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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 indicated that general purpose systems and specialized business systems were examined in the majority of the articles using the UTAUT. The analysis also indicated that cross-sectional approach, survey methods, and structural equation modelling analysis techniques were the most explored research methodologies whereas SPSS was found to be the largely used analysis tools. Moreover, the weight analysis of independent variables indicates that variables such as performance expectancy and behavioural intention qualified for the best predictor category. Moreover, the analysis also suggested that single subject or biased sample as the most explored limitation across all 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, Demographic details, External variables, Methodological analysis, Weight analysis

Paper type Literature review

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, namely: the Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM), the Motivational Model, the Theory of Planned Behaviour (TPB), a combined TBP/TAM, the Model of PC Utilization, Innovation Diffusion Theory (IDT), and Social Cognitive Theory (SCT). These contributing theories and models have all been widely and successfully utilized 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 organizations, which revealed that the eight contributing models explained between 17 and 53 per cent 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 per cent (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 5,000 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,
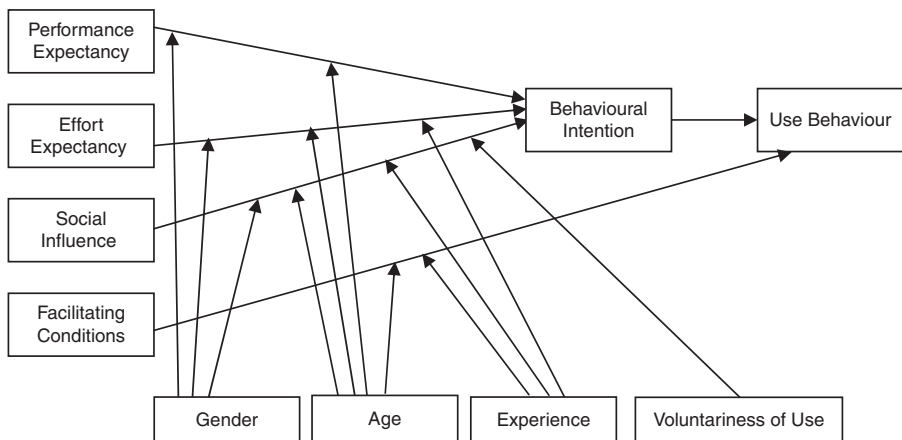

Figure 1.
Unified theory of acceptance and use of technology

Source: Venkatesh *et al.* (2003)

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. 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 I 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 per cent 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.

3.1.2 Contributing universities/institutions and authors. Table II 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 I, 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, US 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.

3.1.3 Most productive departments. Table III 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 III) accounted for 145 of the total of 328 contributing departments.

3.1.4 University affiliation according to country. Table IV presents the 20 countries whose universities contributed the most UTAUT research publications. Of a total of

Prolific authors	University	No. 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

Table I.
Most productive authors

494 occurrences from 36 distinct countries, and 219 unique universities, the highest proportion of work was produced from universities in the USA (No. 140, 28 per cent), followed by some way behind by Taiwan (No. 46), China (No. 43), the UK (No. 38), Belgium (No. 28), Malaysia (No. 26), and Australia (No. 21). The low ranking of

University/institution	No. 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

Table II.
Publications by university/institution

Department/school	No.
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

Table III.
Most productive departments

Researchers' originating country	No.	Researchers' originating country	No.
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
The Netherlands	18	Singapore	4
Germany	16	Slovenia	4
Finland	16	Uganda	4

Table IV.
University affiliation according to country

USA-based universities in Table II and their top ranking in Table IV 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 IV due to space limitations.

3.1.5 Sources of primary data by country. Our findings (Table V) 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 (No. 45), followed some way behind by China (No. 19), Taiwan (No. 17), and then Malaysia (No. 10), Australia (No. 8), India (No. 6), Belgium (No. 5), and Saudi Arabia (No. 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.

3.1.6 Authors' academic backgrounds. In order to examine the academic background of the authors, their associated organizations were divided into three major divisions; academics, public sector, and industry. The findings suggest a summary of the results – unsurprisingly 98 per cent (No. 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.

Country	No.	Country	No.
USA	45	Germany	4
China	19	Canada	3
Taiwan	17	Greece	3
Malaysia	10	Jordan	3
Australia	8	The Netherlands	3
India	6	Qatar	3
Belgium	5	Singapore	3
Saudi Arabia	5	South Africa	3
Finland	5	Total	145

Table V.
Most used countries for primary data collection

3.1.9 Publication outlets for UTAUT researchers. Table VI 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 (No. 6), the European Conference of Information Systems (No. 5), the IEEE Conference (No. 4), and the Hawaii International Conference on System Sciences (No. 4) among others. Similarly, a series of high-ranking internationally recognized journals including *Expert Systems with Applications* (No. 3), *Government Information Quarterly* (No. 3), *Information & Management* (No. 3), and *MIS Quarterly* (No. 3) also appear in Table VI, indicating their willingness to accept and publish UTAUT-based research. In addition to the conferences and journals appearing in Table VI, 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.

3.2 IS research topics and types of systems examined

3.2.1 Keyword analysis. Table VII 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" (No. 79) appeared most often, followed by "Technology Acceptance" (No. 27), "Technology Acceptance Model" (No. 20), "Adoption" (No. 13), "Technology Adoption" (No. 13), "E-Government" (No. 11), "User Acceptance" (No. 11), and "Trust" (No. 9) as some of the other more frequently utilized keywords. In addition,

Journal/conference name	No.
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

Table VI.
Publishers of
UTAUT research
articles

Keywords	No.	Keywords	No.
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
Source: Dwivedi *et al.* (2008)			

Table VII.
Most frequently
used keywords

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 (No. 418) appear once (No. 369) or twice (No. 49), and these aspects are worthy of further exploration.

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 VIII presents details of systems included within each category along with the associated publications.

3.3 Methodological analysis
3.3.1 Research methodology used. Our findings (see Table IX) revealed that only 18 out of 174 studies were longitudinal in nature, the majority of studies (No. 135) using a cross-sectional approach. As far as research methodologies were concerned, survey

Type	No. 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 (2007a, b)
		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 systems	90 (52%)	Internet/Online Banking (10)	Abu-Shanab et al. (2010), Abu-Shanab and Pearson (2007, 2009), Al-Somali et al. (2009), Cheng et al. (2008a, b, c), 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), Pahmila 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), Al Awadhi and Morris (2008), 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)

(continued)

Table VIII.
Systems used in
UTAUT studies

Table VIII.

Type	No. of IS ISs for each category	Associated publication(s)
	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 (2007a)
	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)

(continued)

Type	No. of IS	ISs for each category	Associated publication(s)
Office systems	11 (6%)	Cross-Cultural Information Retrieval (1)	Taksa and Flomenbaum (2009)
		Problem Solving Models (1)	Richardson et al. (2009)
		Web sites (1)	van Schaik (2009)
		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 Amaral (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,b)

(continued)

Table VIII.

Table VIII.

Type	No. of IS	ISs for each category	Associated publication(s)
		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, 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)

Source: 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 1,126 (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)

Source: Lee *et al.* (2003)

Table IX.
Research
methodologies

instrument (No. 155) was most commonly used, followed some way behind by a collection of lesser-used techniques including interview (No. 12), case study (No. 4), field study (No. 3), laboratory experiment (No. 3), and literature study (No. 1). Field study (No. 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.

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 (No. 45) using software such as AMOS (No. 12),

PLS (No. 11), and LISREL (No. 8) or regression analysis (No. 42) using SPSS (No. 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 X illustrates that the UTAUT studies can be divided in four broad categories according to user type or alternative source of data, namely: 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.

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 XI, 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 summarized in Table XI.

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 were extracted from Table XI (and is summarized in Table XII), 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.

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).

User type	No. 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)

Source: Lee *et al.* (2003)

Table X.
Research subjects

Study	PE-BI	EE-BI	SI-BI	FC-BI	FC-U	BI-U
Abu-Shanab and Pearson (2007)	Yes	Yes	Yes	X	X	X
Abu-Shanab et al. (2010)	Yes	Yes	Yes	X	X	X
Aggelidis and Chatzoglou (2009)	X	X	Yes	Yes	X	X
Al Awadhi and Morris (2008)						
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 behaviour	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 (2008)	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

(*continued*)

Table XI.
Results of examining
relationships

Study	PE-BI	EE-BI	SI-BI	FC-BI	FC-U	BI-U
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

Table XI.

(*continued*)

Study	PE-BI	EE-BI	SI-BI	FC-BI	FC-U	BI-U
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 web site	Yes	Yes	No	X	No	Yes
Study 2 – Site 1 – library web site	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

(*continued*)

Table XI.

Study	PE-BI	EE-BI	SI-BI	FC-BI	FC-U	BI-U
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

Notes: 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

Table XI.

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 no. 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

Table XII.
Relationships
between major
UTAUT variables

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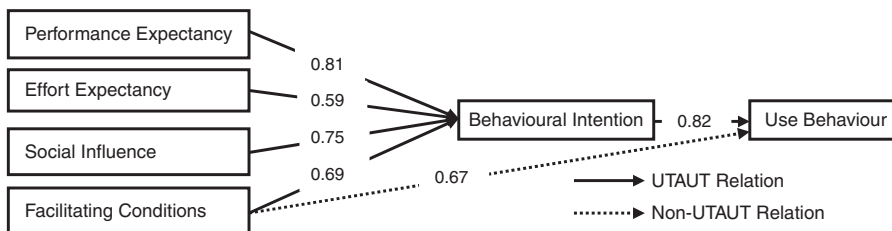
3.5 Analysis of external variables
3.5.1 Relationship of external variables with UTAUT constructs. In the studies we examined, a number of external variables being introduced onto the major constructs of UTAUT. In keeping with the work of Lee *et al.* (2003) and their work on TAM, we illustrate the mapping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

3.5.2 Most frequently used external variables. Table XIII 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.

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, organization, 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 XIV, along with associated references. Nine limitations were reported only in a single study – these are documented in Table XIV in the other limitations category.

Source: Venkatesh *et al.* (2003)
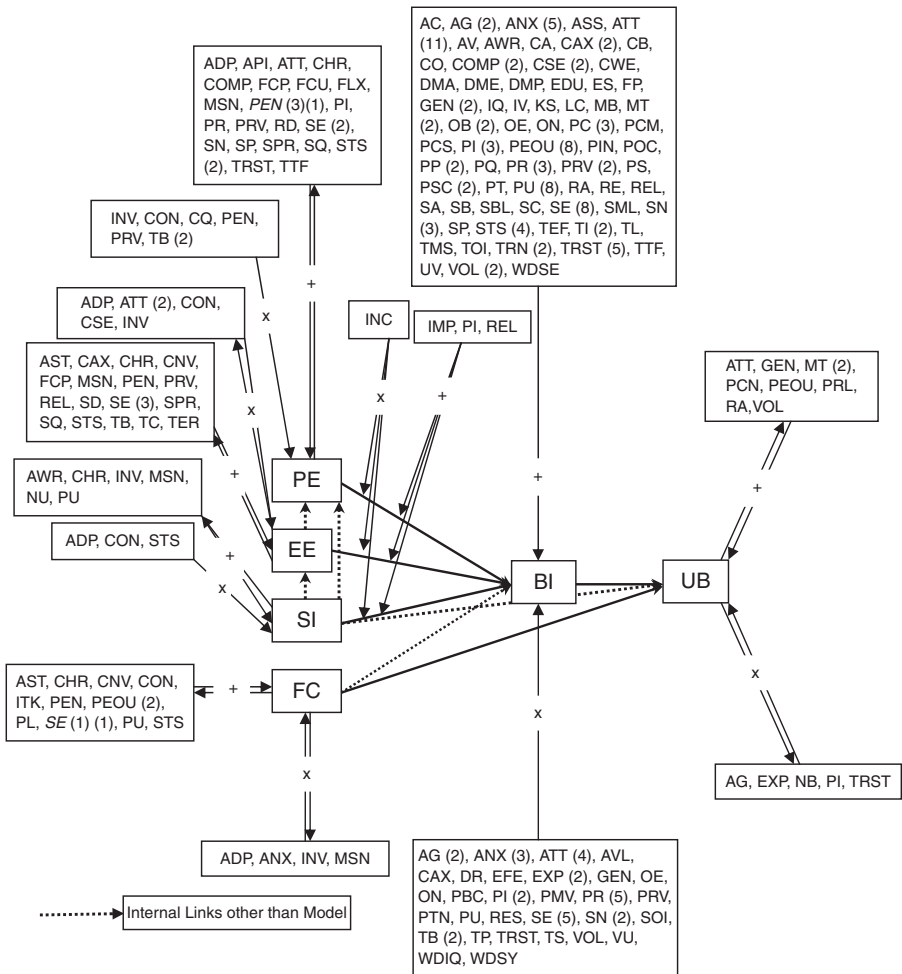
Figure 2.
Weight significance
between UTAUT
constructs

Figure 3.
Diagrammatic
representation of
external variables

Source: Approach adapted from Lee et al. (2003)

3.7 Theoretical and methodological details

Table AI (see Appendix) 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 (six occurrence), TAM2 and the DeLone
and McLean IS Success Model (five occurrences each), IDT and TTF (three
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
AI that the majority of studies used an appropriate sample size, although some
employed small samples with fewer than 50 participants (e.g. BenMessaoud et al.,
2011; Biemans et al., 2005; Lee et al., 2010b; Samoutis et al., 2008). Some authors

EV (no.)	Definition	Origin	Referred articles
SE (21)	The belief that one has the capability to perform a particular behaviour	Bandura (1997)	Hutchison and Bekkering (2009), Johnston and Warkentin (2010)
ATT (20)	Person's evaluation of a specified behaviour	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)	Abu-Shanab *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 towards 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 behaviour 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 judgement 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)

Table XIII.
Variables used in
UTAUT research

EV (no.)	Definition	Origin	Referred articles
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)

Notes: ANX, anxiety; ATT, attitude; CAX, computer anxiety; COMP, compatibility; CSE, computer self-efficacy; EV (no.), 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. Italic indicates the external variables were used across both studies of TAM (by Legris *et al.*, 2003) and UTAUT analysed here.
Source: Lee *et al.* (2003)

Table XIII.

(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, 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, 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 per cent 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

Limitation	No.	Explanation	Studies
Single subject/ biased sample	35	Sample based on only one or limited community, culture, country, organization, 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, 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), Al Awadhi and Morris (2008), 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, 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 (2007a), Im et al. (2008), Or et al (2011), Schaupp et al. (2010), Terzis and Economides (2011), van Schaik (2009), Wu et al. (2007)

(continued)

Table XIV.
Limitations in
UTAUT studies

Table XIV.

Limitation	No.	Explanation	Studies
Self-reported usage	11	Did not measure the actual usage	Abu-Shanab and Pearson (2007, 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	Al Awadhi and Morris (2008), Carter and Schaupp (2009), Im et al. (2008), Johnston and Warkentin (2010), Luo et al. (2010), McLeod et al. (2009a, b), 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^2/ nexplained σ^2	2	Variance not explained	Hung et al. (2007), Teo (2011)
Other limitations	9	(1) Cultural factors not analysed (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 having technical skills	(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)

Source: Lee et al. (2003)

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 (No. 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 per cent 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 organizational 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 per cent) 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 behaviour, 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 behavioural 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

Study	System/software/application type	Sample size	Model(s) used
Abu-Shanab and Pearson (2007)	Internet Banking	523 non-Internet banking customers	UTAUT
Abu-Shanab and Pearson (2009)	Internet Banking	878 bank customers	UTAUT
Abu-Shanab et al. (2010)	Internet Banking	523 non-Internet banking customers	UTAUT
Aggelidis and Chatzoglou (2009)	Hospital Information System	283 employees	UTAUT+TAM
Alapetite et al. (2009)	Speech Recognition System	39 physicians	UTAUT
Al Awadhi and Morris (2008)	E-Government Services	880 students	UTAUT
Al-Gahtani et al. (2007)	Information Technology	722 knowledge workers	UTAUT+Theory of Cultural Dimension
Al-Harby et al. (2010)	Biometrics Authentication System	306 under/post-graduate students	UTAUT
Al-Rajhi et al. (2010)	Information System	*Study not validated yet*	UTAUT
Al-Shafi and Weerakkody (2009)	E-Government Services	216 citizens	UTAUT
Al-Shafi and Weerakkody (2010)	E-Government Services	1,179 citizens	UTAUT
Al-Sobhi et al. (2011)	E-Government Services	750 citizens	UTAUT
Al-Somali et al. (2009)	Online Banking	202 bank customers	UTAUT+TAM2
Ambali (2009)	E-Filing System	300 taxpayers	UTAUT+TAM
Anderson et al. (2006)	Tablet PCs	37 faculty members	UTAUT
Aoun et al. (2010)	Accounting Information System	192 accounting practitioners	UTAUT
Avdic and Eklund (2010)	Reference Databases	150 students	UTAUT
Bandyopadhyay and Bandyopadhyay (2010)	Information Technology	762, 502 professionals	UTAUT
Barati and Mohammadi (2009)	Mobile Banking	*Exploratory Study- data to be collected*	UTAUT+TAM
Barnes and Vidgen (2009)	Corporate Intranet	131 sales and marketing professionals	UTAUT+TAM
BenMessaoud et al. (2011)	Robotic-Assisted Surgery	21 surgeons	UTAUT
Benslimane et al. (2004)	Web Systems for e-Procurement	136 corporate buyers	UTAUT+TAM
Biemans et al. (2005)	Medical Teleconferencing Application	18 nurses	UTAUT
Brown and Venkatesh (2005)	Information Technology	746 households	UTAUT
Brown et al. (2010)	Collaboration Technology	349 SMS users	UTAUT
Butler and Richardson (2008)	iBrainz Technology	47 students	UTAUT
Cabral et al. (2009)	Water Treatment Technology	*No data value collected yet*	UTAUT+TAM
Carlsson et al. (2006)	Mobile Devices/Services	157 subjects	UTAUT

Table AI.
Methodological details

(*continued*)

Study	System/software/application type	Sample size	Model(s) used
Carter and Schaupp (2009)	E-File	260 students	UTAUT
Chan et al. (2010)	E-Government Technology	1,179 citizens	UTAUT
Chang et al. (2007)	Clinical Decision Support System	140 physicians	UTAUT
Chen et al. (2008)	Weblog System	153 students	UTAUT
Cheng et al. (2008a)	Internet Banking	413 professionals	UTAUT
Cheng et al. (2008b)	Internet Banking	313 professionals	UTAUT
Cheng et al. (2008c)	Internet Banking	313 professionals	UTAUT+DeLone & McLean ISS Model
Chisolm et al. (2010)	Electronic Medical Record	71 clinicians	UTAUT
Chiu and Eysenbach (2010)	E-Health Services	46 professionals	UTAUT+Andersen's Behavioral Model
Chiu and Wang (2008)	Web-Based Learning	286 respondents	UTAUT
Chiu et al. (2010)	Online Auctions	412 buyers	UTAUT
Cody-Allen and Kishore (2006)	E-Quality	*Data collection to be done in the future*	UTAUT+DeLone & McLean ISS Model
Cornacchia et al. (2008)	ICT	40 employees	UTAUT
Coss (2009)	Medical Support System	*Data collection to be done in the future*	UTAUT
Curtis and Payne (2008)	Computer-Assisted Audit Techniques	139 professionals	UTAUT
Curtis et al. (2010)	Social Media	409 professionals	UTAUT
Dada (2006)	E-Readiness	328 people from Tanzania +78 from SA	UTAUT
Dadayan and Ferro (2005)	Technology	*Data collection will be done latter*	UTAUT+TAM
Dasgupta and Gupta (2010)	Internet Technology	102 government employees	UTAUT
de Silva and Ratnadiwakara (2009)	Mobile Technology	9,540 telephone users	UTAUT+TAM
Debuse et al. (2008)	Automated Feedback System	8 academic staff	UTAUT
Diaz and Loraas (2010)	Existing Technology	69 students	UTAUT
Dulle and Minishi-Majanja (2011)	Open Access	544 teachers	UTAUT
Duyck et al. (2008)	PACS System	56 professionals	UTAUT
Duyck et al. (2010)	PACS System	203, 159, 362 Physicians-Radiologists	UTAUT
Fitterer et al. (2010)	Health Information System	79 professionals	UTAUT
Foon and Fah (2011)	Internet Technology	200 professionals	UTAUT
Gunther et al. (2009)	Micro Blogging	25 Twitter Users	UTAUT
Gupta et al. (2008)	ICT	102 employees	UTAUT
Hailemariam et al. (2010)	Telemedicine	Physicians and health workers	UTAUT
He and Lu (2007a)	Mobile Advertising	243 mobile consumers	UTAUT+IDT+TTF
He and Lu (2007b)	Mobile Business	74 journal articles	UTAUT+TAM+TPB+TTF

(*continued*)

Table AI.

Study	System/software/application type	Sample size	Model(s) used
He and Wei (2009)	Knowledge Management System	161 professionals	UTAUT
Heerink et al. (2009)	Interface Robot	42 elderly citizens	UTAUT
Heikkila and Smale (2010)	Electronic HRM System	18 HR managers	UTAUT
Hennington et al. (2009)	Electronic Medical Record System	23 Nurses and 4 Nurse Managers	UTAUT
Ho and Chou (2009)	Mobile Podcasting	246 citizens	UTAUT
Huang and Wang (2009)	ERP System	236 professionals	UTAUT+TAM
Huang et al. (2010)	Information Technology	Healthcare professionals from 10 firms	UTAUT
Hung et al. (2007)	E-Government Services	244 citizens	UTAUT
Huser et al. (2010)	EHR Query System	18 human subjects	UTAUT+TAM
Hutchison and Bekkering (2009)	Remote Desktop Application	25 students	UTAUT
Im et al. (2008)	Technologies for Communication	161 subjects	UTAUT+TAM
Jalaldeen et al. (2009)	Knowledge Management Process	*Conceptual model - to be used latter*	UTAUT
Jayasingh and Eze (2009)	M-Coupon System	781 mobile consumers	UTAUT+TAM2
Johari et al. (2010)	Information Kiosk	*Data collection to be done in the future*	UTAUT
Johnston and Warkentin (2010)	Security Information System	275 subjects	UTAUT
Jong and Wang (2009)	Web-based Learning System	606 students	UTAUT
Keller et al. (2007)	E-Learning System	67 students	UTAUT+IDT
Kijsanayotin et al. (2009)	Health Information Technology	1,187 community health centres	UTAUT
Koh et al. (2010)	Software Technologies	333 employees	UTAUT+DeLone & McLean ISS Model
Koivumaki et al. (2008)	Mobile Services	243 mobile consumers	UTAUT
Kourouthanassis et al. (2010)	Mobile Internet Application	139 subscribers	UTAUT+TPB+DOI
Laumer et al. (2010)	Information Technology	323 students	UTAUT
Lee and Lin (2008)	Podcasting	190 students	UTAUT+TAM
Lee et al. (2007)	Forecasting Support System	54 students	UTAUT
Lee et al. (2010a)	Activity Based Management System	112 professionals	UTAUT
Lee et al. (2010b)	DEMATEL	10 professionals	UTAUT+TAM2
Li (2010)	Virtual Knowledge Sharing	41 employees	UTAUT
Li and Kishore (2006)	Online Community Weblog System	265 students	UTAUT
Lin et al. (2004)	Instant Messaging	300 students	UTAUT
Liu et al. (2008)	Internet banking	413 professionals	UTAUT+DeLone & McLean ISS Model +TM
Loo et al. (2009)	Smartcard Application	200 MyKad holders	UTAUT
Louho et al. (2006)	Hybrid Media Application	19 test users	UTAUT

Table AI.

Study	System/software/ application type	Sample size	Model(s) used
Lubrin *et al.* (2006)	Motes	103 anonymous participants	UTAUT
Luo *et al.* (2010)	Mobile Banking	122 students	UTAUT
Mahzan and Lymer (2008)	CAATTs	46 members of IIA-UK	UTAUT
Maldonado *et al.* (2009)	Educational Portal	150 students	UTAUT
Maldonado *et al.* (2011)	Educational Portal	150 students	UTAUT
Marchewka *et al.* (2007)	Course Management Software	132 students	UTAUT
Mayer *et al.* (2011)	Smart Products	166 citizens	UTAUT
McLeod *et al.* (2009a)	Tax Software System	74 professionals and 56 novices	UTAUT
McLoad *et al.* (2009b)	Tax Preparation Software	215 students	UTAUT
Neufeld *et al.* (2007)	Information Technology	209 professionals	UTAUT
Niehaves and Plattfaut (2010)	Internet	192 elderly citizens	UTAUT
Nistor *et al.* (2010)	E-Learning System	732 students	UTAUT
Nov and Ye (2009)	Digital Library	271 students	UTAUT
Or *et al.* (2011)	Web-Based Technology	101 patients	UTAUT+TAM+TPB
Oshlyansky *et al.* (2007)	Validating UTAUT tool	1,489 students from nine countries	UTAUT+TAM
Pahlke and Beck (2009)	Enterprise Mashup System	*Constructs to be operationalized latter*	UTAUT
Pahnila *et al.* (2011)	Auction Site	180 students	UTAUT
Pai and Tu (2011)	CRM Systems	271 professionals	UTAUT+TTF
Pappas and Volk (2007)	Audience Counts & Reporting System	27 independent education organizations	UTAUT
Park *et al.* (2007)	Mobile Technology	221 citizens	UTAUT
Pavon and Brown (2010)	World Wide Web	228 job seekers	UTAUT
Payne (2008)	Web 2.0	338 members of public relations society	UTAUT
Pynoo *et al.* (2008)	PACS System	600, 180 physicians	UTAUT+TAM
Pynoo *et al.* (2011)	Digital Learning Environment	64, 41, 55 teachers	UTAUT
Qingfei *et al.* (2008)	Mobile Commerce	*Data collection and analysis to be done*	UTAUT
Randeree (2009)	Personal Health Record System	128 students	UTAUT
Reunis and Santema (2005)	E-Ordering Application	25 professionals	UTAUT
Richardson *et al.* (2009)	Problem Solving Models	33 students	UTAUT
Sahu and Gupta (2007)	E-Government	163 users of Indian central excise	UTAUT+TAM
Sambasivan *et al.* (2010)	Electronic Procurement System	358 users from various ministries	UTAUT+DeLone & McLean ISS Model
Samoutis *et al.* (2008)	Quality Improvement Intervention	18 patients	UTAUT+TRA+TPB
Sapio *et al.* (2010)	Digital Television	181 citizens	UTAUT
Schaper and Pervan (2004)	ICT	6,500 professionals	UTAUT
Schaper and Pervan (2006)	Technologies	2,870 professionals	UTAUT+TAM
Schaupp *et al.* (2010)	E-File	260 taxpayers	UTAUT

(*continued*)

Table AI.

Study	System/software/application type	Sample size	Model(s) used
Seymour et al. (2007)	Enterprise Resource Planning Systems	59 students	UTAUT
Shamsuddin (2009)	Computer Graphics Technology	46 students	UTAUT
Sharma and Citurs (2004)	Information Technology	*Proposed model would be tested latter*	UTAUT
Shi (2009)	Smart Phone Application Software	653 professionals	UTAUT
Shin (2009)	Mobile Wallet	296 professionals	UTAUT+TAM
Shin (2010)	MVNO Services	296 members of community	UTAUT+IDT+TAM
Song and Han (2009)	Mobile System	570 consumers	UTAUT
Suhendra et al. (2009)	Information Technology	150 SME operators	UTAUT
Suki and Ramayah (2010)	E-Government Services	200 respondents	UTAUT+TAM
Sumak et al. (2010)	Virtual Learning Environment	235 students	UTAUT
Taksa and Flomenbaum (2009)	Cross-Cultural Information Retrieval	20 Web sites	UTAUT
Tan and Wu (2010)	Mobile Commerce	300 students	UTAUT+TAM
Tavares and Amaral (2010)	Peer-to-Peer Academic Networks	10 interviews from users and non-users	UTAUT
Teo (2011)	Intention to Use Technology	592 teachers	UTAUT+TAM+TPB
Terzis and Economides (2011)	Computer Based Assessment Model	173 students	UTAUT+TAM+TPB
Tibenderana et al. (2010)	Hybrid Library Services	445 staff and students	UTAUT
Trimmer et al. (2008)	Electronic Medical Record Systems	*Data collection in process*	UTAUT
Tsai et al. (2009)	Learning Behaviour Formation	759 students	UTAUT+SCT
Udeh (2008)	Wi-Fi System	129 respondents	UTAUT+TAM
Uzoka (2008)	E-Commerce	150 organizations	UTAUT
van Biljon and Kotze (2008)	Mobile Phone	59 students	UTAUT+TAM
van Biljon and Renaud (2008)	Mobile Phone	34 elderly citizens	UTAUT
van Dijk et al. (2008)	Government Internet Services	1,225 respondents	UTAUT
van Raaij and Schepers (2008)	Virtual Learning Environment	45 students	UTAUT+TAM+TAM2
van Schaik (2009)	Web sites	118, 121 students	UTAUT
van Setten et al. (2006)	Recommender System	1,872 television viewers	UTAUT
Venkatesh et al. (2008)	New System Use	321 employees	UTAUT+TAM2
Verhoeven et al. (2010)	ICT	714 students	UTAUT
Wang and Shih (2009)	Information Kiosks	244 respondents	UTAUT
Wang et al. (2009)	Mobile Learning	330 Respondents with IT experience	UTAUT
Wang et al. (2010)	Mobile Internet	343 respondents	UTAUT
Weerakkody et al. (2009)	E-Government	1,179 citizens	UTAUT
Whitten et al. (2009)	Telehospice	25 employees	UTAUT
Wills et al. (2008)	Electronic Medical Record	52 professionals	UTAUT

Table AI.

Study	System/software/ application type	Sample size	Model(s) used
Wu *et al.* (2007)	3G Mobile Communication	394 professionals	UTAUT
Wu *et al.* (2008)	3G Mobile Telecommunication	394 professionals	UTAUT
Wu *et al.* (2010)	Educational Technology System	240 students	UTAUT+TAM
Xu and Gupta (2009)	Location-Based Services	101 students	UTAUT
Yang (2010)	Mobile Shopping Services	400 mobile consumers	UTAUT
Yang *et al.* (2008)	Software Cost Estimation	116 organizations	UTAUT
Yao and Murphy (2007)	Remote Electronic Voting Systems	453, 253, 196 voters	UTAUT+TAM
YenYuen and Yeow (2009)	Internet Banking	280 general users	UTAUT
Yeow and Loo (2009)	ATM and Transit Application	500 MyKad holders	UTAUT
Yeow *et al.* (2008)	Online Banking Service	190 respondents	UTAUT
Zhang *et al.* (2010)	Mobile Search Service	195 students	UTAUT+TTF
Zhou (2008)	Mobile Commerce	250 mobile commerce users	UTAUT
Zhou *et al.* (2010)	Mobile Banking	250 students and professionals	UTAUT+TTF

Notes: CAATTs, Computer-Assisted Audit Tools and Techniques;, DeLone & McLean ISS Model: DeLone and McLean IS Success Model, DEMATEL: Decision Making Trial and Evaluation Laboratory System, ICT: Information and Communication Technology, IDT: Innovation Diffusion Theory, TM: Trust Model, TTF: Task Technology Fit. Italic font, under sample size indicates that sample data have not been collected, analysed, or validated
Source: Legris *et al.* (2003)

Table AI.

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