% variation of behavioural intention to adopt a new technology, but TAM only explained about 40% variation (Wills, El-gayar and Bennett, 2008). It is arguably the most used framework for studying technology adoption and system usage (Wu, 2009). UTAUT incorporated relevant human and social factors to improve its prediction and explanatory powers (Venkatesh *et al*., 2003).

The UTAUT was formulated by theorising four core factors that play an important role as a direct effect of user adoption and user behaviour (i.e. system usage) which are:

- Performance expectancy: defined as the degree to which an individual believes that using the system will help him or her attain benefits in his or her job (Cody-Allen and Kishore, 2006). Performance expectancy is an integration of similar concepts namely PU, outcome expectancy, relative advantage, job-fit and extrinsic motivation from other models (Kijsanayotin, 2009). UTAUT suggests that the effect of performance expectancy on BI is moderated by gender and age such that it is more salient to the youth, more particularly to males (Venkatesh *et al*., 2003). Kijsanayotin (2009); and Venkatesh and Davis (2000) have shown performance expectancy to be a strong predictor of BI to system usage.

Venkatesh *et al*. (2003) used data from four organizations over a period of six months to validate UTAUT and found the effect of performance expectancy on BI to be stronger for men as compared to women.

- Effort expectancy is defined as the degree of effort an individual believes is required for using the system (Assadi and Hassanein, 2009). Effort expectancy is one of the most important factors required for accepting a new system (Schaper and Pervan, 2007), however Chau and Hu (2002) did not find this factor to significantly influence BI towards system usage. Effort expectancy affects have been postulated as factors of an individual's BI to use a new system (Cody-Allen and Kishore, 2006). According to Venkatesh *et al*. (2003), the relationship of effort expectancy on BI is moderated by age, gender and experience such that it is more salient to women, more particularly young women.

- Social influence is defined as the degree to which an individual perceives the importance of others believing he or she should use the system (Venkatesh *et al*., 2003). The effect of social influence on BI to use the system has been shown to have a significant effect in a study by Venkatesh and Davis (2000), however another study exhibited a non-significant effect (Chau and Hu, 2002). UTAUT postulates the effect of social influence on BI is moderated by gender, age, experience and voluntariness of system use (Venkatesh *et al*., 2003). Venkatesh *et al*. (2003) revealed that the effect of social influence on BI was stronger for women than men and the effect was more important in the context of mandatory system use, more so among older women.

- Facilitating conditions is defined as the degree to which an individual believes that organizational and technical infrastructure exists to support use of the system (Venkatesh *et al*., 2003). This factor integrates the PBC factor concepts from the TPB model (Kijsanayotin, 2009; Venkatesh *et al*., 2003).

Previous studies on technology adoption found that facilitating conditions predict system use but did not predict BI when both performance expectancy and effort expectancy factors are present in the model (Chau and Hu, 2002; Venkatesh *et al*., 2003). UTAUT postulates the effect of facilitating conditions on BI is moderated by age and voluntariness of system use (Venkatesh *et al*., 2003). The four core factors discussed are moderated by either gender, age, experience or voluntariness to explain the influence of individual differences in system usage (Sun and Zhang, 2006). Figure 2.8 illustrates the relationships between these factors of UTAUT. Since the inception of UTAUT, it has been applied and modified in several works in the healthcare context to study IT adoption and use.

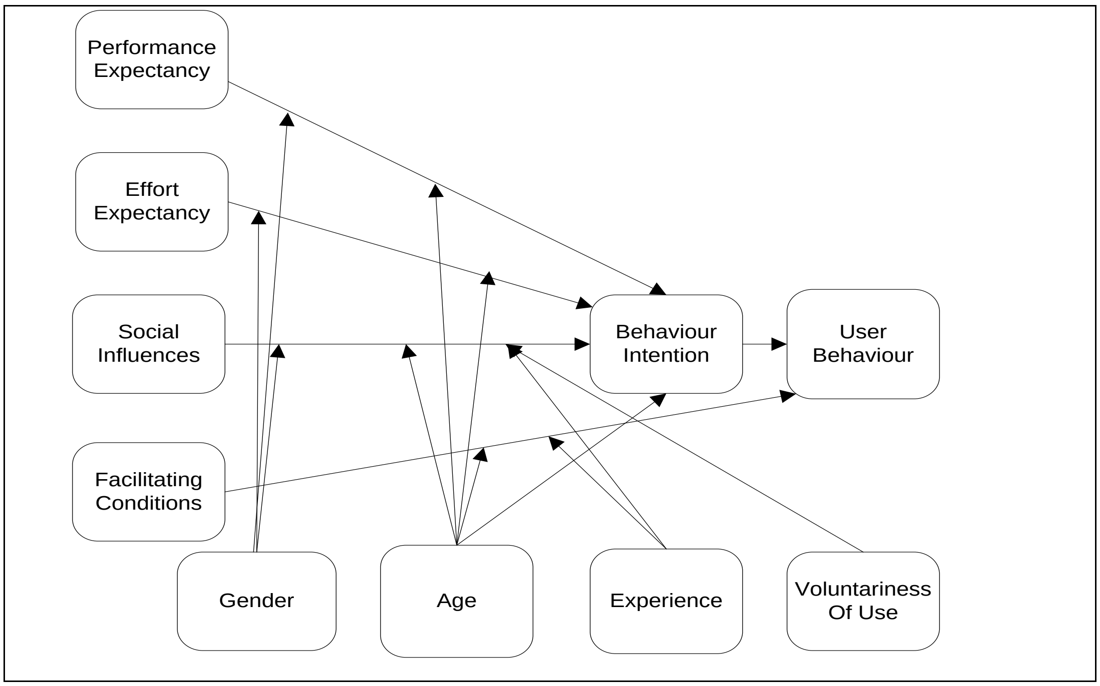

Figure 2.8: Unified Theory of Acceptance and Use of Technology (Venkatesh *et al*., 2003)

Studies show that UTAUT and its modified model are applicable in explaining IT adoption and use in healthcare settings (Kijsanayotin, 2009). However, a majority of these studies were conducted in developed countries (Chang, Hwang, Hung and Li, 2007; Schaper and Pervan, 2007) with very little studies employing UTAUT model in developing countries healthcare context (Kijsanayotin, 2009). Further to this, UTAUT has attracted many scholars in technology adoption and usage research. Moran (2006) studied the adoption of Tablet Personal Computers and modified UTAUT by introducing self-efficacy and anxiety factors because of their significance in other technology adoption and usage models which the results showed a high correlation between attitude towards technology use and anxiety. Cody-Allen and Kishore (2006) extended UTAUT by adding e-quality, trust and satisfaction factors to develop an e-business quality model. Engebresten (2005) validated UTAUT factors in health research project to study the adoption of EpiHandy in Uganda and South Africa. The results indicated that health workers in Uganda accept EpiHandy more than their counterparts in South Africa (Engebresten, 2005). Wills *et al*. (2008) conducted a study that utilize UTAUT as the theoretical model, using PLS analysis technique to assess adoption of Electronic Medical Records (EMR) by health care professionals and the results indicated that UTAUT was able to provide a reasonable variance in adoption of EMR.

Bagozzi (2007) pointed out several common deficiencies of extant technology adoption and usage models like UTAUT, TAM and TAM2. These deficiencies include: naivety of extant models; lack of any practical value and falsifiability; questionable heuristic value; limited explanatory and predictive powers; and creation of an illusion of progress in knowledge accumulation and theoretically chaotic. Hence, it was of paramount importance to further evaluate differences and similarities in extant technology adoption and usage models theoretically and empirically.

2.3 EVALUATION OF TECHNOLOGY ADOPTION AND USAGE MODELS

There have been tests of extant technology adoption and usage models but only a few studies reporting empirical-based comparison of two or more of existing technology adoption and usage models. This study compares existing technology adoption and usage theories using a metric of four criteria namely: classification; data analysis technique used; empirical; and theoretical comparison. Appendix D provides a summary of completed research on extant technology adoption and usage models in an ERP system context.

2.3.1 Using classification

Technology adoption and usage models can be classified into intention-based and goal-based categories. Intention-based models postulate that technology adoption is determined by user BI (Davis, 1989; Venkatesh and Davis, 2000). Many existing technology adoption and usage models fall into this category, but with differing assumptions about the underlying factors that dictate user intention. Examples of these models are TAM, TPB and UTAUT.

Moreover, intention based technology adoption models often lack tying adoption decisions to goal attainment as motivation and outcome to represent technology values (Brandyberry, 2011). In general, intention-based models, especially TAM and its variants have received a lot of criticism about some of the deficiencies. For example, BI may not always influence user behaviour towards using a system in a consistent manner, lack of any practical value, questionable heuristic value and limited predictive powers (Bagozzi, 2007; Bhattacherjee and Sanford, 2009; Brandyberry, 2011). Goal-based models (Bagozzi, 2006; Brandyberry, 2011) were introduced to address the deficiencies of intention based models. Goal-based models are suitable for representing the decision making process behind technology adoption. However such models do not measure technology post-adoption system usage. This study hence applies an intention-based model to improve ERP system usage in a university context.

2.3.2 Using data analysis techniques

Literature on technology adoption and usage indicates that studies apply or modify existing models, hence as part of the analysis, test for possible relationship between factors is common in all the studies with different analysis techniques used. There are several methods of analyzing relationships between factors each with its own merits namely: multiple Regression Analysis (MRA), Path Analysis (PA), Factor Analysis (FA) and Structural Equation Model (SEM). However, it can be seen in Appendix D, the widely used analysis method is SEM which has been used in TAM, TPB and UTAUT. FA, MRA and PA are suitable for studies that deal with relationship between single dependent factors and many independent observable factors. However, this study has more than one dependent factor, hence the afore-mentioned analysis methods are appropriate for this study. Furthermore, MRA does not provide any test on validation or reliability for measuring latent factors (Aibinu and Al-Lawati, 2010). PA and MRA deals with observed factors rather than latent factors and assume that the data used is normally distributed.

FA can detect latent factor from manifest factors and can provide information on the relationship between detected latent factors and their corresponding observed factors from them (Aibinu and Al-Lawati, 2010). This is equivalent to measurement item loadings in SEM model, however FA do not provide information about relationship among detected latent factors. SEM allows simultaneous assessment of reliability and validity of measurement items of each factor of a model and estimates relationship among latent factors and their dependent factors at the same time (Barclay, Thompson and Higgins, 1995). This approach used by SEM has the capability to advance understanding of theoretical and empirical knowledge not possible with MRA, FA and PA. This study found SEM to be the suitable data analysis approach.

2.3.3 Empirical comparison

There are numerous empirical studies using social cognitive models, however there has not been enough empirical work comparing the predictive power of the different models. The lack of comparison studies means that there is little consensus on whether some factors are more influential than others and whether some models of technology adoption and usage are more predictive than others (Weinstein, 1993). Venkatesh *et al*. (2003) noted that there has been many individual tests of IS models however, there are few empirically based comparison studies reported even those reported were not conducted in a single study.

Davis *et al*. (1989) studied the predictive power of the TRA and the TAM models to predict an individual’s intention to use a word processor application with a sample of 107 students. Using a cross-sectional analysis, they found that TRA explained 26% and TAM explained 51% of intention to use word processor. Taylor and Todd (1995) compared the variance in intention to use computing resources explained by the TAM and TPB models among 786 students using a cross-sectional analysis. They found that the variation of intention explained by TAM was 52%, less than TPB which was at 57%. Another comparison study of behavioural intention is in the context of electronic payment system using smart card to compare the TAM model and the IDT (Innovation Diffusion Theory) model by Plouffe, Hulland and Vandenbosch (2001). 176 merchants were recruited and a survey was administered after 10 months of use. Using a cross-sectional analysis method, 33% variance of intention was explained by TAM and IDT explained 45%. Venkatesh *et al*. (2003) conducted an empirical comparison of the predictive power of eight models to predictive intention to use information system. Using data from four organizations over a six-month period with three measurement points they used a PLS analysis technique. The results revealed that UTAUT had the highest predictive power of about 70%

followed by TAM with 39%, then IDT and SCT with 38%. TRA had the lowest predictive power of 26%.

Taylor and Todd (1995) compared the TAM to a traditional version of TPB and DTPB to assess which model best help to understand usage of information technology in their study. They concluded that the DTPB should have more advantages than TAM in that it does not only identify specific salient beliefs (perceived usefulness and perceived ease of use) that may influence IT usage as TAM does, but also incorporates extra factors (subject norm and perceived behaviour control) that are not presented in TAM. These extra factors have been found to influence system usage behaviour (Ajzen, 1991). DTPB should therefore provide a more complete understanding of technology usage (Taylor and Todd, 1995).

2.3.4 Theoretical comparison

There has been a considerable overlap between factors contained in models of the same domain, and more especially theoretical models (Armitage and Conner, 2001; Conner and Norman, 2005); moreover differences appear in labeling rather than in underlying factors. As noted by Conner and Norman (2005), this suggests that there might be some benefit in developing integrated theoretical models. Such an integrated model has been conducted in the field of IS by Venkatesh *et al*. (2003) who consolidated factors of existing information systems (IS) models to develop UTAUT. Most social cognition models focus on the perceived consequences of performing behaviour (Conner and Norman, 2005; Rosenstock, Strecher and Becker, 1988); for example, behavioural beliefs in TPB, perceived usefulness in TAM and performance expectancy in UTAUT. It has been noted that a number of models also focus on behaviour control issues. Thus, a similarity between control beliefs in the TPB and effort expectancy in the UTUAT can be noted.

The models (TPB, TAM and UTAUT) include an intervening factor which is seen to mediate the relationship between other factors and behaviour (i.e. system usage). These models use BI as the intervening factor to mediate the relationship between other factors and system usage. Technology adoption and usage models like TAM and TPB tend to treat the technology adoption and usage decision as static and each decision is viewed in isolation. However, according to

Brandyberry (2011) there are beliefs that real world organizational adoption decisions are affected by previous decisions and outcomes and that the parameters treated as static are actually dynamic.

2.4 SUMMARY

The literature review on the evolution of ERP, ERP in higher education and technology adoption and usage models presented in this chapter formed the basis for this study. Existing research on ERP in higher education revealed studies focusing on initial ERP implementation factors which lead to success and failure. The evaluation of extant technology adoption and usage model revealed common deficiencies of naivety of extant models, limited explanatory and predictive power. Other differences do appear in labeling rather than differences in underlying factors. Behavioural beliefs in TPB, perceived usefulness in TAM and performance expectancy in UTAUT where found to be similar to each other but differs in labeling. Another similarity in labeling was found in control belief issues, such factor in TPB was labeled PBC whereas in UTUAT it was labeled effort expectancy. The next chapter presents a thorough rationale of this study's research model development and the research design for this study.

CHAPTER 3
RESEARCH METHODOLOGY

The preceding chapter presented a review of pertinent literature that served as a foundation for the development of the research model in this study. This chapter presents the rationale for the research model before discussing the research design approach in this study. This is followed by a detailed explanation of the sampling design and the data collection procedures. Lastly the data analysis process carried out and the ethical considerations of the study are explained.

3.1 DEVELOPMENT OF THIS STUDY'S RESEARCH MODEL

Literature has identified common deficiencies of extant technology adoption and usage models which includes lack of any practical value and falsifiability, questionable heuristic value, limited explanatory and predictive powers (Bagozzi, 2007). For these reasons, researchers have attempted to develop and empirically test models of continued IT usage behaviour (Karahanna, Straub and Chervany, 1999; Premkumar and Bhattacherjee, 2006). This study builds on these efforts in developing a research model (*see* Figure 3.1) to improve ERP system usage in the university context. To achieve this aim, this study adapted the TAM2 theoretical model through the integration of additional IT usage factors and the interaction effect of age, gender and experience were also integrated to enhance the research model's predictive power. TAM2 is an improvement of the TAM model that was designed specifically to understand technology system usage behaviour (Davis *et al*., 1989) and is the most widely used IT adoption and usage model (Davis *et al*., 1989; Lee, Kazar, and Larsen, 2003; Williams, Dwivedi, Lal and Schwarz, 2009).

3.1.1 Additional IT system usage factors

Based on literature, the additional IT system usage factors in the research model proposed in this study were chosen because of their predictive utility in IT usage research (Brancheau and Wetherbe, I990; Moore and Benbasat, 1991; Tornatzky and Klein, 1982) and their widespread application in user technology acceptance behaviour (Ajzen, 1991; Ajzen and Fishbein, I980) to provide a more complete test of the important factors of IT usage. As suggested by Taylor and Todd (1995), factors believed to be relevant to IT usage can be derived from different streams of literature such as social psychology and human–computer interaction (HCI). The additional IT system usage factors that this study validates are: training; technical support; perceived behavioural control; and management support as illustrated in Figure 3.1.

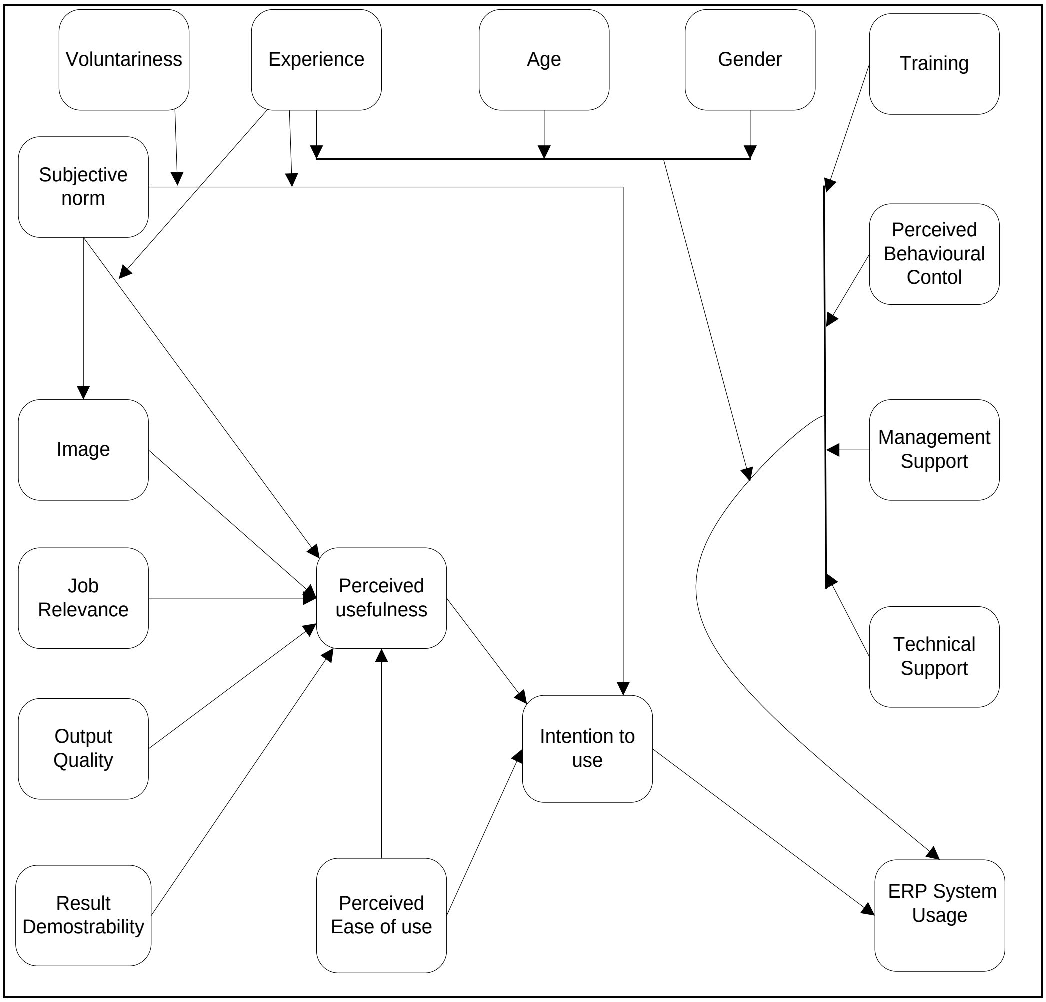

Figure 3.1: Research model developed in this study

3.1.1.1 Training

Guimaraes and Igbaria (1997) found user training to be an important factor in promoting increased ERP system usage. Coe (1996) concurs that ensuring that users are effectively trained, is critical for effective ERP system use and that training should show employees why an ERP is important and why it was implemented. Employees should understand how their jobs are related to other functional areas within organizations (Soja, 2006). Training in ERP systems help users to know these tools, as well as to reduce obstacles derived from technological complexity

(Amoako-Gyampah and Salam, 2004). Prior research also reported that training promotes greater understanding, favorable attitudes, more frequent use, and more diverse use of ERP systems (Raymond, 1988). Hence, the following hypothesis is proposed:

H1. Training has a significant influence on ERP system usage.

3.1.1.2 Technical support

Technical support refers to the extent to which an organization provides technical assistance for ERP use-related issues (Igbaria, Zinatelli, Cragg and Cavaye, 1997; Karahanna and Straub, 1999). An organization may disseminate the knowledge and skills required to use an ERP through individual guidance, skills training, seminars, computer-aided instructions or self-training (i.e. manuals, books, and computer-aided software) to build up ERP use capabilities (Igbaria *et al.*, 1997). As the technical and skill guidance becomes more comprehensive, ERP users can gain a deeper understanding of the system and thereby increase their usage of system features. Similarly, by providing technical consultation and guidance in a timely manner when ERP users encounter problems (i.e. questions pertaining to a system feature, system error, data error, and operational error), the problems can be dealt with efficiently which in turn boosts the system usage extent (Chang, Lie and Fan, 2010). From this perspective, the following hypothesis has been defined:

H2. Technical support has a significant influence on ERP system usage.

3.1.1.3 Perceived behavioural control

According to Taylor and Todd (2001), PBC may be an important factor of ERP system usage. In a direct test, Mathieson (1991) found that PBC did have a significant relationship with behavioural intention and usage. Indirect evidence with respect to PBC can also be found in the literature, for example, Moore and Benbasat (1991) found that perceived voluntariness which they liken to PBC was a significant factor of system usage. Similarly, Hartwick and Barki (1994) noted that mandated and voluntary use results in different relative impacts for attitude and subjective norm. Furthermore, Compeau and Higgins (I995) have shown that self-efficacy has a significant impact on usage. Overall, literature suggests that PBC should influence ERP system usage (Taylor and Todd, 2001). The following hypothesis is thus proposed:

H3. Perceived behavioural control has a significant influence on ERP system usage.

3.1.1.4 Management support

Past studies have pointed out that information system use is deeply affected by external factors and that management support is one of the facilitating conditions for system use (Igbaria *et al.*, 1997; Taylor and Todd, 2001). Public or non-public encouragement or advocacy at the managerial level to support and promote ERP system use can stimulate and strengthen the associated motivation to employ the system thereby producing substantive influences on system use behaviour (Leonard-Barton and Deschamps, 1988). They add that the management, through communications with the staff and active participation in the work activities of system users, may reduce any psychological resistance reinforces a positive perception linked to the system which will boost ERP system use. Consequently, if the management recognizes the potential benefits of an ERP system and shows strong support, this will create a favorable environment for system use within the organization thus advancing the extent of system usage (Lucas, 1978). This proposition allows the formulation of the following hypothesis:

H4. Management support has a significant influence on ERP system usage.

3.1.2 Interaction effect

Interaction effect has been couched under the term ‘moderator’ (Chin, Marcolin and Newsted, 1996) and provides information on whether the relationship between two factors is contingent upon the value of a third. In other words, an interaction effect hypothesis states that the relationship between two factors or the effect of one factor on a second one, depends on the value of a third (moderator) factor (Aguinis and Gottfredson, 2010). Adams *et al.* (1992) called for further examination of moderating factors in models of user technology adoption and Lucas and Spitler (1999) for the inclusion of moderating factors. In addition, Agarwal and Prasad (1998) explicitly criticized the absence of moderating factors in technology acceptance model and called for more research to investigate moderators in theoretical models. Heeding this call for more research on interaction effects, the researcher was interested in evaluating the interaction effect of age, gender and experience.

3.1.2.1 Gender, age and experience

Gender, age and experience differences have been shown to exist in IT usage contexts (Morris and Venkatesh, 2000). It is evident that gender, age and experience significantly moderate the influence of the factors on behaviour intention. Venkatesh *et al.* (2003) found that: the effect of performance expectancy (perceived usefulness) on behaviour intention was moderated by gender and age; the influence of effort expectancy (perceived ease of use) on behaviour intention was moderated by gender, age and experience; the influence of social influence on behaviour intention was moderated by gender, age, voluntariness and experience; computer self-efficacy was not significant in determining behaviour intention and has not been tested with any moderators; and the influence of the facilitating conditions factor on behaviour intention was moderated by age and experience.

Experience was clearly theorised as a moderator in TAM2, in that experience significantly moderated the influence of subjective norms toward behaviour intention (Venkatesh and Davis, 2000). Although, experience was not explicitly included in the original TAM model, the role of experience was empirically examined using a cross-sectional analysis (Davis *et al*., 1989), no change in the salience of factors was found. In contrast, attitude was found to be more important with increasing experience while subjective norm became less important with increasing experience. It is evident that experience moderated the relationship between subjective norm and behavioural intention (Karahanna *et al*., 1999). Experience was not explicitly included in the original TPB as well but it has been incorporated into TPB *via* follow-on studies (Morris and Venkatesh, 2000).

Despite the fact that individual characteristics were investigated as moderators relating to technology acceptance, some previous research used demographic factors or individual characteristics (such as age and gender, computer experience, computer anxiety, computer self-efficacy, computer skills, cognitive style, self-competence, and perceived relevance) as predictors and not as moderators. They found that these factors are significant predictors of ERP system usage (Durrington, Repman and Valente, 2000). However it depended on the type of tasks (activities) investigated as different predictors influence different tasks (Chiero, 1997). Zakaria (2001) found that some demographic factors such as age and gender were not significant predictors of system usage. Inconsistencies were found in using individual characteristics, sometimes as moderators, sometimes as predictors.

It is evident that in the specific investigation of technology acceptance and usage, these individual characteristics gender (Venkatesh and Morris, 2000; Venkatesh *et al*., 2003), age (Venkatesh *et al*., 2003) and experience (Taylor and Todd, 2001; Venkatesh and Morris, 2000; Venkatesh *et al*., 2003) were usually examined as moderators. This proposition allows the formulating of the following hypotheses:

H5a. The effect of training on ERP system usage is moderated by gender.

H5b. The effect of technical support on ERP system usage is moderated by gender.

H5c. The effect of management support on ERP system usage is moderated by gender.

H5d. The effect of perceived behavioural control on ERP system usage is moderated by gender.

H5e. The effect of training on ERP system usage is moderated by experience.

H5f. The effect of technical support on ERP system usage is moderated by experience.

H5g. The effect of management support on ERP system usage is moderated by experience.

H5h. The effect of perceived behavioural control on ERP system usage is moderated by experience.

H5i. The effect of training on ERP system usage is moderated by age.

H5j. The effect of technical support on ERP system usage is moderated by age.

H5k. The effect of management support on ERP system usage is moderated by age.

H5l. The effect of perceived behavioural control on ERP system usage is moderated by age.

3.1.3 Predictive power

To measure quality and to understand the value of the additional IT system usage factors, two extant commonly used adoption and usage behaviour theoretical models of TAM2 and TPB were adapted with the integration of the additional IT system usage factors. The purpose was to test if the predictive power of these models was higher in the context of improving understanding of the extent of ERP system usage in the DUT. This proposition allows the formulation of the following hypotheses:

> H6: Additional IT system usage factors will improve predictive power of the original TAM2 model in the context of ERP system usage.

> H7: Additional IT system usage factors will improve predictive power of the original TPB model in the context ERP system usage.

This study's research design procedures chosen to test the research model hypotheses above are discussed below.

3.2 RESEARCH DESIGN

A research design is a framework or blueprint for conducting the research project by specifying the procedures necessary for obtaining the required information needed to solve the research problem (Malhotra, 2011). Its purpose is to design a study that will test the hypotheses of interest by providing a sound conceptual foundation for the research project (Ohab, 2010).

This study adopted a quantitative research approach as it is a robust and systematic way to examine and measure developed research models significantly, and it emphasizes the measurement and analysis of causal relationships between factors (Denzin and Lincoln, 1998). It is most often used in studies to test hypotheses objectively or to test models that are built based on theories (Kaplan and Duchon, 2000). The reason for choosing a quantitative research method to conduct this study was for the analysis of the factors affecting the extent of usage of the university's ERP system by end-users at the DUT and to test hypotheses of the proposed research model. The most common examples of quantitative methods include survey, field experiments and mathematical modeling (Shadish, Cook and Campbell, 2002). Most of the studies which analysed the acceptance, adoption and use of ERP systems employed a survey (Bueno and Salmeron, 2008; Buonanno, Faverio, Pigni, Ravarini, Sciuto and Tagliavini, 2005; Laukkanen, Sarpola and Hallikainen, 2007) hence a survey was deemed appropriate for this study. According to Ohlsson and Ollfors (2001) a survey is commonly used for research projects that are based on a descriptive research approach. This research espoused a descriptive research approach for the data obtained was subjected to quantitative analysis (Malhotra, 2011). In order for the researcher to undertake the survey, a questionnaire was designed (*see* section 3.4.1). The steps taken in eliciting the correct data with the use of an appropriate sample design are: to identify the target population; establish a sampling frame; choose a sampling method; and evaluate the sample size.

3.3 SAMPLE DESIGN

Jankowiez (2005) states that a good sample design helps identify the correct type of data that leads to efficient and accurate data collection. According to Nel, Van Dyk, Haasbroek, Schultz, Sono and Werner (2003), the sample design may consist of defining the target population, determining the sampling frame, selecting a sample and determining the sampling size.

3.3.1 Target population

The target population is the collection of elements (i.e. people) from which information is to be gathered to solve the research problem (Nel *et al*., 2003). Full-time academics who have experience using the university ERP system known as ITS from the various departments across six campuses of the DUT formed the target population for this study. Since it is not possible to study the whole target population, researchers have to draw a sample that is, a subset of the target population called a sampling frame (Babbie, 1990).

3.3.2 Sampling frame

Baines and Chansarkar (2002) define a sampling frame as a list or means of representing the sampling units (i.e. items being measured or is available for measurement at some stage of the sampling process) containing the elements of a target population. The closer the sampling frame approximates the target population, the less the error that is introduced into the research study (Krysik and Finn, 2010).

3.3.3 Sample

The researcher obtained a staff list from the Human Resource Department at the DUT of full-time academics from various departments across six campuses of the university, excluded from this staff list were academics who did not teach full-time (e.g. tutors, moderators, etc.). This was done in order to gather data only from individuals who were commonly influenced by the institutional and social factors in existence at the DUT with regard to use of the university's ERP system. A list of 624 academics as at 31st October 2011 was therefore obtained. According to Diamantopoulos and Schlegelmilch (2006), there are various sampling methods that can be used to obtain a sample. Leedy and Ormrod (2005) add that often researchers overlook practical issues related to data availability or the availability of respondents. Taking into account the availability of the targeted respondents in various academic departments from six campuses across DUT, the researcher deemed convenience sampling to be adequate for this study to ensure sufficient data collection in order to meet the objectives of this study. Diamantopoulos and Schlegelmilch (2006) state that for a convenience sample, participants are chosen on the basis of being readily available and accessible to the researcher. Following Poba-Nzaou, Raymond and Fabi (2008) and Ramayah and Lo's (2007) study on ERP acceptance and usage, this study used convenience sampling.

3.3.4 Sample size

In general, the larger the sample, the better the result is for research purposes. However, this generalization does not fit all situations. Leedy and Ormrod (2005) agree that to some extent, the size of an adequate sample depends on how homogeneous or heterogeneous the population is, in other words, how alike or different its members are. They explain that a heterogeneous population requires larger samples whereas smaller samples are adequate for a homogeneous population. According to Sekaran and Bougie (2010), sample sizes larger than 30 and less than 500 are appropriate for most research. Leedy and Ormrod (2005) add that a population of over 500 is well served with a 50% sample (that is, 250 responses). Based on this, 312 respondents should be selected for this study but in order to cater for unreturned and unusuable responses, a sample size of 335 were used. It was necessary to collect the sample data to be used for analysis.

3.4 DATA COLLECTION

Churchill and Lacobucci (2005) state that data collection is an important part of a problem solving process to clarify the aim of any research. According to Lubbe and Klopper (2005), data can be collected from either a primary or secondary source. While primary data is collected during the research and for the particular research only, secondary data on the other hand, is data collected for the purpose of other research different from the current research (Ghauri and Gronhaug, 2010). Saunders, Lewis and Thornhill (2009) state that the technique of collecting data from a set of respondents is classified as collecting primary data. Sources of primary data include among others: interviews, questionnaires, research data, letters and speeches (Lubbe and Klopper, 2005). Questionnaires are one of the most widely used tools for data collection (McMillian and Schumacher, 2009). Several ERP system research studies have made use of questionnaires to gather responses from users of ERP systems, top level management, as well as small, medium and large enterprises regarding perceptions about ERP system use (Raymond and Uwizeyemungu, 2007; Reuther and Chattopadhyay, 2004). Hence, due to the empirical support for the use of a questionnaire in ERP research, the researcher chose a questionnaire as the primary source for data collection to target as many respondents in various academic departments from DUT for the analysis of factors that affect the extent of usage of the university ERP system.

3.4.1 Questionnaire design

Bourque and Clark (1994) propose that in questionnaire design, researchers may opt to adopt questionnaires used in other similar research, they may adapt items used in other questionnaires, or they may develop their own questionnaire. According to Saunders *et al.* (2009), adopting or adapting items allows reliability to be achieved and is more efficient than developing one's own items to meet the set research objectives. The research questionnaire (*Appendix B*) used in this study adopted and adapted items and their respective 5-point and 7-point Likert and Semantic Differential scales that were validated from previous similar research works of Agarwal and

Prasad (1998); Bagozzi, Dholakia and Basuroy (2003); Davis (1989); Davis *et al.* (1992); Hartwick and Barki (1994); Moore and Benbasat (1991); and Taylor and Todd (2001).

The questionnaire consisted of ten pages, a Covering Letter which indicated the purpose of the study, contact details for the researcher and a Letter of Informed Consent (*Appendix B*) that indicated all information obtained would be used only for the purposes of the present study and assured participants of anonymity and confidentiality. The questionnaire was structured and separated into 16 sections with a total of sixty two items in the respective sections. Section A dealt with biographical information of respondents, highest qualification and experience using the ERP system at DUT. Sections B to P focused on the factors in the proposed research model that were expected to measure the respondents' extent of ERP system usage in the university.

Section B: Perceived Usefulness - this factor measures the degree to which the individual believes that using the ERP system will help him or her to attain gains in job performance. Five items with a 7-point Likert scale adopted from Davis (1989) ranging from "Strongly disagree" to "Strongly agree" were used to measure this factor.

Section C: Perceived Ease of Use - this factor measures the degree of ease of use associated with the use of the ERP system. Four items with a 7-point Likert scale adopted from Davis (1989) ranging from "Strongly disagree" to "Strongly agree" were used to measure this factor.

Section D: Intention to Use - this factor measures the degree to which an individual intends to continue using the ERP system. Four items with a 7-point Likert scale adopted from Agarwal and Prasad (1998) ranging from "No chance at all" to "One hundred percent likely" were used to measure this factor.

Section E: Subjective Norm - this factor measures the degree to which an individual perceives that most people who are important to him think he should or should not use the ERP system. Four items with a 7-point Likert scale adopted from Taylor and Todd (2001) ranging from "Extremely unlikely "to "Extremely likely" were used to measure this factor.

Section F: Voluntariness - this factor measures the degree to which use of the ERP system is perceived as voluntary. Three items with 7-point Likert scale adopted from Moore and Benbasat (1991) ranging from "Extremely disagree "to "Extremely agree" were used to measure this factor.

Section G: Image - this factor measures the degree to which an individual perceives the use of the ERP system as a means of enhancing one's status within the organization. Three items with a 7-point Likert scale adopted from Moore and Benbasat (1991) ranging from "Extremely disagree "to "Extremely agree" were used to measure this factor.

Section H: Job Relevance - this factor measures the degree to which an individual's perception regarding the extent to which the ERP system is applicable to his or her job. Three items with a 7-point Likert scale adopted from Davis *et al.* (1992) ranging from "Strongly disagree" to "Strongly agree" were used to measure this factor.

Section I: Output Quality - this factor measures the degree to which an individual believes that the quality of the output from the ERP system (i.e. screen based and printed) matches their job goals. Four items with a 7-point Likert scale adopted from Davis *et al.* (1992) ranging from "Strongly disagree" to "Strongly agree" were used to measure this factor.

Section J: Result Demonstrability - this factor measures the degree to which an individual perceives the tangibility of the results of using the ERP system including their observability and communicability. Three items with a 7-point Likert scale adopted from Hartwick and Barki (1994) ranging from "Extremely disagree "to "Extremely agree" were used to measure this factor.

Section K: Management Support - this factor measures the degree to which an individual believes that management assistance exists to support use of the ERP system. Four items with a 5-point Likert adopted from Agarwal and Prasad (1998) ranging from "Strongly disagree "to "Strongly agree" were used to measure this factor.

Section L: Technical Support – this factor measures the degree to which an individual believes that technical infrastructure exists to support use of the ERP system. Four items with a 5-point Likert adopted from Agarwal and Prasad (1998) ranging from "Strongly disagree "to "Strongly agree" were used to measure this factor.

Section M: Perceived Behavioural Control – this factor measures the degree to which an individual believes he/she has control of use of the ERP system based on the availability of resources and opportunities required for its use. Three items with a 5-point Likert scale adopted from Bagozzi *et al*. (2003) ranging from "Strongly disagree "to "Strongly agree" were used to measure this factor.

Section N: Training – this factor measures the degree to which an individual believes he/she had adequate training to use the ERP system. Three items with a 5-point Likert scale adopted from Moore and Benbasat (1991) anchored ranging from "Strongly disagree "to "Strongly agree" were used to measure this factor.

Section O: Attitude - this factor measures the degree of an individual's positive or negative feelings about using the ERP system. Five items with a 7-point Semantic Differential scale adopted from Bagozzi *et al.* (2003) anchored with "Bad to Good", "Useless to Useful", "Foolish to Wise", "Harmful to Beneficial" and "Disadvantageous to Advantageous" were used to measure this factor.

Section P: Usage - the first two items measured an individual's current usage of the ERP system with a 5-point Semantic Differential scale adopted from Davis *et al*. (1992) anchored with "Infrequent to Frequent" and "Light to Heavy". The last two items measured an individual's future usage of the ERP system with a 5-point Semantic Differential scale adopted from Davis *et al.* (1992) anchored with "Infrequent to Frequent" and "Light to Heavy".

This approach of collating items from other similar research instruments has been adapted by other researchers, for example Davis (1989); Venkatesh and Davis (2000); and Venkatesh and Morris (2000). The designed questionnaire underwent a pilot study before final distribution.

3.4.2 Pilot study

The objective of a pilot study is to evaluate the items used in the design questionnaire (Hair, Black and Babin, 2006) and check its validity and reliability (Saunders *et al*., 2009). An appropriate pilot study was conducted amongst three academic personnel not part of the study's sample using purposive sampling technique. Purposive sampling allows the researcher to focus on people that will be critical to the research (Denscombe, 2010). The purpose of the pilot study was to detect any problems in the questionnaire instructions or design, whether the respondents had any difficulty understanding the questionnaire or whether there are any ambiguous or biased questions (Sekaran, 2003). The results of the pilot study provided valuable information; the factors in section B to P were not clearly defined and this led to confusion. Subsequently the researcher amended the questionnaire to include a definition of each factor before final distribution.

3.4.3 Administration

In order to cater for unusable responses, a total of 335 questionnaires were disseminated to achieve the desired sample size (*see* section 3.3.4). The researcher chose the sample members based on being conveniently available and easily reached as mentioned in section 3.3.3. Questionnaires were administered to the chosen sample participants *via* the departmental secretaries to full-time academics from various departments across six campuses at the university. A period of approximately 5 weeks was given to complete the questionnaire, but due to the December recess and January registration a further 5 weeks was given to the respondents. This was communicated *via* the departmental secretaries. The researcher felt it was important to issue follow-up reminders with the help of the departmental secretaries to alleviate a poor response of completed questionnaires following the guideline of Van Selm and Jankowitz (2006) who mentioned that a poor response rate is generally a problem with questionnaires whether in print or online. Return of the questionnaires to the researcher was facilitated through DUT's internal mailing system as well as physical drop-off and collection from the departmental secretaries. Data analysis was the next step in the research methodology process to interpret and draw conclusions from the mass of collected data to either support or reject the hypotheses.

3.5 DATA ANALYSIS

According to Sekaran and Bougie (2010), the data should be accurate, complete and suitable for further analysis. Hence this study's data was prepared before further analysis. Data preparation refers to the process of checking the quality of the data gathered during fieldwork and converting it into an electronic format so that it can be read and manipulated (Nel *et al*., 2003). For the purposes of this study, the data collected from the questionnaire were prepared in the following way: editing, data entry and data cleaning.

3.5.1 Editing

As explained by Malhotra (2011), editing entailed review of the questions with the objective of increasing accuracy and precision, it consisted of screening questionnaires to identify illegible, incomplete, inconsistent or ambiguous responses. As the respondents remained anonymous, incomplete and inconsistent questionnaires were discarded. This did not affect the analysis in any way as the researcher administered more questionnaires to overcome such problems as stated in section 3.4.3.

3.5.2 Data entry

Data entry involves the process of transferring the response data from the questionnaires onto a computer program (Cooper and Schindler, 2003). The data from the questionnaires were transferred to a Statistical Package for the Social Sciences (SPSS) version 19 and PLS software version 2.0.

3.5.3 Data cleaning

Data cleaning includes consistency checks and treatment of missing responses. Even though preliminary consistency checks had been done during the editing stage, the checks at this stage are more thorough and extensive as a computer program carries it out (Malhtora, 2011). Any incomplete or inconsistent questionnaires not picked up in the editing stage were discarded during data cleaning with the use of statistical package SPSS v19. Once the data preparation was complete, the data were then ready for inclusive analysis.

3.5.4 Analysis technique

There are a number of techniques that can be used to analyze relationships between model factors, each with its own merits and requirements. These techniques include Multiple Regression Analysis (MRA), Factor Analysis (FA), Path Analysis (PA) and Structural Equation Modeling (SEM). The SEM analytic modelling technique is able to handle measurement errors when compared to MRA which assumes that measurements are free of errors and sample data are normally distributed (Chin, Marcolin and Newsted, 1996). In this study, it was assumed that sample data collected were of unknown distribution because measurements were based on subjective perception of respondents.

There are two approaches to SEM techniques, namely: covariance based and component based SEM. Covariance based SEM is implemented by AMOS software and component based SEM is generally called PLS (Wold, 1974) and is implemented by SmartPLS software version 2.0 (Ringle, Wende and Will, 2005). Covariance based SEM requires that sample data under study be of normal distribution. Contrarily, PLS makes no assumptions about the distribution of the data (i.e. it is non-parametric) so it is more robust than a parametric modeling approach (which assumes multi-variate normality) (Staples and Steddon, 2004). PLS was thus chosen for this study as it would appear to be superior to covariance based SEM because of its generality. Furthermore, PLS is certainly gaining more popularity as an alternative to covariance based SEM because of its ability to handle heterogeneous data with a small sample size (Rigdon, Ringle and Sarstedt, 2010).

3.5.5 Reliability and validity

Reliability was measured by the estimate of internal consistency and composite reliability. Individual item reliability is the extent to which the measurements of factors measured with multiple-item scale reflects the true score of the factors relative to the error (Aibinu and Al-Lawati, 2010). Internal consistency of a factor estimates how similar individuals responded to the items within a scale (Shin, 2009). Composite reliability is a measure of the overall reliability of a collection of heterogeneous, but similar items (Roca, Garcia and De La Vega, 2009). Composite Reliability (CR) is estimated in terms of the outer loading of an item λ_i to represent correlations between items, for all factors in this study's research model (shown in Figure 3.1), CR was calculated using equation (1) (Henseler, Ringle and Sinkovics, 2009).

$$CR = \frac{(\sum \lambda_i)^2}{(\sum \lambda_i)^2 + \sum (1 - \lambda_i^2)} \tag{1}$$

Internal consistency is calculated for the number of model items (N) and mean inter-correlation among items ($\bar{r}$) using Cronbach alpha (α). The Cronbach alpha measures how well a set of items measures a single unidimensional factor, for all factors in this study's research model, α was calculated using equation (2) (Cronbach, 1951).

$$\alpha = \frac{N - \bar{r}}{1 + (N - 1) - \bar{r}} \tag{2}$$

Validity was measured by the estimate of convergent validity and discriminate validity of model factors. Validity tells whether a measuring instrument measures what it is supposed to measure in the context in which it is applied (Raykov, 2011). Convergent validity is the extent to which items of a factor represent the same factor (Fornell and Larcker, 1981). Discriminate validity indicates the extent to which a given factor differs from other factors (Pahnila and Warsta, 2010). Convergent validity is measured by Average Variance Expected (AVE), which is calculated to determine the amount of variance that a factor captures from its measurement items. To test for convergent validity, AVE for all factors in this study's research model was calculated using equation (3) (Henseler *et al*., 2009).

$$AVE = \frac{\sum \lambda_i^2}{\sum \lambda_i^2 + \sum (1 - \lambda_i^2)} \tag{3}$$

Discriminate validity is measured by calculating the Pearson product moment correlation between all pairs of factors. The Pearson product moment correlation r between factors x and y with means $\bar{x}$ and $\bar{y}$ respectively was calculated using equation (4) (Spiegel, 1972), and for validity purposes this was conducted for all factors in this study.

$$r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 (y_i - \bar{y})^2}} \qquad (4)$$

3.5.6 Model predictive power

To assess the predictive power of this study's research model, the coefficient of determination (R^2) of a dependent factor criterion was used. R^2 is the amount of variance in a dependent factor (for example ERP system usage) that is explained by the research model. R^2 was computed using equation (5) (Cornell and Berger, 1987).

$$R^2 = 1 - \frac{\sum (y_i - \hat{y}_i)^2}{\sum (y_i - \bar{y})^2} \qquad (5)$$

Where y_i is the i^th^ observation of the dependent factor, x_i is the value of the independent factor at which y_i is observed, $\hat{y}_i$ is the predicted responses at each point x_i obtained with a fitted regression equation and $\bar{y}$ is the mean of y_i. R^2 values of 0.67, 0.33 and 0.19 are respectively considered to be substantial, moderate and weak (Chin, 1998). In addition, R^2 value of the dependent factor (ERP system usage) was analyzed to determine whether it was significantly different from zero using F-test as shown in equation (6) (Aibinu and Al-Lawati, 2010).

$$F = \frac{R^2 (N - M - 1)}{M(1 - R^2)} \qquad (6)$$

Where N is the total number of sample size, M is the number of independent factors and M and (N-M-1) are degrees of freedom. In the situation where the R^2 has to be compared to an arbitrary point for example, in this study, R^2 value of the developed research model was compared against the R^2 value of the original TAM2 model, the effect size approach using equation (7) was applied.

3.5.7 Model interaction effect

The test for interaction effect on this study's research model was assessed by determining its effect size and then testing for its significance. The effect size (f^2) was calculated in terms of $R^2(i)$ with interaction effects (research model including moderators of gender, experience and age) and $R^2(e)$ with main effects (research model excluding moderators) using equation (7) (Helm, Eggert and Garnefeld, 2010).

$$f^2 = \frac{R^2(i) - R^2(e)}{1 - R^2(i)} \qquad (7)$$

The effect size is considered large, medium and small if greater than 0.35, 0.15 and 0.02 respectively (Cohen, 1988). The significance of the effect size was tested using the pseudo F-test as shown in equation (8) (Aibinu and Al-Lawati 2010).

$$F = (f^2)(N - M - 1) \qquad (8)$$

3.6 ETHICAL CONSIDERATIONS

Research needs to be conducted in an ethical manner (Hofstee, 2006). In conducting this research, permission to conduct research at the DUT was obtained from the Research and Postgraduate Support Directorate at DUT (*Appendix A*). The researcher did not coerce potential research participants to participate in the study. Hence, all participants signed a Letter of Informed Consent (*Appendix B*) and were treated with respect in terms of human dignity, time, position, information provided and willingness to participate in the study (Myers and Newman, 2007).

3.7 SUMMARY

This chapter highlighted how the research was planned and executed. The hypotheses to be tested in the study were carefully detailed. A detailed account of the research model development, methods and procedures that were used in data collection were presented. Reliability and validity measures were explained with the aid of equations. This chapter highlighted the analysis techniques used in analyzing data and the ethical principles observed during the process. The next chapter presents the analysis of the data and discussion of the results.

CHAPTER 4
RESULTS AND DISCUSSION

In the preceding chapter, the rationale for the development of the research model and the research methods employed in this study were presented. This chapter discusses the empirical results of this study as follows: respondents' demographic data; validation of this study's research model; the comparative results between this study's research model and the original TAM2 model; and the original and improved TPB model.

4.1 DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

The data for this research was elicited by a survey that was administered to full-time academics from various departments across six campuses at the DUT. Departmental secretaries assisted the researcher to administer the survey and this yielded a favorable response rate. In order to cater for unusable responses, a total of 335 questionnaires were distributed to achieve the desired sample size of 312, out of which 324 were returned. Among the returned surveys, 12 were unusable because 8 had cases of missing data and 4 had cases of respondents not being academic staff members. As a result, 312 responses were used for data analysis. This sample size is acceptable for PLS analysis technique which was used in this study. Haenlein and Kaplan (2004) and Marsh *et al*. (1998) recommend a minimum sample size of 200 cases to avoid results that cannot be interpreted, such as negative variance estimates or correlations greater than one (Haenlein and Kaplan, 2004).

4.1.1 Biographic data

The characteristics of the sample for the data analysis were based on gender, age, education level, academic position and ERP system experience at DUT as presented in Table 4.1. The profile of respondents reflects that there were no respondents under 20 years of age. Respondents' age group were as follows: 20-29 years (1.0%), 30-39 years (39.1%), 40-49 years (43.6%), 50-59 years (13.8%) and 60 plus (2.6%). Respondents were categorized into younger (20-39 years) and older subjects (40 years and above), in order to determine whether there were any differences between younger and older subjects; there were more (59.9%) older than younger (40.1%) subjects.

Table 4.1: Characteristics of respondents (N=312)

Characteristic	Content	Frequency (%)
Age	Under 20 years	0 (0.0)
	20-29 years	3(1.0)
	30-39 years	122 (39.1)
	40-49 years	136(43.6)
	50-59 years	43(13.8)
	60 plus	8(2.6)
Gender	Male	151(48.4)
	Female	161 (51.6)
Educational Level	Diploma	0 (0.0)
	Degree	231 (74.0)
	Honours	35(11.2)
	Masters	39(12.5)
	Doctorate	7(2.2)
	Other	0(0.0)
Academic Position	Junior Lecturer	4(1.3)`
	Lecturer	276 (89.1)
	Senior Lecturer	16(5.1)
	Head of Department (HoD)	12(3.8)
	Professor	4(1.3)
	Other	0(0.0)
ERP system experience at DUT	Less than 1 year	8(2.6)
	1 year to 5 years	138(44)
	6 year to 10 years	151(48)
	Greater than 10 years	15(5)

The majority of the academics who responded to the survey were female (51.6%) compared to male (48.4%) as shown in Table 4.1. The researcher ascribes this to his experience with offering past ERP system workshops, training and technical support where female users have demonstrated more interest in participating, finding out and learning about how to better use the system compared to male users.

Regarding education level, the majority graduated at Degree level (74.0%) compared to Master's level (12.5%), Honours degree level (11.2%) and Doctoral degree level (2.2%). The highest percentage in terms of academic position was Lecturer (89.1%), Senior Lecturer (5.1%), HoD (3.8%), Professor (1.3%), and Junior Lecturer (1.3%). At the time of the survey, academics who had used the ERP system at DUT for about 6-10 years were in the majority (48%), compared to 1-5 years (44%), greater than 10 years (5%) and less than 1 year (2.6%).

4.2 RESEARCH MODEL VALIDATION

To determine the acceptability of the research model developed in this study to support decision making in the context of ERP usage improvement, six steps were followed, namely: analysis of item reliability and validity; item factor reliability and validity; research model predictive power analysis; direct effect relationship analysis of additional IT usage factors and ERP system usage; gender, experience and age interaction effect analysis; and ERP system usage factor ranking.

4.2.1 Item reliability and validity

The purpose of measurement item reliability analysis is to identify low reliability items by evaluating their item loadings. Confirmatory factor analysis (CFA) was performed using SmartPLS 2.0 software to test the quality of our research model. For the CFA analysis, all measured items were specified as reflective of their corresponding factors and each factor was allowed to co-vary freely with all other factors. The raw dataset was used as input to the PLS software and path significances were estimated using the bootstrapping re-sampling technique with 500 sub-samples. Bootstrapping is a procedure that is used in PLS to provide confidence intervals for all parameter estimates building the basis for statistical inference (Henseler *et al*., 2009).

Table 4.2 shows the result of confirmatory factor analysis, wherein it can be seen that factor loadings were all significant at p-value < 0.05 and exceeded 0.50, with a minimum loading of 0.54 for perceived behavioural control item PBC2. Researchers have accepted items with a significant loading of 0.50 (Chin, 1998; Hair *et al*., 2006; Pahnila and Warsta, 2010). Items with poor loadings were discarded (Aibinu and Al-Lawati, 2010). All measurement items factor loadings (as shown in Table 4.2) for the factors of: image; intention to use; technical support; job relevance; output quality; perceived behavioural control; perceived ease of use; perceived usefulness; result demonstrability; subjective norm; and training and ERP system usage were significant at p-value < 0.01 except for management support item MS4 which was significant at p-value < 0.05.

Table 4.2: Confirmatory factor analysis

Factors	Scale item	Item mean	Item Stdev	Item loading	t-value	p-value
Image	IM1	3.27	1.497	0.78	4.72	0.0001*
	IM2	3.33	1.580	0.95	6.95	0.0001*
	IM3	3.40	1.616	0.90	7.07	0.0001*
Intention to use	IU1	5.48	1.308	0.80	19.25	0.0001*
	IU2	5.19	1.372	0.88	42.93	0.0001*
	IU3	4.63	1.250	0.60	6.90	0.0001*
	IU4	4.96	1.462	0.76	16.97	0.0001*
Technical Support	TS1	3.58	1.281	0.79	3.34	0.0009*
	TS2	3.27	1.176	0.92	3.61	0.0004*
	TS3	3.22	1.284	0.85	3.73	0.0002*
Job Relevance	JR1	3.98	1.820	0.84	12.31	0.0001*
	JR2	4.52	1.706	0.86	18.65	0.0001*
Management Support	MS1	3.60	1.249	0.85	3.52	0.0005*
	MS2	3.70	1.195	0.89	3.78	0.0002*
	MS3	3.52	1.246	0.79	3.52	0.0005*
	MS4	3.28	1.227	0.61	2.48	0.0136**
	MS5	3.79	1.279	0.85	3.31	0.001*
Output Quality	OQ1	4.71	1.501	0.91	8.76	0.0001*
	OQ2	4.38	1.508	0.76	4.40	0.0001*
	OQ3	4.65	1.393	0.91	9.35	0.0001*
	OQ4	4.32	1.372	0.85	8.51	0.0001*
Perceived Behavioural Control	PBC1	2.00	0.793	0.54	1.60	0.0002*
	PBC2	2.09	0.750	0.90	3.37	0.0008*
Perceived Ease of Use	PE1	4.47	1.641	0.89	40.93	0.0001*
	PE2	4.73	1.682	0.90	50.45	0.0001*
	PE3	4.45	1.623	0.87	28.73	0.0001*
	PE4	4.39	1.744	0.85	27.83	0.0001*
Perceived Usefulness	PU1	5.30	1.436	0.75	16.85	0.0001*
	PU2	5.17	1.427	0.85	32.52	0.0001*
	PU3	5.17	1.498	0.83	36.36	0.0001*
	PU4	5.13	1.758	0.83	29.49	0.0001*
	PU5	5.24	1.492	0.80	19.58	0.0001*
Result Demonstrability	RD1	4.15	1.739	0.84	24.93	0.0001*
	RD2	4.72	1.518	0.91	69.99	0.0001*
	RD3	4.40	1.592	0.90	44.85	0.0001*

Factors	Scale item	Item mean	Item Stdev	Item loading	t-value	p-value
Subjective Norm	SN1	5.22	1.510	0.81	7.83	0.0001*
	SN2	4.11	1.568	0.73	5.98	0.0001*
	SN3	3.88	1.557	0.64	4.86	0.0001*
	SN4	5.57	1.511	0.77	6.78	0.0001*
Training	TR1	2.56	1.125	0.72	6.16	0.0001*
	TR2	3.16	1.301	0.78	9.15	0.0001*
	TR3	3.52	1.233	0.80	10.10	0.0001*
ERP system usage	US1	3.30	1.394	0.78	16.18	0.0001*
	US2	3.27	1.358	0.81	27.98	0.0001*
	US3	3.71	1.236	0.86	30.10	0.0001*
	US4	3.51	1.212	0.83	24.49	0.0001*

* p-value < 0.01; ** p-value < 0.05

The average factor loading for all measurement items was 0.82 which was greater than the acceptable factor loading of 0.50. It can therefore be concluded that all items which were retained, are reliable.

Measurement item validity was assessed using Chin's (1998) cross factor loading technique. This method prescribes a requirement for measurement items to load higher on a factor than the scale items for other factors and for no cross-loading to occur. As part of item validity testing, cross factor loading may be examined to determine whether measurement items can discriminate between factors being studied from other similar factors (Leedy, 1997). Discriminate validity results were thus computed with SmartPLS software version 2.0 using path weighting scheme (*Appendix C*). All items measuring a particular factor loaded higher in their respective factor as compared to other factors. The highest average factor loading was 0.88 for image, perceived ease of use and result demonstrability, and the lowest was 0.72 for perceived behavioural control. It can therefore be concluded that this study's measurement items were all discriminate valid.

4.2.2 Factor reliability and validity

Factor reliability is a check of internal consistency; it is traditionally measured with Cronbach's α (Cronbach, 1951) which provides an estimate of the reliability based on the item inter correlations. However, PLS provides a better measure of internal consistency through composite reliability (CR) which uses the item loading obtained within the research model (Aibinu and Al-Lawati, 2010). Equations 1 and 2 (discussed in Chapter 3, section 3.5.5) were used to estimate composite reliability and Cronbach's α . Table 4.3 shows the result of scale properties in which all items are composite reliabile as they exceed the benchmark of 0.70 (Pahnila and Warsta, 2010).

Table 4.3: Scale properties

	Inter-factor correlation												
Factors	1	2	3	4	5	6	7	8	9	10	11	12	13
(1) Image	1.00												
(2) Intention to use	0.15	1.00											
(3) Technical Support	-0.28	-0.10	1.00										
(4) Job Relevance	0.16	0.30	-0.09	1.00									
(5) Management Support	-0.07	-0.01	0.19	0.14	1.00								
(6) Output Quality	0.04	-0.03	0.00	0.01	-0.06	1.00							
(7) Perceived Behavioural Control	0.03	0.05	-0.01	0.10	-0.02	0.01	1.00						
(8) Perceived Ease of Use	0.22	0.27	-0.16	0.20	0.02	0.10	-0.17	1.00					
(9) Perceived Usefulness	0.13	0.42	-0.04	0.34	0.04	0.19	0.02	0.23	1.00				
(10) Result Demonstrability	0.07	0.33	0.03	0.31	0.04	0.06	-0.04	0.35	0.40	1.00			
(11) Subjective Norm	-0.08	0.23	0.00	0.20	0.16	0.10	0.02	0.08	0.20	0.11	1.00		
(12) Training	-0.02	0.11	0.17	-0.01	0.05	0.12	-0.05	0.14	0.08	0.13	0.19	1.00	
(13) ERP system usage	-0.09	0.17	0.09	0.05	-0.07	0.08	0.14	0.17	0.21	0.23	0.22	0.25	1.00
Internal consistency (Alpha)	0.86	0.76	0.82	0.62	0.90	0.89	0.23	0.90	0.87	0.86	0.74	0.65	0.84
Composite reliability (CR)	0.91	0.85	0.89	0.84	0.90	0.92	0.70	0.93	0.91	0.91	0.83	0.81	0.89
Convergent validity (AVE)	0.77	0.59	0.72	0.73	0.64	0.74	0.55	0.77	0.66	0.78	0.55	0.59	0.67

Factor validity was assessed through the analysis of average variance extracted (AVE) which must exceed 0.50 for each factor to be valid (Bhattacherjee and Sanford, 2009; Fornell and Larcker, 1981; Pahnila and Warsta, 2010). The results calculated using Equation (3) (discussed in Chapter 3, section 3.5.5) are shown in Table 4.3, all factors exhibited AVE value > 0.50. The smallest AVE value among all thirteen factors in the CFA model was 0.55 for perceived behavioural control and subjective norm. In addition, discriminate validity was assessed using the criterion that square root of AVE for each factor should exceed the correlations between that and all other factors (Bhattacherjee and Sanford, 2009; Fornell and Larckers, 1981; Pahnila and Warsta, 2010). Table 4.3 shows the result of scale properties computed using Equation (4) (discussed in Chapter 3, section 3.5.5), wherein it can be seen that the highest correlation between any pair of factors in the CFA model was 0.42 (perceived usefulness and intention to use). This value was lower than the lowest square root of AVE among all factors, which was 0.74 for perceived behavioural control and subjective norm. Hence, all criteria for factor validity were met.

4.2.3 Model predictive power analysis

This study's research model predictive power was estimated after the determination of reliability and validity. The predictive power (R^2) of the main effect model (excluding moderators) was calculated using Equation 5 (discussed in Chapter 3 section 3.5.6). Figure 4.1 shows this result, wherein the factors of perceived usefulness, intention to use, and ERP system usage have R^2 values of 0.30, 0.27 and 0.23 respectively. This result suggests that this study's research model fit to data is of a weak to moderate level ($R^2 < 0.33$) (Chin, 1988). However, before a conclusion can be made, the R^2 values had to be tested to determine if they were statistically significant from zero (Aibinu and Al-Lawati, 2010). The results of the F-test for perceived usefulness ($F = 26.23$ and p-value = 0.0001), intention to use ($F = 18.61$ and p-value = 0.0001), and ERP system usage ($F = 7.44$ and p-value = 0.0001) was computed using Equation (6) (discussed in Chapter 3, section 3.5.6) and indicates that the R^2 values of 0.30, 0.27, and 0.23 are statistically greater than zero (Aibinu and Al-Lawati, 2010). This means that the model fit to data is statistically significant.

A further analysis to examine age, gender and experience differential in the model predictive power (R^2) was conducted. This was achieved by analyzing the research model with data from younger and older, less experienced and more experienced, and male and female ERP system users separately. The effect size (f^2) of age, gender and experience in R^2 value of ERP system usage was computed using Equation 7 (discussed in Chapter 3, section 3.5.7). Thereafter the statistical significance of the calculated effect size was determined based on a pseudo F-test using Equation 8 (discussed in Chapter 3, section 3.5.7).

Age differential in the research model was assessed by analyzing the predictive power of the model with younger (20-39 years) and older (40 years and above) ERP system users separately.

The result indicates that the model fit ($f^2 = 0.06$, $F = 18.36$ and p-value = 0.0001) for older users ($R^2 = 0.32$) was higher than that of younger users ($R^2 = 0.27$). Hence, it can be inferred that the research model explanatory power is higher for older ERP system users than younger users.

Experience differential in ERP system usage was analyzed by comparing the model (R^2) for more experienced (6-10 years) and less experienced (5 years and less) ERP system users. The result indicates that the model fit ($f^2 = 0.03$, $F = 9.18$ and p-value = 0.0001) for more experienced ERP system users ($R^2 = 0.30$) was higher than that of less experienced ERP system users ($R^2 = 0.28$). Hence it can be deduced that the model explanatory power is higher for more experienced ERP system users than less experienced users.

Gender differential in ERP system usage was analyzed by comparing the model R^2 for male and female ERP system users. The result indicates that the model fit ($f^2 = 0.05$, $F = 15.3$ and p-value = 0.0001) for female users ($R^2 = 0.31$) was higher than that of male users ($R^2 = 0.27$). Hence, it can be inferred that the model explanatory power is higher for female ERP system users than male ERP system users. In conclusion the model fit to data is higher for older experienced female ERP system users.

4.2.4 Direct effect analysis

In order to establish the robustness of the research model developed in this study, the direct effect of additional IT usage factors i.e. training, technical support, management support and perceived behavioural control on the research model were tested. The path coefficient, standard deviation and t-value of hypothesized casual paths were obtained using SmartPLS 2.0 bootstrapping procedure.

Table 4.4 indicates that training directly influenced ERP system usage with an estimated path coefficient of 0.212, t-value of 3.25 and p-value of 0.001, thus supporting hypothesis 1. For the path between technical support and usage behaviour, this study estimated path coefficient of -0.292, t-value of 4.504 and p-value of 0.0001. This means that technical support influenced ERP system usage, hypothesis 2 was therefore supported. Moreover management support was not found to influence ERP system usage with an estimated path coefficient of 0.059, t-value of

1.570 and p-value of 0.117 thereby not supporting hypothesis 3. Lastly, perceived behavioural control directly influenced ERP system usage with an estimated path coefficient of 0.187, t-value of 2.549 and p-value of 0.011 thereby supporting hypothesis 4. The results above indicate that training, technical support and perceived behavioural control were found to influence ERP system usage whereas management support did not.

Table 4.4: Test of direct path coefficients

Hypothesis	Factors	Path coefficient	Stdev	t- value	p-value
H1	Training -> ERP system usage	0.212	0.067	3.250	0.001*
H2	Technical support -> ERP system usage	-0.292	0.072	4.504	0.0001*
H3	Management support -> ERP system usage	0.059	0.035	1.570	0.117
H4	Perceived behavioural control -> ERP system usage	0.187	0.070	2.549	0.011**

* p-value < 0.01; ** p-value < 0.05

4.2.5 Interaction effect analysis

This study evaluated the interaction effect of three factors, namely: gender; experience; and age on the relationship between additional IT usage factors (training, management support, technical support and perceived behavioural control) and ERP system usage. In order to confirm any factor as a moderator, the path coefficient of the interaction effect must be significant.

The examination of gender as a moderator resulted in the formulation of hypotheses 5a to 5d. The results are shown in Table 4.5 which indicates that the path coefficient of the interaction effect (training * gender) is not significant (p-value of 0.340 > 0.05), meaning that the relationship between training and ERP system usage does not differ depending on gender. Hypothesis 5a was therefore not supported. The path coefficient of the interaction effect (technical support * gender) is significant (p-value of 0.040 < 0.05), meaning that the there is gender interaction effect on the relationship between technical support and ERP system usage, thereby supporting hypothesis 5b. Similarly gender interaction effect on the relationship between management support and ERP system usage, was confirmed to exist (p-value of 0.011 < 0.05). Hence hypothesis 5c was supported. Lastly, gender interaction effect on the relationship between perceived behavioural control and ERP system usage, was found to exist (p-value of 0.0004 < 0.05), hence hypothesis 5d was supported. Overall, gender moderated the effect of technical support, management support and perceived behavioural control on ERP system usage but not the effect of training.

Table 4.5: Interaction effect analysis

Hypothesis	Factor	Moderator	Path coefficient	t-value	p-value
H5a	Training	Gender	0.040	0.955	0.340
H5b	Technical Support	Gender	0.215	2.066	0.040**
H5c	Management Support	Gender	-0.084	2.568	0.011**
H5d	Perceived Behavioural Control	Gender	0.168	3.564	0.0004*
H5e	Training	Experience	-0.113	3.834	0.0002*
H5f	Technical Support	Experience	-0.208	6.021	0.0001*
H5g	Management Support	Experience	0.148	4.488	0.0001*
H5h	Perceived Behavioural Control	Experience	0.043	0.726	0.469
H5i	Training	Age	-0.090	1.252	0.211
H5j	Technical Support	Age	0.101	2.424	0.016**
H5k	Management Support	Age	0.003	0.261	0.794
H5l	Perceived Behavioural Control	Age	-0.086	1.388	0.166

* p-value < 0.01; ** p-value < 0.05

The examination of experience as a moderator resulted in the formulation of hypotheses 5e to 5h. The analysis of the results in Table 4.5, show that the path coefficient of the interaction effect (training * experience) was significant (p-value of 0.0002 < 0.05), indicating that the relationship between training and ERP system usage differ depending on experience. Hypothesis 5e was thus supported. In addition, the path coefficient of the interaction effect (technical support * experience) was significant (p-value of 0.0001 < 0.05) indicating that the relationship between technical support and ERP system usage varies depending on experience. This resulted in the acceptance of hypothesis 5f. Experience was also found to moderate the effect of management support on ERP system usage.

The interaction effect (management support * experience) was significant (p-value of 0.0001 < 0.05), hence hypothesis 5g was supported. Hypothesis 5h was not supported (p-value of 0.469 > 0.05) meaning that the effect of perceived behavioural control on ERP system usage does not differ depending on gender. Overall experience moderated the effect of training, technical support, management support on ERP system usage but not the effect of perceived behavioural control.

Lastly, the examination of age as a moderating factor was tested in hypotheses 5i, 5j, 5k and 5l. The results in Table 4.5 show that age did not moderate the effect of training on ERP system usage (p-value of 0.211 > 0.05) thereby rejecting hypothesis 5i. The moderating effect of age on the relationship between technical support and ERP system usage (p-value of 0.016 < 0.05) was found to be significant thereby accepting hypothesis 5j. Age was not confirmed to moderate the effect of management support on ERP system usage (p-value of 0.794 > 0.05). Hypothesis 5k was therefore not supported. The same held true regarding the effect of perceived behavioural control on ERP system usage (p-value of 0.166 > 0.05), hence hypothesis 5l was not supported. In conclusion age moderated the effect of technical support on ERP system usage but not the effect of perceived behavioural control, training and management support.

4.2.6 ERP system usage factor ranking

The k-related sample Friedman test was performed using SmartPLS 2.0 software according to mean ranks to select the four most important factors that decision makers should consider while making decisions to improve the usage of the ERP system at the university. The test was conducted for male and female users, less experienced and more experienced users and younger and older users. Table 4.6 shows this result, wherein factors that the ranked items measured were those selected as important; these factors were the ones that most improved usage of the ERP system at the university.

Table 4.6: Item mean ranking

	Gender		**Age**		**Experience**	
Overall	**Male**	**Female**	**Younger**	**Older**	**More**	**Less**
PBC1(6.8)	PBC1(6.19)	PBC1(7.26)	PBC(16.26)	PBC2 (6.48)	PBC2(6.59)	PBC1(6.6)
TR1(9.91)	TR1(9.72)	TR1(10.21)	TR1(10.08)	TR1(8.97)	TR1(9.81)	TR1(9.91)
TS4(14.57)	IM1(13.78)	TS3(14.54)	TS3 (12.97)	IM1 (13.45)	IM2(14.4)	MS4(14.08)
MS4(14.71)	TS4(13.89)	MS4(14.82)	MS4(13.48)	MS4 (15.32)	TS3(14.75)	TS3(14.62)

Note. PBC = perceived behavioural control; TR = training; TS = technical support; MS = management support; IM = image

The result of the k-related sample Friedman test of the four most important factors that improve understanding of the extent of usage of ERP systems were perceived behavioural control (PBC1 = 6.8), training (TR1 = 9.91), technical support (TS4 = 14.57); and management support (MS4 = 14.71). Perceived behavioural control and training were considered the first two important factors independent of gender, age and experience. However, young (TS3 = 12.97) female (TS3 = 14.54) ERP users preferred technical support to be the third most important factor that improves ERP system usage whereas, older (IM1 = 13.45) and more experienced (IM2 = 14.4) male users (IM1 = 13.78) preferred image (their status). Less experienced (MS4 = 14.08) users preferred management support to be the third most important factor. Younger (MS4 = 13.48) and older (MS4 = 15.32) ERP users considered management support as the fourth most important factor; and more experienced (TS3 = 14.75) and less experienced (TS3 = 14.62) considered technical support. On the other hand, male (TS4 =13.89) ERP users preferred technical support while female (MS4 = 14.82) ERP users preferred management support as the fourth most important factor.

A Spearman correlation test was performed to further investigate gender, age and experience differential (as shown in Table 4.6) in order of the importance of factors that improve ERP system usage. The Spearman correlation in item mean rankings between each pair (younger and older, less experienced and more experienced, and male and female ERP system users) of distribution are shown in Table 4.7.

Table 4.7: Spearman correlation

Moderators	**Correlation coefficient**	**p-value**
Age	0.967	0.0001*
Experience	0.964	0.0001*
Gender	0.975	0.0001*

*significant

The results reveal that there is a strong correlation in the order of importance in factors that improve understanding of the extent of usage of ERP systems between younger and older, less experienced and more experienced, and male and female ERP system users. This means that age, experience and gender differential in the order of importance in factors that improve understanding of the extent of ERP system usage does not exist. This indicates that the difference in the order of importance of factors shown in Table 4.6 is insignificant; it can therefore be confirmed that the four most important factors in improving understanding of the extent of ERP system usage are: perceived behavioural control; training; technical support; and management support.

4.3 RESEARCH MODEL COMPARISON

To understand the value of the additional IT usage factors which were adapted in this study's research model and used to improve TPB model, this study compared: the original TAM2 model against the research model of this study; and the original TPB against the improved TPB model. The comparison was based on the model's predictive power and the effect size of factors. This was undertaken to assess the effect of the additional IT usage factors across different models. All models were fitted to this study's data using SmartPLS 2.0.

The predictive power of the models and the effect size of the additional IT usage factors were computed using Equation 5 (discussed in Chapter 3, section 3.5.6) and Equation 7 (discussed in Chapter 3, section 3.5.7) respectively. The statistical significance of the effect size was tested using Equation 8 (discussed in Chapter 3, section 3.5.7).

4.3.1 Comparison of this study's research model with the TAM2 model

The predictive power of this study's research model was first compared against the original TAM2 model. This comparison was done to determine whether the additional IT usage factors improve the predictive power of the TAM2 theoretical model as shown in Figure 4.1. The results show that only 3.6 % of the variance in the usage of ERP system is explained by factors of the original TAM2 model as shown in Figure 4.2. Whereas this study's research model explains 23% as shown in Figure 4.1 compared to the original TAM2 model.

The difference in predictive power was tested for statistical significance and the result ($F = 61.26$ and p-value = 0.0001) indicated that the research model of this study better explained ERP system usage as compared to original TAM2 model.

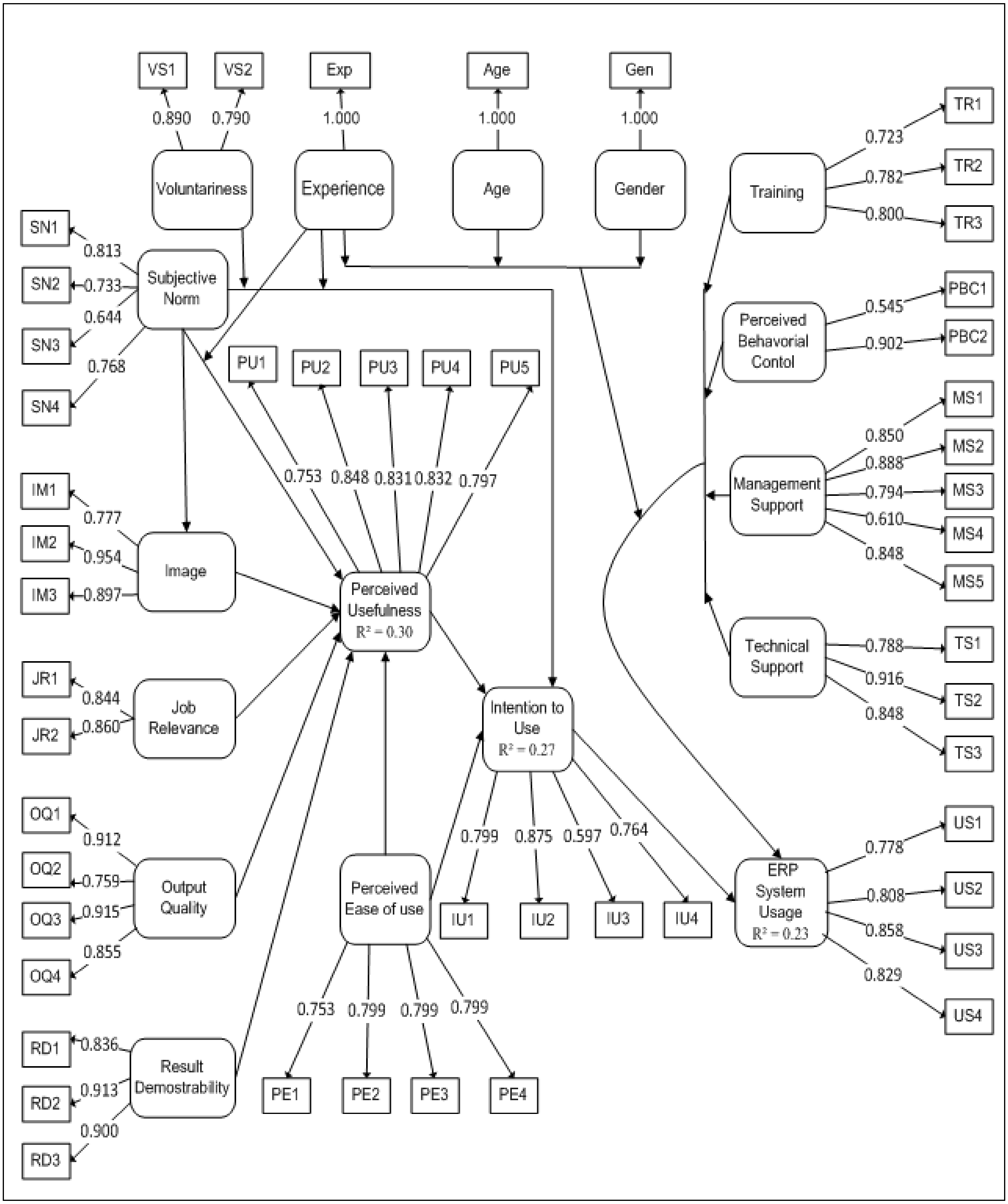

Figure 4.1: ERP system usage explained by this study's research model

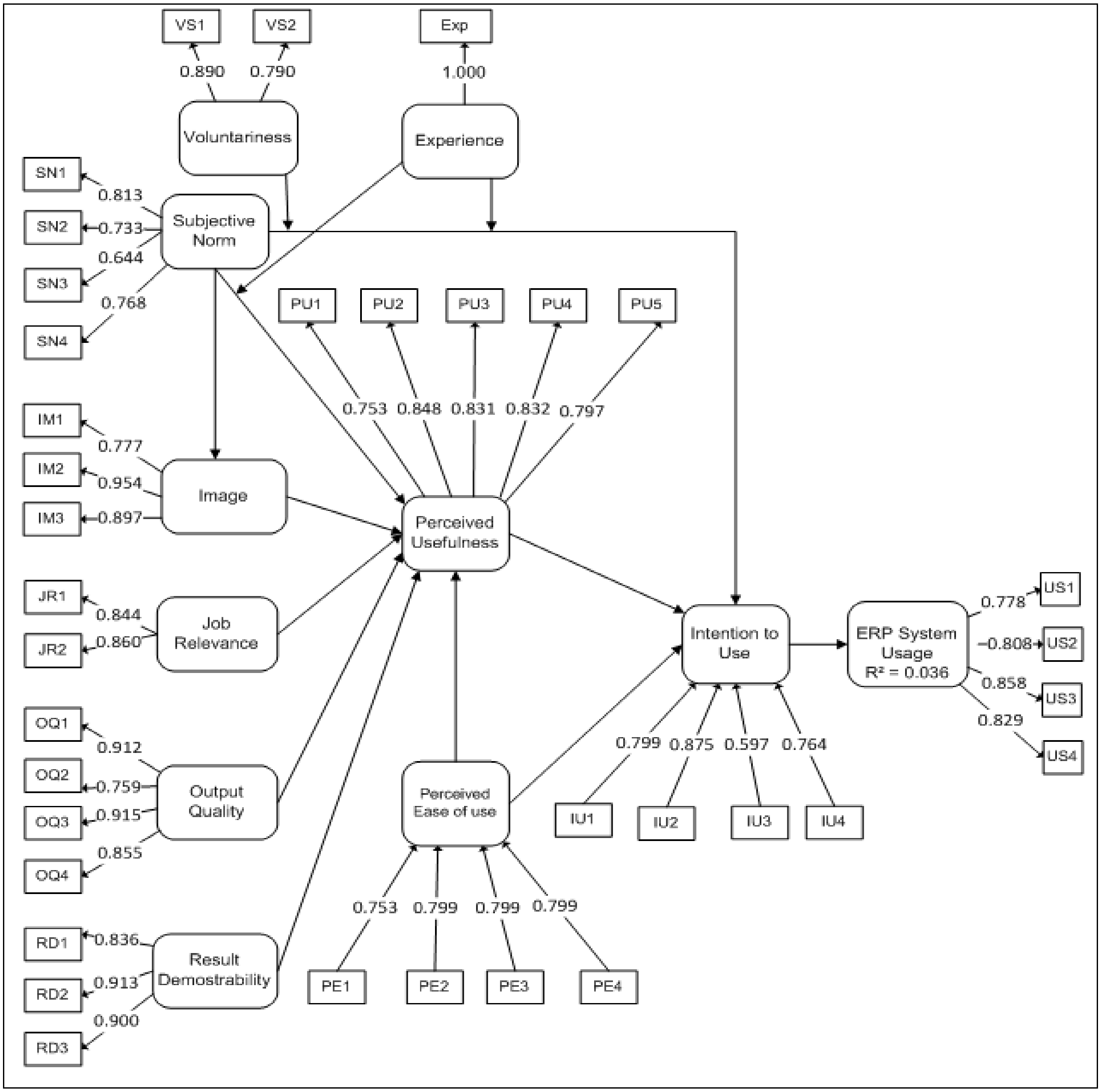

Figure 4.2: ERP system usage explained by the original TAM2 model

4.3.2 Comparison of the original TPB model with the improved TPB model

The predictive power of the original TPB model was compared to the improved TPB model. This comparison was done to determine whether the additional factors improve the predictive power of the TPB theoretical model. The result shows that only 5.2% of the variance in the ERP system usage was explained by factors of the original TPB as shown in Figure 4.3.

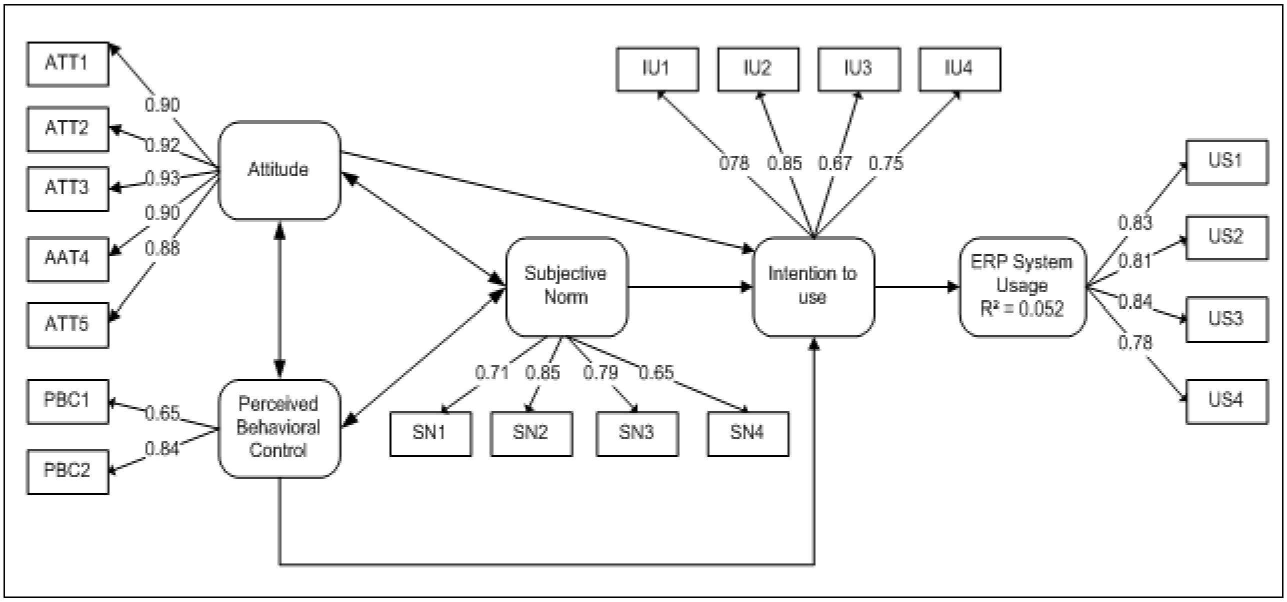

Figure 4.3: ERP system usage explained by the original TPB model

Factors of the improved TPB model explained 22.5% of variance in ERP system usage as shown in Figure 4.4. The difference in predictive power was tested for statistical significance and the result (F = 55.84 and p-value = 0.0001) showed that the improved TPB model better explained ERP system usage as compared to the original TPB model.

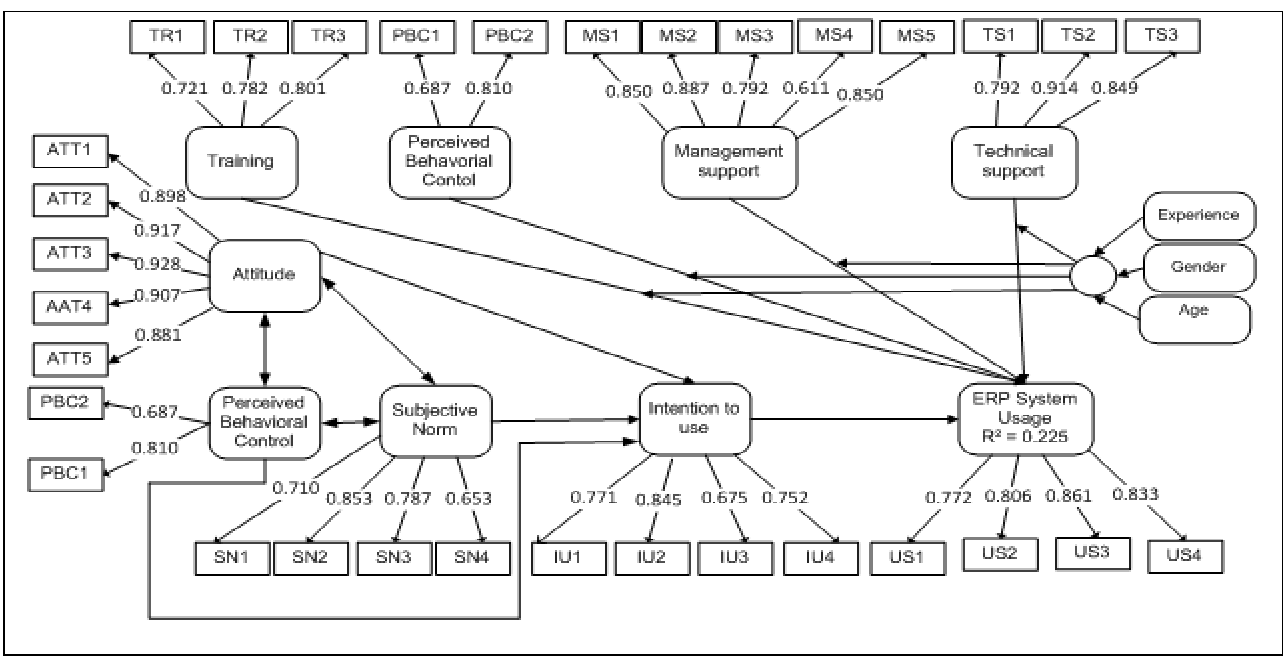

Figure 4.4: ERP system usage explained by the improved TPB model

In conclusion, the predictive power comparison shows that both the research model of this study and the improved TPB model have a higher predictive power as compared to the original TAM2 and TPB models respectively. This implies that the additional IT usage factors of training, technical support, management support and perceived behavioural control improved predictive power of the original TAM2 and TPB models. Hypotheses (6) and (7) respectively were thus supported.

4.3.3 Effect size analysis

A further analysis of the predictive power (R^2) was performed to evaluate the contribution of each independent factor (additional IT usage factors) to the R^2 value of the dependent factor (ERP system usage) across the two theoretical models (research model and improved TPB model). The effect size (f^2) of training, technical support, management support, and perceived behavioural control on ERP system usage was computed using Equation 7 (discussed in Chapter 3, section 3.5.7) and all positive effect size were tested for statistical significance using Equation 8 (discussed in Chapter 3, section 3.5.7).

Table 4.8: Effect size comparison of additional IT usage factors

Factors	**Theoretical model**	**R^2 Included**	**R^2 Excluded**	**f^2**	**F-test**
Training	Research model	0.229	0.174	0.07	20.38*
	Improved TPB	0.225	0.169	0.07	20.62*
Technical support	Research model	0.229	0.218	0.01	4.30*
	Improved TPB	0.225	0.216	0.01	3.51*
Management support	Research model	0.229	0.211	0.02	6.98*
	Improved TPB	0.225	0.207	0.02	6.95*
Perceived behavioural control	Research model	0.229	0.186	0.05	16.16*
	Improved TPB	0.225	0.181	0.05	16.44*

*significant

The results in Table 4.8 reveal that the effect of all the additional IT usage factors on ERP system usage improved the R^2 value of ERP system usage. However the improvement (effect size) exhibited by training (f^2 = 0.07), management support (f^2 = 0.02), and perceived behavioural control (f^2 = 0.05), was significantly small regardless of the theoretical model used but technical support exhibited an effect size (f^2 = 0.01) less than the smallest benchmark of 0.02.

The effect size comparison result also reveals a consistent effect size of each of the additional IT usage factors on the R^2 values of this study's research model and the improved TPB model.

4.4 SUMMARY

In this chapter the empirical results of the study were analyzed and discussed. The findings indicate that most of the respondents (59.9%) were 40 years and above, 51.6% of the total respondents were female and the majority (53%) had more than six years of ERP system experience at DUT. Validation of the research model developed in this study results revealed that: items and factors retained, were reliable and valid; the developed research model fit to data was significant, and higher for older experienced female ERP system users; and direct effect hypothesis testing showed that the factors of training, technical support and perceived behavioural control were found to influence ERP system usage, whereas management support did not. Gender and experience moderated the effect of technical and management support on ERP system usage whereas age was not found to moderate the effect of all the additional IT usage factors on ERP system usage. The k-related sample Friedman test ranked perceived behavioural control, training, technical support, and management support as the four most important factors that improve understanding of the extent of ERP system usage. The research model comparison was conducted to understand the value of the additional IT usage factors which were adapted in this study's developed research model and used to improve the TPB model. The findings of predictive power comparison showed that both the research model of this study and the improved TPB model have a higher predictive power when compared to the original TAM2 and TPB models respectively. The effect size of the additional IT usage factors on ERP system usage revealed a consistent effect independent of the research model used. The following chapter presents the conclusions and recommendations pertaining of this study.

CHAPTER 5
CONCLUSION AND RECOMMENDATONS

In this study, the TAM2 theoretical model was adapted with additional IT usage factors of training, technical support, management support and perceived behavioural control to improve understanding of the extent of ERP system usage at the DUT. A dataset of 312 ERP system user respondents was collected for the study. The dataset was analyzed using PLS to determine the predictive power of the research model for male and female, more and less experienced, and younger and older users of the ERP system. This chapter discusses how the objectives of this study were achieved and the limitations of this study. In addition recommendations emanating from the findings and suggestions for future research are discussed.

5.1 ACHIEVEMENT OF OBJECTIVES

The two objectives of this study were: to adapt the TAM2 theoretical model through the integration of additional IT usage factors to improve understanding of the extent of ERP system usage at the DUT; and to determine the superiority of the developed research model and the impact of the additional IT usage factors, the developed research model was compared against the original TAM2 in improving understanding of the extent of ERP system usage. In order to achieve these objectives, a set of research hypotheses were proposed and they were validated using the developed research model in the context of ERP system usage in a higher education institution i.e. DUT.

5.1.1 Research model validation (Objective 1)

The first objective of this study resulted in the formation of research hypotheses 1 to 5, in which 1 to 4 was a test for direct effect of additional IT usage factors on ERP system usage. Whereas hypotheses 5a to 5l was the test for interaction effect of age, gender and experience on the relationship between the additional IT usage factors and the dependent factor of ERP system usage. PLS path analysis procedure was used to validate each hypothesis.

Research hypothesis 1 was to examine if training directly influenced ERP system usage. The result indicated that training influenced ERP system usage with estimated path coefficient of 0.212, t-value of 3.25 and p-value of 0.001 implying that the process of improving knowledge and skill through training influenced the extent of ERP system usage by university staff. Hypothesis 2 was to determine whether technical support directly influences ERP system usage. The results indicated that there was a direct relationship between technical support and ERP system usage with estimated path coefficient of -0.292, t-value of 4.504 and p-value of 0.0001. This means that in order to improve ERP system usage in the university, technical consulting and assistance for ERP system user-related issues must be addressed.

Hypothesis 3 was to determine whether management support directly influenced ERP system usage. The results indicate that there was no relationship between management support and ERP system usage with estimated path coefficient of 0.059, t-value of 1.570 and p-value of 0.117. Thus hypothesis 3 was not supported, implying that the continuous provision of ERP system assistance and encouragement from management to use the ERP system does not directly contribute to improving ERP system usage by university staff. A plausible reason could be that the impact of management support is largely limited to the initial adoption stage of ERP systems, rather than the post adoption stages (Chang *et al*., 2010).

Hypothesis 4 sought to examine if perceived behavioural control directly influenced ERP system usage. The results indicate that there is a direct relationship between perceived behavioural control and ERP system usage with estimated path coefficient of 0.187, t-value of 2.549 and p-value of 0.011. This findings implies that the resources and opportunities available to the university ERP system users impacts the extent of such system usage, therefore this factor must be addressed to improve the use of ERP system in the university.

Hypothesis 5 was the test of gender, age and experience interaction effect on the relationship between the additional IT usage factors and ERP system usage. Gender interaction effect was tested in hypotheses 5a to 5d. Hypothesis 5a was the test of whether the relationship between training and ERP system usage was influenced by gender, 5b examined whether gender influenced the relationship between technical support and ERP system usage, 5c determined whether there was gender interaction effect in the relationship between management support and ERP system usage. Lastly hypothesis 5d finds out if the effect of perceived behavioural control on ERP system usage was influenced by gender. Gender interaction effect on the relationship between training and ERP system usage was not found to exist. This was supported by the insignificant p-value of 0.340 of the estimated path coefficient (0.040). However, gender was found to influence the effect of technical support path coefficient = 0.215 and p-value = 0.040), management support (path coefficient = -0.084 and p-value = 0.011) and perceived behavioural control (path coefficient = 0.168 and p-value = 0.0004) on ERP system usage. This implied that in order to improve ERP system usage, gender differential must be addressed when providing ERP system user-related support and with regard to resources and opportunities available to university ERP system users.

Experience interaction effect was tested in hypotheses 5e to 5h. Hypothesis 5e was the test of whether the relationship between training and ERP system usage was influenced by experience, while hypothesis 5f examined whether experience influences the relationship between technical support and ERP system usage. Whereas, hypothesis 5g determined whether there was experience interaction effect in the relationship between management support and ERP system usage and lastly hypothesis 5h found out if the effect of perceived behavioural control on ERP system usage was influenced by experience. The results indicates that there was experience differential in the effect of training (path coefficient = -0.113 and p-value = 0.0002), technical support (path coefficient = -0.208 and p-value = 0.0001) and management support (path coefficient = 0.148 and p-value = 0.0001) on ERP system usage. This implied that in order to improve ERP system usage, experience must be considered when providing training, technical support and management support to ERP system users. For example, training and user support packages must be experience based to be well accepted by both more and less experienced ERP system users.

Interaction effect of age was tested in hypotheses 5i to 5l. Hypothesis 5i was the test of whether the relationship between training and ERP system usage was influenced by age, while hypothesis 5j examined whether age influences the relationship between technical support and ERP system usage. Hypothesis 5k determined whether there was age interaction effect in the relationship between management support and ERP system usage and hypothesis 5l determined if the effect of perceived behavioural control on ERP system usage was influenced by age. The results enabled the rejection of hypotheses 5i to 5l, meaning that there was no age differential in the relation between the independent factors of training (path coefficient = -0.090 and p-value = 0.211), technical support (path coefficient = 0.101 and p-value = 0.016), management support (path coefficient = 0.003 and p-value = 0.794) and perceived behavioural control (path coefficient = -0.086 and p-value = 0.166) on the dependent factor of ERP system usage. The implication of these results is that age does not influence the effect of training, technical support, management support and perceived behavioural control on ERP system usage. Therefore in improving the use of the ERP system, age is not a critical factor to be addressed.

5.1.2 Research model comparison (Objective 2)

The second objective of this study resulted in the formation of research hypotheses 6 and 7. These research hypotheses determined whether the additional IT usage factors will improve predictive power of TAM2 and TPB models respectively in improving understanding of the extent of ERP system usage in the university. The purpose of this was to determine the superiority of this study's research model.

The predictive power of this study's research model reflects that the model fit to data was of weak to moderate level (Chin, 1988) and statistically significant from zero (Aibinu and Al-Lawati, 2010). Meaning that about 23% of the variation in ERP system usage was as a result of all the independent factors (subjective norm, image, job relevance, output quality, result demonstrability, perceived usefulness, perceived ease of use, intention to use, training, technical support, management support and perceived behavioural control) to the dependent factor (ERP system usage).

In order to determine the superiority of this study's research model, it was important to adapt more than one similar system usage model (TAM2 and TPB) with the additional IT usage factors. The adapted models (improved) and original models were validated with the methodology of this study for comparison purposes. The results show that the predictive power of the improved TPB is significantly higher than the original TPB (F = 55.84 and p-value =

0.0001) and similarly, the predictive power of the research model was also significantly higher than that of the original TAM2 ($F = 61.26$ and p-value = 0.0001). These findings provide evidence that the additional IT usage factors improve the ERP system usage model's predictive power. Even though the predictive power of this study's research model (23%) is of weak to moderate level (Chin, 1998), it better explains ERP system usage as compared to the original TAM2 (3.6%). Therefore it can be concluded that the research model ($R^2 = 23\%$) of this study is superior to the original TAM2 model ($R^2 = 3.6\%$) and the original TPB model ($R^2 = 5.2\%$) in improving understanding of the extent of ERP system usage. However, the predictive power of this study's research model of 23% is still lower as compared to previous IT usage studies with a predictive power of about 33.4% (Bhattacherjee and Sanford, 2009; Davis *et al*., 1989; Venkatesh *et al*., 2003). A possible reason could be the difference in the context of the study involved. While this study focused on ERP system usage in higher education, the study by Bhattacherjee and Sanford (2009) investigated system usage in the context of real estate industry, this could account for the variance in predictive power. Another possible reason in the variance in predictive power could be population heterogeneity in sample data collected (Muthen and Satorra, 1995).

In order to determine the effect size of each of the additional usage factors, the contribution of each of the factors to the predictive power of this study's research model and improved TPB model was compared. The results indicate that the effect size of training ($f^2 = 0.07$), management support ($f^2 = 0.02$) and perceived behavioural control ($f^2 = 0.05$) was significantly small (Cohen, 1988) but technical support resulted in an effect size ($f^2 = 0.01$) less than the smallest benchmark of 0.02 (Cohen, 1988) independent of the model.

5.2 LIMITATIONS OF THIS STUDY

Research will always have some shortcomings (Hofstee, 2006). The sample size of this study was 312 respondents from one university, the Durban University of Technology in South Africa. A larger sample size which cuts across different levels of university professions or positions (admin and academics) might be desirable to detect other significant effects. The findings from this study cannot be generalized for the entire university due to the fact that a convenience sampling method was used to collect data from academic staff only.

The research included one ERP system that is the ITS system. The views and experiences of the respondents regarding the ITS system might not be the same with another ERP system because of possible levels of complexity and functionality in the use of different ERP systems. For example this study has found training, technical support and perceived behavioural control to influence ITS system usage but this may not be the same with another ERP system. Hence the findings of this study cannot be generalized for all ERP systems.

The researcher works at the DUT were the data was collected among his colleagues; this may possibly have introduced participant bias with regard to responses. Respondents may have been influenced as they know the researcher and may therefore have not reflected their true responses, but the fact that responses were anonymous may have negated any bias. Any significant results emerging from this study therefore may not reflect the situation regarding ERP system usage at all HEIs, but will undoubtedly prove useful in beginning to understand and address the issues around gender and experience differential with additional IT usage factors in the context of ERP system usage in HEIs.

5.3 RECOMMENDATIONS

The research model developed in this study provides a better understanding of ERP system usage in a university context. Knowledge acquired from this study can potentially benefit university stakeholders and all interested groups in improving ERP system usage in a developing country such as South Africa. It may also provide insight into understanding some of the reasons why university staff will or will not use an ERP system.

The findings of this study make several contributions. This study adapts the TAM2 theoretical model to improve understanding of the extent of ERP system usage with an HEI context. The factors of training, technical support and perceived behavioural control were found to have a direct influence on ERP system usage. The implication of these findings is that in order to improve ERP system usage at DUT, training, technical support and perceived behavioural control must be taken into consideration. Currently, DUT provides ITS system training for academics once off during their induction programme when they join the university, but the duration of the induction programme might not be enough to cover training for all aspects of the system. It is therefore recommended that in addition to the induction programme, periodical training sessions be provided to staff in an attempt to enhance and improve system usage.

In recent years, the Department of Information Technology Support Services (ITSS) which provides systems support at the DUT has recognized the importance of technical support and implemented a user support system for logging technical problems. However users are reluctant to give a full description of the fault as this takes time and there is no instant help which leaves the user frustrated since the user has to wait for the next available technician. It is clear that more still has to be done to address the issue of technical support in the form of dedicated ERP system specialists from the onsite ERP vendor.

The examination of gender interaction effect revealed gender differences in the effect of technical support, management support and perceived behavioural control on ERP system usage. These findings concur with previous technology adoption usage studies regarding the open issue of gender differences (Umrani and Ghadially, 2008), hence this study's result does not differ. From the researcher's experience, he is aware that there has not been any gender based ERP system support or management encouragement with relation to ERP system use. It is thus recommended that DUT address this on an on-going basis. This could be achieved by conducting a survey on staff skills requirements by the ITSS department through the respective HoDs which will enable training to be designed specifically for individuals.

The examination of experience interaction effect revealed experience differential in the effect of training, technical support and management support on ERP system usage. It is recommended that ITS super users or champions (more experienced users) could be trained to advise other staff users on how they can fully utilize features as the university has invested a considerable amount of capital and resources hoping to improve staff performance.

The findings of this study reveal that the four most important factors users consider when formulating their decisions about using the ERP system to improve the efficiency of administrative tasks in order of importance are: perceived behavioural control; training; technical support; and management support. This suggests that stakeholders and all interested groups in improving ERP system usage in the university must address these factors to achieve better system usage. For example, ERP improvement interventions should demonstrate acceptable levels of user control which might include ease of use, affordability, reliability and many other factors depending on the kind of intervention. In this regard the ITSS Department in consultation with the DUT management should investigate the roll out of ERP system training at minimal cost to the institution compared to the present scenario where the ERP vendor consultants conduct system training (at high cost to DUT). Another intervention could be for the ITSS department to allow users to send requests for customization of the ERP system to better suit their individual or departmental needs in allowing them to do their daily work or tasks easily and more efficiently.

5.4 SUGGESTIONS FOR FUTURE RESEARCH

This research opens avenues for a number of future studies based upon the results presented in chapter 4, and based on the limitations observed and other questions brought up during the course of the research. An obvious avenue for further research would be a replication to cover samples representing the entire university that is both academics and administrative personnel, thereby increasing the generalizability of results obtained. Another study should be done on ERP systems at HEIs in South Africa while a further study should be conducted with international HEIs.

There were hypotheses not supported during the analysis of the data collected. For example, management support was not found to influence ERP system usage and there was no interaction effect of age between additional IT usage factors and ERP system usage. Only through further research will the value of these hypotheses be fully known. Also, future studies may choose to investigate another ERP system besides ITS for comparative analysis purposes.

This study only focused on the four additional IT usage factors of ERP system usage. Future studies may, based on their respective contexts and theories, further investigate other system usage factors. For instance, it has been pointed out that factors that influence and contribute to system usage extent involve mainly user evaluation systems and characteristics of different dimensions such as systems, users, tasks and organizational environments (Chang *et al*., 2010).

5.5 CONCLUDING REMARKS

In general, the findings of this study add a new dimension to the examination of gender and experience differentials with additional IT usage factors in the TAM2 theoretical model for HEIs in the context of ERP system usage. This could be relevant for future comparative analysis of issues in comparable regions in advanced countries. The discourse presented in this study will hopefully benefit government, policy makers and individuals concerned regarding the improvement of administrative task efficiency in the university through the improvement of ERP system use.

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APPENDICES

APPENDIX A: PERMISSION TO CONDUCT RESEARCH AT THE DUT

DURBAN
UNIVERSITY of
TECHNOLOGY

Directorate for Research and Postgraduate Support
Durban University of Technology
Tromso Annexe, Steve Biko Campus
P.O. Box 1334, Durban 4000
Tel.: 031-3732576/7
Fax: 031-3732946
E-mail: moyos@dut.ac.za

21st November 2011

Mr. S. Mudaly
c/o ITSS Department
Durban University of Technology

Dear Mr. Mudaly

PERMISSION TO CONDUCT RESEARCH AT THE DUT

Your email correspondence dated 26th October 2011 in respect of the above refers. I am pleased to inform you that the Institutional Research Committee (IRC) will grant permission to you to conduct your research at the Durban University of Technology.

We would be grateful if a summary of your key research findings can be submitted to the IRC on completion of your studies.

Kindest regards.
Yours sincerely

[redacted]

PROF. S. MOYO
DIRECTOR (ACTING): RESEARCH AND POSTGRADUATE SUPPORT

APPENDIX B: RESEARCH QUESTIONNAIRE

Dear Staff Member

I am studying towards a Master of Technology degree in Information Technology at the Durban University of Technology. The aim of my study is to design a model for the improvement of the extent of usage of Enterprise Resource Planning systems at the Durban University of Technology.

Kindly assist me by completing the attached questiionnaire. The information you provide will be kept strictly confidential and you will remain completely anonymous.

Participation in this research study is voluntary and you may withdraw from the study at any time without having to give reason. If you have any questions, please contact me *via* email: sherwinm@dut.ac.za or work number: ext 5211.

Thank you very much for your time and effort.

Yours sincerely

[redacted]

Sherwin Mudaly

LETTER OF INFORMED CONSENT

Dear Participant

Thank you for agreeing to participate in this research study titled: *Designing a model for the improvement of the extent of usage of Enterprise Resource Planning systems at the Durban University of Technology.* This study aims to develop a research model to improve the extent of ERP system usage by university end-users.

The researcher undertakes to assure you of the following:

- to maintain your confidentiality
- to protect your rights and welfare, i.e to ensure that no harm comes to you as a result of your participation in this research;
- to present information and transcripts used in this research in such a way as to maintain your dignity, and if in doubt to first consult with you; and
- to make available to you the final copy of this research publication.

You are free to withdraw from this research at any time, if the need should arise. No manipulation or withholding of information is involved in this study.

Thank you for volunteering to add to a body of knowledge in Information Technology.

Yours sincerely

[redacted]

Sherwin Mudaly

MTech: Information Technology

<u>Please place a cross (x) in the box below to indicate your consent:</u>

I HAVE READ THE CONSENT FORM AND HEREBY AGREE TO PARTICIPATE IN THIS STUDY	

PLEASE WORK THROUGH EACH PART OF THE QUESTIONNAIRE BY READING EACH STATEMENT AND TICKING √ THE APPROPRIATE RESPONSE OR COMPLETING THE TEXT BOX.

Please Note: The term ERP (Enterprise Resource Planning) system referred to in this questionnaire is the ITS system at DUT such as: Online leave; online requisition; capturing of student test marks; subject class lists; student reports; etc….

Section A: Biographical Information

1. Please indicate your age:

   Under 20 years ☐

   20-29 years ☐

   30-39 years ☐

   40-49 years ☐

   50-59 years ☐

   60 plus ☐

2. Please indicate your gender:

   Male ☐

   Female ☐

3. Please indicate your Job title:

   ☐ Jnr lecturer ☐ Lecturer ☐ Snr lecturer ☐ HOD ☐ Professor ☐ Other…………….

4. Please indicate your highest qualification**:**

   ☐ Diploma ☐ Degree/BTech ☐ Honors ☐ Masters ☐ Doctorate ☐ Other…………..

5. Please indicate your experience in using the ERP system at DUT:

   ☐☐ years ☐☐ months

Section B: Perceived Usefulness: The degree to which an individual believes that using the ERP system will help him or her to attain gains in job performance.

	Strongly disagree	Moderately disagree	Somewhat disagree	Neither disagree nor agree	Somewhat agree	Moderately agree	Strongly agree
6) Using the ERP system improves my performance in terms of my job.	O	O	O	O	O	O	O
7) Using the ERP system in my job increases my productivity.	O	O	O	O	O	O	O
8) Using the ERP system enhances my effectiveness in my job.	O	O	O	O	O	O	O
9) I find the ERP system to be useful in my job.	O	O	O	O	O	O	O
10) Using the ERP system makes it easier to do my job.	O	O	O	O	O	O	O

Section C: Perceived Ease of Use: The degree of ease associated with the use of the ERP system.

	Strongly disagree	Moderately disagree	Somewhat disagree	Neither disagree nor agree	Somewhat agree	Moderately agree	Strongly agree
11) The ERP system is clear and understandable.	O	O	O	O	O	O	O
12) I find the ERP system is easy to use.	O	O	O	O	O	O	O
13) I find it easy to get the ERP system to do what I want it to do.	O	O	O	O	O	O	O
14) Using the ERP system does not require a lot of mental effort.	O	O	O	O	O	O	O

Section D: Intention to Use: The degree to which a person's intends to continue using the ERP system or intends to use the ERP system in the future.

	No chance at all	Highly unlikely	Unlikely	Neither unlikely nor likely	Likely	Highly likely	One hundred percent likely
15) I intend to continue using the ERP system to learn new features.	O	O	O	O	O	O	O
16) I intend to immediately use the ERP system to improve my job tasks.	O	O	O	O	O	O	O
17) I intend to acquire the ERP system in the next few months if I have the means.	O	O	O	O	O	O	O
18) I intend to use the ERP system in the next few months to improve my career.	O	O	O	O	O	O	O

Section E: Subjective Norm: The degree to which a person's perception that most people who are important to him/her think he/she should/should not use the ERP system.

	Extremely unlikely	Quite unlikely	Slightly unlikely	Neither unlikely nor likely	Slightly likely	Quite likely	Extremely likely
19) My manager who influences my behaviour thinks that I should use the ERP system.	O	O	O	O	O	O	O
20) My friends who are important to me think that I should use the ERP system to become more skilled in my job.	O	O	O	O	O	O	O
21) My family who are important to me think that I should use the ERP system to improve my career.	O	O	O	O	O	O	O
22) My job tasks require me to use the ERP system.	O	O	O	O	O	O	O

Section F: Voluntariness: The degree to which use of the ERP system is perceived as voluntary.

	Extremely disagree	Quite disagree	Slightly disagree	Neither disagree nor agree	Slightly agree	Quite agree	Extremely agree
23) My manger does not require me to use the ERP system.	O	O	O	O	O	O	O
24) Although it might be helpful, using the ERP system is certainly not compulsory in my job.	O	O	O	O	O	O	O
25) In my job the ERP system is mandatory.	O	O	O	O	O	O	O

Section G: Image: The degree to which an individual perceives the use of the ERP system as a means of enhancing one's status within the organization.

	Extremely disagree	Quite disagree	Slightly disagree	Neither disagree nor agree	Slightly agree	Quite agree	Extremely agree
26) Staff in my organization who use the ERP system have a high profile.	O	O	O	O	O	O	O
27) Having the ERP system is a status symbol in my organization.	O	O	O	O	O	O	O
28) Using the ERP system enhances my status among my peers.	O	O	O	O	O	O	O

Section H: Job Relevance: Is an individual's perception regarding the extent to which the ERP system is applicable to his or her job.

	Extremely disagree	Quite disagree	Slightly disagree	Neither disagree nor agree	Slightly agree	Quite agree	Extremely agree
29) In my job, usage of the system has helped people to appreciate my work more.	O	O	O	O	O	O	O
30) In my job, usage of the system is mandatory.	O	O	O	O	O	O	O
31) In my job, I would rather use other systems or software than the ERP system.	O	O	O	O	O	O	O

Section I: Output Quality: The degree to which an individual believes that the quality of the output from the ERP system (i.e. screen based and printed) matches their job goals.

	Strongly disagree	Moderately disagree	Somewhat disagree	Neither disagree nor agree	Somew hat agree	Mode rately agree	Strongly agree
32) The quality of the output from the ERP system has improved my job efficiency.	O	O	O	O	O	O	O
33) My manager is satisfied with the high quality of the reports I produce using the ERP system.	O	O	O	O	O	O	O
34) The quality of the output I get from the ERP system is high.	O	O	O	O	O	O	O
35) I have no problem with the quality of the ERP system's output.	O	O	O	O	O	O	O

Section J: Result Demonstrability: The degree to which an individual perceives the **t**angibility of the results of using the ERP system including their observability and communicability.

	Extremely disagree	Quite disagree	Slightly disagree	Neither disagree nor agree	Slightly agree	Quite agree	Extremely agree
36) I believe I could communicate to others the consequences of using the ERP system.	O	O	O	O	O	O	O
37) The results of using the ERP system are apparent to me.	O	O	O	O	O	O	O
38) I have no difficulty explaining why using the ERP system may or may not be beneficial.	O	O	O	O	O	O	O

Section K: Management support: The degree to which an individual believes that organizational assistance exists to support use of the ERP system.

	Strongly disagree	Disagree to some extent	Neither disagree nor agree	Agree to some extent	Strongly agree
39) My manager always supports the use of the ERP system for job-related work.	O	O	O	O	O

	Strongly disagree	Disagree to some extent	Neither disagree nor agree	Agree to some extent	Strongly agree
40) My manager constantly encourages the use of the ERP system for job-related work.	O	O	O	O	O
41) My manager is really keen to see that staff is happy with using the ERP system.	O	O	O	O	O
42) My manager provides me with the necessary help and resources to use the ERP system.	O	O	O	O	O
43) My manager is aware of the benefits that can be achieved with using the ERP system.	O	O	O	O	O

Section L: Technical support: The degree to which an individual believes that technical infrastructure exists to support use of the ERP system.

	Strongly disagree	Disagree to some extent	Neither disagree nor agree	Agree to some extent	Strongly agree
44) The technical support staff makes it easier for me to use the ERP system.	O	O	O	O	O
45) I always need technical support to use the ERP system.	O	O	O	O	O
46) It is easy to get technical support when I use the ERP system.	O	O	O	O	O
47) I get enough technical support when using the system.	O	O	O	O	O

Section M: Perceived Behavioural Control: The degree to which an individual believes he/she has control of use of the ERP system based on the availability of knowledge, resources and opportunities required for its use.

	No control	Moderate control	Total control
48) How much control do you have over acquiring the resources necessary to use the system?	O	O	O

	No control	Moderate control	Total control
49) How much control do you have over being able to attend training on how to use the ERP system?	O	O	O
50) How much control do you have over being able to adjust the ERP system to be compatible with your work style?	O	O	O

Section N: Training

51) The extent of ERP system training that I received is best described as: (please circle the appropriate number**)**

1 = Never or to a very little extent **2 = To a little extent** **3 = To some extent**

4 = To a great extent **5 = To a very great extent**

52) My organization provides frequent training sessions on the ERP system to improve staff skills:

1 =Strongly disagree **2 = Disagree to some extent** **3 = Neither disagree nor agree**

4 = Agree to some extent **5 = Strongly agree**

53) Sufficient training material on the ERP system is readily available to staff:

1 =Strongly disagree **2 = Disagree to some extent** **3 = Neither disagree nor agree**

4 = Agree to some extent **5 = Strongly agree**

Section O: Attitude

54) Please use the following rating scales to indicate your ATTITUDE towards using the ERP system for your work related tasks: (please circle only one appropriate number for each rating scale**)**

a)	**1** **bad**	**2**	**3**	**4**	**5**	**6**	**7** **good**
b)	**1** **useless**	**2**	**3**	**4**	**5**	**6**	**7** **useful**
c)	**1** **foolish**	**2**	**3**	**4**	**5**	**6**	**7** **wise**

d)	**1** **Harmful**	**2**	**3**	**4**	**5**	**6**	**7** **beneficial**
e)	**1** **disadvantageous**	**2**	**3**	**4**	**5**	**6**	**7** **advantageous**

Section P: Usage

55) Your current usage of the ERP system (last few months) is: (please circle only one appropriate number for each rating scale**)**

a)	**1** **Infrequent**	**2**	**3**	**4**	**5** **Frequent**
b)	**1** **Light**	**2**	**3**	**4**	**5** **Heavy**

56) Your expected future usage of the ERP system (next few months) is:

a)	**1** **Infrequent**	**2**	**3**	**4**	**5** **Frequent**
b)	**1** **Light**	**2**	**3**	**4**	**5** **Heavy**

Thank you for taking the time to complete this questionnaire.

APPENDIX C: CROSS LOADING ANALYSIS OF MODEL ITEMS

Factors	Items	IM	IU	TS	JR	MS	OQ	PBC	PEO	PU	RD	SN	TR	US
Image (IM)	IM1	**0.78**	0.04	-0.13	0.13	0.03	0.07	-0.04	0.11	0.08	0.01	-0.03	0.06	-0.08
	IM2	**0.95**	0.19	-0.29	0.13	-0.09	0.04	0.04	0.23	0.17	0.08	-0.09	-0.03	-0.07
	IM3	**0.90**	0.12	-0.30	0.16	-0.08	0.01	-0.05	0.21	0.06	0.08	-0.09	-0.06	-0.08
Intention to use (IU)	IU1	0.05	**0.80**	-0.02	0.22	0.02	-0.06	0.02	0.23	0.28	0.29	0.12	0.06	0.17
	IU2	0.14	**0.88**	-0.06	0.30	0.04	0.02	0.06	0.25	0.41	0.31	0.25	0.10	0.15
	IU3	0.09	**0.60**	-0.12	0.18	-0.07	-0.03	0.06	0.08	0.25	0.10	0.16	0.03	0.13
	IU4	0.18	**0.76**	-0.11	0.20	-0.05	-0.03	0.01	0.23	0.30	0.27	0.14	0.11	0.07
Technical Support (TS)	TS1	-0.25	-0.12	**0.77**	-0.03	0.21	-0.05	-0.01	-0.15	-0.17	-0.04	0.07	0.15	0.05
	TS2	-0.24	-0.05	**0.93**	-0.10	0.16	0.01	-0.01	-0.09	0.06	0.08	-0.03	0.15	0.10
	TS3	-0.25	-0.11	**0.84**	-0.10	0.13	0.02	-0.02	-0.22	-0.09	0.00	-0.03	0.14	0.05
Job Relevance (JR)	JR1	0.20	0.27	-0.05	**0.84**	0.18	-0.02	0.09	0.17	0.28	0.32	0.16	0.00	0.01
	JR2	0.06	0.25	-0.11	**0.86**	0.05	0.03	0.04	0.17	0.29	0.20	0.18	-0.02	0.07
Management Support (MS)	MS1	-0.06	0.03	0.16	0.22	**0.85**	0.01	0.04	0.05	0.14	0.09	0.15	0.03	-0.05
	MS2	-0.05	-0.03	0.14	0.15	**0.89**	0.02	-0.02	0.07	0.06	-0.04	0.17	0.07	-0.05
	MS3	-0.08	0.00	0.18	0.15	**0.79**	0.05	0.01	0.00	0.14	0.03	0.12	0.08	0.00
	MS4	-0.12	0.01	0.25	0.12	**0.60**	-0.07	0.04	0.02	0.02	0.00	0.01	0.05	0.01
	MS5	-0.08	-0.01	0.21	0.03	**0.85**	-0.16	0.03	-0.06	-0.07	0.06	0.08	0.03	-0.07
Output Quality (OQ)	OQ1	0.02	-0.01	0.02	-0.02	-0.08	**0.91**	0.05	0.08	0.19	0.04	0.09	0.12	0.09
	OQ2	0.00	-0.17	-0.04	-0.02	-0.07	**0.76**	0.08	-0.07	0.02	-0.08	-0.05	0.07	0.04
	OQ3	0.03	-0.05	0.00	0.01	-0.05	**0.91**	-0.02	0.15	0.19	0.06	0.12	0.11	0.13
	OQ4	0.08	0.00	-0.03	0.05	-0.02	**0.85**	0.03	0.03	0.15	0.08	0.06	0.07	-0.01
Perceived Behavioural Control (PBC)	PBC1	-0.07	0.01	-0.01	-0.02	0.09	0.03	**0.53**	-0.10	0.05	0.03	0.08	0.12	0.07
	PBC2	0.03	0.05	-0.01	0.10	-0.02	0.01	**0.91**	-0.17	0.02	-0.04	0.02	-0.05	0.14
Perceived Ease of Use (PE)	PE1	0.16	0.23	-0.13	0.22	0.06	0.09	-0.17	**0.89**	0.23	0.27	0.16	0.15	0.16
	PE2	0.17	0.30	-0.13	0.11	0.00	0.09	-0.12	**0.90**	0.22	0.33	0.08	0.14	0.19
	PE3	0.20	0.18	-0.16	0.18	0.00	0.08	-0.22	**0.87**	0.17	0.34	-0.01	0.09	0.12
	PE4	0.26	0.19	-0.16	0.20	-0.01	0.08	-0.17	**0.85**	0.20	0.29	0.01	0.09	0.13
Perceived Usefulness (PU)	PU1	0.05	0.31	0.05	0.25	0.10	0.18	0.05	0.13	**0.75**	0.21	0.14	0.09	0.10
	PU2	0.19	0.39	-0.09	0.28	0.02	0.15	0.05	0.24	**0.85**	0.34	0.16	0.04	0.20
	PU3	0.13	0.42	-0.07	0.37	-0.01	0.06	-0.01	0.28	**0.83**	0.48	0.17	0.10	0.20
	PU4	0.09	0.30	-0.02	0.21	0.00	0.18	0.00	0.19	**0.83**	0.32	0.11	0.03	0.21
	PU5	0.06	0.24	0.02	0.24	0.05	0.26	0.06	0.05	**0.80**	0.21	0.26	0.07	0.15
Result Demonstrability (RD)	RD1	0.03	0.30	-0.01	0.29	-0.02	0.09	-0.05	0.32	0.31	**0.84**	0.11	0.19	0.22
	RD2	0.07	0.28	0.02	0.32	0.02	0.05	0.00	0.28	0.38	**0.91**	0.10	0.09	0.22
	RD3	0.09	0.29	0.08	0.21	0.11	0.02	0.01	0.34	0.37	**0.90**	0.10	0.09	0.17
Subjective Norm (SN)	SN1	-0.09	0.21	0.01	0.17	0.15	0.06	0.03	0.02	0.19	0.07	**0.81**	0.11	0.16
	SN2	-0.02	0.14	0.00	0.11	0.11	0.16	0.04	0.14	0.12	0.08	**0.73**	0.23	0.14

Factors	Items	IM	IU	TS	JR	MS	OQ	PBC	PE	PU	RD	SN	TR	US
Subjective Norm (SN)	SN3	-0.03	0.10	-0.04	0.13	0.15	0.10	0.04	0.11	0.09	0.06	**0.64**	0.19	0.05
	SN4	-0.08	0.19	0.00	0.15	0.08	0.02	0.06	0.03	0.18	0.12	**0.77**	0.10	0.25
Training (TR)	TR1	-0.09	0.14	0.17	0.11	0.07	-0.01	0.11	0.06	0.03	0.10	0.20	**0.73**	0.19
	TR2	-0.05	-0.02	0.09	-0.17	0.01	0.09	-0.05	0.06	-0.04	-0.02	0.11	**0.78**	0.18
	TR3	0.08	0.12	0.12	0.02	0.04	0.17	-0.06	0.19	0.19	0.21	0.13	**0.79**	0.21
Usage Behaviour (US)	US1	-0.07	0.21	0.08	0.09	-0.07	0.06	0.12	0.19	0.23	0.29	0.21	0.17	**0.80**
	US2	-0.09	0.14	0.09	0.02	-0.05	0.09	0.11	0.13	0.16	0.20	0.15	0.27	**0.83**
	US3	-0.06	0.13	0.05	0.08	-0.09	0.07	0.14	0.19	0.17	0.15	0.19	0.17	**0.84**
	US4	-0.06	0.07	0.06	-0.03	-0.04	0.05	0.14	0.06	0.13	0.10	0.18	0.21	**0.80**

APPENDIX D: SUMMARY OF COMPLETED RESEARCH ON TECHNOLOGLY ADOPTION AND USAGE MODELS IN ERP SYSTEMS

Authors	**Context** / **Theory or Model**	**Source of Data**	**Independent Factors**	**Analysis Method**	**Major Results**
Brazel (2005)	ERP measurement scales based on USA audit firms / TPB	The multiple-item scale developed in this study was assessed with 73 practicing audit seniors from four international and two national public accounting firms.	Training (ERPTRAIN), Experience (ERPEXP), Time (ERPTIME), began career (ERPBEGAN), higher level of expertise (ERPEXPERT), audit experience (AUDEXP)	Exploratory factor analysis	Factor analysis results indicate that all five items satisfactorily load on one factor. The results also suggest that auditors' perceptions of ERP systems expertise are not simply a by-product of general audit experience (AUDEXP).
Kwahk and Lee (2008)	The role of readiness for change in ERP implementation / TPB and TAM	Surveyed 283 ERP users from 72 organizations in Korea.	Readiness for change (RFC), Perceived ease of use (PEU), Perceived usefulness (PUS), Organizational commitment (OCM), Perceived personal competence (PPC), Computer self-efficacy (CSE)	LISREL	The study found that readiness for change had an indirect effect on behavioural intention to use an ERP system. At the same time, readiness for change was found to be enhanced by two factors: organizational commitment and perceived personal competence.

Lee, Lee, Olson and Chung (2010)	Effect of organizational support on ERP implementation TAM	Surveyed 700 users of SME’s in Korea	PEOU, PU and organizational support	Structural equation modeling (SEM)	The results indicate that the organizational support is an important factor for perceived usefulness (PU) and perceived ease of use (PEOU). PU and PEOU seem to lead to a higher level of interest in the ERP system and BI to use the system.
Amoako-Gyampah and Salam (2004)	An extension of the technology acceptance model in an ERP implementation environment TAM	Field survey in a large global organization that has implement SAP.	ERP project communication, ERP training, Belief in the benefits of ERP project, Attitude towards ERP system, Perceived usefulness and Ease of use	SEM	This study found 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.
Youngberga, Olsenb and Hauserb (2009)	Professionally autonomous end user acceptance in an enterprise resource planning system	Surveyed 66 professionally autonomous end users in USA.	Perceived ease of use, result demonstrability, subjective norm, perceived usefulness, image,	LISREL	The results of this study empirically support most of the constructs of the extended technology acceptance model,

	TAM2		job relevance, output quality,		TAM2. The constructs that significantly influenced participants' perceptions of system usefulness were (a) job relevance, (b) output quality, and (c) perceived ease of use.
Hart and Porter (2004)	The impact of cognitive and other factors on the perceived usefulness of On-line analytical processing ERP system TAM2	Surveyed 65 companies in South Africa licensed to use an industry top-ranked On-line analytical processing product.	Perceived ease of use, result demonstrability, output quality and job relevance.	Correlation and Regression analysis.	Found that the factors perceived ease of use, result demonstrability, output quality, and job relevance are positively associated to the dependent factor and perceived usefulness.
Alshare and Lane (2011)	Predicting Student-Perceived Learning Outcomes and Satisfaction in ERP Courses: An Empirical Investigation UTAUT	Convenience sample of 102 students enrolled in ERP courses	Student attitude, performance expectancy, effort expectancy, training (hands-on), course structure, and perceived instructor knowledge	LISREL	The results showed that student attitude had the largest significant direct impact on student-perceived learning outcomes and satisfaction. Effort expectancy and performance expectancy had significant direct

					impacts on attitude. Course structure and training (hands-on) had indirect effects on attitude through effort expectancy and performance expectancy.
Adam *et al*. (2011)	Adoption of enterprise resource planning (ERP) systems by small enterprises in South Africa. UTAUT	Literature study, surveyed 16 small manufacturing enterprises and interviewed 2 ERP system consultants.	Performance expectancy, effort expectancy, social influence and facilitating conditions	Textual analysis and descriptive data analysis	All four determinates of UTAUT affected theadoption of ERP systems.
Bandyopadhyay and Barnes (2012)	User Acceptance of ERP Systems in the United States UTAUT	A national survey was conducted with ERP users from any industry. A total of 502 usable responses were obtained from the national survey.	Social Influence (SI), Effort Expectancy (EE) and Social Influence (SI)	SEM	All three (performance expectancy, effort expectancy, and social influence) determinants of acceptance of the ERP system were found to influence the acceptance of ERP systems by users in the United States.
Keong, Ramayah, Kurnia and Chiun	Explaining intention to use an enterprise resource	Used from literature	Performance expectancy, Effort expectancy, Social influence,	Literature review	The findings show that shared beliefs, project communication and

(2012)	planning (ERP) system UTAUT		Facilitating conditions, Shared beliefs, Training and Project communication		training can be used to offer intervention measures to help in the adoption and usage of ERP.
Fillion, Braham, and Ekionea (2010)	Testing UTAUT on the use of ERP systems by middle managers and end-users of medium- to large-sized Canadian enterprises UTAUT	Surveyed six medium- to large sized Canadian enterprises yielding 126 usable responses	Performance expectancy, effort expectancy, social influence , Facilitating Conditions Self-efficacy and Anxiety	SEM	The results highlight the key role of three independent variables (facilitating conditions, anxiety, and behavioral intention) and a moderator variable (age) of UTAUT model as influencing factors on the use of ERP systems in medium- to large-sized Canadian enterprises.
Bradford and Florin (2003)	Enterprise resource planning (ERP) implementation success. IDT	A survey on members of America's SAP User Group (ASUG)	Technical compatibility, perceived complexity, business process reengineering, top management support, organizational objectives consensus, training and competitive pressure.	Stepwise linear regression models	Top management support and training are positively related to user satisfaction. Perceived complexity of ERP and competitive pressure show a negative relationship.