

2011

A Preliminary Introduction to the OTAM: Exploring Users' Perceptions of their on-going Interaction with Adopted Technologies

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This article was originally published as: Knight, S., & Burn, J. M. (2011). A Preliminary Introduction to the OTAM: Exploring Users' Perceptions of their on-going Interaction with Adopted Technologies. *Australasian Journal of Information Systems*, 17(1), 5-41. Original article available [here](#)

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A Preliminary Introduction to the OTAM: Exploring Users' Perceptions of their on-going Interaction with Adopted Technologies

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ABSTRACT

A common criticism directed at Davis' (1986; 1989) Technology Acceptance Model relates to its failure to adequately frame the "experienced" user's ongoing adoption and exploitation of information technologies. Given the pervasive nature of technology into individual users' ongoing, everyday communication and information interactions, along with the "new adopter" becoming an increasingly rare entity, the TAM is in danger of becoming a somewhat obsolete framework for investigating user-technology interaction.

Presented is critical analysis of the development and current state of the TAM, followed by a proposed addition to the existing Perceived Usefulness (PU) and Perceived Ease of Use (PEoU) TAM constructs. The paper contends that the inclusion of a Perception of Interaction (PoI) construct allows researchers to develop an investigative framework which facilitates an exploration of users' ongoing perceptions of the predictability of their technology interaction processes.

KEYWORDS: Technology Acceptance Model, TAM, Ongoing Technology Acceptance Model, OTAM, Perceived Usefulness, PU, Perceived Ease of Use, PEoU, Perception of Interaction, PoI.

INTRODUCTION

Since its first introduction to Information Systems (IS) research, the Technology Acceptance Model (TAM) (Davis, 1986; 1989; Davis *et al.*, 1989) has been explored in literally thousands¹ of research papers. Based largely on Ajzen & Fishbein's (1980) Theory of Reasoned Action (TRA) – a social psychology model concerned with the determinants of consciously intended behaviours – the TAM postulates that two user perceptions, namely; *Perceived Usefulness* (PU) and *Perceived Ease of Use* (PEoU); shape users' intended behaviours towards their adoption of specific technologies.

As a model for user information system adoption, the TAM has now been tested and extended by a multitude of researchers for some twenty years (Adams *et al.*, 1992; Agarwal & Jayesh, 1999; Brown *et al.*, 2002; Burton-Jones & Hubona, 2006; Chau, 1996; Dishaw & Strong, 1998; Lederer *et al.*, 1998; Liaw & Huang, 2003; Mathieson, 1991; McFarland & Hamilton, 2006; Moon & Kim, 2001; Shih, 2004; Taylor & Todd, 1995; Teo, Lim & Lai, 1999; Venkatesh & Davis, 2000). In that time, the model has acquired various evolving states (Lee, Kozar & Larsen, 2003) being protracted and validated – albeit to varying degrees – with a variety of other constructs as a way

of both; (1) reckoning whether PU and PEOU tell the entire story of user technology adoption; and (2) to determine if other constructs might act as antecedents to PU and PEOU. Clearly, that the model has been tested so extensively adds to its rigour, yet also serves to highlight that researchers’ continue to feel uncomfortable with the notion that PU and PEOU represent an adequate description of the motivating factors for user technology adoption, particularly in relation to the continued, or on-going, adoption of technologies.

It is in the context of this growing disquiet regarding the adequacy of the TAM constructs (Bagozzi, 2007; Benbasat & Barki, 2007; Straub & Burton-Jones, 2007) that the author set out to;

- 1.) Theoretically examine the current constructs of the TAM, in order to determine whether they are able to examine users’ ongoing adoption of technology;
- 2.) Develop a qualitative analysis of a TAM driven survey, designed to investigate a technologically experienced user-group’s attitudes and perceptions of Web-based search engine technology.

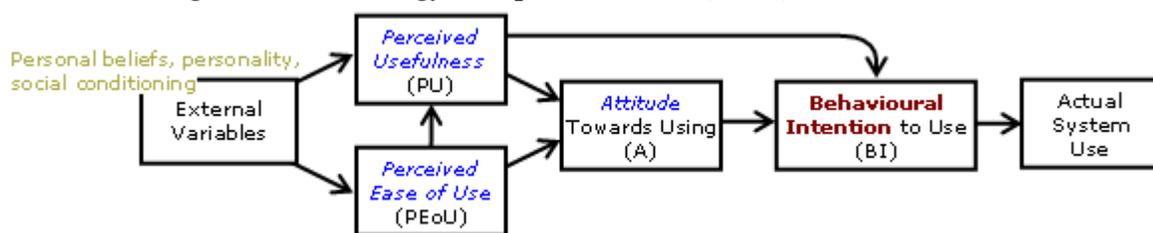
The paper discusses the theoretical inclusion of a third major construct – Perception of Interaction (PoI) – to the existing TAM, designed to measure users’ perceptions of the *predictability* of their ongoing interactions with their adopted technologies. The evolution of the PoI construct’s inclusion into the TAM is discussed in the context of the design and analysis of user-data associated with the research project “*name of research project withheld in order to protect identity of author*” (Withheld, 2007).

THE TAM: A HISTORICAL SUMMARY (Literature Review)

The beginnings of the TAM

The main supposition of Davis’ (1986, 1989) model, was that PU & PEOU were the primary influencing variables in individual user’s attitudes and therefore *intention* to engage technologies. Davis *et al.*, further stated (1989) that PEOU indirectly influenced Behavioural Intent (BI) through its effect on PU. Attitude – as a construct – was, by and large, bi-passed, assumed to be “positive” (i.e.; not variable-driven) in that users intention to engage technology at that time, was largely volitional.

Figure 1: Technology Acceptance Model (TAM) Davis et al 1989



Mathieson (1991), in comparing the TAM to the Theory of Planned Behaviour (TPB) (Ajzen, 1991), contended that the TAM, although statistically sound – and far more simple to use than the TPB – had a tendency to over-simplify important predictors of behavioural intention, particularly in relation to users who experience initial difficulties with their systems use. Mathieson concluded that TPB could be used to fill-in-the-gaps of the TAM if the two models were used together in investigating users intended technology adoption. Adams *et al.* (1992) like Mathieson, advocated the inclusion of additional constructs to TAM’s PU and PEOU, namely

Perceived Inabilities as a negative predictor of user attitude and BI.

Extending the TAM: Constructs for Mandated Technologies

Taylor & Todd (1995) reintroduced the TRA's *subjective norm* (SN) construct to the TAM's PU and PEOU in the context of the increasingly mandated technology use imposed on users by business and organisations through the 1990's. The "early adopters" of Davis' original TAM, who did not need the added social influence of colleagues and other professionals had now been replaced by a typical user who felt somewhat pressured to adopt technologies. Taylor & Todd added the construct of Perceived Behavioural Control (PBC) as a means of quantifying users previous experiences with technologies, which by replacement, devalued the *attitude* construct in the TAM paradigm.

Extending The TAM: Constructs for the World Wide Web

By the time Lederer *et al.* (1998), Agarwal & Jayesh (1999) and Teo *et al.* (1999) published their TAM variations, the World Wide Web had become an established information systems environment. Once again, users were seen as having a greater degree of choice in the how, why and when of technology adoption, and the principles of TAM were found to apply relatively well to the prediction of technology use. With the increasing variables between typical user characteristics however, what Davis (1989) had termed "external variables" in the original TAM began to be explored with greater vigour. Individual Differences (IDV) in users (Agarwal & Jayesh, 1999), and task variables (Lederer *et al.*, 1998) were investigated in conjunction with TAM to examine their relationship with the PU and PEOU constructs. Teo *et al.* (1999) went as far as introducing a new construct, *Perceived Enjoyment* (PE) to investigate the "entertainment" attributes of the World Wide Web.

The various extensions of the TAM, including Dishaw & Strong's (1998) integrated TAM/TFF (Task Technology Fit) model, led to Venkatesh and Davis' publication of TAM II (2000). This was an attempt by the authors to address the issues raised by multiple researchers during the 1990's. Seen by its authors' as a definitive paper, Venkatesh and Davis (2000) contended that many of the additional constructs introduced to the TAM, including constructs like perceived enjoyment could easily be classified within the PU or PEOU constructs. They did, however, reinforce the inclusion of subject norm (SN) elements to explain systems usage in mandated situations.

Despite the TAM II paper, the meteoric growth of Web usage since the late 1990's however, continued to facilitate the rush of papers perpetually adding constructs to the TAM, including;

- Moon & Kim's (2001) *Perceived Playfulness* (PPlay);
- Chau's (2001) *Computer Attitudes* (CA) – introduced specifically to test the role of prior computer experience in technology adoption; *and*
- Liaw & Huang's (2003) *Individual Differences* (IDV) and *System Quality* (SQ) – introduced to investigate the growing divergence in quality standards of computer technologies available on the Web.

Generally speaking, these construct additions were seen as "extensions" to the TAM model, rather than something which could fundamentally evolve the model.

Extending The TAM: Considering User Individual Differences

Shih (2004) pushed Liaw & Huang's ideas further, applying the TAM specifically to the growing

Internet activity of Web search and Information Retrieval (IR). SQ was replaced by such constructs as *Perceived Performance* (PP) of the software engaged by the user (in this case Internet search engines) and *relevance* (R) of system results to user information searching behaviours. This emphasis on PP and relevance judgments introduced post-adoption constructs to the TAM. That is; *perceived performance becomes a predicting construct for the choice of system/task relevance and information strategies the next time the user wishes to perform information retrieval*. Although not demonstrated in Shih's model explicitly, the model at least begins to imply an iterative, cyclical process to user adoption of technologies. This is because successful Web searching is a strategy related task, that often requires the searcher to improvise based on the search results obtained (Quinn, 2003). Part of that improvisation is the natural flow of thoughts associated with a searcher's own self-perceptions of the effectiveness of their strategies. This is a highly cognitive process, involving subjective variables such as; human memory (Fugmann, 1973; Cox, 1999; Quinn, 2003; Macpherson, 2004; Xu, 2007); motivation (Bilal & Kirby, 2002; Ford, 2004); attention (Vakkari, 1999; Woodroof & Burg, 2003; Benoît, 2004; Anderson, 2005); concentration (Spink, 2004; Kuhlthau, 2005); anxiety (Yee, 2004); and self-efficacy (Quinn, 2003; Yee, 2004). As an efficacy related process, Web search is also easily compromised by feelings of self-doubt or negative perceptions regarding the system or results of a search (Quinn, 2003).

The proliferation of home-users with access to the Web, introduced the processes of electronic informational retrieval to a population of end-users who have had little to no formal training in the use of such technologies (Wang, Berry & Yang, 2003). This is reflected in the, at times, seemingly ineffectual use of Internet search engines, despite clear help systems accompanying most search engines (Barnett, 1999). The constantly returning search engine audience, regardless of the success or non-success of user/search-engine engagement, suggests that user perceptions regarding what Shih called *perceived performance*, is tempered by users' own self-perceptions of their information retrieval effectiveness. In regards to the task of Web-based IR, it would appear *users are prone to attributing perceived performance on their own information behaviour*, rather than the effectiveness of the search engine system (Withheld, 2007).

The full effects of highly *individual* characteristics such as anxiety and self-efficacy on the PU and PEOU constructs of the TAM are only now beginning to be discussed within the TAM literature, particularly in relation to TAM and the World Wide Web. These are the "external variables" alluded to by Davis (1989) in the original versions of the TAM.

Extending The TAM: Considering Context

McFarland & Hamilton, (2006) contend that any reasonable investigation into the TAM should acknowledge the context specificity of the case in question, by modeling the external variables present. PU and PEOU were still seen as central to the TAM, but computer-efficacy (CE) and systems usage (SU) were included as constructs that are mediated by the various external variables previously introduced to the TAM model. There was still no explicit indication of any cyclical or feedback mechanisms in the model, which the current author contends is an inherent weakness of the TAM model. Burton-Jones & Hubona (2006) also advocate the mapping of individual differences within a user-group in order to establish their impact on the TAM's PU and PEOU constructs. The complexity of the 'usage' construct, i.e., *technology usage*, was described in terms of both IS-Usage (volume) and IS-Usage (frequency).

THE PROBLEM IS...

“the original TAM has outlived its usefulness”

(Benbasat & Barki, 2007)

The extending and flexing of the TAM paradigm required to include the various individual differences of users served to highlight some of the short-falls of the model, particularly in relation to the TAM's heavy weighting towards the *new* use and adoption of information technologies. It was found that the model could not fully address users' "learned" or "habitual" behaviours. Subsequent computer-use research has indicated a strong causative relationship between such user attributes as *habit* with technology usage (Verplanken, *et al.*, 1998; Gefen, 2003; Limayem, Hirt & Cheung, 2003). This is problematic for the TAM, since habit is a condition said to bi-pass behavioural intention (BI), a central construct of the original TAM paradigm. The implication of this, is that *PU and PEOU may fail to capture the true complexity of the user/system interaction taking place.*

Without a strong body of literature investigating such phenomena as; (1) how users develop PU and PEOU; (2) how PU and PEOU impact behaviour beyond influencing BI; (3) how on-going BI or behavioural outcomes might impact (in a type of feedback loop) PU and PEOU; or (4) how PU and PEOU might change and evolve with on-going systems usage; two decades of TAM investigations have remained somewhat two-dimensional and, by and large, simply served to reiterate initial findings of the model, *the importance of PU* (Benbasat & Barki, 2007).

Some IS researchers, such as Benbasat & Barki (2007) have recently advocated abandoning TAM related research, returning instead to the roots of the TAM, the TRA (Ajzen & Fishbein, 1980) and (later) Theory of Planned Behaviour (TPB) (Ajzen, 1991); in an effort to better understand user engagement of technologies. The problem with such an approach is that both the TRA and TPB (along with the TAM) fall short of providing a framework to investigate users on-going and self-regulatory behaviours involved in their decision making processes (Bagozzi, 2007). Moreover, the pre-supposed link between each of the models' salient belief constructs and user BI, remains central, and unquestioned, within each model. The result is three models that are unable to account for salient constructs that may *bi-pass* user BI.

It is the author's contention that human behaviour is far more complex than a linear, causal relationship between users' salient beliefs, (*which*) influence behavioural intention, (*which*) equals behaviour. This linear-relationship approach to much IS-based research into user engagement with technologies does not lend itself to understanding the complex relationships between;

- 1.) User beliefs and behaviour intentions;
- 2.) Behaviour intentions and actual behaviour – particularly when intention does not lead to expectant behaviours;
- 3.) Behaviour outcomes and evolving user beliefs;
- 4.) Behaviours that bi-pass intentions; *or*
- 5.) Behaviours that occur outside of user beliefs and/or intentions

Information System adaptations of both the TRA and TPB, like the TAM, adhere to what the

author considers a flawed paradigm, which fails to provide a framework for investigating;

- 1.) Non-intended (or unconscious) behaviours;
- 2.) How previous behaviours might cause habitual behaviour;
- 3.) How habitual behaviours might supersede salient beliefs; *and*
- 4.) How on-going usage might impact on, or evolve, salient beliefs.

In this context, the author proposes a shift in the TAM paradigm, which will provide a more useful research framework with which to investigate the relationships between user beliefs and their decision making processes in on-going technology usage.

ADJUSTING THE PARADIGM: Introducing the OTAM

Straub & Burton-Jones (2007) describe the current state of TAM related research as a “logjam” and advocate the need to examine the constructs of the TAM more closely in order to improve the conceptual understanding of the major constructs in the model. This view is echoed by Benbasat & Barki (2007) who assert the restrictive nature of the TAM’s PU and PEOU constructs provide no mechanism for the inclusion of other user perceptions or salient beliefs. The result has been almost two decades of self-justified “extensions” of the TAM whenever researchers propose the inclusion of additional or alternative user belief constructs.

While some authors have proposed a complete shift away from the TAM (Benbasat & Barki, 2007; Bagozzi, 2007), it is the author’s contention that PU and PEOU, if examined conceptually, are still able to provide a useful tool in examining user perceptions of the technologies with which they engage. To that end, the remainder of this paper discusses an *inductive analysis* of the TAM results of eighty users, who regularly engage Web-based search engines in the retrieval of high-quality information. The process of data analysis will be presented with respect to the emergence of the “OTAM” (On-going Technology Acceptance Model) as representing a more useful framework by which to investigate users’ on-going adoption of Web IR technologies.

THE RESEARCH: Methodology & Research Framework

Methodology

A mixed-methodological approach (described in Withheld, 2009) was developed in order to allow a largely inductive analysis of the quantitative data associated with the TAM study. Users were asked to complete one registration form and four separate surveys relating to;

- 1.) Their perceptions of their interactions with Web-based search engines in the context of the two main TAM constructs, PU and PEOU (2 x surveys);
- 2.) Their common Information Seeking Behaviours (ISB) and Information Retrieval (IR) strategies when searching for information on the Web; *and*
- 3.) Their perceptions and value judgements in relation to the Information Quality (IQ) of the information they encountered during their searching.

For the sake of consistency, multiple choice surveys were used for all four surveys, with a total of 126 questions asked of each participant. Twenty four of those questions related to TAM. User TAM results were then inductively analysed in the context of a number of constructed “group-cases”. The constructed group-cases were developed from users’ results to non-TAM questions

in the surveys and registration form, for example; gender; information task; cognitive expectancy; user-role; and self-efficacy, to name a few.

Importantly, as part of an inductive approach to data analysis, the group-cases were not considered as mere “partitions” of the survey data. Each group-case was, in fact, chosen and analysed carefully according to existent theory of specific phenomena, in an effort to develop a rich picture of the user results. The inter-disciplinary research model proposed by [Wilson \(1997\)](#), and adopted as a framework for the current research, implores researchers to properly investigate the theory behind any driving constructs used to partition user data. Accordingly, this behoves the researcher to examine partitioned data more thoroughly, recognising that each cluster of data is not only an imposed construction, but part of a potentially rich data-set that provides multiple contexts from which to investigate the complexities of human/computer interaction (HCI).

Although still numbering in the very small minority, qualitative analysis is not completely foreign to TAM studies, with researchers – particularly of late – taking this approach ([Gerrard, Cunningham & Devlin, 2006](#); [Lin, 2006](#)) in an effort to address the large number of TAM related studies that have merely served to replicate previous studies ([Lee *et al.*, 2003](#); [Benbasat & Barki, 2007](#)) without producing anything significantly new ([Bagozzi, 2007](#)).

The problem with TAM, as an investigative framework, is that it has become a victim of its own success. So narrow in its methodological variance as to become its own paradigm ([Straub & Burton-Jones, 2007](#)) with few researchers venturing to investigate its constructs using different research approaches ([Sharma, Yetton & Crawford, 2004](#)). Unfortunately, the result is a model shallow in its ability to actually explore what PU and PEOU effectively mean ([Bagozzi, 2007](#)). Moreover, when the same methodology is applied to users’ complex individual behavioural differences within the context of a TAM study, nothing of any depth can be discovered or added to the model.

[Bagozzi \(2007\)](#) contends that almost “no research has deepened TAM in the sense of explaining PU and PEOU”, going as far as to call the current extensions of the TAM as “conceptually impoverished”. The author agrees unequivocally with Bagozzi, that a significant reason for this famine in deeper understanding of the driving constructs of the TAM could well be the dearth of research approaches designed to investigate the “why” of the interaction aspects of the TAM.

The current research therefore does not take the standard statistical analysis approach usually associated with TAM, but seeks to develop theoretically sound sets of data which will allow the author to more closely examine variations in users’ results.

The TAM Surveys

The overall study associated with the current research sought to investigate user perceptions of information quality (IQ), and information seeking behaviour (ISB) in the ‘open’ information environment of the Web. The TAM component was used to examine users’ attitudes towards the Web technologies they engaged in order to search for and retrieve the high quality information associated with their work and research as ‘academics’ and ‘post-graduate’ level students. Two TAM surveys were administered, each containing twelve questions, and investigating users’ general attitudes towards;

- 1.) Information retrieval using Web-based search engines (*12 questions*); and
- 2.) Retrieving high quality information from the World Wide Web (*12 questions*).

The driving constructs at this point of the research were PU and PEOU, with six questions in each survey concentrating on elements, or characteristics associated with each construct. Results were then placed together, so that each of the six elements of the PU and PEOU constructs was addressed twice, the ultimate score for which was then averaged between the two results. Results were combined because the investigation sought to examine users' perceptions and attitudes regarding the information behaviour for which they were engaging the technology, rather than simply gaining an understanding of their attitude towards Web search-engines in general.

Within the PU construct, questions relating to such elements as search engine *results*, *effectiveness*, *productivity* and *speed* were addressed. Within the PEOU construct, questions relating to such elements as *task ease* (i.e.; find-ability and locate-ability), *clarity* and *flexibility* were addressed. Questions were all asked in the "positive", and a standard seven-point multiple choice (highly likely through highly unlikely) applied. Table 1 presents the questions asked in the TAM surveys and the constructs those questions were designed to measure.

Table 1. TAM (PU & PEOU) Questions for the current research

Construct	Survey	Question
PU	Survey #1:	Q26. Using the WWW would enable me to accomplish research related tasks more quickly
	Survey #1:	Q27. Using the WWW would improve my research results and performance
	Survey #1:	Q28. Using the WWW would increase my productivity
	Survey #1:	Q29. Using the WWW would enhance my effectiveness as a researcher
	Survey #1:	Q30. Using the WWW would make it easier for me to do my research
	Survey #1:	Q31. I would find access to the WWW useful for my research
PEOU	Survey #1:	Q32. Learning to find information on the WWW would be easy for me
	Survey #1:	Q33. I would find it easy to locate information I am looking for on the WWW
	Survey #1:	Q34. My interactions with information on WWW Websites would be clear and understandable
	Survey #1:	Q35. I would find the WWW flexible to interact with
	Survey #1:	Q36. It would be easy for me to become skilful at using the WWW
	Survey #1:	Q37. I would find WWW technologies easy to use
PU	Survey #2:	Q38. Using the WWW would enable me to locate quality information more quickly
	Survey #2:	Q39. Using the WWW would improve the quality of my research results
	Survey #2:	Q40. Using the WWW would make me more productive
	Survey #2:	Q41. Using the WWW would enhance my ability to find quality information
	Survey #2:	Q42. Using the WWW would make it easier for me to find quality information
	Survey #2:	Q43. I would find access to the WWW useful for retrieving quality information
PEOU	Survey #2:	Q44. Learning to find quality information on the WWW would be easy for me
	Survey #2:	Q45. I would find it easy to locate quality information from non-quality information as I search on the WWW
	Survey #2:	Q46. The steps necessary to select quality info from search results would be clear and understandable
	Survey #2:	Q47. I would find the WWW flexible when locating the type of information I am looking for
	Survey #2:	Q48. It would be easy for me to learn how to find quality information on the WWW
	Survey #2:	Q49. I would find searching for quality information easy to do

The "Group-case" Constructs (Units of Analysis)

Classification of the constructed data-sets were both pre-defined (from previous literature and findings) at the survey design phase of the research; and evolutionary, as some group-case characteristics only became apparent after results were examined and collated. This is consistent with other examples of inductive approaches to research (McClintock *et al.*, 1979; Eisenhardt, 1989).

User results discussed in the current paper fall into the following partitioned constructs, including;

- 1.) User (prior) *experience* (Palmquist & Kim, 2000; Hyldegaard & Seiden, 2004);
- 2.) User *cognitive style* (Palmquist & Kim, 2000; Workman, 2004);
- 3.) User *motivation* to use search engines (motivated, obliged or habitual) (Venkatesh, 1999; Liaw, 2002 & 2005; Chung & Tan, 2004);
- 4.) User pre-supposed *expectancy* of search engine results (Zhang & von Dran, 2001);
- 5.) User self-efficacy (Liaw, 2002; Quinn, 2003; Yee *et al.*, 2004);
- 6.) User task/system confidence (Liaw, 2002; Pace, 2004);

Importantly, in the context of an inductive approach to data analysis, the use of these constructed group-cases is embedded in existent theory as it is not enough to simply present the statistical variance between the clustered sub-groups of users. Each “group-case” presents a context in which to investigate complex cognitive and emotive human behaviour and its possible impact on PU and PEOU. This type of data analysis gives the researcher the opportunity to (1) examine phenomena from multiple perspectives (Stake, 1995; Dooley, 2002); (2) enable a more thorough analysis of the complex constructs chosen to partition data (Adam, Howcroft & Richardson, 2004; Eisenhardt, 1989); and (3) more closely scrutinise the possible co-relationships between the constructs and/or user results (Yin, 1994; Dooley, 2002).

Ultimately, inductive analysis of quantitative measurable data, an example of which is the current research, can provide the researcher with a desirable blend between a large data-set, bound in its collection to the validity scrutiny of quantitative research, and the opportunity to build theory through investigating phenomena from multiple perspectives.

THE INVESTIGATION: A Deeper Analysis

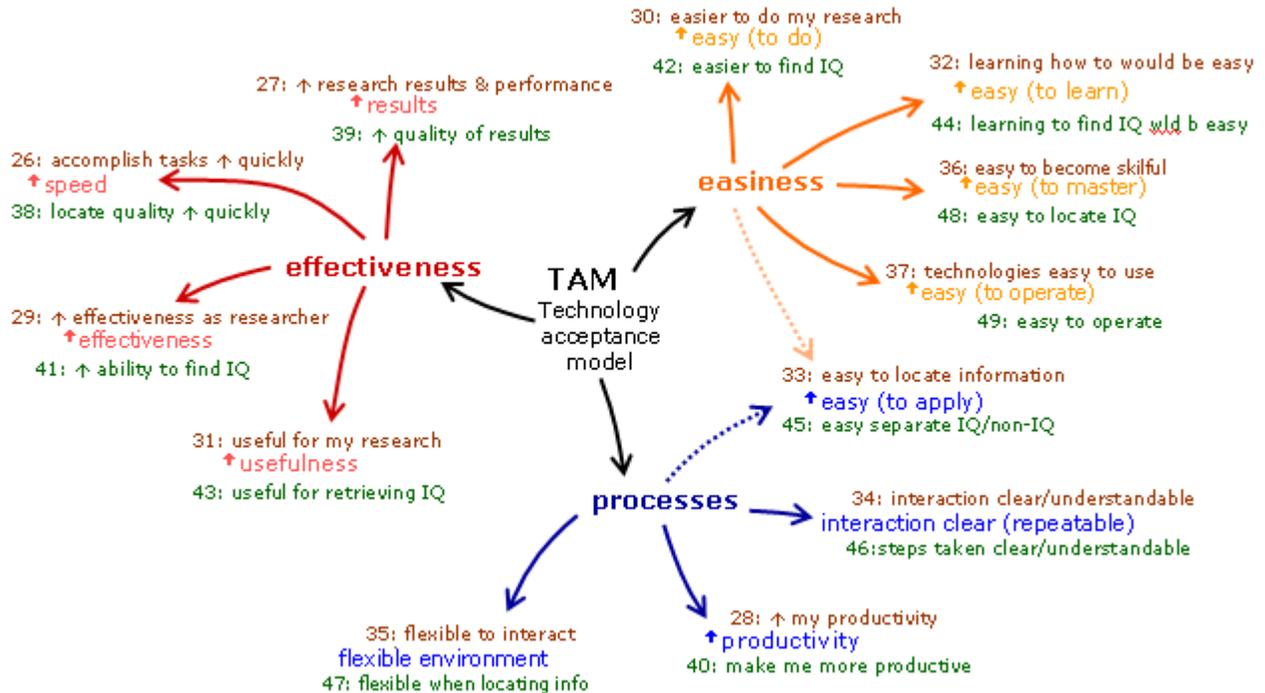
Mapping the Measurement: The development of the PoI construct

By taking a more inductive approach to data analysis, the author – safe in the knowledge that data collection had closely followed an existing, valid model – was able to move out of existing TAM analysis methods, and examine the data with fresh eyes. The author went back to the drawing board, so to speak, and began to scrutinise what user-driven constructs had actually been surveyed. It became apparent to the author that elements of the PU and PEOU constructs contained their own ambiguity regarding which construct was being tested. Amongst the PU questions, for example, was the question “*Using the WWW would make it easier for me to do my research*”. This question was asked in the context of easy accessibility to search engines being perceived by a user as being useful. So, although this was clearly a question asking directly about PEOU, the context, and therefore construct being measured, PU.

This ambiguity of TAM’s constructs is both a weakness and strength of the model. There are many user attitude constructs that can, and do, exist in their own right, which can be explained or classified as PU and/or PEOU. Examples of this include the social normative element, which can be classified within the PU construct, or perceived enjoyment (PE) elements, which can be classified within the PEOU construct.

In order to determine what perceptions were actually being measured, the researcher developed a mind-map, illustrated in figure 2, of each element. PU elements became labelled as measuring a user’s perception of the “*effectiveness*” of an interaction, PEOU was labelled as measuring a user’s perception of the “*easiness*” of an interaction, and a third construct relating to “*processes*” was classified, which measured a user’s perception of the understandability and repeatability; or “*predictability*” of an interaction.

Figure 2. A mind-map of the elements being measured by the TAM constructs



The elements identified in figure 2 became a guide for clustering user-results into three specific constructs. It should be stated here however, that each classification still possesses a degree of ambiguity in that some elements being tested could fall into more than one construct. For example; “*easy (to apply)*” could be included as either an “*easiness*” or a “*processes*” element, because it can refer to either the easiness or repeatability of an action.

Table 2 presents the TAM questions in the context of the mind-map’s constructs and the elements determined to be being measured by each question. Effectiveness and easiness were once again classified as PU and PEOU respectively, and process related elements were classified as *Perception of Interaction* (PoI).

The need for an ongoing/interactive construct

By and large, the TAM is used in deductive research to *quantifiably* measure and predict users’ intention to use an information system or technology, based on their attitudes towards the system (Ragunathan, 1999; Lin & Lu, 2000; King & He, 2006; Kwon Choi & Kim, 2006). This presents two problems for IS research. Firstly, its framework limits a researcher’s investigation of complex human attitude constructs such as PU and PEOU to a statistical analysis of their relative impact on user behaviours, without providing a framework for investigating the hither-to unquestioned relationship between behavioural intent and actual behaviour (Bagozzi, 2007). Moreover, it fails to provide researchers’ with a scaffold to more fully investigate what PU and

PEoU actually are (Benbasat & Barki, 2007). Secondly, TAM was designed to test users' early adoption of various information technologies and systems (Kim & Malhotra, 2005; Wang, Lin & Luarn, 2006), which highlights a generally accepted limitation of TAM (Karahanna & Straub, 1999; Bhattacharjee, 2001; Limayem *et al.*, 2003), that it now requires a change in focus if being employed to investigate on-going, or continued technology/systems usage. The user group associated with the current research, does not fit into the early adoption category, with no single user possessing less than three years experience interacting with Web search engines. Given the pervasive, and therefore expected, role technology plays in daily information transactions, this is most likely the case for other user groups associated with much contemporary research.

Notwithstanding these issues, TAM still provides a framework to begin investigating the useful concepts associated with the model, particularly if a researcher is courageous enough to develop a deeper analysis of the constructs involved.

Table 2: TAM Constructs being measured by the current research

TAM Construct	Mind-map classification	Element being measured	Question		
PU	effectiveness	Speed	Survey #1: Q26. Using the WWW would enable me to accomplish research related tasks more quickly		
			Survey #2: Q38. Using the WWW would enable me to locate quality information more quickly		
		Results	Survey #1: Q27. Using the WWW would improve my research results and performance		
			Survey #2: Q39. Using the WWW would improve the quality of my research results		
		Effectiveness	Survey #1: Q29. Using the WWW would enhance my effectiveness as a researcher		
			Survey #2: Q41. Using the WWW would enhance my ability to find quality information		
		Usefulness	Survey #1: Q31. I would find access to the WWW useful for my research		
			Survey #2: Q43. I would find access to the WWW useful for retrieving quality information		
		PEoU	easiness	Easy (to do)	Survey #1: Q30. Using the WWW would make it easier for me to do my research
					Survey #2: Q42. Using the WWW would make it easier for me to find quality information
Easy (to learn)	Survey #1: Q32. Learning to find information on the WWW would be easy for me				
	Survey #2: Q44. Learning to find quality information on the WWW would be easy for me				
Easy (to master)	Survey #1: Q36. It would be easy for me to become skillful at using the WWW				
	Survey #2: Q48. It would be easy for me to learn how to find quality information on the WWW				
Easy (to operate)	Survey #1: Q37. I would find WWW technologies easy to use				
	Survey #2: Q49. I would find searching for quality information easy to do				
PoI	process	Productivity	Survey #1: Q28. Using the WWW would increase my productivity		
			Survey #2: Q40. Using the WWW would make me more productive		
		Easy (to apply)*	Survey #1: Q33. I would find it easy to locate information I am looking for on the WWW		
			Survey #2: Q45. I would find it easy to locate quality information from non-quality information as I search on the WWW		
		Interaction Clarity	Survey #1: Q34. My interactions with information on WWW Websites would be clear and understandable		
			Survey #2: Q46. The steps necessary to select quality info from search results would be clear and understandable		
		Interaction Flexible	Survey #1: Q35. I would find the WWW flexible to interact with		
			Survey #2: Q47. I would find the WWW flexible when locating the type of information I am looking for		

A “rich” investigation of the constructs of TAM

The unconventional approach taken by the author involved seeing the PU and PEoU constructs as logical presuppositions of users' adoption of technologies. Of course an individual will utilise a

tool if they perceive it to be useful, and of course they will engage that useful tool frequently if they find their engagement requires easily manageable amounts of cognitive effort. This assumption allowed the focus of the research to shift from the statistical analysis of the level of PU and PEOU influence on user behaviour, to one with an investigative focus of “how does this work?”. The current research, therefore, represents an attempt on the part of the researcher to offer to the pool of TAM literature an alternative investigation of its constructs. The result is the addition of a third construct, *perception of interaction*, designed to;

- 1.) Provide a construct which actively seeks a feedback mechanism into the TAM, in the form of a construct which facilitates research into how (initial) resultant behaviour of PU an PEOU impacts on future use;
- 2.) Provide a construct which allows researchers to investigate how users’ individual differences might impact PU an PEOU (as well as PoI);
- 3.) Provide a construct which allows an investigation of user behaviour that may bi-pass the behavioural intention (BI) construct of the current TAM.
- 4.) Provide a framework which facilitates multiple avenues of exploration in relation to data analysis.

Introducing PoI: Perception of Interaction

The OTAM proposes that a third construct, *Perception of Interaction* (PoI), be used in addition to PU and PEOU, to assess users’ ongoing perception of the predictability of their system interaction. This adds to TAM a whole realm of user/technology and user/information engagement not facilitated by the original, or subsequent, TAM frameworks.

Individual constructs have been used to extend TAM in the twenty years since Davis (1986, 1989) first proposed the model, including; *user experience* (Adams *et al.*, 1992; Taylor & Todd, 1995; Liaw, 2002; Gefen, 2003); subjective norm (Taylor & Todd, 1995); motivation (Chung & Tan, 2004; Yi *et al.*, 2006); self-efficacy (Chau, 2001; McFarland & Hamilton, 2006); perceived playfulness (Moon & Kim, 2001; Chung & Tan, 2004); computer attitude (Chau, 2001); computer enjoyment (Liaw, 2002; Teo *et al.*, 1999; Liaw & Huang, 2003; van der Heijden, 2004); computer efficacy (Chau, 2001; McFarland & Hamilton, 2006); computer anxiety (Hackbarth, Grover & Yi, 2003; Schottenbauer *et al.*, 2004); system quality (Liaw, 2002); perceived performance (Shih 2004); system usage (McFarland & Hamilton, 2006); IT continuance usage (Bhattacharjee, 2001; Limayem *et al.*, 2003); habitual behaviour (Gefen, Karahanna & Straub, 2003; Limayem *et al.*, 2003) and trust (Gefen *et al.*, 2003). As well, individual differences, such as; age (Liu *et al.*, 2000; Arning & Ziefle, 2007); gender (Gefen & Straub, 1997; Agarwal & Prasad, 1999; Venkatesh & Morris, 2000; Venkatesh *et al.*, 2004); level of education (Chuang & Chuang, 2002; Burton-Jones & Hubona, 2005); cognitive style (Rapp, Taylor & Crane, 2003); and cognitive absorption (Agarwal & Karahanna 2000; Saadé & Bahli, 2005).

None of these constructs or individual differences, however, have proved to be the illusive co-construct for PU and PEOU, that would enable TAM to become an effective high-level research framework for investigating both new and ongoing adoption of information technologies. If anything, they proved to over-complicate the model, bringing the whole body of TAM literature to a somewhat confused, chaotic state (Benbasat & Barki, 2007). In effect, the plethora of extensions to TAM have lacked the high-level generic qualities of the original PU and PEOU constructs, thereby making each extension too specific to examine multiple user individual

differences or co-dependant sub-constructs. They have also failed to address, what Benbasat and Barki (2007) describe as TAM’s inability as a theory “to provide a systematic means of expanding and adapting its core model ... in the constantly evolving IT adoption context” (p.212).

Of greater concern however, is that TAM, either with or without its variables and extensions, fails to really provide a great deal of value beyond confirming that users engage technologies they perceive will be “useful” (Benbasat & Zmud, 1999). The reality is, PU and PEOU as constructs themselves, require an additional construct which will allow researchers to flesh out the relationship between users’ individual differences, core salient beliefs and the central paradigms of TAM.

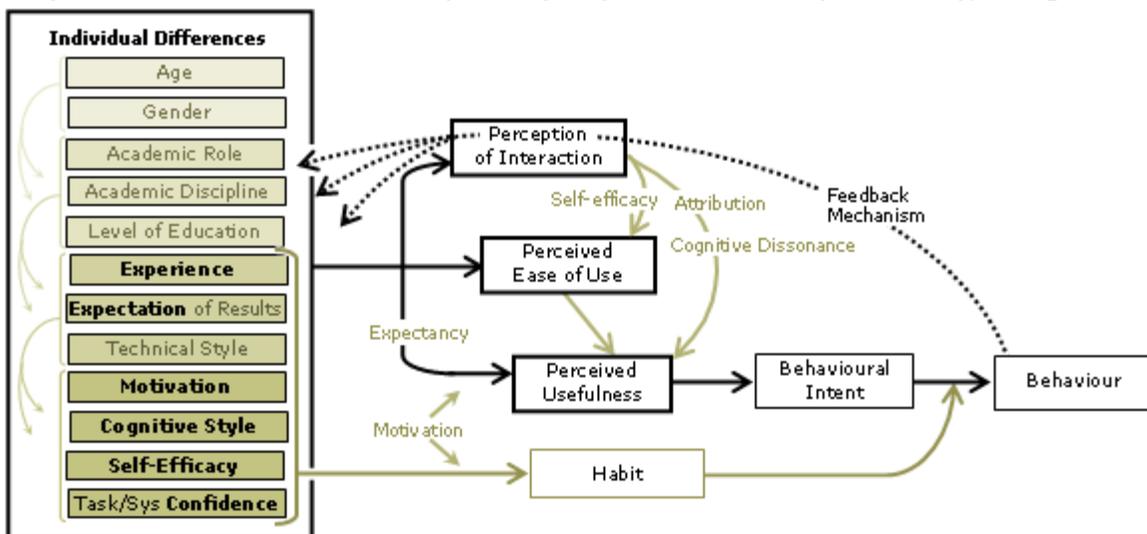
The PoI construct of the OTAM, shares a number of common characteristics with PU and PEOU, not the least of which is that it is a high-level, somewhat ambiguous, construct which itself requires researchers develop ways to measure it. In other words, like PU and PEOU, how a user perceives the predictability of their systems interaction is implied by answers to questions like:

“The steps necessary to complete my assigned task would be clear enough for me to repeat”
or “I would be able to find a similar website tomorrow”

What PoI adds to PU and PEOU however, is that it explicitly allows for a post-adoption technology investigation of user/computer interaction. It recognises that the very act of “interaction” has the capacity to impact and influence PU and PEOU as well as future interaction perceptions. It broadens the depth of TAM to facilitate a proper examination of the complex relationships between users’ individual differences and their PU and PEOU of an information system. Complex cognitive issues relating to phenomena such as users’ *cognitive dissonance* with a system, *attribution* of a successful (or non-successful) interaction or outcome, and general *expectancy* of a system interaction can be addressed in concrete, measurable terms to determine how PU and PEOU influence BI.

Figure 3 presents a schematic illustration of the OTAM and it’s PU, PEOU and PoI constructs. Included are some of the relational pathways investigated as part of the current research. The “individual differences” illustrate twelve of the fourteen group-case constructs developed for the research project of which this paper is a part, six of which are discussed in this paper.

Figure 3. The OTAM constructs for on-going measurement of technology acceptance



Constructs for Data Analysis

Given the research's assumption that users engage technologies at a cognitive level, user attitudes and perceptions, and their impact on PU, PEOU and PoI results were examined in relation to multiple socio-cognitive theories, including;

- 1.) Attribution theory (Weiner, 1974; 1980; 1986)
- 2.) Expectancy theory (Vroom, 1964);
- 3.) Cognitive dissonance theory (Festinger, 1957 & 1959);
- 4.) Self-efficacy theory (Bandur, 1977 & 1982).

Importantly, the concept of “interaction” became an increasingly significant driving concept in the investigation. Previous research, within multiple scientific disciplines, indicates that *interaction* is an important variable in users' behavioural adoption strategies, including; acceptance (Jain, Ross & Prabhakar, 2004); learning (Saadé, 2007); satisfaction (McKinney, Yoon & Zahedi, 2002; Lindgaard & Dudek, 2003); persistence of engagement (Hassenplug & Harnish, 1998; Liaw, 2002); attitude (Bhattacharjee & Premkumar, 2004; Porter & Donthu, 2006); perceptions of quality (Sage, 1991; Barnes & Vidgen, 2006); trust (Gefen *et al.*, 2003; Varlander, 2007); and decision making (Marshall, 2004). Significantly, the PoI context began to prove a rich context for investigating the socio-cognitive theories.

THE RESULTS: Some Research Findings

The User-Group

The goal of the current research was to investigate users' perceptions of Information Quality (IQ) in the context of their World Wide Web Information Search Behaviours (ISB). Of particular interest, was the sub-set of user behaviours typically associated with user search-engine interaction. It was determined that the target user-group should be relatively intellectually sophisticated, possessing (1) a relatively high degree of IQ perception; (2) a work-related information need which demanded a high level of quality in information typically retrieved; and (3) the ability to make (and recount) relevant quality related value-judgments of the information they encounter on the Web.

An assumption was made that such a user-group could be found amongst career academics (researchers and lecturers) and postgraduate (U.S. graduate) level students, engaging Masters, DBA and/or PhD studies. The stated criteria for inclusion in the user-group were;

- 1.) Users who were “academics”, or “postgraduate level” students – including users who fell into both these categories;
- 2.) Users who used the World Wide Web to retrieve information that related to their work/research as academics and/or post-graduate students.

Importantly, the user-group did not necessarily have to feel “comfortable” retrieving work/research related information from the Web, but needed to do so relatively regularly and be personally familiar with the process of using the Web as an information retrieval tool for the high quality content associated with their work, research, or both. Academics who engaged the Web as a means of professional networking, or even entertainment were not excluded from the target user-group, however the surveys and questionnaires they completed did not relate specifically to these interactions.

User-group's General Characteristics:

The user-group of eighty “academics” came from around the world (35% North America; 21.3% Europe/Africa; and 43.7% Australasia), and exhibited a number of key characteristics, including;

- 1.) Technologically Sophisticated;
 - a.) Highly “experienced” with both Web search engines and general web technologies;

Table 3a: Yrs Using Web Technologies

How many years experience do you have using the World Wide Web?	%	#
1-2 years	0%	0
3-5 years	5%	4
5-8 years	18.8%	15
9-12 years	55%	44
↑ 12 years	21.2%	17
Total Respondents		80

Table 3b: Years Using Web Search Engines

How many years experience do you have using WWW Search Engines?	%	#
1-2 years	0%	0
3-5 years	5%	4
5-8 years	35%	28
9-12 years	45%	36
↑ 12 years	15%	12
Total Respondents		80

- b.) Early adopters of Web technologies;
 With user data collection taking place between March 2006 and March 2007, over three quarters of participants had been using Web technologies prior to 1998, and over a fifth using them prior to 1995.

Table 4a: Adoption of Web Technologies

Began engaging Web technologies:	%	#	Tot
pre 2004	100%	80	80
pre 2002	95%	76	80
pre 1998	76.2%	61	80
pre 1995	21.2%	17	80

Table 4b: Adoption of Web Search Engines

Began engaging Web Search Engines	%	#	Tot
pre 2004	100%	80	80
pre 2002	95%	76	80
pre 1998	60%	48	80
pre 1995	15%	12	80

- 2.) Informatically sophisticated;
 It should be noted, the current study in no way advocates that academia holds a monopoly on intelligent individuals or high-end information users. It simply assumes that, in order to participate in post-graduate academic activities, the vast majority of users would possess above average cognitive capabilities and demand a high level of quality in their target IR.

Table 5 Users Highest Completed University Qualification

[#12] (Registration Q.3-2) Indicate your highest completed university education level		
	%	#
Completed Undergraduate degree	43.8%	35
Completed Post-graduate degree	15.0%	12
Completed Masters degree	23.8%	19
Completed PhD doctorate	17.5%	14
Total Respondents		80

- 3.) High Self-efficacy & Task/System Confidence;
 An outstanding characteristic of this user-group was their high levels of self-efficacy and task/system confidence in their ability to search and retrieve their target information. When asked how often they expected to successfully find the information they were looking for, a staggering 88% of participants answered *most* or *every* time. In addition, this high-level of success was rarely attributed to the quality of the search engine used, but was seen by participants as a result of their own “search strategies” and ability to engage the informatic environment of the Web.

Table 6 User Perceptions of their “successful” Web Searches

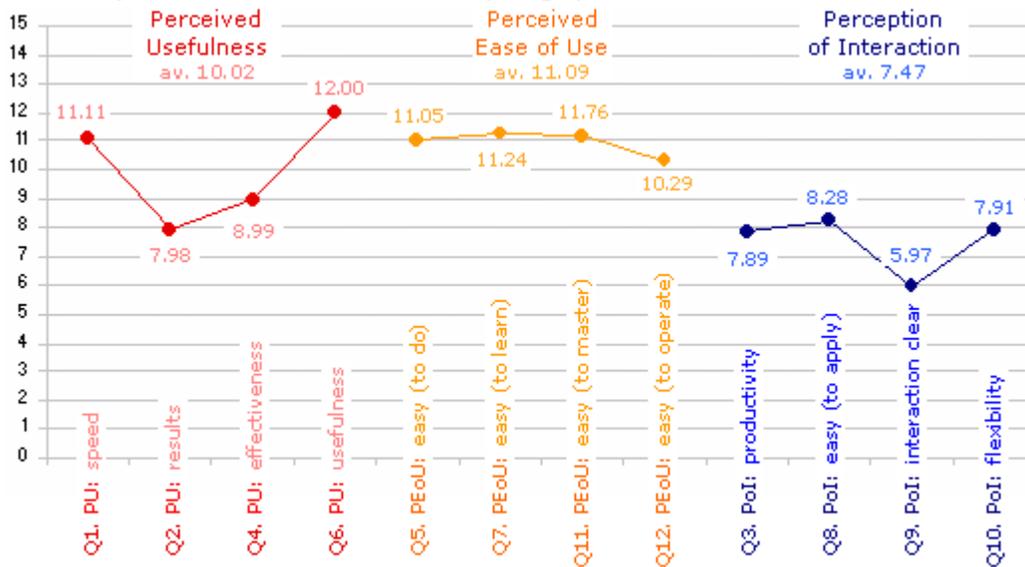
How often do you expect to successfully find relevant info when using a Web search engine?	%	#	A "successful" search outcome to a query is the result of...	%	#
every time	7.5%	6	good luck	0%	0
most times	81.2%	65	a good search engine	13.8%	11
sometimes	11.2%	9	my good search strategies	65%	52
rarely	0%	0	the Web info environment	21.2%	17
Total Respondents 80			Total Respondents 80		

Discussion of Some Findings

The following discussion presents some of the findings of the research using the modified OTAM framework, with results inductively examined in the context of; (1) the entire user-group’s results; and (2) six of the fourteen clustered data-sets (called “group cases”). For the sake of clarity and conciseness, the results discussed will focus particularly on what the proposed PoI construct revealed about user attitudes and perceptions of their search engine engagement.

Figure 4 presents the overall user-group results to the questions presented in Table 2. Results have been categorised into the PU, PEoU and PoI constructs, with each construct being used to measure four elements. Scores presented in the graph are out of 15, derived from using a simple numerical weighting formula (described in Appendix 1). The highest score an element can attain is 15, gained if 100% of the user group select “highly likely” for that element. The average score for each of the three perception constructs is also presented.

Figure 4. User Results (whole group) for PU, PEoU & PoI (OTAM)



General User Results

It was noted that user PoI elements, which relate to the predictability or repeatability of search-engine interactive outcomes, consistently produced the lowest results. Interestingly, *PU: expected S.E. results*, which could also be seen as measuring something of the predictability of the outcome of a user’s search engine interaction, consistently scored the lowest of the PU elements. PEoU results were, by and large, the most consistent, with minimal variation between users results, regardless of which group-case of user results was being observed.

Results for six of the group-cases associated with the current paper are presented in Figure 5. In keeping with the inductive analysis, results are discussed in the context of previous theory.

User Experience – fig 5a:

Often presented as a major influencing factor in user behaviour in previous literature/theory (Hyldegaard & Seiden, 2004; Toms, Dufour & Hesemeier, 2004; Fusilier & Durlabhji, 2005; Castañeda, Muñoz-Leiva & Luque, 2007)

User Experience: Some Observations and Discussion:

Apart from the “PU:results” scores (derived from questions relating to an anticipated improvement in research performance and quality), the elements of the PoI construct represent both the lowest scores and greatest divergence in sub-group results. This is consistent with the whole user-group results for PoI, which suggests that;

the greatest dissonance issue facing Web search engine users remains search engine unpredictability.

Moreover;

this issue does not seem to dissipate over time, even as the user gains more experience using the system.

Users’ level of experience has a direct effect on their perception of their potential productivity. The more experience, the greater the belief, on the part of the user, that their search engine engagement will be productive. Of interest then, is the apparent contradiction between these perceptions and experienced users’ perceptions regarding the *consistency* and *predictability* of these interactions.

Overall, *user-experience* ranked second highest in divergence within its sub-group results, with PU and PoI showing the greatest variety of responses for this group-case. This suggests that;

user experience has a significant influence on users’ attitude towards the system.

This is consistent with previous research findings (Taylor & Todd, 1995; Agarwal & Prasad, 1999; Fusilier & Durlabhji, 2005; Lee, Qu & Kim, 2007) which contends previous exposure to a system, or relative system, is likely to have a positive influence on the constructs measured in the TAM, particularly in relation to PU (Chang *et al.*, 2005), albeit at times, indirectly through increased user self-efficacy (McFarland & Hamilton, 2006).

User Cognitive Style (query construction) – fig 5b:

Cognitive Style has been defined as a user’s preferred (sometimes habitual) approach to both organising and representing information (Frias-Martinez, Chen & Liu, 2007). Search query construction styles, such as keyword and boolean search strategies, have therefore been used previously to investigate user cognitive style (Moss & Hale, 1999; Ford, Miller & Moss, 2005). In the current research, cognitive styles were classified as (a) *phrase searcher* {27.5% of the user-group}; (b) *keywords searcher* {60%}; and (c) *boolean searcher* {12.5%}.

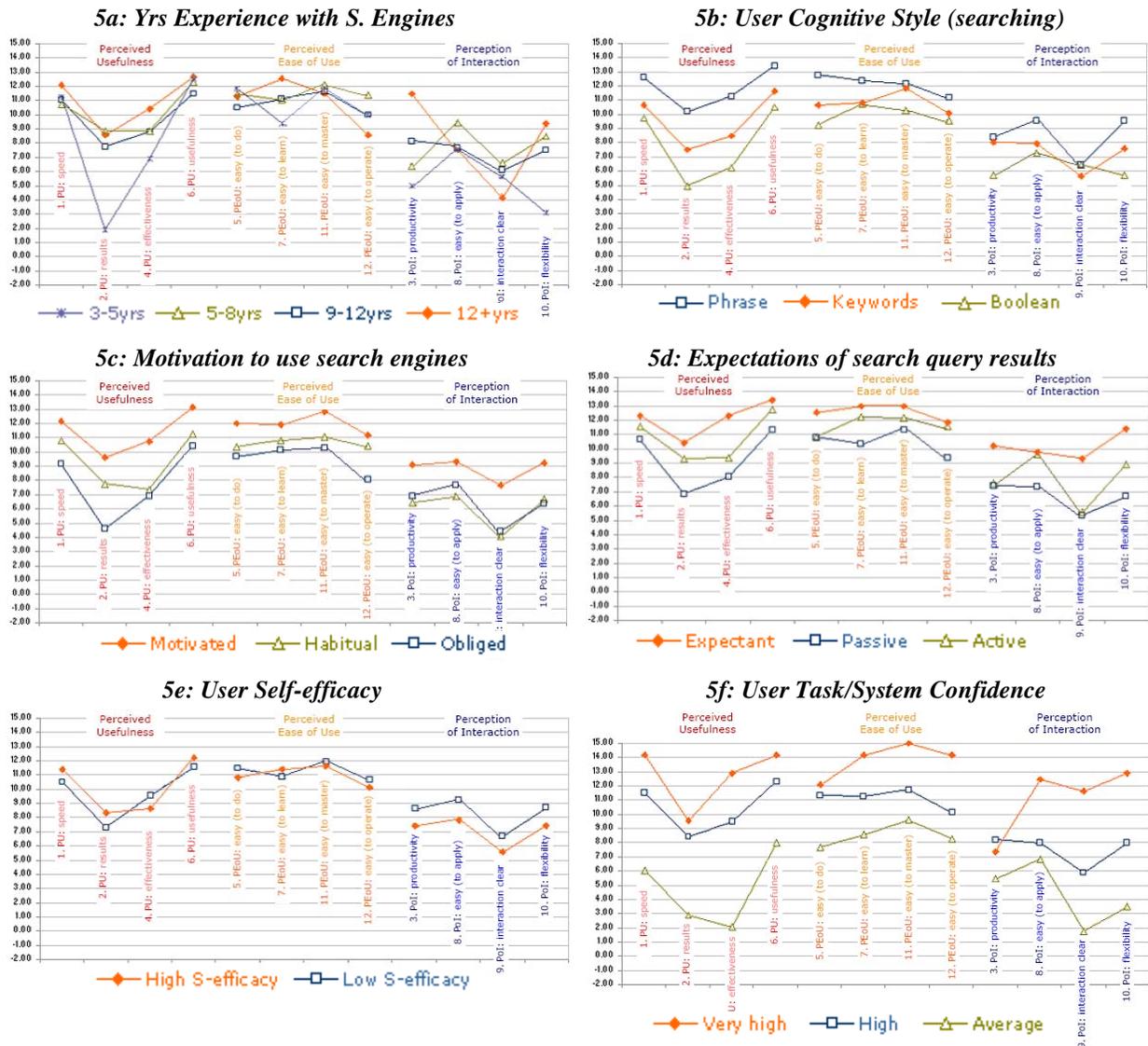
Cognitive Style – Some Observations and Discussion:

Phrase searchers frequently returned more positive perceptions than keywords and boolean searchers, with boolean searchers usually scoring the lowest. Significantly, even though boolean searchers consistently scored other perception elements lowest, their *PoI: clarity of interaction* perception scored higher than the phrase and keywords sub-groups. This is consistent with a boolean searcher’s strategy of gaining greater personal control through manipulating search query

interaction with the use of boolean tactics, supporting [Chen, Magoulas & Macredie, \(2004\)](#) and [\(Graff, 2003\)](#), who found that, in terms of ‘user control’, users’ cognitive styles significantly influences user/system information interaction.

Of particular interest is cognitive style’s impact on users’ PU, which ranks second highest (behind *task/system confidence*) in variation between its sub-groups. In light of previous TAM research findings that PU is the strongest precursor to technology adoption and use ([Davis et al., 1989](#); [Chau, 2001](#)), the impact of cognitive style on user adoption attitudes towards search engines should not be understated.

Figure 5. User sub-group (“group case”) results for OTAM constructs



The concept of users’ cognitive style has been extensively researched in various fields associated with information seeking and retrieval behaviours ([Moss & Hale, 1999](#); [Kim, 1999](#); [Palmquist & Kim, 2000](#); [Ford, Miller & Moss, 2002](#); [Chen et al., 2004](#)), and has been linked with other user characteristics, such as gender ([Ford & Miller, 1996](#); [Ong, Lai & Wang, 2006](#)) and perceived

systems performance (Workman, 2004). The intrinsic nature of the cognitive style user characteristic (Joughin, 1992), and the previously established link between system performance and perceived usefulness (Liu & Ma, 2006) lends itself to the finding that;

cognitive style plays a significant role in search engine adoption through its impact on users' perceptions of search engine usefulness.

Cognitive style, as a construct, presents a significant problem for TAM researchers in that the TRA (Fishbein, 1967), and consequently, TAM, separate the “affective” and “cognitive” domains as distinct constructs of human behaviour, where it is the *affective* domain alone that is said to influence “attitude” (Agarwal & Prasad, 1999). At a conceptual level, *attitude* is said to underlie the TRA (Fishbein & Ajzen, 1975) and subsequent TAM, which postulate that cognition is linked not to attitude, but to belief, through that which is learned. That which is learned, according to Pajares (1997), occurs when a behaviour is acted or observed. If this is true, then the significant relationship between cognitive style and PU is suggestive that;

Perceived usefulness is notably influenced by users' learned behaviours that have (in the past) produced a valued result.

This is significant because it suggests an interactive-driven construct, such as the PoI, is required as part of the TAM framework to fully investigate the complex relationship between users' specific cognitive characteristics and their PU of a system.

Motivation to use search engines – fig 5c:

Classified in the current research project as the *reason* for which users engage search engines, a historical review of TAM literature reveals that a major contributing factor to variations in user results can be traced to whether users make a *conscious choice* regarding their use of a particular technology (Rawstorne, Jayasuriya & Caputi, 2000; Brown *et al.*, 2002). Users were identified as either (a) *motivated*; (b) *habitual*; or (c) *obliged*; search engine users.

Motivation – Some Observations and Discussion:

As expected, motivated users – those users who engage search engines because they find them to be a highly effective information retrieval tool, returned the highest results for all the TAM constructs within this group-case. This result validates the constructed group-case itself, which overtly measures users general attitude towards search engines. Teo *et al.* (1999), in fact, describe extrinsic motivation and “perceived usefulness” as the same entity.

Habitual users returned higher results for the PU and PEoU constructs than obliged users, which was also to be expected. Firstly, given the previous TAM research which demonstrates users who feel obliged to use a system require positive subjective norm antecedents (Taylor & Todd, 1995; Venkatesh & Davis, 2000) in order for their PU and PEoU results to reflect a positive attitude towards that system. And secondly, given the *passive* role this sub-group of users perceive they play in their choice to interact with the system.

The research by Verplanken *et al.*, (1998) into the role of habit versus planned (or intended) behaviour purports that once a behaviour is habitually strong, users rely on their habit to a greater degree than conscious choice strategies. Furthermore, from experiments conducted, the authors concluded that even when the process of choice was externally manipulated, it did not over-ride the effect of habit. Gefen's (2003) research supports this conclusion, finding that once “*specific IT behaviour become routine habit, [it] . . . should become a primary predictor of use*” (2003, p3).

The results for the motivation group-case support the proposition that;

habit has a stronger influence on users attitude toward search engine use than obligation does

Interestingly, the results for the motivation group-case also provides evidence that;

the PoI construct is measuring a different type of attitudinal interaction with the system than PU and PEOU,

as the results for PoI do not simply replicate the PU and PEOU results.

Of note, is that the PoI sub-constructs tested are the only elements to return a more positive result for obliged users than habitual (also, unmotivated) users. Like Boolean searcher results, this could be indicative that;

obliged users play a more cognitively active role in their search engine interaction than habitual users, producing slightly better perceptions of the predictability of their system interaction.

Expectations of search query results – fig 5d:

Much of the TAM research advocates that a user's expectation of a technology has a profound impact on how they feel about, and interact with, that technology (Petersen, Madsen & Kjær, 2002; Staples, Wong & Seddon, 2002; Lindgaard & Dudek, 2003; Tesch *et al.*, 2005). The *expectancy* sub-groups were classified as; (1) *expectant* users – who believed query results would be relevant; (2) *active* users – who acknowledged query results may or may not be relevant; and (3) *passive* users – who assumed query results may be relevant.

Expectancy – Some Observations and Discussion:

Users who had extremely high expectations of the relevance of search engine results to their queries, demonstrated some of the most positive results of the entire study for all three TAM constructs. This is consistent with DeSanctis (1983), who linked high levels of systems expectations with highly positive use of that system. In much of the TAM research, user expectancy is often measured as “perceived performance” (Bhattacharjee, 2001; D'Ambra & Wilson, 2004; Dadayan & Ferro, 2005), and ranks consistently as one of the strongest predictors of user BI (Wang, Wu & Wang, 2008).

Of interest in the context of this group-case was the results for the “active users” sub-group, who were willing to entertain the possibility that some search engine query results may include results that are *not* relevant to their queries. This sub-group recorded higher scores than the more passive sub-group, who stated they believed results may be relevant, without demonstrating a conscious cognition that results may also *not* be relevant. The implication of this is that;

a more cognitively “active” sub-group, while aware of the system's flaws, or perhaps because of the system's flaws, is more likely to recognise and embrace their own cognitive role in the process of web-based information retrieval, leading to a more positive attitude towards the system.

User Self-efficacy – fig 5e:

Self-efficacy refers to the perception a user has of their own role in an outcome to a specific process or behaviour (Compeau, Higgins & Huff, 1999), and is considered to be an important motivational construct (Gist & Mitchell, 1992) in the adoption of specific user attitudes and behaviours. In the current research, users were classified as having high self-efficacy if they attributed a successful Web search to their *own* search strategies.

Self-efficacy – Some Observations and Discussion:

Except for the PoI construct, the variance between the high and low self-efficacy sub-groups is relatively minimal, varying less than one point for most results. This is consistent with a number of previous studies which have generally found that users' degree of self-efficacy has relatively little, to a slightly positive, impact on their PU or PEOU of the system with which they engage (Igarria & Iiravi, 1995; Compeau & Higgins, 1995; Lewis, Agarwal & Sambamurthy, 2003).

Interestingly, the sub-group with lower self-efficacy returned better results for PoI than the high self-efficacy group. PoI is designed to measure users' ongoing perceptions of the predictability of their interactions with search engines. This indicates that;

the higher self-efficacy sub-group have a greater recognition of the system's flaws, and the inconsistencies of their interactions with it, resulting in a negative impact on their perceptions of the system

This is consistent with previous findings regarding the negative impact of high self-efficacy and user perceptions of a system (Ong *et al.*, 2004; Ceaparu *et al.*, 2004). Importantly, other researchers have also noted a higher self-efficacy's negative impact on various elements of TAM's constructs (Chau, 2001), although this seems to occur while having a positive impact on intended use.

The PoI construct then, adds a valuable tool to the original TAM framework when investigating how high self-efficacy can return lower TAM results.

User Task/System Confidence – fig 5f:

As a construct, confidence is recognised as being closely aligned with users' self-efficacy (Igarria & Iivari, 1995; Agarwal & Karahanna, 2000), however a number of authors have recognised the distinction between a user's self-concept of their role and ability to perform a task, and their confidence that the system/technology is able to help them successfully complete that task.

Users' task/system confidence was recorded by asking the user-group "How often do you expect to successfully find relevant information when utilising a Web search engine?" Conceptually, the question seeks to bring together both a user's pre-task (ex ante) expectation and post-task (ex post) evaluation. In this regard, it integrates some of the post-adoptive theory associated with the *Task Technology Fit* (TTF) model (Goodhue, 1995; Goodhue & Thompson, 1995; D'Ambra & Wilson, 2004), and implies a user's level of "satisfaction" with the system (Khalifa, 2004; Tesch *et al.*, 2005).

Task/System Confidence – Some Observations and Discussion:

The task/system confidence group-case returned the largest divergence in sub-group results across all three TAM constructs. Predictably, users with the lowest (classified "average") task/system confidence returned the lowest TAM results and users with "very high" task/system confidence returned the highest results. The user results confirm previous research findings regarding theory related to users' perceived performance and confidence constructs – the higher a user's confidence that they will be able to successfully complete the task for which they have engaged a system, the better their general attitudes towards that system will be (Compeau & Higgins, 1995; Hong *et al.*, 2001)

Taking into account users' results to other questions in the surveys (including non-TAM surveys), the sub-group of users with very high task/system confidence demonstrated;

- higher motivation (66.7%) to use search engines (↑16.7% group norm)
- significantly higher degree of faith (50%) that search engine returns would be relevant to their query (↑36.2% group norm)
- equal weighting of attribution to self and system (50% each) when a search was successful.
- high propensity for minimal strategic change when a search query proved to be unsuccessful, with 83.3% (↑36.2% group norm) stating they would change their keywords rather than selecting a different search-query strategy

These results are of particular interest because they strongly suggest that;

users with very high task/system confidence, and therefore extremely high TAM results, in fact exhibit a reduced tendency to personally “own” the cognitive load of their search engine interaction,

with 0% using the more difficult boolean search tactics (↓12.5 group norm); 50% possessing high self-efficacy (↓15% group norm); and only 16.7% considering the possibility that search-engine query results might not be relevant (↓9.6% group norm).

This finding is supported by evidence that;

users with relatively low task/system confidence demonstrated an increased tendency to personally own the cognitive load of their search-engine interaction;

with 22.2% using boolean search tactics (↑22% high T/S confidence); 66.7% high self-efficacy (↑16.7% high T/S confidence); only 11.1% believing search engine query results would be completely relevant (↓38.9% high T/S confidence), 22.2% considering search engine query returns may be irrelevant (↑5.5% high T/S confidence); and a staggering 88.9% using all the summary information associated with search engine query results to make decisions about a result's relevancy to their information task (↑22.2 high T/S confidence).

These results make a significant contribution to TAM literature, and demonstrate how the inclusion of the PoI construct can facilitate a much richer understanding of users' cognitive processes during systems adoption. The preliminary cross analysis of the actual information seeking behaviours (survey #3) with the very high task/system confidence sub-group implies that while their attitude is towards the technology is extremely positive, actual user/information interaction may be compromised to the extent that the attitude induces a more cognitively lazy approach to information retrieval.

If this is true, then although intent to use the system is increased, effective use may not necessarily be the ultimate outcome. This conclusion is supported by the high task/system confidence sub-group's result to the PoI productivity element, which scored relatively low.

Contribution & Areas for Future Research

Contribution

The contribution of the OTAM to an already over-loaded TAM-driven body of research is two fold. Firstly, the current investigation is an example of an inductive, qualitative investigation of the TAM constructs, rather than a repeat of the common quantitative approach designed to, once again, simply support Davis' (1986, 1989) hypothesis regarding the importance of perceived

usefulness (Benbasat & Barki, 2007). Secondly, for the first time, a third *dynamic* construct has been added to the original TAM, which does not simply represent one or two user-driven “individual differences” or external variables of the user-group being applied to the investigation. Perception of interaction (PoI), or more accurately, *perceived predictability of interaction*, brings to the TAM, a construct allowing the model to finally be applied to users’ ongoing acceptance and adoption of technologies.

Pushing Research Methodology

There is a need in the field of IS literature to develop deeper analysis of the complex relationships between human behaviour and system/technology adoption. As a relatively young discipline, theory developed within IS literature is yet to experience full scrutiny from other scientific disciplines. This is however, changing, and the body of TAM literature, in particular, is being examined by researchers from multiple disciplines², including *Nursing Studies* (Ahasan, Partanen & Keyoung, 2001; Despont-Gros *et al.*, 2004; Ammenwerth, Iller & Mahler, 2006; Breen & Zhang, 2008); *Medicine* (Aguillo, 2000); *Library Science* (Kuhlthau & Tama, 2001; Jiao & Onwuegbuzie, 2003); *Business Studies* (Bruner & Kumar, 2005; Seyal & Rahman, 2007) *Science & Engineering* (Roco, 2005); *Marketing* (Gerrard *et al.*, 2006; Jelinek *et al.*, 2006); and *Education* (Ip, Jones & Jacobs, 2007). It behoves the IS discipline to broaden its investigative methods and more robustly define its conceptual terminologies, particular those which have been adopted and adapted from other disciplines, such as the Social Cognitive Theory (SCT) driven concepts of the TAM.

At a time when the IS discipline is going through what some authors’ have described as an “*identity crisis*” (Benbasat & Zmud, 2003) there has never been a greater need for IS researchers to consider their methodological options. Benbasat & Zmud contend the ever increasingly “eclectic” nature of both the practice and study of IS calls for multiple paradigms and approaches when researching IS. This is of particular concern in relation to the lack of diversity in research approaches within the specific IS research area of *technology adoption* (Choudrie & Dwivedi, 2005).

Significant Findings and Future Research

Expectancy & Motivation

A cross analysis between the user *motivation* and *expectancy* sub-groups reveals some interesting correlations. Motivated users are two times more likely than habitual users, and three times more likely than obliged users, to perceive a search engine *will* return relevant results to their queries. This is a clear confirmation of Vroom’s (1964) hypothesis that expectancy is intrinsically linked to motivation. The higher the (positive) expectancy of a behaviour, the greater is the motivation to perform that behaviour (Rappaport, 2004). Interestingly, this same sub-group of motivated users are also some 2.5 times more likely than habitual users, and two times more likely than obliged users, to not actively consider the likelihood that a search engine may return irrelevant results to their queries, making them the most “*cognitively passive*” group.

Expectancy, as a cognitive construct, is by and large, perceived as a positive antecedent in user adoption of technologies. The current research, however, has identified that when it comes to information search and retrieval, lower expectancy produces a more “cognitively active” searcher, who is more likely to recognise and embrace their own cognitive role in the process of web-based information retrieval and search engine interaction. This cognitively active searcher

warrants further investigation, to determine the role of the “self” in OTAM related attitudes towards Web search engines.

Cognitive Dissonance

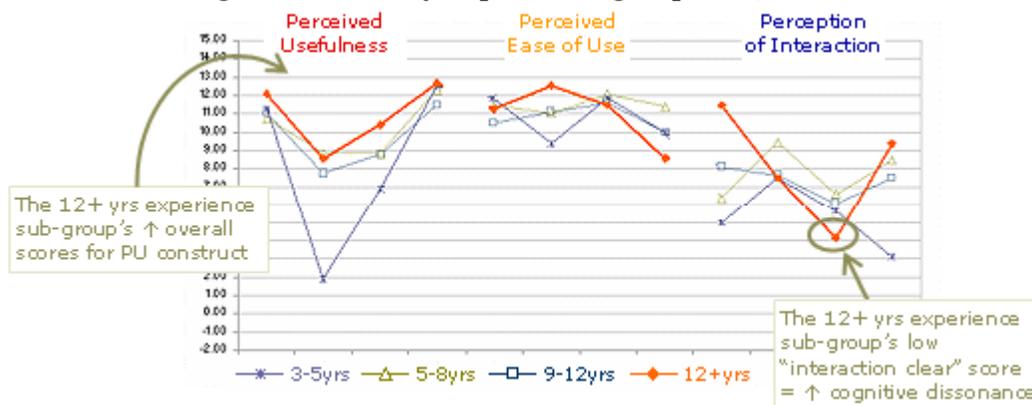
A significant finding of the current research is that;

The PoI construct, and specifically the ‘PoI: Interaction Clear’ sub-construct, provide a framework by which users’ levels of cognitive dissonance can be investigated using the OTAM.

Cognitive dissonance theory (Festinger, 1957) postulates that people adjust their internal attitudes (Whitworth *et al.*, 2007) to overcome stimuli that does not necessarily fit-in with what they feel should be true, and therefore limit any conflict between their expectations and experiences (Brown, Venkatesh & Goyal, 2007).

Karahanna & Straub (1999) contend that users’ natural need to reduce this conflict, or cognitive dissonance, is achievable if they can rationalise their usage behaviour. The authors further suggest that this process of being over-positive is one of the elements captured by TAM’s PU construct. The current research illustrates this process, both in the whole group’s results and, particularly, the user experience sub-group results. Figure 6 illustrates the sub-group of users with 12+ years experience using search engines (see also figure 5a). This sub-group of users had the highest PU scores of the “user experience” group-case, while also recording the lowest score for the PoI’s *clarity of interaction*.

Figure 6: Levels of Experience (group-case) results



Karahanna & Straub’s (1999) research indicated a strong relationship between higher cognitive dissonance and more positive PU results, causing the authors to contend that users attempt to stabilise any conflicting feelings associated with system interaction, by focusing on those things about the system that are useful. The current research supports Karahanna & Straub’s findings by demonstrating that;

even long-term users experienced a degree of cognitive dissonance concerning their search engine interaction.

Significantly, that this dissonance firstly does not dissipate even for users possessing 12+ years experience, and secondly does not prevent users from repeated search engine use suggests that:

a result of greater experience with a system is a higher tolerance for any cognitive dissonance associated with that system.

Self-efficacy

Self-efficacy driven investigations in the context of the TAM have tended to return a mixed bag of results. Authors such as Venkatesh (1999) and Bhattacharjee (2001) align the TAM (in regards to self-efficacy elements) with Social Cognitive Theory's two *expectancy* suppositions, suggesting that the PU construct is similar to SCT's "outcome expectations" and PEOU encompasses similar elements as "self-efficacy".

The constructs of *expectancy* and *self-efficacy* are, at times, confused or used inter-changeably (Bandura, 1977; Gist & Mitchell, 1992). This is particularly true in the field of IS, which has found itself adopting (and adapting) various theories originally associated with the social and psychological sciences, as a bases for investigation the human component of user technology adoption and human computer interactive processes (Chau,1996). In the current research however, a cross-analysis between the expectancy and self-efficacy sub-groups' results confirms Stajkovic & Sommer's (2000) finding that they are separate constructs. The former being primarily about *expected outcome*, the latter more about *locus of control* in the process of achieving an outcome. Both constructs are intrinsically linked to motivation, but not necessarily always to each other.

Of note, is that the divergence in results within the self-efficacy sub-groups (figure 5e) for the PU and PEOU constructs were negligible, however, the sub-group with lower self-efficacy returned better results for the PoI construct than the high self-efficacy sub-group. Chau (2001) noted that self-efficacy had a negative impact on the TAMs constructs, but explained this impact in terms of high self-efficacy still having a positive influence on users' intended use of a system. The results for the PoI related elements sheds more light on Chau's finding, and is suggestive that;

the lower results for the higher self-efficacy group is indicative of this sub-group's awareness and recognition of the system flaws, and the inconsistencies of their interactions with the system.

This awareness of the system's flaws however is countered by their own high level of self-efficacy, or internalised locus of control, which invariably attributes the outcome of an interactive task – in this case information search and retrieval – to their own capabilities or strategies, rather than that of the system. In this regard, users can return poorer results for the PoI construct, while still having an overall positive view of the system.

Conclusion

This paper has argued for the introduction of an interactive-driven construct to be included into the original TAM in order to better investigate users' ongoing adoption of technologies and related systems. It presents the OTAM (Ongoing Technology Acceptance Model), which employs the original TAM constructs of PU and PEOU, and the proposed PoI, as a framework useful for investigating the complex cognitive aspects of human engagement of information technologies. These include; expectancy; motivation; self-efficacy; and cognitive dissonance.

The supposition of the current research is that neither PU or PEOU adequately address the complexities associated with user cognitive behaviours employed during human computer interaction. The PoI construct has been added as a method of analysing those user results indicative of their actual, and ongoing, interactions with a technology system.

The paper has also confirmed the validity of the PoI construct through the discussion of some of

the research project's results, which have not only confirmed previous findings relating to the TAM, but have added additional understanding to those findings.

Finally, the paper has presented a combined methodological analysis of the statistical/quantitative data associated with TAM research. This proved particularly useful when cross-analysing the TAM statistical results with results to other surveys conducted during the course of the whole research project. This type of cross-analysis was presented in the Task/System Confidence - Observations and Discussion section.

Whether PoI lives to become a fully accepted construct of a future version of the TAM remains to be seen, as the model still requires a great deal of exploration and testing, reaching far beyond the scope of this research paper. The researcher acknowledges the possibility that PoI could in fact prove to become part of the existing TAM model, not as a construct, but as an over-arching framework within the model, allowing for a more useful investigation of PU and PEOU. Whichever is the case, an interaction construct is required within the TAM in order to address its "inability as a theory to provide a systematic means of expanding and adapting its core model" (Benbasat & Barki, 2007, p.212)

NOTES

- [1] Google Scholar citations search figures: based on citation search of Davis' two seminal papers (Davis, 1989; Davis et al., 1989); May 2005 = 1155 (771 and 444); May 2007 = 3398 (2116 and 1282); Jan 2008 = 5068 (3154 and 1914). July 2008 = 6141 (3853 and 2288).
- [2] Studies cited here are not just IS researchers' publications in alternative disciplines, but also represent researchers from multiple disciplines using the TAM to investigate technology adoption issues within their disciplines.

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