

DEVELOPMENT OF A SURVEY INSTRUMENT TO INVESTIGATE HOUSEHOLD BROADBAND ADOPTION

PETER ADAMS

(Refereed)

Charles Sturt University
padams@csu.edu.au

Abstract

This paper discusses the initial development of a survey instrument designed to investigate the range of factors affecting broadband adoption in Australia. The development of these constructs builds on existing technology adoption models, innovation diffusion theory and psychology studies related to consumer choice and qualitative research by the author. The survey instrument is designed to capture household consumers' perceptions between the *persuasion* phase and the *decision* phase of the innovation-decision process (Rogers 2003).

Technology adoption studies in the information systems discipline have historically been dominated by models developed to study workplace adoption (e.g. TAM & UTAUT), which do not consider the role of the purchase process in the adoption decision. Recently Venkatesh and Brown have proposed the Model of Adoption of Technology in Households (2005) which looked at PC adoption in US households. Dwivedi, Choudrie and Brinkman (2006) have specifically looked at the development of a survey instrument to study broadband adoption and perceptions of service quality in the UK.

While Adams (2006a) found support for many of the constructs in the TAM, UTAUT and MATH models, key themes emerged which were not described by the existing models. Support was found for the concept of purchase complexity playing an influential role in consumers being confident in making a purchase decision.

This paper describes the development of survey constructs designed to capture consumers' motivations for installing a broadband Internet connection in their homes. Broadband adoption has become a hot political topic in Australia in the last 12 months with the Federal Government, Telstra, the ACCC and the Federal Opposition all taking strong public positions on the issue. The development of a reliable instrument to capture household consumers' motivations for installing a broadband Internet connection is an important building block for gathering baseline data to inform public debate on broadband policy.

Key words: adoption, broadband, diffusion, communications technology, consumer behaviour, model, UTAUT, MATH, TAM, CAIT.

Introduction

Broadband Internet use in Australian households is now a mainstream activity. According to the 2006 Census 39% of Australia's 7.1 million households has a broadband Internet connection¹ (ABS 2007a, ABS 2007b). The mainstream segment of the market for any technological products has different purchase motivations and information needs than the innovators and early adopters in Rogers' diffusion model (Rogers 2003; Moore 2002).

This paper provides an overview of the first stage of development of a survey instrument which will ultimately be used to gather data from a representative sample of the Australian population about their motivations for adopting broadband Internet at home.

Literature overview

Research on technology adoption in the Information Systems (IS) literature has until recently focussed on developing models to investigate adoption in the organisational context. For example the UTAUT (Unified Theory of Acceptance and Use of Technology) (Venkatesh et al. 2003) and TAM (Technology Acceptance Model) (Venkatesh & Davis 2000; Davis 1989). More recently attention has been given to the adoption of technology in the household by building on the well established research models used in organisational studies. Brown & Venkatesh (2005) investigated personal computer (PC) adoption in United States (US) households and developed the Model of Adoption of Technology in Households (MATH).

Dwivedi, Choudrie and Brinkman (2006) developed a survey instrument to investigate the adoption of broadband in British households. While their work has been considered in the development of the survey scales proposed here, their instrument was developed based on work by Venkatesh and Brown (2001), which has since been updated in a 2005 study (Brown & Venkatesh 2005). The time lags associated with academic publishing has meant for this paper the 2005 work by Brown & Venkatesh is more relevant than the Dwivedi et al. work published in 2006, which was based on the original MATH paper (Venkatesh & Brown 2001).

In Australia the issues around broadband adoption have been investigated by Cameron (2003; 2004; 2005) who found some of the key demographic factors related to adoption include location; education level; occupation level and home ownership. Her data was collected in 2003 at which time Australia had around 5% of households connected to broadband. This percentage of adopters is still in the early adopter stage of Rogers' (2003) diffusion curve (see Figure 2), so is not necessarily useful in the context of explaining the drivers for the mainstream adopters.

Rogers, originally from a rural sociology background, has worked on a wide range of diffusion research for over 45 years. His seminal book *Diffusion of Innovations* first published in 1962 is now in its fifth edition (Rogers 2003).

Rogers identifies five attributes used to describe innovations. He argues measuring perceptions of these five attributes can assist in forecasting an innovations' likely adoption. The five attributes Rogers identified are:

- *Relative advantage* defined as the degree to which an innovation is perceived as better than the idea it supersedes;

¹ The Census defined broadband as including ADSL, cable, wireless and satellite connections with no data speed given; while ISDN was defined as a dial-up connection.

- *Compatibility* is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters;
- *Complexity* is the degree to which an innovation is perceived as relatively difficult to understand and to use;
- *Trialability* is the degree to which an innovation may be experimented with on a limited basis;
- *Observability* is the degree to which the results of an innovation are visible to others. (2003, p.265-266)

When we look at the profiles of mainstream consumers as defined by Rogers' bell curve (Figure 1), they are split into two even groups, the *early majority* and the *late majority*.

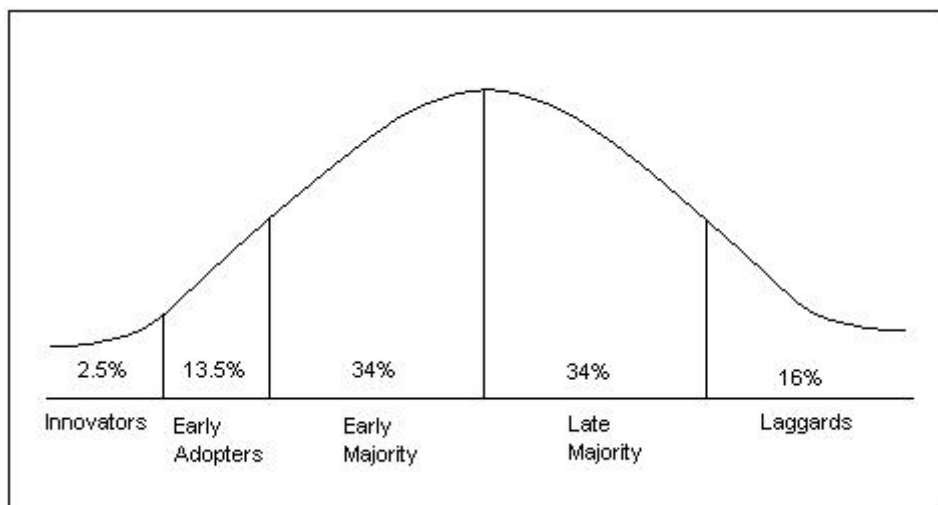


Figure 1 – The non-cumulative adoption of innovations by adopter category over time (Rogers 2003, p.281).

Moore (2002) sees the early majority as the pragmatists who like standards others are using, they are hard to win over, but loyal once a customer. He sees the late majority as conservatives who will not tolerate high price margins and argues they have been ignored by the technology companies historically, although through volume they offer opportunities. The key is the offering cannot be static as the market moves through the diffusion curve and an increasing level of simplicity and service needs to be built in as the market matures (Moore 2002, p.43-51).

Rogers views the *innovation decision process* as having five stages (2003, p. 170) involving: knowledge; persuasion; decision; implementation; & confirmation. The focus of this research is to investigate the key influences at the persuasion stage and how they translate into the decision phase of adoption or rejection for mainstream consumers. From Figure 3, it can be noted the five perceived characteristics of an innovation identified by Rogers (2003) are important at the persuasion stage of the innovation-decision process.

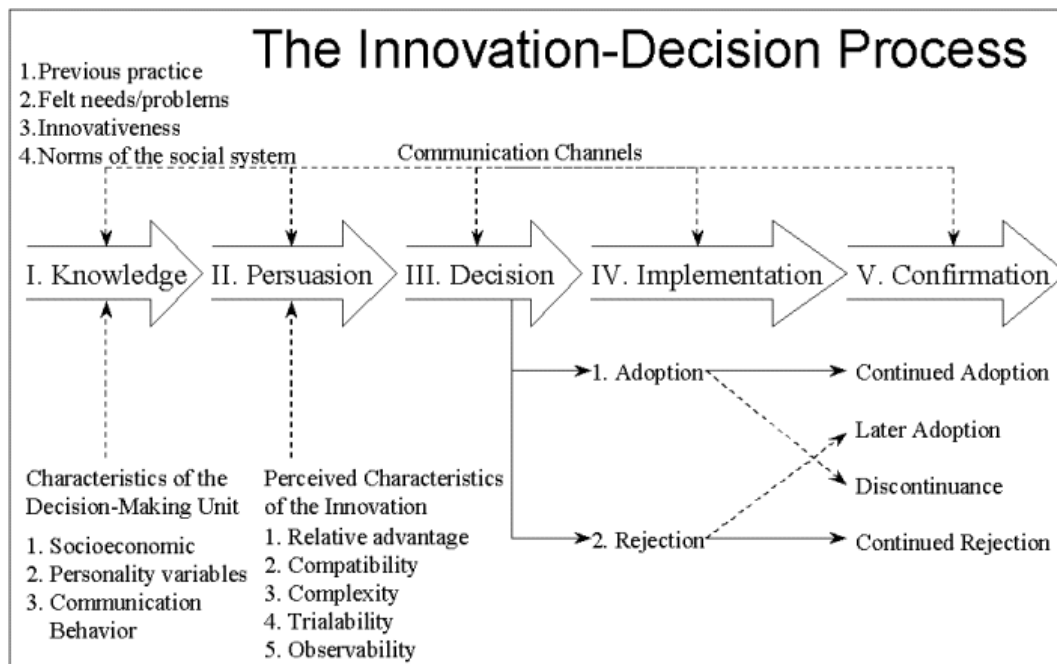


Figure 2 - The Innovation-Decision Process – from Rogers 2003, p.170

The survey scales proposed here build on a previously reported exploratory study by the author of household consumers, where four focus groups were convened to discuss the issues of technology in the home. (Adams 2006a; 2006b). This work found household consumers were frustrated with the complexity of making a purchase decision about installing a broadband Internet connection in their homes.

Looking outside the traditional IS literature relevant research in the area of consumer choice has been undertaken by Schwartz, Ward, Monterosso, Lyubomirsky, White & Lehman (2002), and also Strebel, O'Donnell & Meyers (2004).

Schwartz et al. (2002) suggest that some people can feel worse off as the number of options they face increase. This links to the work by Strebel et al. (2004) who found consumers experience frustration in purchasing high technology products in two dimensions:

Consumers display frustration with the pace of technological change and with processing decision-related information. The results indicate that the probability of committing to a technology is significantly lower the higher consumers' frustration is with their information environment.

(Strebel, O'Donnell & Myers 2004, p.1072)

This work brings a new dimension to the traditional IS view of technology adoption and has been incorporated into the conceptual model outlined below.

Conceptual model

The scales developed in this paper are designed to capture behavioural intention as proposed in the conceptual model below in Figure 3. The revised Consumer Adoption of Interactive Technology (CAIT) conceptual model is built on constructs developed through earlier literature reviews (Adams 2005; 2004) and qualitative research investigating broadband adoption (Adams 2006a; 2006b; 2006c)

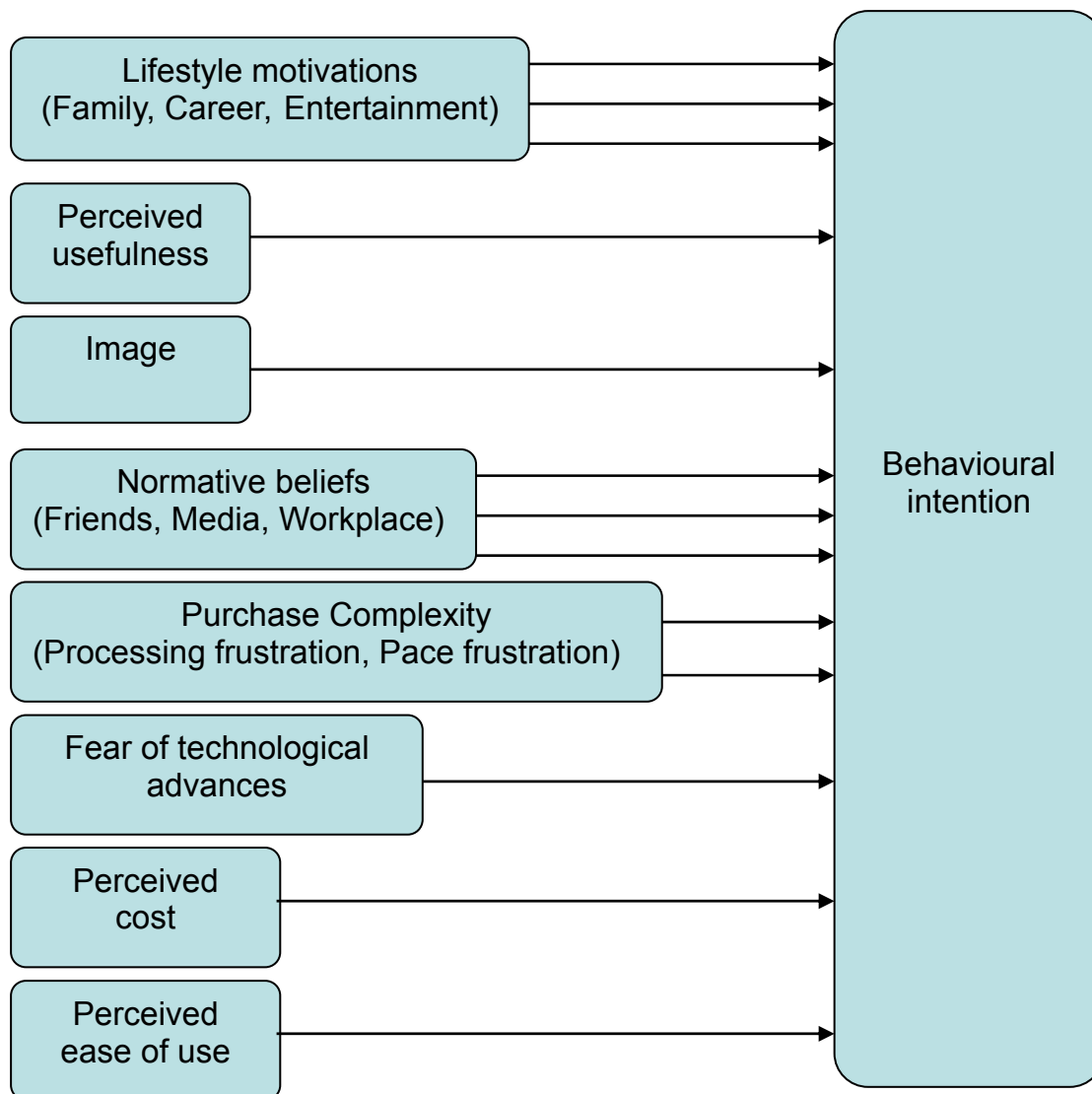


Figure 3 – Consumer Adoption of Interactive Technology (CAIT) conceptual model

The following section summarises the definitions and sources for each of the constructs in the CAIT conceptual model. Due to space considerations only the final source and construct items have been shown, with the other sources reviewed identified by name only. The third column shows the proposed wording of the constructs for use in specifically applying the CAIT model to study broadband adoption.

While the full development of the constructs is outlined in earlier work (Adams 2006a; 2005; 2004), the model is built on a thorough review of the existing IS models and the addition of some relevant work from the psychology area. DeVellis (2003) advises using existing scales where appropriate to improve the validity and reliability of the survey instrument; this of course is contingent on the constructs being drawn from a relevant theoretical basis.

Scale Development

Table 1 summarises the scales developed to operationalise the revised CAIT conceptual model outlined in Figure 2. Explanatory notes have been included to guide the reader for clarity where appropriate.

Table 1 - Survey Constructs – CAIT

CAIT construct definition	Original construct questions from source & other sources considered	Proposed CAIT survey questions (Seven-point Likert with SD(1)...SA(7))
<p>Lifestyle motivations</p> <ul style="list-style-type: none"> - "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and current needs of potential adopters" (Rogers 2003, p.15). <p>Three dimensions based on the Forrester Technographics segments of career, family & entertainment. (Modahl, 2000).</p>	<p>Utility for children (Attitudinal Beliefs – Utilitarian Outcomes)</p> <ul style="list-style-type: none"> • The computer provides applications that my kid(s) can use. • The computer has useful software for my child (or children). • I find the computer to be a useful tool for my child (or children). <p>Utility for work-related use (Attitudinal Beliefs – Utilitarian Outcomes)</p> <ul style="list-style-type: none"> • The computer is useful for me to work-at-home. • The computer provides applications related to my job. • I am able to work at home more effectively because of software on my computer. <p>Applications for fun (Attitudinal Beliefs – Hedonic Outcomes)</p> <ul style="list-style-type: none"> • The computer provides many applications that are enjoyable. • I enjoy playing computer games. • My computer has applications that are fun. • I am able to use my computer to have fun. <p>(Brown & Venkatesh 2005, pp.424-425)</p> <p>Theory and other sources related to developing this construct Rogers 2003 – <i>Compatibility</i> Modahl 2000 – <i>Primary motivation</i> Brown & Venkatesh 2005 – <i>Utilitarian & Hedonic outcomes</i> McDonald, Corkindale & Sharp 2003</p>	<p>Lifestyle motivations</p> <p>Utility for family</p> <ul style="list-style-type: none"> • Broadband would provide access to applications and information that my family can use. • Having broadband would be useful for my family. • We would find broadband to be a useful tool for our family. <p>Utility for career</p> <ul style="list-style-type: none"> • Broadband would be useful for us to work-at-home. • Broadband would provide access to applications and information related to my job. • We would be able to work at home more effectively if we had broadband. <p>Applications for entertainment</p> <ul style="list-style-type: none"> • Broadband would provide access to many applications that are enjoyable. • We would use broadband to access entertainment sites and content. • Broadband provides access to applications that are fun. • Our household would use broadband to do activities which are fun.

<p>CAIT construct definition</p> <p>Perceived usefulness - the degree to which a person believes using the innovation is an improvement over the technology it supersedes (Davis 1989, Rogers 2003).</p>	<p>Original construct questions from source & other sources considered</p> <p>Applications for personal use (Attitudinal Beliefs – Utilitarian Outcomes)</p> <ul style="list-style-type: none"> • I find that the computer has tools for personal productivity. • I find that the computer has tools to support household activities. • The computer has software that helps with activities in the house. <p>(Brown & Venkatesh 2005, pp.424-425)</p> <p>Theory and other sources related to developing this construct Rogers 2003 – <i>Relative advantage</i> Venkatesh & Davis 2000 – <i>Perceived usefulness</i> Lin 2003 – <i>Use factors</i> Venkatesh et al. 2003 – <i>Performance expectancy</i></p>	<p>Proposed CAIT survey questions (Seven-point Likert with SD(1)...SA(7))</p> <p>Perceived usefulness</p> <ul style="list-style-type: none"> • Broadband would improve our household productivity. • Having broadband would support household activities. • Broadband would be useful in our household.
<p>Image - "the degree to which use of an innovation is perceived to enhance one's image or status in one's social system" (Moore & Benbasat 1991, p.195).</p>	<p>Status gains (Attitudinal Beliefs – Social Outcomes)</p> <ul style="list-style-type: none"> • People who use a computer at home have more prestige than those who do not. • People who use a computer at home have a high profile. • Using a computer is a status symbol. <p>(Brown & Venkatesh 2005, pp.424-425)</p> <p>Theory and other sources related to developing this construct Rogers 2003 - <i>Observability</i> Moore & Benbasat - <i>Image</i> Brown & Venkatesh 2005 – <i>Social outcomes</i></p>	<p>Image</p> <ul style="list-style-type: none"> • People who use broadband at home have more prestige than those who do not. • People who use broadband at home have a high profile. • Using broadband at home is a status symbol.

CAIT construct definition	Original construct questions from source & other sources considered	Proposed CAIT survey questions (Seven-point Likert with SD(1)...SA(7))
<p>Normative beliefs - the degree to which social influence and mass media influence the development of an individuals normative beliefs (Brown & Venkatesh 2005, Rogers 2003)</p>	<p>Friends and family influences (Normative Beliefs)</p> <ul style="list-style-type: none"> • My friends think I should use a computer at home. • Those in my social circle think I should use a PC at home. • My family members think I should use a computer at home. • My relatives think I should use a computer at home. <p>Secondary sources' influences (Normative Beliefs)</p> <ul style="list-style-type: none"> • Information from newspapers suggest that I should use a computer at home. • Information that I gather by watching TV encourages me to use a computer at home. • Based on what I have heard on the radio, I am encouraged to use a computer at home. <p>Workplace referents' influences (Normative Beliefs)</p> <ul style="list-style-type: none"> • My co-workers think I should use a computer at home. • My peers at work think I should use a PC at home. <p>(Brown & Venkatesh 2005, pp.424-425)</p> <p>Theory and other sources related to developing this construct Rogers 2003 - <i>Triability</i> Brown & Venkatesh 2005 – <i>Normative beliefs</i> Mahajan, Muller & Bass 1990 Venkatesh et al. 2003 – <i>Social influence</i></p>	<p>Normative beliefs</p> <p>Friends and family influences</p> <ul style="list-style-type: none"> • Our friends think we should use broadband at home. • Those in our social circle think we should use broadband at home. • Our family members think we should use broadband at home. • Our relatives think we should have broadband at home. <p>Mass media influences</p> <ul style="list-style-type: none"> • Information from newspapers and magazines suggest that we should use broadband at home. • Information that we gather by watching TV encourages us to use broadband at home. • Based on what we have heard on the radio, we are encouraged to use broadband at home. <p>Workplace referents' influences</p> <ul style="list-style-type: none"> • Our co-workers think we should use broadband at home. • Our peers at work think we should use broadband at home.

CAIT construct definition	Original construct questions from source & other sources considered	Proposed CAIT survey questions (Seven-point Likert with SD(1)...SA(7))
<p>Purchase Complexity</p> <p>– Frustration stems from the complexity, ambiguity and unavailability of information. Named as processing and pace frustration in this study. (Strebel, O'Donnell & Myers, 2004, p.1060)</p> <p>Note:</p> <ul style="list-style-type: none"> - Strebel et al. report these questions as loading as two constructs, but do not indicate which questions load to which constructs, so the groupings are by Adams. - The questions were supplied by Strebel via email as they were not included in the referenced paper. 	<p>Processing & Pace Frustration</p> <ul style="list-style-type: none"> • Searching for accurate and relevant information about which type of computer (IBM/Compatible vs. Apple/Macintosh) to purchase is a very frustrating process. • I do not know where to begin looking for information about the pros and cons of each type of computer (IBM/Compatible vs. Apple/Macintosh). • I don't see a big difference between the different types of computers (IBM/Compatible vs. Apple/Macintosh). • Knowing what technology to invest in, such as buying a faster processor or a bigger hard disk, is very difficult. • If I could find more information about the exact limitations with each type of computer, I would feel more comfortable choosing one. • I am so confused with the process of buying a computer, I would like to have someone else make the decision for me. • Just thinking about shopping for a computer and having to decide on a particular technology is very stressful. • I would like to be able to compare the two different types of computers (IBM/Compatible vs. Apple/Macintosh) and be able to tell exactly what the differences are, but there does not seem to be that type of information available. 	<p>Purchase Complexity Processing Frustration</p> <ul style="list-style-type: none"> • Searching for accurate and relevant information about broadband is a very frustrating process. • We do not know where to begin looking for information about the pros and cons of broadband. • We don't see a big difference between the different types of broadband plans offered. • Knowing what broadband plan to select is very difficult. • If we could find more information about the exact limitations with each broadband plan, we would feel more comfortable choosing one. • We are so confused with the process of subscribing to broadband; we would like to have someone else make the decision for us. • Just thinking about shopping for a broadband and having to decide on a particular plan is very stressful. • We would like to be able to compare the different broadband plans available and be able to tell exactly what the differences are, but there does not seem to be that type of information available. <p style="text-align: right;"><i>Continued on next page...</i></p>

<p>CAIT construct definition ...continued from previous page</p>	<p>Original construct questions from source & other sources considered</p> <p>Pace Frustration</p> <ul style="list-style-type: none"> The pace of technological innovation with computers is frustrating to keep up with. I can not decide when to buy a computer because it seems as if there is always a better technology just a few months away. Trying to figure out when is the best time to buy a computer is very frustrating. Even though the price of a car drops significantly when you drive it off the lot, at least you know about how much you could sell it for in six months. With a computer, you just can't tell when the next computer or software will come out making your computer obsolete or worth very little. <p>(Strebel, O'Donnell & Myers, 2004)</p> <p>Theory and other sources related to developing this construct Schwarz, Ward, Monterosso, Lyubomirsky, White & Lehman (2002) – <i>Maximizing versus Satisficing</i></p>	<p>Proposed CAIT survey questions (Seven-point Likert with SD(1)...SA(7))</p> <p>Pace Frustration</p> <ul style="list-style-type: none"> The pace of technological innovation with communications technology is frustrating to keep up with. We can not decide when to subscribe to broadband because it seems as if there is always a better technology just a few months away. Trying to figure out when is the best time to subscribe to broadband is very frustrating. We are worried the broadband plan we select may become obsolete quickly.
<p>Fear of technological advances – an individual's optimistic or pessimistic feeling about technology (Modahl 2000).</p>	<p>Fear of technological advances (Control Beliefs)</p> <ul style="list-style-type: none"> The trends in technological advancement are worrisome to me. I fear that today's best home PC will be obsolete fairly soon. I am worried about the rapid advances in computer technology. <p>(Brown & Venkatesh 2005, pp.424-425)</p> <p>Theory and other sources related to developing this construct Modahl 2000 – <i>Attitude toward technology</i> Brown & Venkatesh 2005 – <i>Control beliefs</i> Lin 2003 - <i>Adoption factors</i> Compeau & Higgins 1995 – <i>Self-efficacy</i></p>	<p>Fear of technological advances</p> <ul style="list-style-type: none"> The trends in technological advancement are worrisome for us. We are worried about committing to a broadband service because we think it is likely a better option will be available fairly soon. We are worried about the rapid advances in communications technology. <p><i>Note: see dialogue in the Discussion section on the similarity of this construct and Pace Frustration</i></p>

CAIT construct definition	Original construct questions from source & other sources considered	Proposed CAIT survey questions (Seven-point Likert with SD(1)...SA(7))
<p>Perceived cost - an individual's perception of cost. This is a secondary attribute as it is how the consumer considers price relative to their disposable income that is important (Moore & Benbasat 1991, p.194).</p>	<p>Facilitating Conditions (Control construct) (to Adoption Behaviour) FCR1. My annual household income level is enough to afford subscribing to broadband FCR2. It is not too costly to purchase a new computer or to upgrade my old computer FCR3. It is not too costly for me to subscribe to broadband at its current subscription fee FCR4. I would be able to subscribe to broadband if I wanted to (Dwivedi, Choudrie & Brinkman, 2006, p.713) Theory and other sources related to developing this construct Moore & Benbasat 1991 Brown & Venkatesh 2005 – Cost, Declining cost</p>	<p>Perceived cost</p> <ul style="list-style-type: none"> • We could fit a broadband subscription into our household budget. • For our household broadband is quite pricey. • Broadband is not a priority in our household budget. • Our household could afford broadband if we decided to subscribe.
<p>Perceived ease of use - "the degree to which an innovation is perceived as difficult to understand and use" (Rogers 2003, p.16)</p>	<p>Perceived ease of use (Control Beliefs)</p> <ul style="list-style-type: none"> • My interaction with a computer is clear and understandable. • Interacting with a computer does not require a lot of my mental effort. • I find a computer to be easy to use. • I find it easy to get a computer to do what I want it to do. <p>(Brown & Venkatesh, 2005, pp.424-425)</p> <p>Theory and other sources related to developing this construct Rogers 2003 - Complexity Venkatesh & Davis 2000 – Perceived ease of use Lin 2003 - Technology factors Brown & Venkatesh 2005 – Control beliefs Venkatesh et al. 2003 – Effort expectancy</p>	<p>Perceived ease of use</p> <ul style="list-style-type: none"> • After it is installed, using broadband would be clear and understandable. • Using broadband would not require a lot of mental effort. • Our household would find broadband easy to use. • We would find it easy to use broadband for what we want it to do. <p>Note: This construct is to clearly delineate between the pre purchase/installation issues and focus on the perceived day-to-day use issues.</p>

CAIT construct definition	Original construct questions from source & other sources considered	Proposed CAIT survey questions (Seven-point Likert with SD(1)...SA(7))
Behavioural Intention	Behavioural intention to use the system BI1: I intend to use the system in the next <n> months. BI2: I predict I would use the system in the next <n> months. BI3: I plan to use the system in the next <n> months. (Venkatesh, Morris, Davis & Davis 2003, p.460) Theory and other sources related to developing this construct Brown & Venkatesh 2005 – Behavioural intention	Behavioural intention <ul style="list-style-type: none"> • We intend to install broadband at home in the next 12 months. • In the next 12 months I predict that we would connect broadband at home. • We expect to subscribe to broadband at home within 12 months.
	Note: the Brown & Venkatesh (2005) MATH paper suggests for future research to use "we", "us" and "our" instead of "I", "my" and "me" for their questions.	

Table 1 – Definitions, sources and proposed survey questions related to CAIT constructs

While the constructs have been presented with the questions grouped for the purpose of clarity here; in the final survey instrument the questions should be randomised to prevent leading the respondents into answering in a consistent manner.

Discussion

These survey scales, although based primarily on established constructs, will need to be tested for validity by following a similar process to that used by Moore & Benbasat (1991). Briefly this includes testing for face, content and construct validity; as well as reliability. Before the main survey is conducted, the instrument will need to have both a pre-test and a pilot test to address any issues with wording, internal consistency and to ensure the scales demonstrate acceptable levels of construct reliability (Bearden, Netemeyer & Mobley 1993, pp.3-6). The final testing phase needs to include a confirmatory study where the scales are analysed to ensure they are capturing the theoretical constructs intended (DeVellis 2003).

The intention is to create a parsimonious instrument which provides reliable data on the theoretical constructs being addressed. Given the *purchase complexity* construct has been drawn from outside the existing Information Systems literature, it is expected during the pilot phase there will be modifications to the instrument needed. Initial informal face validity trials suggest the *pace frustration* and the *fear of technological advances* constructs will cross load and will need refinement. For the pilot phase it has been decided to leave them both in a similar format to their original structure and refine the relevant constructs after the initial data analysis.

The quality of the data collected would be strengthened by the inclusion of demographic variables collecting household data on: income; number of people; number of dependent children; education levels; dwelling type and postcode. In addition to providing alternative analysis of the primary data set collected, the demographic data would allow for broad comparisons with Census data.

Future directions for research

Building on this work specifically, once the pilot phase is complete and the final instrument reported, a representative sample of the Australian population can then be surveyed. Sample size becomes important when analysing data you wish to generalise to the broader population. The final scales currently have 51 questions, Hair, Anderson, Tatham & Black (1998) suggest a minimum of five respondents per question are needed and preferably a ten-to-one ratio. This would give a target of 510 useable responses to reach the ten-to-one level. With survey response rates often around the 20% mark, a minimum of 2550 surveys would need to be distributed in normal circumstances. Given this survey is targeting only those households who have not yet adopted broadband, the number of surveys sent should be doubled to allow for the fact that the number of households with broadband is likely to be approaching 50% by the time any survey is distributed.

While beyond the scope of this paper, work needs to be done in specifically looking at the adoption of broadband in Australia by single person households. These households represent 24% of households nationally, but only 19% of single person households have broadband compared to the household average of 39%. The gap is even wider when you consider 59% of households with five people have broadband connected (ABS 2007).

Conclusion

The issues of frustration and the complexity of making a purchase decision serve as barriers for those individuals who are already predisposed to be conservative and like making considered choices in their purchase decisions. The scales proposed here broaden the

existing IS view of technology adoption by including the purchase complexity construct, as well as reframing well established constructs in terms of the households' view.

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