Towards a Conceptual Model of Broadband Diffusion

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Although Information Systems (IS) research has paid attention to the understanding of users' adoption of technology, researchers have had a minimal focus upon the application of various adoption models that study a consumer's adoption of technology. An attempt to fill this gap is undertaken in this research. Therefore, the aim of this study is to provide a comprehensive review of the extant information systems literature related to users and/or consumers' adoption of technology with an emphasis on broadband and to develop a conceptual model based upon the review. To achieve the overall aim, three objectives are proposed and they are: (1) to review and assess the appropriateness of previous technology adoption models and constructs; (2) to identify the appropriate constructs from various models that are used to understand the household diffusion of broadband; and (3) to formulate research hypotheses and to develop a model of broadband adoption. The contributions of this paper are: it integrates the appropriate information systems (IS) literature in order to enhance our knowledge of technology adoption from the consumer perspectives; and provides clear directions for future research. That is, first, this paper evaluates the flexibility of various models for studying technology adoption issues. Second, it assimilates previous research findings to develop a coherent and comprehensive picture of the technology adoption research conducted in the IS field. Third, this paper introduces a conceptual model that integrates factors from different technology adoption models to study home technology diffusion from a consumer perspective. Finally, the future research directions to this research are provided in the concluding section.

Keywords: broadband, consumer behavior, diffusion, adoption, households, model of broadband diffusion, MATH, decomposed TPB.

1. Introduction

New innovations in Internet access technologies are occurring on a rapid rate in our daily lives (Anderson and Tracey, 2001). The most critical transition, which is currently taking place in the Internet access technology area, is a shift from the traditional dial-up (narrowband) connection to broadband in which voice, data and broadcast media are converging together. Due to the aforementioned capabilities broadband telecommunications and interactive multimedia technologies are expected to play an important role in various countries' International competitiveness. This emphasis is true for both sides of the world: South East Asian countries such as Japan, South Korea, Taiwan, Singapore and Hong Kong and European and North American countries such as the United Kingdom (UK), United States of America (USA) and Canada (Langdale 1997, Sawyer et al 2003).

In this transforming climate there is considerable academic and public debate about the consumer adoption of broadband technology. Since the UK government believes that the rapid rollout and adoption of broadband across the nation is important to both its social and economic objectives (Oftel, 2003), it has established a target to make the UK the most competitive and extensive broadband market in the G7 by 2005 (Office of the e-Envoy 2001). However, the reported rate of broadband adoption in the UK is slow, given the early rollout of infrastructure competition (OECD, 2001). This has led researchers to investigate the factors that are responsible for the slow uptake of broadband.

Examination of previous literature in the Information Systems (IS) area illustrates that researchers have not yet undertaken research on broadband in the areas of consumer diffusion, including the adoption and consequences in the household. Instead, most of the research associated with broadband has mainly focused on

its usage and provides little insight into the determinants of consumer adoption or rejection determinants and its post adoption impact (Carriere *et al,* 2000, Horrigan *et al,* 2001, Anderson *et al,* 2002, Dwivedi and Choudrie 2003ab, Lebo, 2001, 2003). Although previous studies of broadband adoption (Lee *et al*, 2001, 2002, 2003, Choudrie and Lee 2004, Gardner, 2003) provide information on the macro level factors leading to adoption in a country; however, none of them focuses upon the determinants of adoption or rejection at a micro level. Recently conducted studies (Oh et al 2003, iSociety 2003, Choudrie and Dwivedi 2004ab, Stanton 2004) highlight the need to understand adoption and diffusion of broadband at consumer levels.

The limitation to studying consumer level adoption at a micro level has resulted in a lack of appropriate theoretical or conceptual models specific to broadband. As pursued in previous adoption studies, constructing a conceptual model specific to broadband diffusion at household consumer level necessitates the review, identification and integration of the relevant factors examined in previous IS studies. Therefore, this paper aims to develop a conceptual model specific to broadband diffusion. To achieve the overall aim, the following three objectives of this paper are: (1) to review and assess the appropriateness of previous technology adoption models and constructs to study broadband diffusion; (2) to identify the appropriate constructs from various models to understand household diffusion of broadband; and (3) to formulate research hypotheses and develop a model of broadband adoption.

1.1. Structure of the Paper

To construct the conceptual model of broadband diffusion (CMBD), several steps were followed and these are described within this paper. Having introduced the topic of interest, this paper now proceeds to set the foundation and delineates the boundaries of topic under discussion in section 2. Section 3 provides a review of the previous works correlated with broadband adoption, usage and impact. This is followed by a review on theoretical models of technology diffusion and adoption in section 4. Section 5 develops a framework to guide broadband diffusion research and justifies propositions by presenting theoretical explanations, past empirical findings, and practical examples. Finally, section 6 presents the concluding implications, future research directions, limitations and contributions of this research.

2. Boundary and Definitions

Whilst studying the diffusion of any new technology there are many stakeholders to consider. Similarly, the diffusion of broadband also involves various stakeholders such as the government, Internet Service Providers (ISPs), business consumers, public organizations and residential consumers (Choudrie et al 2003). The focuses of this study are the consumers. Hence the proposed conceptual model will only considers factors that are relevant to the household consumers. Due to the following reasons residential consumers are considered to be the focuses of this study for the following reasons: first, the previous studies consider supply side stakeholders as mentioned above; however, there is little attention paid to the examination of consumers; second, at this stage of broadband implementation, supply side factors are not considered to be problems; however, growth is constrained by the demand side, as consumers are reluctant to subscribe to the technology in question. Therefore, the object of our study is the consumer.

The second most important thing to clarify at this stage is the meaning of the diffusion of broadband. We consider Rogers (1995) definition of diffusion as most suitable. This suggests that diffusion involves the adoption of new innovation, its usage and subsequent impact of usage. Therefore, the proposed conceptual model has included constructs relevant to adoption, usage and its impact on household consumers.

Before proceeding further, a term frequented within this paper is 'broadband' and a short explanation of it is warranted. The umbrella term of broadband technology embraces a variety of high-speed access technologies including ADSL (Asymmetric Digital Subscriber Line), cable modems, satellite, and Wi-Fi (Wireless Fixed) Networks (Sawyer, *et al* 2003). The term broadband has no established definition. It varies from country to country (Firth and Kelly, 2001) and evolves over time as the underlying

transmission and routing technologies continuously advancement: yesterday's broadband is today's 'narrowband'. Given the variations in defining 'broadband', for the purpose of this research we follow the technology neutral definition suggested by the Broadband Stakeholder Group (2001) that defines broadband as "*always on access, at work, at home or on the move provided by range of fixed line, wireless and satellite technologies to progressively higher bandwidths capable of supporting genuinely new and innovative interactive content, applications and services and the delivery of enhanced public services*' (BSG, 2001). This definition is technology neutral; that is, it has less to do with the technical speed, and focuses on functionality, that is, more to do with what a user can do with broadband (Sawyer, *et al* 2003).

An additional focus of this research is that of the consumers, and at this point the differentiating factor between the terms of consumers and users is provided. According to Rice (1997) 'consumers' are those who pay for services and goods; whilst, 'users' are individuals who are affected by or who affect the product or services. In other words, users are those who use the products and services but do not pay for it (Rice 1997). For example, a child can be categorised as a user since he/she uses broadband for online gaming and to undertake homework; however, the child does not pay for the service. In contrast, the parents are consumers since they pay for the service.

3. State of Broadband Diffusion Research

3.1. Adoption Studies

The adoption studies discussed henceforth mainly provide discussions of the macro factors that drive the success or slow uptake of broadband deployment. In an initial study of broadband deployment in South Korea, Lee *et al,* (2001, 2003) identified three major reasons that explained the high rate of broadband adoption in South Korea. Further research suggested six success factors are responsible for driving the high penetration rate of broadband within the South Korean residential consumers (Lee and Choudrie 2002; Choudrie et al 2003 a, b; Choudrie and Lee 2004). To obtain a more balanced view the UK perspective was also investigated. Dwivedi *et al*, (2003 c) examined the Internet Service Providers (ISPs) views on factors affecting broadband adoption in the UK. This exploratory study suggested that a high price, lack of content, and lack of awareness are the factors that are severely affecting the adoption of broadband amongst the residential consumers. Other exploratory studies that examined the factors affecting the deployment of broadband in the various countries across the globe include Sweden (Shim *et al*, 2003), Australia and Canada (Gardner, 2003; Chang *et al*, 2003). Although previous macro studies are mentioned briefly above, a detailed discussion is beyond the scope of this research.

Consumer level adoption studies have also begun to emerge (Oh et al 2003, Choudrie and Dwivedi 2004 a, b, c, d). These studies are briefly introduced here in this section and detailed discussions are provided in the following section – 4.6. Oh et al (2003) examined the individual level factors affecting the adoption of broadband access in South Korea. This study combines factors from Rogers' diffusion theory and the technology acceptance model developed by Davis (1989). The findings of this study suggest that congruent experiences and opportunities in adopting a new technology affect user attitudes through the three extended technology acceptance model constructs, namely perceived usefulness, perceived ease of use and perceived resources. Dwivedi and Choudrie (2004) developed a conceptual model that was an adaptation of the model of adoption of technology in households. However, that study was limited since it was not supported by empirical data. Choudrie and Dwivedi (2004 a, b) examined broadband adoption employing the aforementioned conceptual model with some minor refinements. The results established that the adoption of broadband is driven by factors such as relative advantage, utility outcomes and hedonic outcomes. Contrastingly, broadband was inhibited by high subscription cost, lack of needs, lack of content and applications. Choudrie and Dwivedi (2004 c) also examined the role of socioeconomic attributes in broadband adoption and found that solitary use of demographic variables such as income, education and occupation fails to identify the broadband adopters and non-adopters patterns. However, cross tabula-

tions of these attributes may help to differentiate the adopters from non-adopters (Choudrie and Dwivedi 2004 c). Stanton (2004) analyzed the secondary data of USA consumers to study the digital divide and suggested urgent needs to understand the demographic and other factors of broadband adopters and non-adopters in order to increase the growth rate of broadband and also to bridge the digital divide (Stanton 2004).

3.2. Usage and Impact Studies

Usage is the other topic of interest in the IS area. Studies in this area have been in the form of user surveys that have examined the broadband users' behavior in comparison to that of the narrowband users. Results from these surveys suggest that Internet users behave differently when they have broadband access. Broadband users use the online facilities on a longer basis, utilize more services or applications and apply them more often. The majority of broadband users rate their on-line experience as compelling (Carriere *et al* 2000, Horrigan *et al* 2001, Anderson *et al*, 2002, Dwivedi and Choudrie 2003 a, Lebo 2001, 2003). In comparison to the dial-up users, broadband users spend 22% more total time on electronic media applications (Bouvard and Kurtzman 2001). Surveys conducted on broadband users also suggest that these users make more online purchases and procure more varied categories of products in comparison to the narrowband users (Carriere *et al* 2000, Dwivedi *et al* 2003 c). Although the aforementioned studies examined the usage of broadband, they lack theoretical underpinnings, as they are data led and exploratory in nature. Understanding the impact of broadband usage on the consumers' daily life is still untouched by previous studies.

From the aforementioned analysis of broadband adoption and usage it was found that there is a need for an appropriate theoretical or conceptual model that can be used to examine overall broadband diffusion within the context of the household. Given the slow uptake of broadband adoption in many countries, it was felt that such research would be beneficial since it would identify areas that require emphasis.

4. Technology Diffusion and Adoption Theories

The study of adoption/acceptance, adaptations and usage of information technology is considered to be one of most mature areas in the information systems (IS) discipline (Benbasat and Zmud, 1999, Hu et al, 1999, Venkatesh et al 2003). Consequently, over time a number of theories and models have been adopted from diverse disciplines, modified, developed and validated by IS researchers in order to understand and predict technology adoption and usage (Benbasat and Zmud, 1999, Venkatesh et al 2003). These include the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975); Theory of Planned Behavior (TPB) (Ajzen and Madden 1986, 1991); Technology Acceptance Model (TAM) (Davis, 1989); Diffusion of Innovation theory (Rogers, 1985, 1995, 2003). According to the needs of IS research, these theories were further modified, extended and integrated. For instance, Taylor and Todd (1995) proposed the decomposed TPB by modifying TPB and integrating the diffusion of innovation constructs within it. Similarly, Venkatesh and Morris (2000) extended TAM by integrating gender and subjective norm constructs with the original TAM model. Venkatesh and Brown (2001) modified the TPB to study technology adoption issues within the household context. Due to the large numbers of choices of theories and models, a selection of an appropriate model or various constructs from different models is posing to be a problem for upcoming technology adoption researchers. Venkatesh et al (2003) argued that researchers are confronted with a choice amongst a multitude of models and find that they must "pick and choose" constructs across the models, or choose a "favoured model" and largely ignore the contributions from alternative models. This led Venkatesh et al (2003) to review, discuss and integrate elements across eight prominent user acceptance models that resulted in proposing the Unified Theory of Acceptance and Use of Technology (UTAUT).

Since the traditional focus of IS researchers were the 'users' of technology, all the previous models including UTAUT, were adopted, modified and developed in the context of user adoption of technology within an organizational environment. Although these models and theories

are widely tested and validated to explain usage and adoption of technology from the 'users' perspective, their application is limited to study the 'consumers'. Realising the potential of emerging information and communication technologies (ICTs) for household consumers, recent information systems (IS) researchers have also begun to investigate the consumer adoption, usage and the impact of technology (Venkatesh and Brown, 2001; Oh et al, 2003; Dwivedi and Choudrie, 2004; Choudrie and Dwivedi, 2004 a, b, c). Since the focus on consumers within the IS field is new, the guiding theories, models and research approaches are in the initial stage of development, testing and validation. Therefore, the following section will review prominent technology diffusion and adoption models and highlight their strengths and weaknesses to study the adoption and usage of technology from the consumers' perspectives. The theory and models will be discussed in the light of empirical studies available in the related area. A combination of the various models that led us to propose the model of consumer adoption and usage of broadband technology will be discussed in the following section.

4.1. Diffusion of Innovations

The diffusion of innovations theory (Rogers 1995, Tornatzky and Klein 1982) has been employed to study a wide range of phenomena including the adoption and usage of technology. Within the technology adoption and usage area, this theory was used to examine a variety of factors that are thought to be determinants of IT adoption and usage including individual user characteristics (Brancheau and Wetherbe 1990); information sources and communication channels (Nilikanta and Scammell 1990); and innovation characteristics (Hoffer and Alexander 1992, Moore 1987, Moore and Benbasat 1991). IS researchers also integrated the intentions and innovations theories combining concepts from the Theory of Reasoned Action (Moore and Benbasat 1991) and the Theory of Planned Behaviour (Taylor and Todd 1995, Chau and Hu 2001) with the perceived characteristics of innovations (Rogers 1995). Since the innovations characteristics such as relative advantage, compatibility, and observability are applied in diverse situations and easily integrated with constructs from other theories and models, it is useful to consider appropriate innovations attributes to examine the diffusion of broadband.

4.2. Theory of Planned Behaviour (TPB) and its Variations

Although the Theory of Planned Behaviour (TPB) (Ajzen, 1985, 1988, 1991; Ajzen and Madden, 1986; Schifter and Ajzen, 1985) has its roots within organizational research, it is widely adopted and adapted by IS researchers to the study of IT adoption, implementation, and use (Benbasat and Zmud, 1999). It is an extended form of the Theory of Reasoned Action (TRA) that was developed to overcome the TRA's limitations that dealt with an incomplete volitional control (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975).

The central factor in the TPB that captures the motivational factors that influence behaviour is an individual's 'intention' to perform the behaviour of interest. This was also considered to be a central factor within the TRA. Both the TPB and TRA are considered intentions that indicate the magnitude of willingness and effort exerted, in order to perform the behaviour under question. Therefore, the stronger the individual's intention to engage in behaviour, the more effectively it would be manifested (Ajzen, 1988, 1991).

The TPB believes that an individual's use of a specific IT will be influenced by three independent variables that conceptually determine intentions towards a particular behaviour. These are: (1) attitudes (A) formed by the person's beliefs about the expectations of outcomes associated with IT use; (2) subjective norms (SN) formed by the person's beliefs about how important others expect the person to behave regarding IT use; and (3) perceived behavioural control (PBC) formed by the person's beliefs about the extent to which the person is capable of actually using the IT. The first two independent variables (A, SN) are common in both the TRA and TPB, whilst the third variable PBC is an added extra in the extended framework of TPB to overcome the limitations of incomplete volitional control (Ajzen, 1988).

Although TPB does not describe the process of implementation in a specific context, it has

experienced a high degree of predictive validity and can be used to identify areas of concern for a specific context. According to the IS literatures TPB can serve as an effective diagnostic tool to examine IT adoption or acceptance and usage (Benbasat and Zmud 1999). Therefore, we considered all core constructs (Attitude, Subjective Norms and Perceived Behavioural Control) of TPB to develop proposed conceptual model.

In order to increase the predictability of TPB, Taylor and Todd (1995) decomposed the attitudinal belief dimensions and included innovations characteristics (Rogers 1995) as different dimensions of attitude construct. This study concludes that the decomposed structure helps to increase predictability in comparison to TPB and more in-depth understanding when compared to TAM. This variant of TPB is termed as the decomposed Theory of Planned Behaviour (Taylor and Todd 1995). Bearing the aforementioned reasons in mind, the conceptual model of broadband diffusion adopted the decomposed structure of attitude, subjective norms and perceived behavioural control constructs. However, the dimensions of these are not exactly similar to Taylor and Todd's (1995) study. This is because the context and subject of the two studies are different from one another.

4.3. Technology Acceptance Model

The Technology Acceptance Model is an adaptation of the Theory of Reasoned Action (TRA). This model predicts systems usage by employing two factors; namely, the percieved usefulness and percieved ease of use of an IS (Davis 1989). Perceived usefulness represents the beliefs of users, which are that technology use will enhance performance. These two factors determine the attitude towards the intention to use of the system in question. Understanding the percieved ease of use and percieved usefulness has direct implications for system designers who build a system. Although TAM is a very successful model in terms of studying the users intention of adoption and usage of technology, its application is yet to be investigated for consumers within the household context. Therefore, we did not consider the TAM constructs such as those proposed in our model of broadband diffusion. However, constructs similar to percieved usefulness, which is relative advantage (Taylor and Todd 1995, Oh et al 2003), is considered in our conceptual model.

4.4. Model of Adoption of Technology in Households (MATH)

The model of the Adoption of Technology in the household was applied to investigate PC adoption in the American households. According to this model, technology adoption in the household is determined by a number of factors. These include the attitudinal belief structures such as utilitarian outcomes, hedonic outcomes and social outcomes; normative belief structures such as the influence of friends, family and secondary information sources; and a control belief structure that consists of three barriers namely knowledge, difficulty of use, and cost (Venkatesh and Brown 2001).

The majority of constructs included in this model are also useful to study broadband adoption (Dwivedi and Choudrie 2004, Choudrie and Dwivedi, 2004). However, constructs from this model do not provide insights to the phenomenon of diffusion; they only shed light upon the adoption part of it. Furthermore, this model was constructed to study PC use; therefore a detailed factor needs to be adjusted for broadband. Therefore, we considered the majority of MATH constructs as attitudinal belief dimensions.

4.5. Use Diffusion Model

The use diffusion model was developed to investigate technology use in the husehold context. The model was guided by the following three key components. First, use diffusion (UD) determinants such as household social context, technological dimension, personal dimension and external dimension. Second, UD patterns which are the typology of uses or users consist of two constructs called the variety of use and rate of use. Third, UD outcomes consist of the percived impact of technology, satisfaction with technology and interest in future technologies. This study concludes that user segments vary on the basis of the following factors: social context and technological makeup of the household,

personal factors, external influences, user satisfaction with technology and interest in using future technologies (Shih and Venkatesh 2004).

Since this model focuses upon the usage of technology, its few constrcts such as variety of use and rate of use would be useful to determine broadband usage and users segments. Constructs of this model will also be helpful to bridge the gap between adoption and impact studies.

4.6. Model Applied to Study Broadband Adoption and Diffusion

The discussion in section 3 illustrates that the majority of studies conducted to understand broadband related issues are macro and exploratory in nature. These studies are mostly data-driven in nature, compared to process-driven. Therefore the use of the model or theories is less prominent in initial studies (Anderson et al 2001, Dwivedi and Choudrie, 2003 a, b, c, d). However as the broadband area has matured and the adoption rates increased, researchers have begun to use process- or theory-based investigation to study the issue of diffusion, although such research is still in the embryonic stage.

Oh et al (2003) integrated innovation attributes with technology acceptance constructs such as perceived usefulness and perceived ease of use. Findings of this study suggest that innovation attributes, such as compatibility, visibility, and result demonstrability, have an impact on constructs in the extended technology acceptance model such as perceived usefulness, perceived ease of use and perceived resources. On the basis of this study the implications are that efforts should be made to expand the compatible experience base of broadband Internet in order to facilitate its adoption and use. Although this is a good beginning, this study is limited to study attitude formation since it does not provide any evidence of how attitude building affects behavioral intention to adopt or reject technology in question. Also, this study examined the users of broadband rather than the consumers; therefore the findings are weak as they are only limited to the drivers and inhibitors of broadband adoption. The authors of this study identified the following three important limitations of this study: first, the research model did not consider behavior or behavioral intention constructs; second, the selection and use of statistical tools of data collection; third, the model did not account for the impact of changes in perception and attitudes on the technology usage over a long period of time (Oh et al 2003). Consequently, this study is urging for future refinement of the research model, use of more rigorous statistical tools and hypothesis testing at more than one point of time (Oh et al 2003).

Moving beyond attitude, Dwivedi and Choudrie (2004) developed a conceptual model based on the model of adoption of technology in household (MATH) and included constructs such as attitude, subjective norms and perceived behavioral control factors to measure behavioral intention to adopt broadband. This study also suggested that demographic attributes such as age, income, education and occupation could have a moderate impact upon the factors; therefore these socio-economic factors should also be considered within the adoption model. However, this model was limited due to the lack of empirical evidence. The authors called for researchers to conduct empirical studies that tested the validity of the constructs included within the model. Other limitations of this conceptual model were that it did not include the usage and impact components of broadband diffusion phenomenon. This, in our view is essential to understand sustained adoption and usage of broadband technology.

Choudrie and Dwivedi (2004 a,b) tested the above-discussed model; however they ignored the suggestion of including the socio-economic attribute as a moderating variable within the model. The collected data examined the attitudinal factors such as relative advantage, utility outcome and hedonic outcome; normative factors such as the influence of family and friends and control factors such as cost, knowledge, skill and needs of a particular technology. On this basis of estimated means, most of the factors were found to be significant except the normative factors. The data collection was exploratory in nature; therefore the authors called for a more rigorous approach to validate these factors. Also, this study emphasizes factors that can measure the sustained adoption, usage and impact of broadband within household.

Considering the limitations of previously published models of broadband adoption, we propose to include the constructs which are important to understand, not only initial adoption, but also sustained adoption, usage and impact. In other words, the conceptual model proposed in following section 5 provides a holistic view of the broadband diffusion phenomenon.

5. Proposed Conceptual Model

Taylor and Todd (1995) discussed two main criteria to select an appropriate model. First, a model that provides good prediction while using the fewest predictors is preferable in other word more parsimonious (Bagozzi 1992, Taylor and Todd 1995). Second, the model should provide both reasonable predictive ability and contributes enough to understanding the phenomenon under investigation (Taylor and Todd 1995). Since a broadband diffusion study requires both predictive ability (in case adoption) and contribution to understanding (in case of usage and impact), we adopted the second criterion to develop our conceptual model. At a conceptual level we included all the constructs from the various models, which may in the future provide insights to an understanding of all three stages of diffusion. However, after validation of these constructs, to maintain parsimony of explanatory model, the less significant constructs will be eliminated.

To summarise the aforementioned section, we have discussed the relevant previous technology adoption models and have provided reasons for including or discarding their constructs in the proposed model of broadband diffusion. In the following sub sections we discuses the appropriate constructs and sub constructs of the current study.

5.1. Foundations of Proposed Model

While TPB is a generalised theory, it can be applied to a wide variety of contexts for predicting the adoption of different types of IT. Its major constructs reflect the key variables that have been identified as influential in previous implementation research and are flexible enough to subsume situation-specific factors (Benbasat and Zmud, 1999). Therefore, we consider it as a guiding theory of our adoption research. The decomposed belief structure for household broadband adoption is adopted from Taylor and Todd (1995). The detailed constructs to examine broadband adoption issues are derived directly from Rogers' (1995) innovations characteristics and Venkatesh and Browns' (2001) model of adoption of technology in households. To investigate the usage and impact of broadband technologies we adopt a majority of constructs from the Use Diffusion Theory (Shih and Venkatesh 2004).

5.2. Description of Proposed Model

The adoption components of the proposed diffusion model postulates that a person's intention to adopt broadband at home is determined by three key constructs. These are; (1) **attitude towards behavior**, which describes the perception towards broadband technologies; (2) **subjective norms**, which describes the social influences that may affect the intention to adopt broadband; (3) **perceived behavioral control** that describes the beliefs about having the necessary resources and opportunities to adopt broadband in the home. These three independent variables determine and explain the intention to adopt broadband, which in turn is expected to predict the actual adoption of broadband.

The usage component of the proposed diffusion model postulates that the actual usage of broadband can be determined by: (1) the social context of households, (2) personal dimensions of consumers-users, (3) the variety of use and (4) the rate of use. The impact of broadband is postulated as an ultimate outcome of usage of broadband (Shih and Venkatesh 2004).

In addition, this model also postulates that a person's intention to adopt and use broadband at home can also be explained by the socio-economic characteristics of adopters and non-adopters such as age, education income and occupation that have an impact on attitude, and perceived control behavior constructs.

A detailed description of the aforementioned factors and sub factors and reasons for including them in proposed conceptual model is provided below.

5.3. Attitudinal Factors

According to Venkatesh and Brown (2001) the different magnitudes of attitudinal belief towards the adoption of PC in the household can be measured using three main constructs; namely, utilitarian outcomes, hedonic outcomes, and social outcomes. When examining broadband adoption in the household, this research will adopt the hedonic outcomes, utilitarian outcomes (Venkatesh and Brown, 2001) and relative advantage (Rogers, 1995). Since broadband is not a directly observable product, the social outcome construct of the model of adoption of technology in the household was considered irrelevant to this study. Three constructs, namely, relative advantage, utilitarian outcomes and hedonic outcomes are expected to provide measures of attitude towards the behavior of broadband adoption in the household. Apart from the aforementioned constructs, this study also includes service quality as one dimension of attitude for those consumers who already have broadband. The construct service quality will help to predict if adopters are continuing to subscribe to broadband or else they will discontinue.

Relative Advantage

Rogers (1995) diffusion of innovation theory suggests that the perceived relative advantage of an innovation is positively related to its rate of adoption. Several empirical studies in the past have found that the perceived relative advantage is an important factor in determining the adoption of an innovation (Tornatzky *et al*, 1982, Taylor and Todd, 1995 Tan *et al*, 2000). Similarly, since broadband offers faster, un-metered, always-on access to Internet, it provides a significant advantage, convenience and satisfaction to broadband users in comparison to those of dial-up access. In view of the advantages that broadband offers, it would be expected that individuals who perceive broadband as advantageous would also be likely to adopt the technology. This leads to the hypothesis:

H1: *The greater the perceived relative advantage of using broadband over dial-up, the more likely that broadband will be adopted in the household.*

Hedonic Outcomes

The Venkatesh and Brown (2001) study provides evidence that the hedonic outcome is one of the factors that influences PC adoption in the home. Venkatesh and Brown (2001) defined hedonic outcomes as pleasure derived from PC use; for example, games, fun, and entertainment. Empirical findings from this study established the role of entertainment (PC games, Video games) derived from using the new technology as a factor of consideration on consumer decision making when adopting a technology (Venkatesh and Brown, 2001). The authors argued that the "entertainment functionality of PC provides an opportunity to escape reality and become absorbed in a new world, which exhibits characteristics that are consistent with a hedonic perspective" (Foxall, 1992). The entertainment potential of a PC is much more enhanced by the advent of the Internet. It offers the opportunity of playing online games, downloading music and video, chat and sending online messages. However, this potential was severely hampered by the slow speed of dial-up Internet. This barrier is overcome by broadband technology which offers in terms of data, faster download speeds and streaming capabilities to Internet users; hence more convenient and compelling environments. Recent studies (Lee, 2001, Lee and Choudrie, 2002) suggest that one of the most important factor that was responsible for broadband adoption in South Korea is the PC bang phenomenon. In view of the entertainment potential that broadband offers, it would be expected that individuals who perceive broadband as a good entertainment medium would also be likely to adopt the technology. Similarly, a study by Anderson *et al* (2002) suggests that broadband users are more likely to use the Internet for fun and entertainment in comparison to narrowband users. It can be assumed that the entertaining potential of broadband is one of the critical drivers of adoption in the household. Therefore, the underlying hypothesis is:

H2: *The greater the perceived entertainment (hedonic outcomes) potential of using broadband, the more likely that broadband will be adopted in the household.*

Utility Outcomes

The perceived usefulness construct (Davis, 1989) is one of the strongest predictor's used to examine the adoption and usage of workplace technology. Venkatesh and Brown (2001) proposed and validated the utilitarian outcome factor that can be used to examine the adoption and usage of technology in a household setting. The extent to which using a PC enhances the effectiveness of household activities such as budgeting, homework and work is known as utilitarian outcomes (Venkatesh and Brown, 2001). Broadband offers a more flexible lifestyle. For instance, many people subscribe to broadband in order to work at home instead of travelling to the office; broadband can assist the children with their homework, and many more household activities can be performed conveniently using the faster access of the Internet offered via broadband. Therefore, it is expected that the more the household consumer uses broadband, the more the usefulness of broadband for work or household-related activities is perceived, the more likely will broadband technology be adopted in the home. Thus, the hypothesis is:

H3: *The greater the perceived usage (utility outcomes) of Broadband for household activities the more likely its adoption.*

Service Quality

This construct was not employed in the case of PC adoption studies. This is because when purchasing PC the consumers have only one opportunity to make a choice – to purchase or not to purchase. However, in the case of broadband this does not apply. That is, an annual fee contract-one time fee- is paid for by the consumers and during this period, if the provided service is not satisfactory, then consumers will discontinue the broadband subscription. Alternatively, if consumers had a choice of providers, then they might move to others. Therefore, it is important to understand if consumers are satisfied with their current providers and their provided services or not. Hence, the underlying hypothesis is:

H4: *The greater the perceived service quality from current broadband subscription, the more likely that a consumer will continue to subscribe it.*

5.4. Subjective Norms

Venkatesh and Brown (2001) have considered the social influence of family, friends, TV, and newspapers as a construct that can be used to measure subjective norms. The findings of Venkatesh and Brown (2001) suggest that social influences are significant determinants of the purchasing behaviour of PCs. Similarly, it is expected that households with broadband connections are likely to influence their relatives and friends by informing them of the benefits and convenience offered by broadband. Therefore, it is appropriate to consider social influences as a measure of subjective norm for broadband adoption in the household. Hence, the hypothesis is:

H5: *Social influences by family, friends and colleagues are significantly related to an individual's decision to adopt broadband in homes.*

5.5. The Perceived Behavioural Control (PBC)

Venkatesh and Brown (2001) identified and validated five specific barriers that can inhibit the adoption of PCs in the household, including, a rapid change in technology, declining costs, the high cost of PCs, ease/difficulty of use and a requisite knowledge of the use of PCs. Since the subscription cost of broadband access is stable and technology is not changing rapidly, the declining cost and rapid changes in technology were considered irrelevant factors for the adoption of broadband technologies; hence not included in this research. This study considered the factors of high costs, the ease/difficulty of PCs and Internet use, the lack of knowledge of broadband benefits, and the lack of needs as barriers to the adoption of broadband.

Cost

The South Korean government's vision recognized an affordable monthly cost of broadband for the middle-income household as one of the most important factor that led to the high rates of adoption (Lee and Choudrie, 2002). However, a

previous exploratory study on broadband adoption in the UK suggests that the high monthly cost is a major barrier that is inhibiting the adoption of broadband in the household (Dwivedi *et al,* 2003 c). Therefore, it is expected that if perceived cost is high, then adoption will be slow. Hence, the hypothesis is:

H5: *The greater the perceived monthly cost of broadband access, the less likely that it will be adopted.*

Broadband technology is not compatible to the specifications of the old PCs and necessitates either an upgrade or purchase of a new PC. However, PCs are not easily replaceable commodities for the medium and lower income households. Therefore an economic barrier in the form of costs that are incurred when upgrading or purchasing new personal computers inhibits the adoption of broadband in the household. Therefore, the hypothesis is:

H6: *The greater the perceived cost of upgrading the old PC or buying a new PC, the less likely that broadband will be adopted in the household.*

Requisite Knowledge

The level of knowledge about an innovation, its risks and benefits affect the adoption rate (Rogers, 1995). The greater the awareness of the benefits of the innovation amongst the consumers and users, the more likely the innovation gets adopted. Lee and Choudrie's (2002) research suggests that in South Korea the consumers knew what the potentials of broadband were. The consumers were aware of the benefits of faster Internet access, which was essential to satisfy their needs. It is assumed that the adoption of broadband requires a clear message of its usages and benefits amongst the total segments of society. Also, if consumers are not aware of what the benefits of adopting a particular innovation are, then it is expected that they are more likely to reject the decision to make a purchase due to the lack of the perceived needs. Therefore, the underlying hypotheses are:

H7: *The lack of knowledge on broadband, its availability and benefits inhibit broadband adoption.*

H8: *The lesser the perceived needs of obtaining the broadband, the less likely that it will be adopted.*

Skills of Using PC and Internet

Since the use of broadband also requires using a PC and the Internet, the ease or difficulty of use and requisite knowledge of a PC and Internet use are expected to have an impact of broadband adoption. The South Korean government deployed a variety of promotion policies. "The Ten Million Program" was designed to boost Internet use amongst the housewives, the elderly, military personnel, farmers, and excluded social sectors such as low-income families, the disabled and even prisoners. This promotion of providing PC and Internet skills in the year 2000 contributed towards the adoption of the Internet. A total of 4.1 million people that included one million housewives occurred as a result of such initiatives (Lee and Choudrie, 2002). Therefore, it is expected that household users with basic PC and Internet skills are more likely to adopt the broadband. Hence, the hypothesis is:

H9: *The lesser the skill toward using the PC and Internet, the less likely that broadband will be adopted.*

5.6. Use Diffusion Constructs

In the proposed conceptual model we considered a variety of broadband use and rate of use as dependent variables. The value of variety and rate of broadband usage variables expected to be determined by independent variables such as the household social contexts in which the users operate, the personal dimension of user(s), and external factors such as external communication and media exposure (Shih and Venkatesh 2004). Following the previous study on technology usage (Shih and Venkatesh 2004) we postulate the following hypotheses on broadband use diffusions:

H10a: *Higher intensity of communication with other users about the broadband leads to a higher variety of use.*

H10b: *Higher previous experience of using the Internet results in a higher variety and rate of use.*

H11a: *Higher use innovativeness within broadband users results in higher variety of use.*

H11b: *Higher disturbance due to less security and advertising popup due to a broadband connection leads to lower variety and rate of use.*

H12: *Access to a broadband Internet connection outside the home environment leads to a higher variety of use but lower rates of use in the home.*

5.7. Impact Constructs

According to the diffusion literature, new innovations are likely to change the associated behaviors of users, which are termed as perceived consequences or the impact of new innovations (Rogers, 1995, Shih and Venkatesh 2004). Researchers have demonstrated the impact of various technologies (e.g. automobiles, telephone, computers and Internet) on a user's daily life (Vitalari et al 1985, Anderson et al 2001). Since broadband offers an alternative way of work and entertainment, it is likely to have impact on a user's daily activities. Therefore, we propose the following hypothesis:

H13: *Broadband users are different from narrowband users in terms of the time spent on the Internet and the activities conducted using the Internet.*

H14: *Broadband usage affects other daily life activities undertaken by the users.*

6. Conclusion

In this paper we identified the factors that affect the decisions of broadband adopters and non-adopters. We also analyzed what are the factors responsible for usage of broadband and how the usage of it affects the users' online activities and daily life activities. Using these factors we developed the model of broadband diffusion, which is derived from various technology adoption and diffusion models. The proposed model is based on the assumption that the attitudinal and normative factors are responsible for driving broadband adoption, whilst the perceived behavioural control factors inhibit consumers from subscribing to broadband. The proposed model also included constructs to investigate usage and impact of broadband technology. Whilst discussing the factors we also proposed the underlying hypotheses that need to be tested in order to verify the model.

6.1. Future Research Directions

In order to test the underlying hypotheses that can verify the conceptual model's future work includes: (1) to develop suitable items associated with each factor; (2) to select and develop suitable and reliable data collection tools and conduct pilot research; (3) to select an appropriate sampling frame for the target population; (4) to determine the sample size and generate random numbers; and finally (5) to collect and analyze empirical data collected from the household respondents. Completion of the aforementioned future work will lead us to refinement and validation of the proposed model of broadband diffusion.

6.2. Limitations

This study is limited in terms of comparisons due to the lack of similar previous studies from other countries. Therefore, it would be difficult to analyse the impact of culture on the aforementioned drivers and inhibitors of broadband adoption. The comparison would also help to differentiate the usage and impact of broadband technology across culture. This would be interesting since it would help to understand the reasons of the fast uptake in one country, whilst slow in others. The second major limitation of this study is to collect empirical data from enough participants. Since broadband adoption is still at an early stage of diffusion, it is difficult to know who is a subscriber or who is not. Therefore, in the future, we consider it necessary to send survey questionnaire to a huge number of participants to gather sufficient data in order to validate the conceptual model.

6.3. Research Contributions

The contributions of this paper are that it integrates the appropriate information systems (IS) literature in order to enhance our knowledge

of technology adoption from the consumer perspectives and it provides clear directions for future research. It evaluates flexibility of various models for studying technology adoption issues. Second, it assimilates previous research findings in order to develop a coherent and comprehensive picture of the technology adoption research conducted in the IS field. Third, this paper introduces a conceptual model that integrates factors from different technology adoption models to study home technology diffusion from consumer perspective. Finally, its fourth contribution is future research guideline to follow in order to test and validate the conceptual model of broadband diffusion.

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