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# The Unified Theory of Acceptance and Use of Technology (UTAUT): A Literature Review

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**Abstract**

**Purpose** – The purpose of this paper is to perform a systematic review of articles that have used the unified theory of acceptance and use of technology (UTAUT).

**Design/methodology/approach**: The results produced in this research are based on the literature analysis of 174 existing articles on the UTAUT model. This has been performed by collecting data including demographic details, methodological details, limitations, and significance of relationships between the constructs from the available articles based on the UTAUT.

**Findings**: The findings were categorised by dividing the articles that used the UTAUT model into types of information systems used, research approach and methods employed, and tools and techniques implemented to analyse results. We also perform the weight analysis of variables and found that *performance expectancy* and *behavioural intention* qualified for the best predictor category. The research also analysed and presented the limitations of existing studies.

**Research limitations/implications**: The search activities were centered on occurrences of keywords to avoid tracing a large number of publications where these keywords might have been used as casual words in the main text. However, we acknowledge that there may be a number of studies, which lack keywords in the title, but still focus upon UTAUT in some form.

**Originality/value**: This is the first research of its type, which has extensively examined the literature on the UTAUT and provided the researchers with the accumulative knowledge about the model.

**Keywords**: UTAUT, Systematic review, Weight analysis, External variables, Demographic details, Methodological analysis

**Paper type** Research paper

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## 1. Introduction

The continuing quest to ensure user acceptance of technology is an ongoing management challenge (Schwarz and Chin, 2007), and one that has occupied IS/IT researchers to such an extent that technology adoption and diffusion research is now considered to be among the more mature areas of exploration (Venkatesh *et al.*, 2003). This substantial level of activity has witnessed the use of a wide range of exploratory techniques examining many different systems and technologies in countless different contexts, to the extent that even the most cursory examination of the extant body of literature will reveal a variety of stakeholder perspectives, technologies and contexts, units of analysis, theories, and research methods (Williams *et al.*, 2009). This situation has in turn led to an element of confusion among researchers, as they are often forced to *pick and choose* characteristics across a wide variety of often competing models and theories. In response to this confusion, and in order to harmonize the literature associated with acceptance of new technology, Venkatesh *et al.* (2003) developed a unified model that brings together alternative views on user and innovation acceptance – The Unified Theory of Acceptance and Use of Technology (UTAUT).

The UTAUT (Figure 1) suggests that four core constructs (performance expectancy, effort expectancy, social influence and facilitating conditions) are direct determinants of behavioural intention and ultimately behaviour, and that these constructs are in turn moderated by gender, age, experience, and voluntariness of use (Venkatesh *et al.*, 2003). It is argued that by examining the presence of each of these constructs in a 'real world' environment, researchers and practitioners will be able to asses an individual's intention to use a specific system, thus allowing for the identification of the key influences on acceptance in any given context. The theory was developed through the review and integration of eight dominant theories and models, *viz*: the Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM), the Motivational Model (MM), the Theory of Planned Behaviour (TPB), a combined Theory of Planned Behaviour/Technology Acceptance Model (C-TPB-TAM), the Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT), and Social Cognitive Theory (SCT). These contributing theories and models have all been widely and successfully utilised by a large number of previous studies of technology or innovation adoption and diffusion within a range of disciplines including information systems, marketing, social psychology, and management. In their original article, Venkatesh *et al.* (2003) presented results from a six-month study of four organisations, which revealed that the eight contributing models explained between 17 and 53 percent of variance in user intentions to use IT. However, UTAUT was found to outperform the eight individual models with an adjusted $R^2$ of 69% (Venkatesh *et al.*, 2003).
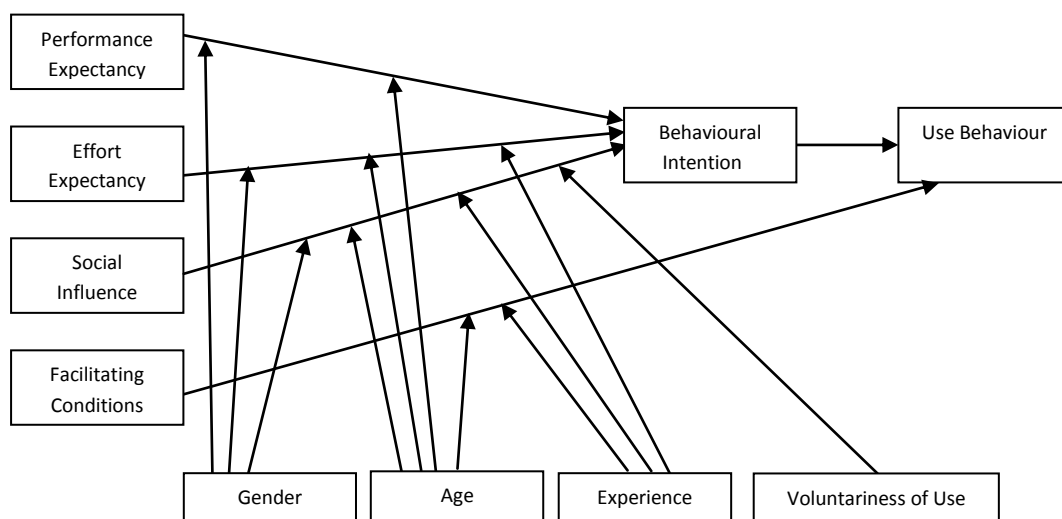
Fig. 1. Unified Theory of Acceptance and Use of Technology (Source: Venkatesh *et al.*, 2003)

In the years since its introduction, UTAUT has been widely employed in technology adoption and diffusion research as a theoretical lens by researchers conducting empirical studies of user intention and behaviour. At the time of writing, the original article Venkatesh *et al.* (2003) has been cited just under 5000 times, with UTAUT being discussed with reference to a range of technologies (including the Internet, Web sites, Hospital Information Systems, Tax Payment Systems and Mobile Technology among others) with different control factors (such as age, gender, experience, voluntariness to use, income, and education), and focusing upon a variety of user groups (for instance, students, professionals, and general users).

However, despite this evident impact, no study to date has either surveyed or reviewed the performance of UTAUT, or explored/assessed the findings, limitations, and potential future directions. In keeping with other review work such as that of Lee *et al.* (2003), such a study is likely to be of value in that it can assist researchers of acceptance and use understand prior UTAUT-related findings, recognize possible future research topics, and guide future research endeavours. The aim of this study therefore is to provide such a review.

The remainder of this paper is structured as follows: In the following section we describe the methodology employed, and follow this with a section presenting our findings based upon an analysis of the material along a series of dimensions - including demographic aspects, types of technology examined, methodological considerations, and an analysis of UTAUT and external constructs employed in various studies. We present a summary of the limitations of extant UTAUT studies, and finally we present our concluding remarks and suggestions for future research directions.

## 2. Research Methodology

This study examines UTAUT research conducted from 2004 to June 2011. A comprehensive electronic search using *ISI Web of Knowledge* and *Google Scholar* resulted in 174 usable research papers. We used the keywords such as "unified theory of acceptance and use of technology" or "UTAUT" to perform the overall search in the title and/or abstract of the articles. The studies, although being scattered across 134 journals and conferences, appeared more frequently in journals such as *Computers in Human Behaviour*, *Computers & Education*, *Communications of the Association for Information Systems*, *Decision Support Systems, Expert Systems with Applications*, *Government Information Quarterly*, *Information & Management*, *International Journal of Electronic Government Research*, and *MIS Quarterly*. Conference proceedings regularly including UTAUT material included the *Americas Conference of Information Systems*, the *European Conference of Information Systems*, the *Hawaii International Conference on System Sciences*, and the *Southern Association for Information Systems Conference*. The keywords associated with these 174 articles were noted, and in keeping with the works of Lee *et al.* (2003) and Legris *et al.*

(2003) in their comparable studies works examining the use of TAM, the articles were analysed in terms of a series of characteristics including types of relationships found between model constructs, external variables, limitations of studies, and methodological details.

## 3. Research Findings

Many different researchers with different research intentions and subjects of focus have conducted UTAUT studies by applying a variety of research methodologies in different environments. This diverse body of work has seen numerous new constructs being incorporated into the original theory, with UTAUT being blended with other theoretical models, and on occasion, a re-specification of the underlying relationships between UTAUT variables. These research papers were published in journals and conferences in diverse streams of study, and in line with the findings of Lee *et al.* (2003) in their study of TAM, were seen to have drawn the attention of both researchers and practitioners. This section presents an analysis of these UTAUT studies by examining a number of variables including most productive authors, universities/institutions and authors, most productive departments, university affiliation according to country, sources of primary data by country, authors' academic backgrounds, publications frequency, number of authors, publication outlets for UTAUT researchers, keyword analysis, types of systems examined, research subjects, relationships between major UTAUT variables, weight analysis, relationship of external variables with UTAUT constructs, and most frequently used external variables.

### 3.1 Demographic Characteristics

*3.1.1 Most Productive Authors*

Our analysis of the most prolific authors revealed that 494 authors contributed to the 174 UTAUT studies. Table 1 illustrates the 11 authors who have published three or more papers. These authors published a total of 23 of the 174 research papers, and thus there currently appears to be no dominant group of authors as such. This result is quite different to that obtained by Lee *et al.* (2003) in their study of TAM, where almost 50% of research papers considered were provided by a group of 11 authors. This clearly indicates that studies on UTAUT are not yet dominated by any group of highly productive individuals, publications currently being scattered across a large number of authors each contributing fewer articles.

Table 1
Most Productive Authors

| Prolific Authors | University | # of Articles |
|---|---|---|
| Gang Liu | Renmin University of China | 4 |
| Susan A. Brown | University of Arizona | 4 |
| Vishanth Weerakkody | Brunel University | 4 |
| Yaobin Lu | Huazhong University of Science and Technology | 4 |
| Viswanath Venkatesh | University of Arkansas | 4 |
| Bram Pynoo | Ghent University | 4 |
| Cheng Qian | Renmin University of China | 3 |
| Dehua He | Huazhong University of Science and Technology | 3 |
| Dong Cheng | Renmin University of China | 3 |
| Paul H.P. Yeow | Multimedia University | 3 |
| Shafi Al-Shafi | Brunel University | 3 |

*3.1.2 Contributing Universities/Institutions and Authors*

Table 2 illustrates 18 universities/institutions associated with the highest combinations of numbers of papers published and associated non-adjusted counts of contributing authors/co-authors. Renmin University in China appears at the top of this list, with five published outputs and a non-adjusted author count of 16. This corresponds with Table 1, which includes three individuals from Renmin University in the list of most productive authors. Ghent University appears in second place, with four publications and a non-adjusted author count of 25, the high author count in this case arising from a single paper with seven authors and three more with six authors each. Surprisingly, U.S Universities (including the University of Arkansas, the University of Nevada, and the University of Georgia) appear relatively low on this list (in comparison with other reviews of research) in terms of the number of papers produced.

Table 2
Publications by University/Institution

| University/Institution | # of Papers | Author Count (Non-adjusted) |
|---|---|---|
| Renmin University of China | 5 | 16 |
| Ghent University | 4 | 25 |
| Brunel University | 4 | 11 |
| Multimedia University | 4 | 8 |
| Huazhong University of Science and Technology | 4 | 6 |
| National Changhua University of Education | 4 | 5 |
| University of St. Gallen | 3 | 9 |
| University of Cape Town | 3 | 5 |
| University of Macedonia | 3 | 5 |
| National Chung Cheng University | 2 | 7 |
| Korea Advance Institute of Science and Technology | 2 | 6 |
| University of Nevada | 2 | 6 |
| University of North Texas | 2 | 6 |
| University of Arkansas | 2 | 5 |
| University of Twente | 2 | 5 |
| University of Georgia | 1 | 7 |
| Chinese Academy of Sciences | 1 | 6 |
| University of Technology Sydney | 1 | 5 |

*3.1.3 Most Productive Departments*

Table 3 illustrates the home departments of the authors or co-authors who have contributed to publishing papers on UTAUT. By far the majority of authors belonged to departments related to the business, management, information systems and technology fields, whereas a far smaller group belonged to departments including journalism and mass communication, and radiology and medical imaging. These departments (Table 3) accounted for 145 of the total of 328 contributing departments.

Table 3
Most Productive Departments

| Department/School | # |
|---|---|
| Department of Information Management / Systems | 57 |
| School /college of Business / Management / Business School | 55 |
| Department of Radiology / Medical Imaging | 15 |
| Faculty of Psychology and Educational Sciences | 7 |

| College of Journalism and Mass Communication | 7 |
| Department of Telecommunication, Information Studies and Media | 4 |

*3.1.4 University Affiliation According to Country*

Table 4 presents the 20 countries whose universities contributed the most UTAUT research publications. Of a total of 494 occurrences from 36 distinct countries, and 219 unique universities, the highest proportion of work was produced from universities in the USA (#140, 28%), followed by some way behind by Taiwan (#46), China (#43), the UK (#38), Belgium (#28), Malaysia (#26), and Australia (#21). The low ranking of USA-based universities in Table 2 and their top ranking in Table 4 is explained by the diffusion of UTAUT research across a large number of institutions in the USA, each producing a comparatively low number of publications. Universities in numerous countries contributed three or fewer studies, including Cyprus, Ethiopia, Hong Kong, Peru, Saudi Arabia, and Tanzania, which contributed one study each - these are not listed in Table 4 due to space limitations.

Table 4

University Affiliation According to Country

| Researchers' Originating Country | # | Researchers' Originating Country | # |
| --- | --- | --- | --- |
| USA | 140 | Greece | 13 |
| Taiwan | 46 | South Korea | 10 |
| China | 43 | Italy | 9 |
| UK | 39 | South Africa | 9 |
| Belgium | 28 | Canada | 7 |
| Malaysia | 26 | Switzerland | 7 |
| Australia | 21 | Sweden | 6 |
| Netherlands | 18 | Singapore | 4 |
| Germany | 16 | Slovenia | 4 |
| Finland | 16 | Uganda | 4 |

*3.1.5 Sources of Primary Data by Country*

Our findings (Table 5) reveal that published UTAUT research has been based on primary data captured in 41 countries. By far the most popular source of primary data has been the USA (#45), followed some way behind by China (#19), Taiwan (#17), and then Malaysia (#10), Australia (#8), India (#6), Belgium (#5), and Saudi Arabia (#5). Countries such as Hong Kong, Italy, Peru, Sweden, Tanzania, Thailand, and the UK were used only twice to collect primary data, and a large number of countries - including Austria, Bangladesh, Cyprus, Denmark, Ethiopia, Indonesia, Kuwait, Lithuania, Pakistan, Philippines, Portugal, Romania, Slovenia, South Korea, Sri Lanka, Switzerland, and Uganda - were each used only once to collect such data.

Table 5

Most Used Countries for Primary Data Collection

| Country | # | Country | # |
| --- | --- | --- | --- |
| USA | 45 | Germany | 4 |
| China | 19 | Canada | 3 |
| Taiwan | 17 | Greece | 3 |
| Malaysia | 10 | Jordan | 3 |
| Australia | 8 | Netherlands | 3 |
| India | 6 | Qatar | 3 |

| Belgium | 5 | Singapore | 3 |
|---|---|---|---|
| Saudi Arabia | 5 | South Africa | 3 |
| Finland | 5 | Total | 145 |

### 3.1.6 Authors' Academic Backgrounds

In order to examine the academic background of the authors, their associated organisations were divided into three major divisions; academics, public sector, and industry. The findings suggest a summary of the results - unsurprisingly 98% (#484) of authors had an academic background, whereas only four belonged to the public sector, and six were from industry.

### 3.1.7 Frequency of Publication

This analysis displays the number of publications of UTAUT work appearing between 2004 and June 2011. The findings indicate that the number of publications has generally increased year upon year since the appearance of the original article such as four articles each in 2004 and 2005, nine articles in 2006, 16 articles 2007, 35 articles in 2008, 46 articles in 2009, and the highest 48 articles in 2010, with a significant increase in numbers since 2008 and before a complete trend for the further years was analysed. We suggest that this upward trend will continue and future years will see a further increase in the number of UTAUT-related papers published.

### 3.1.8 Number of Authors

The findings on the number of authors reveal the frequency of UTAUT research publications being authored and co-authored by between one and seven authors. Two authors created the largest 61 research papers, whereas two papers were published by a group of seven authors. Moreover, 16 articles were single authored, three authors authored 54 articles, four authors authored 28 articles, five authors authored five articles, and six authors authored eight articles.

### 3.1.9 Publication Outlets for UTAUT Researchers

Table 6 illustrates 20 outlets that have each published two or more UTAUT research papers. Numerous conferences have published UTAUT-research, including the Americas Conference of Information Systems (#6), the European Conference of Information Systems (#5), the IEEE Conference (#4), and the Hawaii International Conference on System Sciences (#4) among others. Similarly, a series of high-ranking internationally recognized journals including Expert Systems with Applications (#3), Government Information Quarterly (#3), Information & Management (#3), and MIS Quarterly (#3) also appear in Table 6, indicating their willingness to accept and publish UTAUT-based research. In addition to the conferences and journals appearing in Table 6, a further 111 outlets each published one paper. This suggest that the publishing landscape for UTAUT researchers is currently quite diverse and widespread, and this is quite unlike the findings of Lee *et al.* (2003) in their study of TAM which found TAM outputs to be concentrated across a relatively small number of journals such as MIS Quarterly, Information & Management, Information Systems Research, and the Journal of Management Information Systems among others.

Table 6

Publishers of UTAUT Research Articles

| Journal / Conference Name | # |
|---|---|
| Americas Conference on Information Systems | 6 |
| European Conference on Information Systems | 5 |
| Computers in Human Behavior | 4 |
| Computers & Education | 4 |
| IEEE Conference | 4 |
| Hawaii International Conference on System Sciences | 4 |
| Communications of the Association for Information Systems | 3 |
| Expert Systems with Applications | 3 |
| Government Information Quarterly | 3 |
| Information & Management | 3 |
| International Journal of Electronic Government Research | 3 |
| MIS Quarterly | 3 |
| Decision Support Systems | 2 |
| Communications of the IBIMA | 2 |
| DIGIT 2009 | 2 |
| International Journal of Accounting Information Systems | 2 |
| International Journal of Medical Informatics | 2 |
| Southern Association for Information Systems Conference | 2 |
| WEBIST | 2 |
| European Journal of Information Systems | 2 |

## 3.2 IS Research Topics and Types of Systems Examined

### 3.2.1 Keyword Analysis

Table 7 lists the 30 most frequently used keywords (each occurring three or more times across 174 studies) in UTAUT research. These keywords account for 272 of the overall total of 739 keyword occurrences of the 450 unique keywords identified. As expected, "Unified Theory of Acceptance and Use of Technology"/"UTAUT" (#79) appeared most often, followed by "Technology Acceptance" (#27), "Technology Acceptance Model" (#20), "Adoption" (#13), "Technology Adoption" (#13), "E-Government" (#11), "User Acceptance" (#11), and "Trust" (#9) as some of the other more frequently utilized keywords. In addition, various constructs of UTAUT such as "performance expectancy", "effort expectancy", and "social influence" were also among the keywords appearing three or more times. The regular appearance of certain words and terms such as "acceptance", "adoption", "Internet banking", "end user", "electronic government", "electronic commerce" and "mobile commerce", "structural equation modelling" and "partial least squares" gives the suggestion that many UTAUT studies are focused on investigating the acceptance, adoption, and use of technology in various forms of banking, government services and commerce, and are employing widely utilized analysis methods such as SEM and PLS. However, a large body of keywords (#418) appear once (#369) or twice (#49), and these aspects are worthy of further exploration.

Table 7

Most Frequently Used Keywords (Approach from Dwivedi et al., 2008)

| Keywords | # | Keywords | # |
|---|---|---|---|
| Unified Theory of Acceptance and Use of Technology | 79 | Acceptance | 4 |
| Technology Acceptance | 27 | Performance Expectancy | 4 |
| Technology Acceptance Model | 20 | Saudi Arabia | 4 |
| Adoption | 13 | Structural Equation Modelling | 4 |
| Technology Adoption | 13 | M-Commerce | 4 |

| E-Government | 11 | E-Commerce | 3 |
|---|---|---|---|
| User Acceptance | 11 | Ease of Use | 3 |
| Trust | 9 | Effort Expectancy | 3 |
| Internet Banking | 7 | Evaluation | 3 |
| E-Learning | 6 | Gender | 3 |
| Intention To Use | 6 | Information Systems | 3 |
| Developing Countries | 5 | Information Technology | 3 |
| Partial Least Squares | 5 | End User | 3 |
| Perceived Risk | 5 | Mobile Business | 3 |
| Social Influence | 5 | Usability | 3 |

*3.2.2 Systems Examined*

Over 98 different types of system were examined in the articles under analysis, being classified into the same four categories originally defined by Lee *et al.* (2003) in their review of TAM research: communication systems (25), general-purpose systems (90), office systems (11), and specialized business systems (48). General purpose systems were most frequently examined, and office systems the least. As per the work of Lee *et al.* (2003), general-purpose systems include Windows, personal computers, microcomputers, workstations, the Internet, and other general-purpose computer facilities. Communication systems included mobile-based technology, kiosk systems, automated feedback systems, instant messaging, and other systems primarily used for communications. Mobile technology was the most widely examined technology for communication systems. Office systems include applications that are commonly found in the office environment (such as desktop applications, database and query systems), whereas specialized systems included systems such as e-procurement systems, ERP systems, and e-voting systems. Table 8 presents details of systems included within each category along with the associated publications.

Table 8
Systems Used in UTAUT Studies (Approach from Lee *et al.*, 2003)

| Type | # of IS | ISs for Each Category | Associated Publication(s) |
|---|---|---|---|
| Communication Systems | 25 (14%) | Mobile Banking (4) | Barati and Mohammadi (2009), de Silva and Ratnadiwakara (2009), Luo et al. (2010), Zhou et al. (2010) |
| | | Robot System (2) | BenMessaoud et al. (2011), Heerink et al. (2009) |
| | | Mobile Podcasting (1) | Ho and Chou (2009) |
| | | M-Coupon System (1) | Jayasingh and Eze (2009) |
| | | Information Kiosk (2) | Johari et al. (2010), Wang and Shih (2009) |
| | | Mobile Internet Application (1) | Kourouthanassis et al. (2010) |
| | | Instant Messaging (1) | Lin et al. (2004) |
| | | Mobile Commerce (2) | Qingfei et al. (2008), Tan and Wu (2010) |
| | | Mobile Technology (2) | Park et al. (2007), Song and Han (2009) |
| | | Mobile Phone/Internet (3) | van Biljon and Kotze (2008), van Biljon and Renaud (2008), Wang et al. (2010) |
| | | Mobile Shopping Services (1) | Yang (2010) |
| | | Mobile Advertising (1) | He and Lu (2007) |
| | | 3G Mobile Communication (2) | Wu et al. (2007), Wu et al. (2008) |
| | | Digital Television (1) | Sapio et al. (2010) |
| | | Automated Feedback System (1) | Debuse et al. (2008) |
| General Purpose | 90 | Internet/Online Banking (10) | AbuShanab et al. (2010), AbuShanab |

| Systems | (52%) | | and Pearson (2007), Abu-Shanab and Pearson (2009), Al-Somali et al. (2009), Cheng et al. (2008a), Cheng et al. (2008b), Cheng et al. (2008c), Liu et al. (2008), YenYuen and Yeow (2009), Yeow et al. (2008) |
|---------|-------|---|---|
| | | Information System/Technology (14) | Al-Gahtani et al. (2007), Al-Rajhi et al. (2010), Bandyopadhyay and Bandyopadhyay (2010), Brown and Venkatesh (2005), Dadayan and Ferro (2005), Diaz and Loraas (2010), Laumer et al. (2010), Neufeld et al. (2007), Pahnila et al. (2011), Schaper and Pervan (2006), Sharma and Citurs (2004), Suhendra et al. (2009), Teo (2011), Venkatesh et al. (2008) |
| | | E-Government Services (9) | Al-Shafi and Weerakkody (2009), Al-Shafi and Weerakkody (2010), Al-Sobhi et al. (2011), AlAwadhi and Morris (2011), Chan et al. (2010), Hung et al. (2007), Sahu and Gupta (2007), Suki and Ramayah (2010), Weerakkody et al. (2009) |
| | | E-Filing System (3) | Ambali (2009), Carter and Schaupp (2009), Schaupp et al. (2010) |
| | | Tablet PCs (1) | Anderson et al. (2006) |
| | | Internet/Intranet Technology (6) | Barnes and Vidgen (2009), Dasgupta and Gupta (2010), Foon and Fah (2011), Huang et al. (2010), Niehaves and Plattfaut (2010), van Dijk et al. (2008) |
| | | E-Quality (2) | Cody-Allen and Kishore (2006), Samoutis et al. (2008) |
| | | ICT (5) | Cornacchia et al. (2008), Gupta et al. (2008), Im et al. (2008), Schaper and Pervan (2004), Verhoeven et al. (2010) |
| | | E-Readiness (1) | Dada (2006) |
| | | Knowledge Management System (3) | He and Wei (2009), Jalaldeen et al. (2009), Li (2010) |
| | | Security Information System (1) | Johnston and Warkentin (2010) |
| | | Web-based Virtual M-Learning System (8) | Chiu and Wang (2008), Jong and Wang (2009), Keller et al. (2007), Nistor et al. (2010), Sumak et al. (2010), Tsai et al. (2009), van Raaij and Schepers (2008), Wang et al. (2009) |
| | | Software Technologies (1) | Koh et al. (2010) |
| | | Podcasting (1) | Lee and Lin (2008) |
| | | Activity Based Costing (1) | Lee et al. (2010a) |
| | | Smart Products (1) | Mayer et al. (2011) |
| | | Wi-Fi System (1) | Udeh (2008) |
| | | E-Commerce/Mobile Commerce (2) | Uzoka (2008), Zhou (2008) |
| | | World Wide Web (1) | Pavon and Brown (2010) |
| | | Web 2.0 (1) | Payne (2008) |
| | | Educational Technology System (1) | Wu et al. (2010) |
| | | Location-Based Services (1) | Xu and Gupta (2009) |
| | | Collaboration Technology (1) | Brown et al. (2010) |
| | | E-Health Services/Health IS (2) | Chiu and Eysenbach (2010), Fitterer et al. (2010) |
| | | Social Media (1) | Curtis et al. (2010) |
| | | Open Access (1) | Dulle and Minishi-Majanja (2011) |

| | | Mobile Business (2) | He and Lu (2008), He et al. (2007) |
|---|---|---|---|
| | | Mobile Services (2) | Carlsson et al. (2006), Koivumaki et al. (2008) |
| | | Educational Portal (2) | Maldonado et al. (2009), Maldonado et al. (2011) |
| | | Web-Based Technology (1) | Or et al. (2011) |
| | | Digital Learning (1) | Pynoo et al. (2011) |
| | | Cross-Cultural Information Retrieval (1) | Taksa and Flomenbaum (2009) |
| | | Problem Solving Models (1) | Richardson et al. (2009) |
| | | Websites (1) | van Schaik (2009) |
| Office Systems | 11(6%) | Accounting Information System (1) | Aoun et al. (2010) |
| | | Computer-Assisted Audit Techniques (2) | Curtis and Payne (2008), Mahzan and Lymer (2008) |
| | | Remote Desktop Application (1) | Hutchison and Bekkering (2009) |
| | | Reference Databases (1) | Avdic and Eklund (2010) |
| | | Decision Making Trial and Evaluation (1) | Lee et al. (2010b) |
| | | Computer Graphics Technology (1) | Shamsuddin (2009) |
| | | Peer-to-Peer Academic Networks (1) | Tavares and Amarel (2010) |
| | | Computer Based Assessment Model (1) | Terzis and Economides (2011) |
| | | EHR Query System (1) | Huser et al. (2010) |
| | | Software Cost Estimation (1) | Yang et al. (2008) |
| Specialized Business Systems | 48 (28%) | Biometrics Authentication System (1) | Al-Harby et al. (2010) |
| | | Medical Teleconferencing Application (1) | Biemans et al. (2005) |
| | | iBrainz Technology (1) | Butler and Richardson (2008) |
| | | Water Treatment Technology (1) | Cabral et al. (2009) |
| | | Weblog Technology (2) | Chen et al. (2008), Li and Kishore (2006) |
| | | Medical Support System (1) | Coss (2009) |
| | | Micro Blogging (1) | Gunther et al. (2009) |
| | | Electronic HRM (1) | Heikkila and Smale (2010) |
| | | Electronic Medical Record System (4) | Chisolm et al. (2010), Hennington et al. (2009), Trimmer et al. (2008), Wills et al. (2008) |
| | | Telemedicine (1) | Hailemariam et al. (2010) |
| | | Hybrid Media Application (1) | Louho et al. (2006) |
| | | Motes (1) | Lubrin et al. (2006) |
| | | Course Management Software (1) | Marchewka et al. (2007) |
| | | Tax Software System (2) | McLeod et al. (2009a, 2009b) |
| | | Enterprise Mashup System (1) | Pahlke and Beck (2009) |
| | | Personal Health Record System (1) | Randeree (2009) |
| | | E-Ordering Application (1) | Reunis and Santema (2005) |
| | | Electronic Procurement System (2) | Benslimane et al. (2004), Sambasivan et al. (2010) |
| | | Enterprise Resource Planning Systems (1) | Seymour et al. (2007) |
| | | Hybrid/Digital Library (2) | Nov and Ye (2009), Tibenderana et al. (2010) |
| | | Picture Archiving and Communication System (3) | Duyck et al. (2008), Duyck et al. (2010), Pynoo et al. (2008) |
| | | ATM and Transit Application (1) | Yeow and Loo (2009) |
| | | ERP System (1) | Huang and Wang (2009) |
| | | Customer Relationship Management (CRM) Systems (1) | Pai and Tu (2011) |
| | | Audience Counts and Reporting System (1) | Pappas and Volk (2007) |
| | | Smart Phone Online Application (1) | Shi (2009) |
| | | MVNO Services (1) | Shin (2010) |
| | | Telehospice (1) | Whitten et al. (2009) |
| | | Remote Electronic Voting Systems (1) | Yao and Murphy (2007) |

| | | Hospital Information System (1) | Aggelidis and Chatzoglou (2009) |
| Speech Recognition System (1) | Alapetite et al. (2009) |
| Clinical Decision Support System (1) | Chang et al. (2007) |
| Online Auctions (1) | Chiu et al. (2010) |
| Health Information Technology (1) | Kijsanayotin et al. (2009) |
| Mobile Wallet (1) | Shin (2009) |
| Forecasting Support System (1) | Lee et al. (2007) |
| Smartcard Application (1) | Loo et al. (2009) |
| Human Computer Interaction Tool (1) | Oshlyansky et al. (2007) |
| Recommender System (1) | van Setten et al. (2006) |

## 3.3 Methodological Analysis

### 3.3.1 Research Methodology Used

Our findings (see Table 9) revealed that only 18 out of 174 studies were longitudinal in nature, the majority of studies (#135) using a cross-sectional approach. As far as research methodologies were concerned, survey instrument (#155) was most commonly used, followed some way behind by a collection of lesser-used techniques including interview (#12), case study (#4), field study (#3), laboratory experiment (#3), and literature study (#1). Field study (#3) is currently one of the least used methodologies in our research, unlike Lee *et al.*'s (2003) examination of TAM research in which field study was seen to be the most common methodology.

Table 9
Research Methodologies (Approach from Lee et al., 2003)

| Methodology | Details | Example Reference(s) |
|---|---|---|
| Research Approach | Longitudinal (18) | Brown and Venkatesh (2005), Heerink et al. (2009) |
| | Cross-Sectional (135) | Al-Somali et al. (2009), Johnston and Warkentin (2010) |
| | Exploratory Study (21) | Al-Rajhi et al. (2010), Cody-Allen and Kishore (2006) |
| Methodology | Survey (155) | Kourouthanassis et al. (2010), Venkatesh et al. (2008) |
| | Interview (12) | Heikkila and Smale (2010), Li (2010) |
| | Case Study (4) | Samoutis et al. (2008), Trimmer et al. (2008) |
| | Field Study (3) | Brown et al. (2010), Chen et al. (2008) |
| | Laboratory Experiment (3) | Al-Harby et al. (2010), Lee et al. (2007) |
| | Literature Study (1) | He and Lu (2007b) |
| Analysis Method | Structural Equation Modelling (45) | Laumer et al. (2010), Wang et al. (2010) |
| | Regression Analysis (42) | Sapio et al. (2010), van Dijk et al. (2008) |
| | PLS Analysis (27) | Koh et al. (2010), Lin et al. (2004) |
| | Confirmatory Factor Analysis (15) | Wu et al. (2010), Xu and Gupta (2009) |
| | Factor Analysis (13) | Curtis et al. (2010), Fitterer et al. (2010) |
| | ANOVA (12) | Cornacchia et al. (2008), Shamsuddin (2009) |
| | Correlation Analysis (6) | Cornacchia et al. (2008), Heerink et al. (2009) |
| | Cluster Analysis (1) | Benslimane et al. (2004) |
| | Content Analysis (1) | BenMessaoud et al. (2011) |
| | Descriptive Analysis (1) | Huang and Wang (2009) |
| | ANCOVA (1) | van Schaik (2009) |
| | OLS (1) | Ambali (2009) |

| | AVE Analysis (1) | Yao and Murphy (2007) |
|---|---|---|
| | Invariance Analysis (1) | Li and Kishore (2006) |
| | Structural Model (1) | Chan et al. (2010) |
| | Path Analysis (1) | Suhendra et al. (2009) |
| | Secondary Analysis (1) | Or et al. (2011) |
| Analysis Tool | SPSS (30) | Jayasingh and Eze (2009), Pynoo et al. (2008) |
| | AMOS (12) | Schaupp et al. (2010), Shin (2010) |
| | LISREL (8) | Song and Han (2009), Zhou et al. (2010) |
| | PLS Graph 3.0 (7) | van Raaij and Schepers (2008), Wu et al. (2010) |
| | Smart PLS 2.0 (3) | Chan et al. (2010), Laumer et al. (2010) |
| | Build 1126 (1) | Brown et al. (2010) |
| | SAS (1) | Tsai et al. (2009) |
| | SQL (1) | Huser et al. (2010) |
| | Visual Basic 6.0 (1) | van Schaik (2009) |

Survey instruments were commonly used in different forms such as questionnaire survey, telephone survey, and online or Web-based survey. Much data analysis involved structural equation modelling (#45) using software such as AMOS (#12), PLS (#11), and LISREL (#8) or regression analysis (#42) using SPSS (#30). Currently, SPSS is the most commonly used data analysis tool, whereas Lee *et al.*'s (2003) study on TAM revealed the use of LISREL to be predominant.

### 3.3.2 Research Subjects

Table 10 illustrates that the UTAUT studies can be divided in four broad categories according to user type or alternative source of data, *viz*: general users, professionals, students, and literature studies. The studies of Brown *et al.* (2010), McLeod *et al.* (2009a), Tibenderana *et al.* (2010), and Zhou *et al.* (2010) used more than one user type for data collection, thus accounting for the total of 178 studies.

Table 10
Research Subjects (Approach from Lee et al., 2003)

| User Type | # of Studies | Example Studies |
|---|---|---|
| General Users | 63 | Johnston and Warkentin (2010), Park et al. (2007) |
| Professionals | 74 | Pai and Tu (2011), Pynoo et al. (2008) |
| Students | 40 | Maldonado et al. (2011), Tsai et al. (2009) |
| Literature Study | 1 | He and Lu (2007b) |

## 3.4 Internal Variable Analysis

### 3.4.1 Relationships between Major UTAUT Variables

UTAUT's six main variables are: Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Behavioural Intention (BI), and Usage Behaviour (UB), BI being both an independent and dependent variable. A total of 102 of the 174 studies were quantitative in nature and presented quantitative representations of the relationships between constructs. Of these 102 studies, 32 made use of UTAUT more than once in the same study due to different models, user types, or time span implementations resulting in a total of 159 different occurrences of the relationships between corresponding variables. As shown in Table 11, no single study was seen to support all UTAUT relationships (indeed, some studies did not examine all relationships, and yet others examined variations in the original relationships), but all UTAUT relationships are supported by at least one study. The results of this analysis are summarised in Table 11.

Table 11

Results of Examining Relationships (Approach from Legris et al., 2003)

| Study | PE-BI | EE-BI | SI-BI | FC-BI | FC-U | BI-U |
|---|---|---|---|---|---|---|
| AbuShanab and Pearson (2007) | Yes | Yes | Yes | x | x | x |
| AbuShanab *et al.* (2010) | Yes | Yes | Yes | x | x | x |
| Aggelidis and Chatzoglou (2009) | x | x | Yes | Yes | x | x |
| AlAwadhi and Morris (2011) | | | | | | |
|    T1- 4 Weeks | Yes[E] | Yes[E] | Yes | x | x | x |
|    T2- 3 Months | Yes | Yes | x | x | x | x |
|    T3- Future | Yes | Yes | x | x | x | x |
|    Impact on Use Behavior | x | x | x | x | Yes | Yes |
| Al-Gahtani *et al.* (2007) | | | | | | |
|    Model 1 - Without Moderating Variables | Yes | Yes | x | x | Yes | Yes |
|    Model 2 - With Moderating Variables | Yes[AE] | No[AE] | x | x | No[AE] | Yes[AE] |
| Al-Shafi and Weerakkody (2009) | Yes | Yes | Yes | x | x | x |
| Al-Shafi and Weerakkody (2010) | No | Yes | Yes | x | x | x |
| Al-Sobhi *et al.* (2011) | No | Yes | Yes | x | Yes | No |
| Ambali (2009) | x | x | x | x | Yes | x |
| Anderson *et al.* (2006) | | | | | | |
|    Model-1 | x | x | x | x | No | x |
|    Model-2 | x | x | x | x | No | x |
| Aoun *et al.* (2010) | Yes | Yes | No | x | Yes | Yes |
| Bandyopadhyay and Bandyopadhyay (2010) | | | | | | |
|    India | Yes[M] | Yes[M] | Yes[M] | x | x | x |
|    USA | Yes[M] | No[M] | Yes[M] | x | x | x |
| Barnes and Vidgen (2009) | x | x | Yes | x | x | Yes |
| Brown *et al.* (2010) | | | | | | |
|    Study 1 - Without Moderating Variable | No | No | No | x | Yes | Yes |
|    Study 1 - With Moderating Variable | Yes[AG] | Yes[AGE] | Yes[AGE] | Yes[AE] | Yes[AE] | x |
|    Study 2 - Without Moderating Variable | No | No | No | x | No | Yes |
|    Study 2 - With Moderating Variable | Yes[AG] | Yes[AGE] | Yes[AGE] | x | Yes[AE] | x |
| Butler and Richardson (2005) | Yes | Yes | x | x | x | x |
| Carlsson *et al.* (2006) | Yes | Yes | Yes | No | x | Yes |
| Carter and Schaupp (2009) | Yes | No | Yes | Yes | x | x |
| Chang *et al.* (2007) | Yes | Yes | Yes | x | Yes | Yes |
| Chen *et al.* (2008) | Yes | Yes | Yes | x | x | Yes |
| Cheng *et al.* (2008a) | Yes | No | Yes | x | x | x |
| Cheng *et al.* (2008b) | Yes | No | Yes | x | x | x |
| Cheng *et al.* (2008c) | Yes | No | Yes | x | x | x |
| Chiu *et al.* (2010) | Yes | No | Yes | Yes | x | Yes |
| Chiu and Wang (2008) | Yes | Yes | No | No | x | x |
| Cornacchia *et al.* (2008) | x | x | Yes | x | Yes | x |
| Dasgupta and Gupta (2010) | Yes[G] | Yes[G] | Yes[G] | x | Yes | No |
| Dulle and Minishi-Majanja (2011) | | | | | | |
|    Model 1 | Yes | Yes | No | x | x | x |
|    Model 2 | x | x | x | x | Yes | x |
| Duyck *et al.* (2008) | | | | | | |
|    UTAUT | Yes | Yes | No | Yes | x | x |
|    UTAUT+Attitude | No | No | No | Yes | x | x |
|    UTAUT+Self-Efficacy | Yes | No | No | Yes | x | x |
|    UTAUT+Anxiety | Yes | No | No | Yes | x | x |
| Duyck *et al.* (2010) | | | | | | |
|    T1-Pre-Implementation Model | Yes | Yes | No | Yes | x | x |
|    T2-After 1-Year | Yes | No | Yes | Yes | Yes | No |
|    Pooled | Yes | Yes | Yes | Yes | x | x |
| Foon and Fah (2011) | Yes | Yes | Yes | Yes | x | x |
| Gupta *et al.* (2008) | Yes[G] | Yes[G] | Yes[G] | x | Yes | No |

| | | | | | | |
|---|---|---|---|---|---|---|
| He and Lu (2007a) | | | | | | |
|   Model 1 | Yes | No | Yes | x | Yes | Yes |
|   Model 2 | No | No | Yes | x | Yes | Yes |
|   Model 3 | No | No | Yes | x | Yes | Yes |
| He and Wei (2009) | x | x | x | x | Yes | Yes |
| Hung *et al.* (2007) | Yes | Yes | Yes | x | Yes | Yes |
| Hutchison and Bekkering (2009) | No | No | No | No | x | x |
| Jayasingh and Eze (2009) | x | x | Yes | x | x | x |
| Johnston and Warkentin (2010) | x | x | Yes | x | x | x |
| Jong and Wang (2009) | Yes | x | Yes | Yes | x | Yes |
| Kijsanayotin *et al.* (2009) | Yes | Yes | Yes | x | Yes | Yes |
| Koh *et al.* (2010) | | | | | | |
|   Model 1 | Yes | x | Yes | x | x | No |
|   Model-2 | Yes | x | Yes | x | x | No |
| Kourouthanassis *et al.* (2010) | Yes | No | Yes | x | x | x |
| Laumer *et al.* (2010) | | | | | | |
|   Under-Age Applicants | Yes | No | No | Yes | x | x |
|   Full-Age Applicants | Yes | No | Yes | No | x | x |
| Lee and Lin (2008) | Yes | Yes | Yes | Yes | x | x |
| Lee *et al.* (2010a) | Yes | No | Yes | x | Yes | Yes |
| Lin *et al.* (2004) | | | | | | |
|   Without Moderating Effect | No | Yes | x | No | x | Yes |
|   With Moderating Effect | No[G] | No[GE] | x | x | No[E] | Yes |
| Liu *et al.* (2008) | Yes | No | Yes | x | x | x |
| Louho *et al.* (2006) | Yes | Yes | No | No | x | No |
| Luo *et al.* (2010) | | | | | | |
|   PLS Analysis | Yes | x | x | x | x | x |
|   Post-Hoc Analysis | Yes | x | x | x | x | x |
| Maldonado *et al.* (2009) | | | | | | |
|   Without Moderating Effect | x | x | Yes | x | No | Yes |
|   With Moderating Effect on SI-->BI | x | x | Yes | x | No | Yes |
| Maldonado *et al.* (2011) | | | | | | |
|   Without Moderating Effect | x | x | Yes | x | No | Yes |
|   With Moderating Effect on SI-->BI | x | x | Yes | x | No | Yes |
| Marchewka *et al.* (2007) | No | Yes | Yes | No | x | x |
| Mayer *et al.* (2011) | Yes | Yes | Yes | x | x | x |
| McLeod *et al.* (2009a) | | | | | | |
|   Professionals | Yes | No | No | x | x | x |
|   Novices | No | Yes | Yes | x | x | x |
| McLeod *et al.* (2009b) | Yes | Yes | Yes | x | x | x |
| Neufeld *et al.* (2007) | Yes | Yes | Yes | x | Yes | Yes |
| Niehaves and Plattfaut (2010) | | | | | | |
|   Without Moderating Effect | Yes | Yes | Yes | x | Yes | Yes |
|   With Moderating Effect | No | No | No | x | No | Yes |
| Nistor *et al.* (2010) | Yes | Yes | Yes | x | No | Yes |
| Nov and Ye (2009) | Yes | Yes | x | x | x | x |
| Or *et al.* (2011) | Yes | x | x | x | x | Yes |
| Pahnila *et al.* (2011) | Yes | Yes | Yes | x | Yes | Yes |
| Pai and Tu (2011) | No | Yes | Yes | x | Yes | Yes |
| Pavon and Brown (2010) | Yes | No | x | x | x | x |
| Payne (2008) | No[AG] | No[AGE] | No[M] | No | Yes[AE] | Yes |
| Pynoo *et al.* (2008) | | | | | | |
|   T1 - University Hospital | Yes | No | No | Yes | x | x |
|   T2 - University Hospital | Yes | No | No | No | No | Yes |
|   T3 - University Hospital | Yes | No | No | Yes | No | No |
|   T1 - Private Hospital | No | Yes | No | No | x | x |
|   T2 - Private Hospital | Yes | No | Yes | Yes | No | Yes |

| | | | | | | |
|---|---|---|---|---|---|---|
| T3 - Private Hospital | No | No | No | Yes | No | No |
| Pynoo *et al.* (2011) | | | | | | |
| Time - T1 | Yes | No | Yes | No | x | x |
| Time - T2 | Yes | No | No | No | x | x |
| Time - T3 | No | Yes | Yes | No | x | x |
| Pooled Over Three Measurements | Yes | No | Yes | No | x | x |
| Sahu and Gupta (2007) | Yes | Yes | Yes | x | x | x |
| Sambasivan *et al.* (2010) | x | x | x | Yes | x | x |
| Sapio *et al.* (2010) | | | | | | |
| General STB Use | x | x | x | x | Yes | x |
| Interactive Service Use | x | x | x | x | Yes | x |
| Informative Service Use | x | x | x | x | No | x |
| Schaupp *et al.* (2010) | Yes | No | Yes | Yes | x | x |
| Shi (2009) | Yes | Yes | No | Yes | x | x |
| Shin (2009) | | | | | | |
| Initial Model | x | x | No | x | x | Yes |
| Extended Model | x | x | Yes[B] | x | x | Yes |
| Shin (2010) | x | x | Yes | x | x | Yes |
| Song and Han (2009) | Yes | Yes | x | x | x | x |
| Sumak *et al.* (2010) | No | No | Yes | x | Yes | Yes |
| Tan and Wu (2010) | x | x | Yes | x | x | x |
| Teo (2011) | x | x | x | Yes | x | x |
| Tibenderana *et al.* (2010) | No | x | Yes | x | Yes | x |
| Tsai *et al.* (2009) | | | | | | |
| Model 1 | x | x | Yes | Yes | x | x |
| Model 2 | x | x | Yes | Yes | x | x |
| Model 3 | x | x | Yes | Yes | x | x |
| Udeh (2008) | x | x | x | x | Yes | x |
| van Biljon and Kotze (2008) | x | x | Yes | Yes | x | x |
| van Dijk *et al.* (2008) | Yes | Yes | x | x | x | x |
| van Schaik (2009) | | | | | | |
| Study 1 - Virtual Learning Environment | No | No | Yes | x | No | No |
| Study 1 - Library Website | Yes | Yes | No | x | No | Yes |
| Study 2 - Site 1 - Library Website | Yes | Yes | No | x | Yes | No |
| Study 2 - Site 2 - Goal Mode | No | No | Yes | x | x | Yes |
| Study 2 - Site 3 - Action Mode | Yes | Yes | No | x | x | Yes |
| Venkatesh *et al.* (2008) | x | x | x | x | Yes | Yes |
| Wang and Shih (2009) | | | | | | |
| Younger People | Yes | Yes | Yes | x | Yes | Yes |
| Older People | Yes | Yes | Yes | x | Yes | Reverse |
| All Respondents | Yes | Yes | Yes | x | Yes | Yes |
| Wang *et al.* (2009) | | | | | | |
| For Males | Yes | Yes | Yes | x | x | x |
| For Females | Yes | Yes | No | x | x | x |
| For Younger People | Yes | x | x | x | x | x |
| For Older People | Yes | Yes | Yes | x | x | x |
| For All Respondents | Yes | Yes | Yes | x | x | x |
| Weerakkody *et al.* (2009) | Yes | Yes | Yes | Reverse | x | Yes |
| Wang *et al.* (2010) | Yes | Yes | Yes | x | x | x |
| Wills *et al.* (2008) | Yes | Yes | Yes | x | Yes | Yes |
| Wu *et al.* (2007) | Yes | No | Yes | Yes | Yes | Yes |
| Wu *et al.* (2008) | Yes | No | Yes | Yes | Yes | Yes |
| Xu and Gupta (2009) | | | | | | |
| Potential Users | Yes | Yes | x | x | x | x |
| Experienced Users | Yes | Yes | x | x | x | x |
| Yang (2010) | Yes | No | Yes | Yes | x | x |
| Yao and Murphy (2007) | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| For Women | x | Yes | x | x | x | x |
| For Men | x | No | x | x | x | x |
| For Overall Voters | x | Yes | x | x | x | x |
| Yeow and Loo (2009) | | | | | | |
| MyKad Touch n' Go Application | Yes | Yes | Yes | Yes | x | x |
| MyKad ATM Application | Yes | Yes | Yes | No | x | x |
| Zhang *et al.* (2010) | | | | | | |
| Without Moderating Variable | Yes | No | Yes | x | x | x |
| With Moderating Variable (Gender) | No | No | No | x | x | x |
| Zhou (2008) | Yes | No | Yes | Yes | x | Yes |

[**Legend: Yes**: Relation was found to be significant and positive, **No**: Relation was found to be non-significant, **x**: Relation was not examined, **Reverse**: Relation was found to be significant but negative, **Yes**[M]/**No**[M]: Relation was significant/non-significant due to moderating effect of all moderating variables age, gender, experience, and voluntariness of use, **Yes**[G]/**No**[G]: Relation was significant/non-significant due to moderating variable gender, **Yes**[E]/**No**[E]: Relation was significant/non-significant due to moderating variable experience, **Yes**[AE]/**No**[AE]: Relation was significant/non-significant due to moderating variable age and experience, **Yes**[AG]/**No**[AG]: Relation was significant/non-significant due to moderating variable age and gender, **Yes**[AGE]/**No**[AGE]: Relation was significant/non-significant due to moderating variable age, gender, and experience, **Yes**[B]: Relationship of SI was found to be significant both on BI and Usage]

### 3.4.2 Weight Analysis

In order to better understand the predictive power of each individual independent variable, a weight analysis was performed for each independent/dependent variable pairing. We adopted an approach in line with the work of Jeyaraj *et al.* (2006) in order to identify the most/least frequently used predictors, and among these, the best, worst, and promising predictors. Data for this analysis was extracted from Table 11 (and is summarised in Table 12), weights being calculated by the value obtained by dividing the number of times a particular independent/dependent variable relationship was found to be significant by the total number of times that the relationship had been examined across all studies.

Table 12

Relationships between Major UTAUT Variables

| Relations | PE-BI | EE-BI | SI-BI | FC-BI | FC-U | BI-U |
|---|---|---|---|---|---|---|
| Significant Relation | 93 | 64 | 86 | 32 | 36 | 49 |
| Non-Significant Relation | 23 | 46 | 29 | 15 | 18 | 11 |
| Negative Relation | 0 | 0 | 0 | 1 | 0 | 1 |
| Not Tested | 33 | 39 | 34 | 101 | 95 | 88 |
| Total | 149 | 149 | 149 | 149 | 149 | 149 |
| Total Relations Examined | 116 | 110 | 115 | 48 | 54 | 61 |
| Total # of Significant Relations | 93 | 64 | 86 | 33 | 36 | 50 |
| Weight of Predictors | 93/116 =0.80 | 64/110 =0.58 | 86/115 =0.75 | 33/48 =0.69 | 36/54 =0.67 | 50/61 =0.82 |

A weight of '1' indicates that the relationship between the two constructs is significant across all studies, whereas '0' indicates that this relationship is non-significant across all the studies examined. The weights are an indication of the analytical power of an independent variable. However, care must be taken whilst considering these values, as it is not simply a weight of '1' that would declare a variable as being a best predictor. It is also important to note how many times a particular relationship was examined, as consistent evidence across studies is required in order that a best predictor be identified (Jeyaraj *et al.*, 2006).
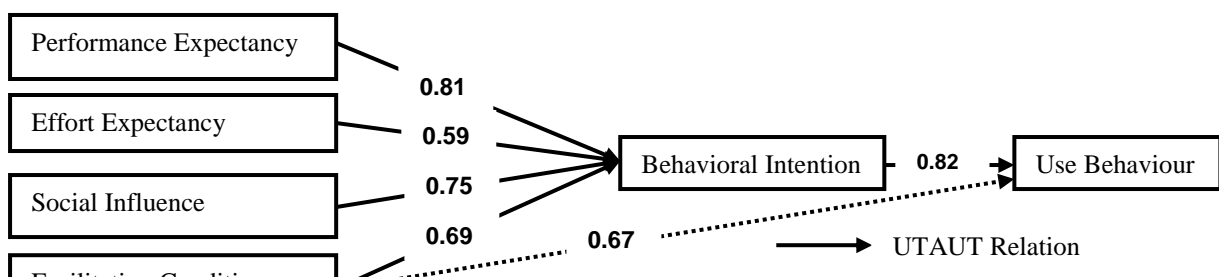
This was not particular an issue in our study, as all relationships had been examined numerous times. Jeyaraj *et al.* (2006) suggest that a weight of 0.80 or more is required for an independent variable to qualify as a best predictor, and we adopt this threshold in our work. Figure 2 illustrates the predictive power of the independent variables of UTAUT. Weight analysis of the independent variables indicates that only two variables (PE and BI) qualify for the best predictor category, whereas the other variables did not meet this requirement, the closest being social influence, with a weight of 0.74.

## 3.5 Analysis of External Variables

### 3.5.1 Relationship of External Variables Constructs

In the studies we number of being introduced constructs of work and
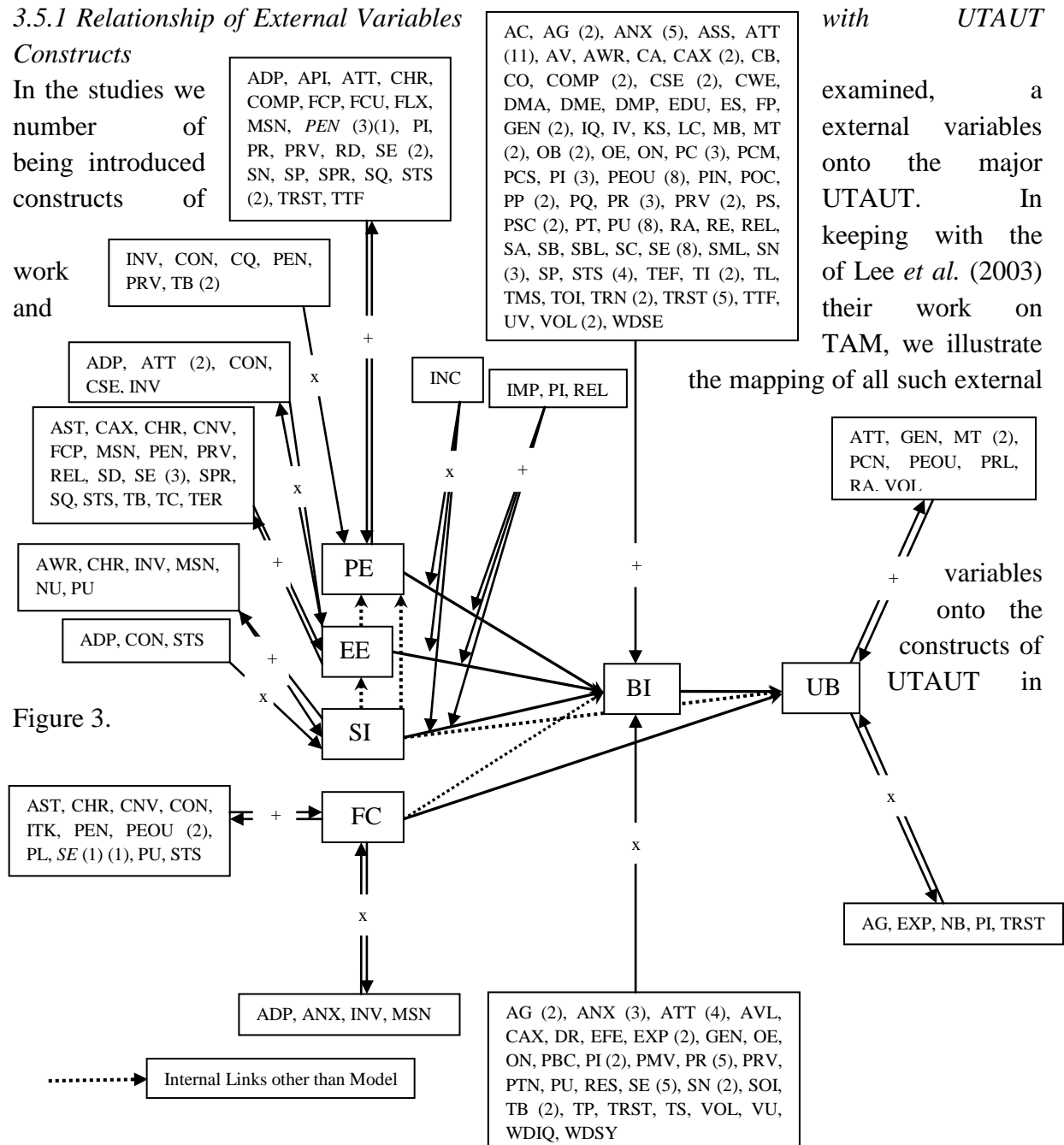
with UTAUT examined, a external variables onto the major UTAUT. In keeping with the of Lee *et al.* (2003) their work on TAM, we illustrate the mapping of all such external variables onto the constructs of UTAUT in Figure 3.

ADP, API, ATT, CHR, COMP, FCP, FCU, FLX, MSN, *PEN* (3)(1), PI, PR, PRV, RD, SE (2), SN, SP, SPR, SQ, STS (2), TRST, TTF

AC, AG (2), ANX (5), ASS, ATT (11), AV, AWR, CA, CAX (2), CB, CO, COMP (2), CSE (2), CWE, DMA, DME, DMP, EDU, ES, FP, GEN (2), IQ, IV, KS, LC, MB, MT (2), OB (2), OE, ON, PC (3), PCM, PCS, PI (3), PEOU (8), PIN, POC, PP (2), PQ, PR (3), PRV (2), PS, PSC (2), PT, PU (8), RA, RE, REL, SA, SB, SBL, SC, SE (8), SML, SN (3), SP, STS (4), TEF, TI (2), TL, TMS, TOI, TRN (2), TRST (5), TTF, UV, VOL (2), WDSE

INV, CON, CQ, PEN, PRV, TB (2)

ADP, ATT (2), CON, CSE. INV

AST, CAX, CHR, CNV, FCP, MSN, PEN, PRV, REL, SD, SE (3), SPR, SQ, STS, TB, TC, TER

INC

IMP, PI, REL

ATT, GEN, MT (2), PCN, PEOU, PRL, RA. VOL

AWR, CHR, INV, MSN, NU, PU

ADP, CON, STS

Figure 3.

PE

EE

SI

BI

UB

variables onto the constructs of UTAUT in

AST, CHR, CNV, CON, ITK, PEN, PEOU (2), PL, *SE* (1) (1), PU, STS

FC

AG, EXP, NB, PI, TRST

ADP, ANX, INV, MSN

AG (2), ANX (3), ATT (4), AVL, CAX, DR, EFE, EXP (2), GEN, OE, ON, PBC, PI (2), PMV, PR (5), PRV, PTN, PU, RES, SE (5), SN (2), SOI, TB (2), TP, TRST, TS, VOL, VU, WDIQ, WDSY

Internal Links other than Model

Fig. 3. Diagrammatic Representation of External Variables (Approach Adapted from Lee et al., 2003)

### 3.5.2 Most Frequently Used External Variables

Table 13 presents the 20 most frequently used external variables that affect PE, EE, SI, FC, BI, or UB, and provides the definitions as given in their originating studies. Results reveal that self-efficacy (21 occurrences) is most often used external variable, closely followed by attitude (20 occurrences) and trust (18 occurrences). Comparing these results with those of Lee *et al.* (2003) in their study of TAM reveals that self-efficacy, personal innovativeness, subjective norms, voluntariness, computer anxiety, compatibility, and relative advantage were examined a number of times across both TAM and UTAUT studies.

Table 13

Variables Used in UTAUT Research (Approach from Lee et al., 2003)

| EV (#) | Definition | Origin | Referred Articles |
|---|---|---|---|
| **SE** (21) | The belief that one has the capability to perform a particular behavior | Bandura (1977) | Hutchison and Bekkering (2009), Johnston and Warkentin (2010) |
| ATT (20) | Person's evaluation of a specified behavior | Fishbein and Ajzen (1975) | Al-Somali et al. (2009), Hutchison and Bekkering (2009) |
| TRST (18) | Willingness of party to be vulnerable to the actions of the another party based on the expectations that the other party will perform a particular action important to the trustor | Mayers et al. (1995) | Foon and Fah (2011), Sambasivan et al. (2010) |
| PU (15) | The user's perception to the extent that the system will improve the user's workplace performance-- | Davis (1989) | Ambali (2009), Barnes and Vidgen (2009) |

| | | | |
|---|---|---|---|
| PEOU (15) | The extent to which a user believes that using a particular system will be effortless | Davis (1989) | Shin (2010), Udeh (2008) |
| ANX (12) | An unpleasant emotional state or condition which is characterized by subjective feelings of tension, apprehension, and worry | Spielberger (1972) | AbuShanab et al. (2010), Carlsson et al. (2006) |
| PR (10) | A combination of uncertainty and plus seriousness of outcome involved | Bauer (1960) | Abu-Shanab and Pearson (2009), Luo et al. (2010) |
| **PI** (8) | An individual trait reflecting a willingness to try out any new technology | Agarwal and Karahanna (2000) | Jayasingh and Eze (2009), Xu and Gupta (2009) |
| STS (7) | The attitude that a user has toward an information system | DeLone and McLean (1992) | Chan et al. (2010), Liu et al. (2008) |
| TB (7) | The perception that the trustworthiness of the vendor consists of a set of specific beliefs about integrity, benevolence, and competence | McKnight and Chervany (2002) | Luo et al. (2010), Shi (2009) |
| **SN** (6) | Person's perception that most people who are important to him think he should or should not perform the behavior in question | Fishbein and Ajzen (1975) | Laumer et al. (2010), Or et al. (2010) |
| **VOL** (6) | The degree to which use of the innovation is perceived as being voluntary | Moore and Benbasat (1991) | Anderson et al. (2006), Hutchison and Bekkering (2009) |
| **CAX** (5) | An individual's apprehension, or even fear, when she/he is faced with the possibility of using computers | Simonson et al. (1987) | Lin et al. (2004), Nistor et al. (2010) |
| CSE (5) | An individual judgment of one's capability to use a computer | Compeau and Higgins (1995) | Chiu and Wang (2008), Nov and Ye (2009) |
| PEN (4) | The extent to which the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system usage | Davis et al. (1992) | Song and Han (2009), Wu et al. (2010) |
| **COMP** (3) | The degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters | Rogers (1983) | Chan et al. (2010), Jayasingh and Eze (2009) |
| PC (3) | The belief that the promise of another can be relied upon even under unforeseen circumstances | Suh and Han (2002) | YenYuen and Yeow (2009), Yeow and Loo (2009) |
| RD (2) | The degree to which the results of adopting/using the IS innovation are observable and communicable to others | Rogers (1983) | Keller et al. (2007), Nov and Ye (2009) |
| **RA** (2) | The degree to which an innovation is perceived as being better than its precursor | Rogers (1983) | Shin (2010), Udeh (2008) |
| OB (2) | A systematic error in perception of an individual's own standing relative to group averages, in which negative events are seen as less likely to occur to the individual than average compared with the group, and positive events as more likely to occur than average compared with the group | Weinstein (1980) | Carter and Schaupp (2009), Schaupp et al. (2010) |

[**Legend**: ANX: Anxiety, ATT: Attitude, **CAX: Computer Anxiety**, **COMP: Compatibility**, CSE: Computer Self-Efficacy, EV (#): External Variable with its Occurrences across Relevant Studies; OB: Optimism Bias, PC: Perceived Credibility, PEN: Perceived Enjoyment, PEOU: Perceived Ease of Use, **PI: Perceived Innovativeness**, PR: Perceived Risk, PU: Perceived Usefulness, **RA: Relative Advantage**, RD: Result Demonstrability, **SE: Self-Efficacy**, **SN: Subjective Norms**, STS: Satisfaction, TB: Trust Belief, TRST: Trust, **VOL: Voluntariness, Bold:** Indicates the external variables were used across both studies of TAM (by Legris *et al.*, 2003) and UTAUT analysed here]

## 3.6 Major Limitations of UTAUT Studies

An analysis of acknowledged limitations across studies indicated that focusing on a single subject - in terms of a community, culture, country, organisation, agency, department, person, or age group - was the most widespread reported constraint (35 studies). This was followed by 27 studies acknowledging their focus on a single task at a given point of time, and hence according to Lee *et al.* (2003), limiting the potential of generalization of findings - a key weakness. In Lee et al's (2003) work on TAM, self-reported usage was the weakness most often acknowledged, whereas in our study, it appeared in seventh place in our list of acknowledged limitations. A series of additional limitations (including limited sample size, use of students to explore workplace issues, no use of moderating variables, and lack of exogenous factors) were also reported in the literature. Details of these and others are presented in Table 14, along with associated references. Nine limitations were reported only in a single study - these are documented in Table 14 in the *other limitations* category.

Table 14

Limitations in UTAUT Studies (Approach from Lee et al., 2003)

| Limitation | # | Explanation | Studies |
|---|---|---|---|
| Single Subject/ Biased Sample | 35 | Sample based on only one or limited community, culture, country, organisation, agency, department, person, or age-group | Aggelidis and Chatzoglou (2009), Brown and Venkatesh (2005), Brown et al. (2010), Chang et al. (2007), Chiu et al. (2010), Dasgupta and Gupta (2010), He and Lu (2007a), Ho and Chou (2009), Hung et al. (2007), Jayasingh and Eze (2009), Koh et al. (2010), Koivumaki et al. (2008), Laumer et al. (2010), Lee et al. (2010a), Li (2010), Mahzan and Lymer (2008), Maldonado et al. (2009), Maldonado et al. (2011), Niehaves and Plattfaut (2010), Or et al. (2011), Pai and Tu (2011), Sahu and Gupta (2007), Samoutis et al. (2008), Schaper and Pervan (2006), Shin (2009), Tibenderana et al. (2010), Tsai et al. (2009), Wang and Shih (2009), Wang et al. (2009), Wu et al. (2007), YenYuen and Yeow (2009), Yeow and Loo (2009), Yeow et al. (2008), Yao and Murphy (2007), Zhou et al. (2010) |
| Single Task | 27 | Difficult to generalize the result | Abu-Shanab and Pearson (2009), Aggelidis and Chatzoglou (2009), Alapetite et al. (2009), AlAwadhi and Morris (2011), Brown and Venkatesh (2005), Carter and Schaupp (2009), Chang et al. (2007), Chiu and Wang (2008), Hung et al. (2007), Huser et al. (2010), Kijsanayotin et al. (2009), Mahzan and Lymer (2008), Maldonado et al. (2009), Maldonado et al. (2011), Mayer et al. (2011), Schaper and Pervan (2006), Shin (2009), Shin (2010), Sumak et al. (2010), Teo (2011), Terzis and Economides (2011), Tsai et al. (2009), van Raaij and Schepers (2008), Wang and Shih (2009), Xu and Gupta (2009), Yao and Murphy (2007), Zhou et al. (2010) |
| Cross Sectional Study | 17 | One time cross-sectional study | Al-Gahtani et al. (2007), Aoun et al. (2010), Chiu et al. (2010), Chiu and Wang (2008), Heikkila and Smale (2010), Hung et al. (2007), Kijsanayotin et al. (2009), Luo et al. (2010), Neufeld et al. (2007), Sambasivan et al. (2010), Schaupp et al. (2010), Shin (2010), Tibenderana et al. (2010), Wang et al. (2009), Wills et al. (2008), Wu et al. (2007), Zhou et al. (2010) |

| | | | |
|---|---|---|---|
| Limited Sample Size | 14 | Small sample size | Aggelidis and Chatzoglou (2009), Chiu and Eysenbach (2010), Duyck et al. (2008), Foon and Fah (2011), Hutchison and Bekkering (2009), Lee et al. (2010a), Maldonado et al. (2009), Marchewka et al. (2007), McLeod et al. (2009a), Pynoo et al. (2011), Or et al. (2011), Trimmer et al. (2008), van Raaij and Schepers (2008), Wills et al. (2008) |
| Single IS | 12 | Only a Single IS for the research | Aggelidis and Chatzoglou (2009), Aoun et al. (2010), Brown et al. (2010), Carlsson et al. (2006), Chang et al. (2007), Chiu and Wang (2008), Gupta et al. (2008), Im et al. (2008), Sambasivan et al. (2010), Wang and Shih (2009), Wang et al. (2009), Zhou et al. (2010) |
| Limited external factors or variables | 11 | Counted number of external constructs | Chan et al. (2010), Chiu and Eysenbach (2010), Gupta et al. (2008), He and Lu (2008), He et al. (2007), Im et al. (2008), Or et al. (2011), Schaupp et al. (2010), Terzis and Economides (2011), van Schaik (2009), Wu et al. (2007) |
| Self-reported Usage | 11 | Did not measure the actual usage | Abu-Shanab and Pearson (2007), Abu-Shanab and Pearson (2009), de Silva and Ratnadiwakara (2009), Hung et al. (2007), Jayasingh and Eze (2009), Lin et al. (2004), Luo et al. (2010), van Schaik (2009), Venkatesh et al. (2008), Wang et al. (2009), Zhang et al. (2010) |
| Student Sample | 11 | Improper to reflect the real working environment | AlAwadhi and Morris (2011), Carter and Schaupp (2009), Im et al. (2008), Johnston and Warkentin (2010), Luo et al. (2010), McLeod et al. (2009a), McLeod et al. (2009b), Sumak et al. (2010), Tsai et al. (2009), Wu et al. (2010), Zhang et al. (2010) |
| Self-reported/selection Bias | 7 | Poll suffering from self-selecting opinion | Carter and Schaupp (2009), Chan et al. (2010), Chiu et al. (2010), Chiu and Wang (2008), Sahu and Gupta (2007), Schaupp et al. (2010), Teo (2011) |
| No moderating variables | 6 | No moderating variables used | Al-Sobhi et al. (2011), Chen et al. (2008), Huser et al. (2010), Loo et al. (2009), Yeow and Loo (2009), YenYuen and Yeow (2009) |
| Explanatory Study/ Incomplete research | 4 | Partially complete research | Barati and Mohammadi (2009), Debuse et al. (2008), Koivumaki et al. (2008), YenYuen and Yeow (2009) |
| Limited exposure to the technology | 3 | Target population least aware to technology | Huser et al. (2010), Hutchison and Bekkering (2009), Shin (2009) |
| Common method bias/variance | 3 | Data collected using same survey | Laumer et al. (2010), Tsai et al. (2009), Wang et al. (2009) |
| Gender Bias - Majority female/male | 2 | Majority of either male or female | Sumak et al. (2010), Wills et al. (2008) |
| Male sample | 2 | Only male respondents | Al-Sobhi et al. (2011), Dasgupta and Gupta (2010) |
| Low R-Square/ Unexplained $\sigma^2$ | 2 | Variance not explained | Hung et al. (2007), Teo (2011) |
| Other Limitations | 9 | (1) Cultural factors not analyzed (2) Lack a measure of acceptance (3) Limited applications (4) Difficulty to measure BI, (5) Original variance not explored, (6) Low response rate, (7) Use of partial constructs of UTAUT, (8) Disproportionate sample, and (9) Respondents already | (1) de Silva and Ratnadiwakara (2009), (2) Duyck et al. (2010), (3) Loo et al. (2009), (4) Neufeld et al. (2007), (5) Pai and Tu (2011), (6) Pynoo et al. (2011), (7) Shamsuddin (2009), (8) Shin (2009), and (9) Sumak et al. (2010) |

| | | having technical skills | |
|---|---|---|---|
| | | | |

## 3.7 Theoretical and Methodological Details

Table 15 (see Appendix A) presents an overview of the type of system/software/application established, the size and user type forming the sample, and the model tested (in addition to the UTAUT) in each study. It can be seen that TAM (with 29 occurrences) is the most commonly applied model in conjunction with UTAUT, which is followed some way behind by TPB (6 occurrence), TAM2 and the DeLone and McLean IS Success Model (5 occurrences each), IDT and TTF (3 occurrences each), and one occurrence each for TRA, SCT, Trust Model, Andersen's Behavioural Model, and the Theory of Cultural Dimension. It is apparent from Table 15 that the majority of studies used an appropriate sample size, although some employed small samples with fewer than 50 participants (for example, BenMessaoud *et al.*, 2011; Biemans *et al.*, 2005; Lee *et al.*, 2010b, and Samoutis *et al.*, 2008). Some authors (including Chiu and Eysenbach, 2010; Duyck *et al.*, 2008; Hutchison and Bekkering, 2009; Pynoo *et al.*, 2011; van Raaij and Schepers, 2008) acknowledged a small sample size as being one of their limitations, whereas others (including Foon and Fah, 2011; Lee *et al.*, 2010a), in addition to this acknowledgement, also recognized that their limited sample size could hamper generalization of the overall results of their studies. It is worth noting that some studies (Bandyopadhyay and Bandyopadhyay, 2010; Duyck *et al.*, 2010; McLeod *et al.*, 2009a; Pynoo *et al.*, 2008; Pynoo *et al.*, 2011; Yao and Murphy, 2007) utilized more than one sample to test their models, the rationale in some cases (Duyck *et al.*, 2010; Pynoo *et al.*, 2008; Pynoo *et al.*, 2011) being the longitudinal nature of the investigation.

## 4. Discussion

Our intention in this paper was to present the results of a systematic and comprehensive review of the development of UTAUT since its inception in 2003. Based on a review of 174 papers identified from various sources such as Thompson Scientific *Web of Science* database and *Google Scholar*, results were presented in terms of six major aspects: demographic characteristics, research topics and types of technology examined, methodological analysis, internal and external variable analysis, analysis of major limitations, and theoretical and methodological details.

Our analysis of the most prolific authors illustrates that the 11 most productive individuals (e.g., Brown et al., 2010; Liu et al., 2008; Weerakkody et al., 2009) in terms of UTAUT-based publications contributed to 13% of the total number of articles, which is around a quarter of the volume produced by the same number of the most productive authors (see Lee

et al., 2003; Legris et al., 2003) publishing TAM related research. This indicates that the field currently remains diversified in terms of the number of authors contributing to the UTAUT related articles, with no prominent group of individuals dominating. A similar picture emerges from our analysis of outlets publishing UTAUT research, the field currently being highly diversified with no "obvious" journal or set of journals being the natural home for UTAUT work. This contrasts with the situation pertaining to TAM research, where a number of key journals (including *MIS Quarterly* and *Information & Management*) have attracted a substantial amount of content. The natural and obvious reason for this would be the greater level of maturity of TAM compared to UTAUT, however, some nine years after the appearance of the original UTAUT article by Venkatesh *et al.* (2003), and despite a fast growing and substantial number of citations, the number of studies published in comparable journals actually making use of UTAUT remains relatively low.

Our country analysis indicates that research in the 174 publications considered was conducted in 41 countries via the activities of researchers affiliated to universities in 36 different countries. The USA was the leading country both in terms of location for research and number of research affiliations. It was noticeable that in a number of cases, numerous authors were affiliated with universities in a particular country, but little primary data has actually been collected in that country - for instance, 38 researchers were affiliated with universities in the UK, yet only two studies were based on primary data collected in the UK. Given the current dominance of the USA as the principal location for collecting primary data (and the limited work conducted elsewhere), there is clearly ample opportunity for researchers to conduct original work by collecting data in additional countries.

Given our analysis examined 174 articles, it was noticeable that there was no leading institution or group of institutions in terms of the number of articles published, with Renmin University in China being the leading institution in terms of number of papers produced (#5). Despite the USA being by far the preferred location for collecting primary data, and USA-based researchers dominating in terms of the number of articles actually produced, only four USA-based institutions appear in the list of the top 18 universities in terms of number of articles produced, the universities of Nevada and North Texas being placed equal 12th. This indicates that the large amount of UTAUT-related research effort in the USA is spread throughout a large number of contributing institutions, rather than any small number being seen to specialize in such work.

A similar line of enquiry for the most prolific authors also suggests that there is no monopoly of any group of authors in publishing research on UTAUT. Six authors, including Venkatesh, jointly hold the leading position with four articles each, followed by five authors with three articles each. A further 39 authors contributed two articles each, and by far the largest group of 377 authors contributed to just one article each, indicating again that research using UTAUT has been diversified over the years, and no researchers appear to have yet made it their primary area of focus.

Analysis of the most productive departments reveals that most UTAUT work has been carried out by researchers based in departments related to the business, management, information systems and technology fields. This is as might be expected, and we suggest that extended use of UTAUT in additional and diverse fields of study (we have currently seen some limited use in journalism, psychology, education and medicine) is likely to augment the

level of understanding of the value of the theory, along with contributing to the identification of further strengths and weaknesses.

Our analysis in terms of publication statistics demonstrates that the number of UTAUT-related publications appearing has generally increased year upon year since the appearance of the original article, with a significant increase in numbers since 2008. Our results show fewer articles appearing in 2011 due to the timing of our data collection activities, but we anticipate that the upward trend will continue, albeit in relatively modest terms.

Results of our keyword analysis suggest that the model has been primarily used for technology adoption and acceptance research in the areas of e-government, e-banking, e-learning and e-commerce. In terms of the eight contributing theories and models, TAM has been most often discussed alongside UTAUT. Our findings reveal that office systems have attracted little investigative attention from researchers making use of UTAUT, which is in direct contrast to the findings of Lee *et al.* (2003) in their study of TAM, in which the study of office systems accounted for 27% of cases. This situation is essentially a comment on the evolution of systems that are of interest to researchers - clearly in the period covered by Lee *et al.* (2003), office systems were deemed worthy of investigation, whereas they are now commonplace, and not viewed as being a particularly new technology in the organisational environment. The relatively recent widespread introduction and use of customer-facing technology in domains such as government, retailing, and education has seen a range of new opportunities for original research emerge and continue to materialize, and there is still ample opportunity for researchers to conduct innovative work.

In terms of the methodological aspects of UTAUT research, our investigation revealed a very similar set of results to those of Lee *et al.* (2003) in that despite the acknowledged value of longitudinal studies in investigating users' changing attitudes toward technology over time as they become familiarized (Doll and Ahmed, 1983), only a minority of studies have been longitudinal in nature, with by far the majority of studies making use of a cross-sectional approach. This may be a result of the relatively recent emergence of UTAUT, but when combined with the dominance of the survey approach, it can be seen that there remains ample scope for original research beyond the current cross-sectional/survey dominance by making use of alternative methodological contexts, tools and techniques. According to Lee *et al.* (2003) in their study of TAM research, field study and lab experiment were the most common approaches, whereas in our examination of UTAUT research, they appear to have been little used thus far.

PLS and regression analysis have been commonly used in both TAM and UTAUT-based studies, and while other techniques such as SEM, CFA, and FA have been frequently employed to date in UTAUT research, they have been used to a far lesser extent in the TAM context. This may be a reflection on the gradual evolution of methodological preferences, or may be accounted for by other reasons - hence this aspect and other methodological issues would appear to be worthy of further investigation. In terms of software tools used to support analysis during UTAUT investigations, SPSS currently appears to be most favoured, while AMOS, LISREL, and PLS Graph have also been used on a number of occasions. This overall situation is again in contrast to the findings of Lee *et al.* (2003) in which analysis in TAM studies was generally carried out using LISREL.

A reasonably large (22.5%) contribution of data collected during the UTAUT research considered in our study came from students, and while it is acknowledged that such data samples may not always be representative of the situation in the "real world" (Dwivedi *et al.*, 2008), it does reflect that the approach remains a relatively convenient way for academic researchers to capture data.

Of the 102 quantitative studies using theories and theoretical constructs, 32 made use of more than one model in the same study to differentiate between aspects of research in terms of models, user types, and sector types. This use of multiple models within a single study expands the number of results we are able to consider in our investigation from 102 to 159, and hence increased the amount of input into our analysis of the overall performance of the theory and its constituent relationships. Results from our corresponding weight analysis between sets of relationships indicated that only PE and BI met the requirements of Jeyaraj *et al.* (2006) to be classed as best predictors of BI and Use Behavior respectively. Hence, there is still a need for further work in this respect in order to examine the role played by other variables, and their potential to qualify for the best predictor category.

From our diagrammatic representation of the diverse range of external variables examined by various studies (see Figure 3), it can be seen that the largest group of variables was examined in terms of their influence on the behavioral intention construct. This is entirely as would be expected given the intention of UTAUT to assist with the measurement of the intention to adopt a new technology. Our analysis of the most frequently external constructs indicated that aspects viewed by Venkatesh *et al.* (2003) as being accounted for and measured as part of the original UTAUT model often also appear as external variables in published UTAUT-related research - in essence, such cases see the variables concerned as being measured to a greater extent than anticipated. Our results in this respect mirror to an extent those of Lee *et al.* (2003) in their study of TAM research that also identified certain external variables being accounted for to a greater or lesser extent by TAM itself.

Limitations acknowledged by the studies included in our investigation appear to center on data collection issues - such as focusing on single subject or single task, conducting investigations that are cross sectional in nature and those which are limited in sample size. Self-reporting of actual use was also an issue, but not to the same extent as reported by Lee *et al.* (2003) in their study of TAM research, which identified self-reporting of system use as the main weakness. There would therefore appear to be much scope for researchers to conduct original work that addresses these reported limitations.

## 5. Conclusion, Limitations, and Future Work

Our intention in this paper is to present an overview of the current state of UTAUT-related research by presenting the results of a systematic and comprehensive review of 174 articles appearing since 2004. Results were presented in terms of six major aspects: demographic characteristics, research topics and types of technology examined, methodological analysis, internal and external variable analysis, analysis of major limitations, and theoretical and methodological details. Our intent in conducting the investigation was to provide a useful and usable resource for future researchers by providing information on the key areas previously addressed in UTAUT research, how UTAUT research tends to be carried out, and what is usually studied during the course of UTAUT research.

In keeping with previous 'state of play' studies of this nature, we posit that our findings highlight promising lines of inquiry as well as those that are neglected and those that have already received much attention. All three aspects of analysis in our study imply that UTAUT research is still in its relatively early stages of development, with no clear areas of maturity, but appears to be developing quickly. UTAUT has evolved and been tested and augmented by researchers making use of existing models in conjunction with UTAUT, and by introducing variables and exploring alternative relationships between its constituent components in various contexts and environments, but there are still ample and clear opportunities for researchers to engage with and further shape and develop the field.

Our results reveal that there are many journals and conferences publishing UTAUT research, with contributors from many regions although the majority is unsurprisingly from the USA. There are therefore many opportunities for researchers from other regions to embark on original studies of culture and context-related UTAUT research. The acknowledged limitations of published work provide an initial point from which to identify areas suitable for further research - overly focused subjects and tasks, limited sample sizes in some studies, and a lack of longitudinal work all provide indicators to further opportunities for researchers. Self-reported usage, use of student samples, and a lack of consideration of moderating variables also suggest areas where additional work can be viewed as being necessary. Finally, the results of our weight analysis suggest that the cumulative predictive power of each individual independent variable was not consistent or at the level expected, with only two variables (performance expectancy and behavioural intention) meeting the benchmark of Jeyaraj *et al.* (2006) and qualifying for best predictor category. Further investigation into the performance of the relationships within the model would therefore appear to be appropriate.

We anticipate this paper will prove to be a useful source of information for those readers who wish to learn more about the various facets pertaining to published UTAUT research, and suggest that the findings of this study may help in directing limited and valuable research resources to potentially fruitful lines of inquiry as well as strengthening the overall field of UTAUT research by facilitating consideration of useful alternative theoretical and methodological perspectives, and by highlighting aspects requiring further scrutiny. However, we acknowledge that our study has a number of limitations and readers should interpret the material presented in this paper within the context of these limitations.

Perhaps the most obvious limitation is that of literature forming our sample - as with all articles of this type, our results reflect the material actually examined, and clearly there may be significant and influential work that we have not included. For instance, our search activities were centered on occurrences of keywords in order to avoid locating large numbers of publications where these keywords might have been used as casual words in the main text. We fully acknowledge that there may be numerous studies, which lack keywords in the title, but still focus upon UTAUT in some form. We admit this aspect and encourage further research to extend the amount of material considered. However, we posit that our sampling approach was sufficient to provide a representative reflection of the current state of UTAUT research.

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Appendix A.

Table 16

Methodological Details (Approach from Legris *et al.*, 2003)

| Study | System/Software/Application Type | Sample Size |
|---|---|---|
| AbuShanab and Pearson (2007) | Internet Banking | 523 non-Internet banking customers |
| Abu-Shanab and Pearson (2009) | Internet Banking | 878 bank customers |
| AbuShanab *et al.* (2010) | Internet Banking | 523 non-Internet banking customers |
| Aggelidis and Chatzoglou (2009) | Hospital Information System | 283 employees |
| Alapetite *et al.* (2009) | Speech Recognition System | 39 physicians |
| AlAwadhi and Morris (2011) | E-Government Services | 880 students |
| Al-Gahtani *et al.* (2007) | Information Technology | 722 knowledge workers |
| Al-Harby *et al.* (2010) | Biometrics Authentication System | 306 under/post-graduate students |
| Al-Rajhi *et al.* (2010) | Information System | *Study not validated yet* |
| Al-Shafi and Weerakkody (2009) | E-Government Services | 216 citizens |
| Al-Shafi and Weerakkody (2010) | E-Government Services | 1179 citizens |
| Al-Sobhi *et al.* (2011) | E-Government Services | 750 citizens |
| Al-Somali *et al.* (2009) | Online Banking | 202 bank customers |
| Ambali (2009) | E-Filing System | 300 taxpayers |
| Anderson *et al.* (2006) | Tablet PCs | 37 faculty members |
| Aoun *et al.* (2010) | Accounting Information System | 192 accounting practitioners |
| Avdic and Eklund (2010) | Reference Databases | 150 students |
| Bandyopadhyay and Bandyopadhyay (2010) | Information Technology | 762, 502 professionals |
| Barati and Mohammadi (2009) | Mobile Banking | *Exploratory Study- data to be collected* |
| Barnes and Vidgen (2009) | Corporate Intranet | 131 sales and marketing professionals |
| BenMessaoud *et al.* (2011) | Robotic-Assisted Surgery | 21 surgeons |
| Benslimane *et al.* (2004) | Web Systems for e-Procurement | 136 corporate buyers |
| Biemans *et al.* (2005) | Medical Teleconferencing Application | 18 nurses |
| Brown and Venkatesh (2005) | Information Technology | 746 households |
| Brown *et al.* (2010) | Collaboration Technology | 349 SMS users |
| Butler and Richardson (2008) | iBrainz Technology | 47 students |
| Cabral *et al.* (2009) | Water Treatment Technology | *No data value collected yet* |
| Carlsson *et al.* (2006) | Mobile Devices/Services | 157 subjects |
| Carter and Schaupp (2009) | E-File | 260 students |
| Chan *et al.* (2010) | E-Government Technology | 1179 citizens |
| Chang *et al.* (2007) | Clinical Decision Support System | 140 physicians |
| Chen *et al.* (2008) | Weblog System | 153 students |
| Cheng *et al.* (2008a) | Internet Banking | 413 professionals |

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|---|---|---|
| Cheng *et al.* (2008b) | Internet Banking | 313 professionals |
| Cheng *et al.* (2008c) | Internet Banking | 313 professionals |
| Chisolm *et al.* (2010) | Electronic Medical Record | 71 clinicians |
| Chiu and Eysenbach (2010) | E-Health Services | 46 professionals |
| Chiu and Wang (2008) | Web-Based Learning | 286 respondents |
| Chiu *et al.* (2010) | Online Auctions | 412 buyers |
| Cody-Allen and Kishore (2006) | E-Quality | *Data collection to be done in the future* |
| Cornacchia *et al.* (2008) | ICT | 40 employees |
| Coss (2009) | Medical Support System | *Data collection to be done in the future* |
| Curtis and Payne (2008) | Computer-Assisted Audit Techniques | 139 professionals |
| Curtis *et al.* (2010) | Social Media | 409 professionals |
| Dada (2006) | E-Readiness | 328 people from Tanzania+78 from SA |
| Dadayan and Ferro (2005) | Technology | *Data collection will be done latter* |
| Dasgupta and Gupta (2010) | Internet Technology | 102 government employees |
| de Silva and Ratnadiwakara (2009) | Mobile Technology | 9540 telephone users |
| Debuse *et al.* (2008) | Automated Feedback System | 8 academic staff |
| Diaz and Loraas (2010) | Existing Technology | 69 students |
| Dulle and Minishi-Majanja (2011) | Open Access | 544 teachers |
| Duyck *et al.* (2008) | PACS System | 56 professionals |
| Duyck *et al.* (2010) | PACS System | 203, 159, 362 Physicians-Radiologists |
| Fitterer *et al.* (2010) | Health Information System | 79 professionals |
| Foon and Fah (2011) | Internet Technology | 200 professionals |
| Gunther *et al.* (2009) | Micro Blogging | 25 Twitter Users |
| Gupta *et al.* (2008) | ICT | 102 employees |
| Hailemariam *et al.* (2010) | Telemedicine | Physicians and health workers |
| He and Lu (2007a) | Mobile Advertising | 243 mobile consumers |
| He and Lu (2007b) | Mobile Business | 74 journal articles |
| He and Wei (2009) | Knowledge Management System | 161 professionals |
| Heerink *et al.* (2009) | Interface Robot | 42 elderly citizens |
| Heikkila and Smale (2010) | Electronic HRM System | 18 HR managers |
| Hennington *et al.* (2009) | Electronic Medical Record System | 23 Nurses and 4 Nurse Managers |
| Ho and Chou (2009) | Mobile Podcasting | 246 citizens |
| Huang and Wang (2009) | ERP System | 236 professionals |
| Huang *et al.* (2010) | Information Technology | Healthcare professionals from 10 firms |
| Hung *et al.* (2007) | E-Government Services | 244 citizens |
| Huser *et al.* (2010) | EHR Query System | 18 human subjects |
| Hutchison and Bekkering (2009) | Remote Desktop Application | 25 students |

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|---|---|---|
| Im *et al.* (2008) | Technologies for Communication | 161 subjects |
| Jalaldeen *et al.* (2009) | Knowledge Management Process | *Conceptual model - to be used latter* |
| Jayasingh and Eze (2009) | M-Coupon System | 781 mobile consumers |
| Johari *et al.* (2010) | Information Kiosk | *Data collection to be done in the future* |
| Johnston and Warkentin (2010) | Security Information System | 275 subjects |
| Jong and Wang (2009) | Web-based Learning System | 606 students |
| Keller *et al.* (2007) | E-Learning System | 67 students |
| Kijsanayotin *et al.* (2009) | Health Information Technology | 1187 community health centres |
| Koh *et al.* (2010) | Software Technologies | 333 employees |
| Koivumaki *et al.* (2008) | Mobile Services | 243 mobile consumers |
| Kourouthanassis *et al.* (2010) | Mobile Internet Application | 139 subscribers |
| Laumer *et al.* (2010) | Information Technology | 323 students |
| Lee and Lin (2008) | Podcasting | 190 students |
| Lee *et al.* (2007) | Forecasting Support System | 54 students |
| Lee *et al.* (2010a) | Activity Based Management System | 112 professionals |
| Lee *et al.* (2010b) | DEMATEL | 10 professionals |
| Li (2010) | Virtual Knowledge Sharing | 41 employees |
| Li and Kishore (2006) | Online Community Weblog System | 265 students |
| Lin *et al.* (2004) | Instant Messaging | 300 students |
| Liu *et al.* (2008) | Internet banking | 413 professionals |
| Loo *et al.* (2009) | Smartcard Application | 200 MyKad holders |
| Louho *et al.* (2006) | Hybrid Media Application | 19 test users |
| Lubrin *et al.* (2006) | Motes | 103 anonymous participants |
| Luo *et al.* (2010) | Mobile Banking | 122 students |
| Mahzan and Lymer (2008) | CAATTs | 46 members of IIA-UK |
| Maldonado *et al.* (2009) | Educational Portal | 150 students |
| Maldonado *et al.* (2011) | Educational Portal | 150 students |
| Marchewka *et al.* (2007) | Course Management Software | 132 students |
| Mayer *et al.* (2011) | Smart Products | 166 citizens |
| McLeod *et al.* (2009a) | Tax Software System | 74 professionals and 56 novices |
| McLeod *et al.* (2009b) | Tax Preparation Software | 215 students |
| Neufeld *et al.* (2007) | Information Technology | 209 professionals |
| Niehaves and Plattfaut (2010) | Internet | 192 elderly citizens |
| Nistor *et al.* (2010) | E-Learning System | 732 students |
| Nov and Ye (2009) | Digital Library | 271 students |
| Or *et al.* (2011) | Web-Based Technology | 101 patients |
| Oshlyansky *et al.* (2007) | Validating UTAUT tool | 1489 students from nine countries |

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|---|---|---|
| Pahlke and Beck (2009) | Enterprise Mashup System | *Constructs to be operationalized latter* |
| Pahnila *et al.* (2011) | Auction Site | 180 students |
| Pai and Tu (2011) | CRM Systems | 271 professionals |
| Pappas and Volk (2007) | Audience Counts & Reporting System | 27 independent education organizations |
| Park *et al.* (2007) | Mobile Technology | 221 citizens |
| Pavon and Brown (2010) | World Wide Web | 228 job seekers |
| Payne (2008) | Web 2.0 | 338 members of public relations society |
| Pynoo *et al.* (2008) | PACS System | 600, 180 physicians |
| Pynoo *et al.* (2011) | Digital Learning Environment | 64, 41, 55 teachers |
| Qingfei *et al.* (2008) | Mobile Commerce | *Data collection and analysis to be done* |
| Randeree (2009) | Personal Health Record System | 128 students |
| Reunis and Santema (2005) | E-Ordering Application | 25 professionals |
| Richardson *et al.* (2009) | Problem Solving Models | 33 students |
| Sahu and Gupta (2007) | E-Government | 163 users of Indian central excise |
| Sambasivan *et al.* (2010) | Electronic Procurement System | 358 users from various ministries |
| Samoutis *et al.* (2008) | Quality Improvement Intervention | 18 patients |
| Sapio *et al.* (2010) | Digital Television | 181 citizens |
| Schaper and Pervan (2004) | ICT | 6500 professionals |
| Schaper and Pervan (2006) | Technologies | 2870 professionals |
| Schaupp *et al.* (2010) | E-File | 260 taxpayers |
| Seymour *et al.* (2007) | Enterprise Resource Planning Systems | 59 students |
| Shamsuddin (2009) | Computer Graphics Technology | 46 students |
| Sharma and Citurs (2004) | Information Technology | *Proposed model would be tested latter* |
| Shi (2009) | Smart Phone Application Software | 653 professionals |
| Shin (2009) | Mobile Wallet | 296 professionals |
| Shin (2010) | MVNO Services | 296 members of community |
| Song and Han (2009) | Mobile System | 570 consumers |
| Suhendra *et al.* (2009) | Information Technology | 150 SME operators |
| Suki and Ramayah (2010) | E-Government Services | 200 respondents |
| Sumak *et al.* (2010) | Virtual Learning Environment | 235 students |
| Taksa and Flomenbaum (2009) | Cross-Cultural Information Retrieval | 20 Websites |
| Tan and Wu (2010) | Mobile Commerce | 300 students |
| Tavares and Amarel (2010) | Peer-to-Peer Academic Networks | 10 interviews from users and non-users |
| Teo (2011) | Intention to Use Technology | 592 teachers |
| Terzis and Economides (2011) | Computer Based Assessment Model | 173 students |
| Tibenderana *et al.* (2010) | Hybrid Library Services | 445 staff and students |
| Trimmer *et al.* (2008) | Electronic Medical Record Systems | *Data collection in process* |

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|---|---|---|
| Tsai *et al.* (2009) | Learning Behaviour Formation | 759 students |
| Udeh (2008) | Wi-Fi System | 129 respondents |
| Uzoka (2008) | E-Commerce | 150 organizations |
| van Biljon and Kotze (2008) | Mobile Phone | 59 students |
| van Biljon and Renaud (2008) | Mobile Phone | 34 elderly citizens |
| van Dijk *et al.* (2008) | Government Internet Services | 1225 respondents |
| van Raaij and Schepers (2008) | Virtual Learning Environment | 45 students |
| van Schaik (2009) | Websites | 118, 121 students |
| van Setten *et al.* (2006) | Recommender System | 1872 television viewers |
| Venkatesh *et al.* (2008) | New System Use | 321 employees |
| Verhoeven *et al.* (2010) | ICT | 714 students |
| Wang and Shih (2009) | Information Kiosks | 244 respondents |
| Wang *et al.* (2009) | Mobile Learning | 330 Respondents with IT experience |
| Wang *et al.* (2010) | Mobile Internet | 343 respondents |
| Weerakkody *et al.* (2009) | E-Government | 1179 citizens |
| Whitten *et al.* (2009) | Telehospice | 25 employees |
| Wills *et al.* (2008) | Electronic Medical Record | 52 professionals |
| Wu *et al.* (2007) | 3G Mobile Communication | 394 professionals |
| Wu *et al.* (2008) | 3G Mobile Telecommunication | 394 professionals |
| Wu *et al.* (2010) | Educational Technology System | 240 students |
| Xu and Gupta (2009) | Location-Based Services | 101 students |
| Yang (2010) | Mobile Shopping Services | 400 mobile consumers |
| Yang *et al.* (2008) | Software Cost Estimation | 116 organizations |
| Yao and Murphy (2007) | Remote Electronic Voting Systems | 453, 253, 196 voters |
| YenYuen and Yeow (2009) | Internet Banking | 280 general users |
| Yeow and Loo (2009) | ATM and Transit Application | 500 MyKad holders |
| Yeow *et al.* (2008) | Online Banking Service | 190 respondents |
| Zhang *et al.* (2010) | Mobile Search Service | 195 students |
| Zhou (2008) | Mobile Commerce | 250 mobile commerce users |
| Zhou *et al.* (2010) | Mobile Banking | 250 students and professionals |

[**Legend**: CAATTs: Computer Assisted Audit Tools and Techniques (CAATTs), DeLone & McLean ISS Model: DeLone and
Decision Making Trial and Evaluation Laboratory System, ICT: Information and Communication Technology, IDT: Innovation
Task Technology Fit, *Italic font*: under sample size indicates that sample data have not been collected, analysed, or validated]