The Usage and Impact of Broadband: A South African Household analysis

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Abstract: Broadband infrastructure is seen as crucial to a country's social, economic and scientific goals and a requirement of the knowledge economy. Broadband has the ability to improve the lives of citizens as it can provide ICT skills for employment and improve access to online forms of education. It has been purported to provide consumers with better work/life balance attributed to increased empowerment and productivity, the ability to work from home and reduced stress. South Africa has recognized the importance of high-speed broadband technology to advance the communications infrastructure of the country. However, although the demand for broadband is quite high, the adoption of the technology is lower than anticipated, particularly within the households of consumers. South Africa has fallen behind international peers in both the developed and some developing markets in its rollout of broadband services. While various studies and models aim to explain the adoption of broadband, there is little literature on the impact of broadband services in African countries. To address this need this paper investigates the use and impact of broadband services in South African households. The research comprises an initial literature review, followed by a qualitative study which is then validated by a quantitative study. The study shows that South African broadband users are predominantly experimental users. Users with higher usage of broadband in terms of variety or rate of use are able to work from home and purport to save time which results in a more comfortable lifestyle. They are more satisfied with the technology and show an interest in future-oriented communication technologies. The resultant model adds to the existing literature and this analysis will allow various stakeholders such as government, Internet Service Providers (ISP), business consumers and public organisations to make more informed decisions on broadband infrastructure investments.

Keywords: broadband, South Africa, broadband benefits, broadband usage, broadband impact

1. Introduction

South Africa is considered one of the world's leading emerging economies and is part of the Brazil, Russia, India, China and South Africa (BRICS) group of emerging economies (BRICS, 2012).The country has vast opportunities within the telecommunications sector and has seen much technological advancement, yet it has been undermined by low internet penetration rates below 14% (InternetWorldStats, 2012). The South African government has stated that the Information and Communication Technologies (ICT) industry is fundamental to the country's development; however, regulations and policies have not always supported this stance (Francis, 2010). Moreover, once regarded as a telecommunication powerhouse, South Africa is slowly losing ground to its African counterparts such as Botswana, Zambia and Kenya due to stagnant inland infrastructure developments (Balancing-Act, 2010). While the demand for broadband is high, the adoption of the technology is lower than anticipated and this particularly within the households of consumers (Muller, 2010). Figures for broadband adoption in 2011 were a mere 3.6%; with fixed wired connections 1.6%; multiple times lower than the OECD countries average of 25% (Department of Communications, 2011; Muller, 2011b; OECD, 2012).

Various studies and models have aimed to explain the adoption of broadband services in several countries. Large-scale qualitative studies of the barriers to broadband adoption in the United States analysed broadband adoption among low-income communities (Dailey et al., 2010; Powell, Bryne and Dailey, 2010) and recommended a renewed focus on factors that sustain home broadband access and usage (Powell, Bryne and Dailey, 2010). Broadband access is seen as a requirement of socio-economic inclusion and that while usage is impacted by high monthly fees, there are also concerns around hardware costs, hidden fees, billing transparency, quality of service, and availability (Dailey et al., 2010). An economic study in the United States recommended targeted programs that educate households about broadband benefits (Rosston, Savage and Waldman, 2010). In their study they noted that experienced broadband users are more aware of Broadband benefits.

There has been little research focus on broadband adoption within the African continent and even less on the use and impact of broadband services in African countries after the adoption process occurs. To address this need, this research investigates the use and impact of broadband services in South Africa. The research started with a literature review, followed by a qualitative study which was

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subsequently validated by a quantitative study. Through a review of the literature various models to understand household broadband use and impact were identified and reviewed so as to propose a model for broadband use and impact.

2. Literature review

Broadband is widely used as shorthand for high-speed Internet access (Kim, Kelly and Raja, 2010; Sacks, 2002). Broadband can also be defined in terms of the technology used, in terms of the transmission capacity provided, or in terms of the functionality enabled (Kim, Kelly and Raja, 2010; Sacks, 2002). Compared to traditional narrowband connections, broadband access is immediate. Large volumes of data can be instantly transmitted, waiting times are reduced and efficiency for users is improved. In contrast narrowband connections are slow where it is estimated that one third of user time online is spent waiting (Spurge and Roberts, 2005). For the purpose of this research broadband is regarded as "an always available, multimedia capable connection with a download speed of at least 256 kbps" as defined by the South African Department of Communications (Department of Communications, 2010:7). Broadband technologies are divided into fixed line technologies, fixed wireless technologies and wireless mobile technologies (Corning, 2005). Fixed line technologies include digital subscriber lines (DSL), cable modems, broadband over power lines (BPL) and fibre optics such as fibre to the home (FTTH). Fixed wireless technologies include satellite, wireless fidelity (Wi-Fi) and worldwide interoperability for microwave access (WiMAX). Wireless mobile technologies include 3G and its evolutionary paths 3.5G, high speed data packet access (HSDPA), high speed packet access plus (HSPA+) and 4G or long term evolution (LTE). ADSL is the most popular of the fixed line technologies while Wi-Fi and 3G/HSDPA are the most popular of the fixed wireless and mobile wireless technologies respectively (Corning, 2005).

2.1 Broadband benefits and impact

Broadband technologies are able to provide a mix of data, voice, and video services over one "pipe". Some advantages include faster access to the internet, 'always on' and making calls while surfing the Internet. Disadvantages include security threats, higher service fees than dial-up and lack of availability in rural areas. Broadband is seen as a requirement for "Digital citizenship" which is defined as the skills, access, and education needed for participation in the information age (Mossberger, Tolber and McNell, 2008). The benefits to consumers include improved access to online education, economic opportunities and civic services. Wieck and Vidal (2011) have reviewed research that indicates a positive relationship between broadband investment and both economic growth and employment. Yet, Middleton and Chang (2008) comment that research showing the positive economic evidence of broadband usage is preliminary and that there is little evidence to justify these claimed benefits. Middleton (2009) argues that broadband usage could have negative consequences in terms of increasing energy usage through the increased usage of broadband devices.

2.2 Broadband in South Africa

The most advanced country in terms of broadband penetration is South Korea (Bernabé, 2010). Factors that contributed to this include infrastructure competition from a supply side and high demand from the demand side (Akamai, 2010). Low broadband penetration in developing countries has been as a result of limited fixed line infrastructures, high costs of international bandwidth and monopolies held by telecommunication companies (Goldstuck, 2010; Kim, Kelly and Raja, 2010). In South Africa the top broadband players include semi-privatised and state owned Telkom for fixed lines, iBurst for fixed wireless, the first, second and third largest mobile operators Vodacom, MTN and Cell C respectively for mobile wireless. The price of broadband dropped significantly in a 3 year span from 2006 to 2009 mostly due to the introduction of the new SEACOM and WACS cables bringing in more international bandwidth to the country (Goldstuck, 2010). Compared to international standards, these prices are still exceptionally high and not affordable by many consumers. South Africa was placed 103rd (Muller, 2011a) in the world in broadband speed rankings taking into consideration the cost to speed ratio.

This poor performance in broadband uptake needs to be looked at in contrast with repeated promises from Government to deliver on supporting broadband infrastructure. Recently, the South African Communications minister, Dina Pule, in her 2012 budget speech, stated that "the Department of Communications remains committed to delivering 100% broadband penetration by 2020 and delivering a million jobs by 2020" (Muller, 2012). However similar promises have been made by the Government since 2006 and analysts have criticised the government for lack of delivery and too much

consultation (Muller, 2012). The Department of Communications has budgeted R1.2-billion on broadband and Internet access for 2010/11 and this has been criticised as being inadequate, especially considering that the Internet economy is estimated to contribute 2% to South Africa's gross domestic product (GDP) and this contribution is rising by around 0.1% a year (Vorster, 2012). Goldstuck in (Vorster, 2012) states: "The message to government is equally clear: invest more actively in the Internet economy, and the benefits will spill over directly into the overall economy."

2.3 Broadband diffusion theories

Over the past two decades, an increasing body of work attempted to explain and predict user acceptance/adoption of new technologies. Some of the most commonly used ones include the Technology Acceptance Model (TAM) by Davis (1989), the Innovation Diffusion Theory (IDT) by Rogers (1995) and the Decomposed Theory of Planned Behaviour by Taylor & Todd (1995). Other theoretical models, which have been used, include the Theory of Reasoned Action (TRA), proposed by Ajzen & Fishbein (1980) and the Theory of Planned Behaviour (TPB) by Ajzen (1991). For the needs of IS research these theories were modified, extended and integrated in order to understand and predict technology adoption and usage. Examples include Taylor and Todd's (1995) decomposed TPB where the Theory of Planned Behaviour has been modified and integrated with the Diffusion of Innovations constructs and Venkatesh and Brown (2001) modification of the TPB to study technology adoption issues in the household. Subsequently, there have been various theoretical frameworks proposed on the subject of broadband adoption. Some of these were from emerging economies, such as Pakistan (Dwivedi et al., 2007) India (Dwivedi et al., 2008) and Malaysia (Ooi et al., 2011).

Yet, Shih and Venkatesh (2004) state that previous diffusion studies have focused mostly on the adoption perspective. There are limitations to the adoption diffusion (AD) of technology and though the diffusion processes cannot be understood without studying the nature of adoption, to complete the diffusion story, use-diffusion processes also need to be examined (Shih and Venkatesh, 2004). Shih and Venkatesh's (2004) research extends the diffusion concept further with a systematic study of post-adoption usage. In their model, the variable of interest is use or, more specifically, rate of use and variety of use. The theoretical elements for their model are the evolving nature of use (rate and variety), sustained continuous use and technology outcomes (technology integration, perceived essentialness of technology, impact of technology, and user proneness to adopt new technologies) (Shih and Venkatesh, 2004). Choudrie and Dwivedi, (2004a) argued that researchers have demonstrated the impact of various technologies such as the Internet on a user's daily life and considering that broadband offers an alternative way of work and entertainment, it is likely to impact a user's daily activities. According to Choudrie and Dwivedi (2004b), broadband users are different from narrowband users in terms of the time spent on the Internet and the activities conducted using the Internet.

2.4 A proposed model for broadband use and impact in South African households

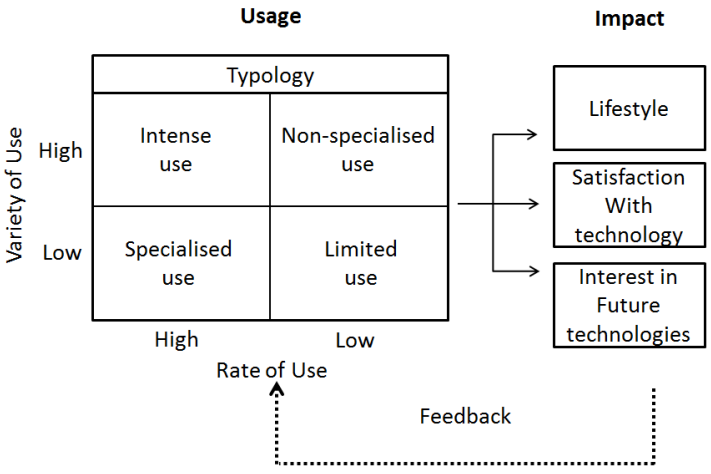

Figure 1: Proposed model for broadband use and impact in the household

Using the Model of Adoption of Technology in the Home (Venkatesh and Brown, 2001), removing the adoption components and combining literature outcomes, the proposed model was formulated (Figure

1). A feedback loop was included, as through the continued use of broadband the outcomes of broadband usage has a continued changing effect on the rate and variety of use of broadband by the user. In the case of rate and variety of use, the effect can cause a user to move within the topology. An example would be where a limited user can move to become a specialised or an intense user. It therefore becomes necessary to investigate how the impact of broadband affects the rate and variety of use through the feedback loop.

3. Research questions and approach

This study attempts to answer the following questions:

- How do South African consumers use broadband?
- What impact does broadband have on South African consumers and their interest in future oriented technologies?

The overall research study makes use of multiple philosophies i.e. an interpretative and a positivist philosophy. Each philosophy when used independently in research has its advantages as well as its disadvantages. Therefore in order to attain accurate findings in any study it becomes necessary to rid the study of the disadvantages inherent in a particular philosophy (Lee, 1991). Therefore taking Lee's (1991) framework into consideration, this study first uses an interpretative qualitative approach followed by a positivist quantitative approach and then integrates them to ensure that the benefits of each study are realised. The qualitative study attempted to expand and enhance through semi-structured interviews the proposed model provided by the initial literature review. The data analysis compiled the data collected into patterns and themes and structured the data into a framework (Attride-Stirling, 2001). Using the input from the qualitative analysis, hypotheses were developed. The next step was to validate the model through the use of the developed questionnaire. Participants in South Africa were sent questionnaires and the data obtained was analysed quantitatively using statistical techniques. Relationships between the different variables within the model were tested to develop a model of broadband use and impact in households of South Africa. While the qualitative study preceded the quantitative study the results will be discussed together in this paper.

4. The qualitative study

To select interviewees, a purposive sampling method was used with selection criteria developed with the research questions in mind. Interviews were conducted with 16 respondents, six adopters who were also users (C1-6), one user (U1) and nine non-adopters (N1-9) (Table 1). All respondents had formal education ranging from university degrees to college diplomas. Most of these formal educations made way for their occupational roles. Occupational roles within the IT industry ranged from being lecturers of IT, systems architects and software developers to students in IT. The respondents were therefore given the title of either IT or non-IT depending on their occupational classification. The respondents who were in the high and medium income brackets had professional occupations while those in the lower income bracket were university students or casual workers in retail.

The study followed an inductive approach to analyse the data collected resulting in categories (Thomas, 2006). Constant comparative analysis (Anfara, Brown and Mangione, 2002) was performed to ensure coherence. To ensure that the data collected was reliable and valid, a triangulation of interviews was performed with audio tapes and notes taken. The qualitative study also provided a general idea of whether the issues are comparable to those experienced in other countries and provided an indication of the expected relationship between variables. Furthermore, it was expected that some factors would correlate with those identified in the literature survey and some additional new factors/constructs would be discovered.

Table 1: Demographics of individual respondents

ID	Age Group	Disposable Income(R)	Formal Education	Occupation	IT Related	Access
C1	50+	20000-30000	B. Proc LLB	Magistrate	Non-IT	4Mb ADSL
C2	18-30	5000-10000	Masters Degree	Student	IT	384Kb 3G
C3	31-40	>30000	Honours	Systems Architect	IT	1Mb IBurst
C4	50+	20000-30000	Masters Degree	Lecturer	IT	4Mb ADSL
C5	18-30	5000-10000	Diploma in IT	Sales Assistant	Non-IT	384Kb ADSL
C6	50+	10000-20000	PhD	Lecturer	IT	384Kb ADSL
U1	18-30	< R5000	B.Bus. Sci.	Postgraduate Student	Non-IT	4Mb ADSL
N1	18-30	5000-10000	Masters	PhD Student	Non-IT	Home dial-up
N2	18-30	5000-10000	Masters	PhD Student	Non-IT	Home Dial-up
N3	18-30	<5000	Honours	Masters Student	IT	None
N4	31-40	5000-10000	Technikon	Proprietor	Non-IT	None
N5	18-30	10001-20000	Diploma	Software Developer	IT	Home Dial-up
N6	41-50	20001-30000	PhD	Assoc. Professor	IT	Home Dial-up/Work LAN
N7	18-30	10001-20000	Masters	Lecturer	IT	Work LAN
N8	18-30	20001-30000	Honours	Equity Derivatives Broker	Non-IT	None
N9	31-40	20001-30000	PhD	Lecturer	IT	Dialup/Work

5. The quantitative study

The quantitative study was cross-sectional in that it analysed responses at a single point in time in 2009. While past as well as future behaviour and attitudes are of interest, it is believed that the experience of change over time could be relayed by the respondents. Based on the model derived from both the literature review and qualitative study, research hypotheses were proposed. To validate the feedback loop requires that the study be longitudinal in order to assess the changes of usage over time. Therefore, as this was a cross-sectional study, the feedback loop fell out of scope. Survey questionnaires were deemed suitable as they allow objective data to be collected from a large sample in a standardised way.

A pilot questionnaire was devised to resolve any difficulties that respondents faced when completing the questionnaire and was then initially sent to 20 respondents who have experience in research studies. For the final sample, a stratified random sample was used to look at distinct sub groups based on age, occupation and income of adopters and non-adopters. The demographics of the respondents are shown in Table 2. Of the 177 respondents, 155 had Internet access at home and 22 did not. Only one respondent had a dialup or narrowband connection while the rest had a broadband connection. It should be noted that of the 154 respondents that did have a broadband connection, 32 respondents had more than one type of broadband connection in their household.

Table 2: Profile of survey respondents

	Categories	Frequency	Percentage
Age	18-25	75	42.4%
	26-30	55	31.1%
	31+	47	26.5%
	Total	**177**	**100.0%**
Education	Matric Ex./High School Diploma	67	38%
	Degree/Technikon Diploma	44	25%
	Honours Degree (Postgraduate)	53	30%
	Masters and PhD (Postgraduate research)	13	7%
	Total	**177**	**100.0%**
Occupation	Legislators, Senior Officials, Directors, Managers & Owner Managers	13	7.3%
	Professionals	61	34.5%
	Technicians & Associate Professionals	77	43.5%
	Clerks & Administrative Workers, Service & Sales Workers, Skilled Agricultural & Fishery Workers, Skilled Workers, Craft & Related Trades, Plant & Machine Operators & Assemblers, Labourers & Elementary Occupations	26	14.7%
	Total	**177**	**100.0%**
Income	< R5000	50	28.2%
	R5000 – R10 000	43	24.4%
	R10 001 – R20 000	50	28.2%
	R20 001 +	34	19.2%
	Total	**177**	**100.0%**
Internet Access as Home	Yes	155	87.6%
	No	22	12.4%
	Total	**177**	**100.00%**
Type of Internet Access at Home	Dial-up	1	0.6%
	WiFi	8	4.5%
	WiMAX	3	1.7%
	Broadband with DSL/ADSL	113	63.8%
	Mobile 3G/HSDPA	57	32.2%
	Other	5	2.8%
	Total	**187**	**105.7%**

6. Broadband usage findings

Showing the recent uptake of broadband, the majority (64%) of respondents had broadband subscriptions for less than 3 years (Figure 2) and almost half (46%) only having broadband for less than two years. Of the 154 adopters, consumers mostly used their broadband connection for downloading files, music and videos. This was followed by time spent communicating online. The third largest category was time spent streaming video or music online. This was followed by time spent working from home, online shopping, creating web content and settling accounts online (Figure 3). Multiple technologies can access broadband connections and in this sample 227 technologies were used by the 154 respondents. Most consumers had personal computers accessing their broadband connection (Figure 4). The second largest category was consumers with laptops followed by mobile phones. The smallest category coded as other was predominantly PDA's.

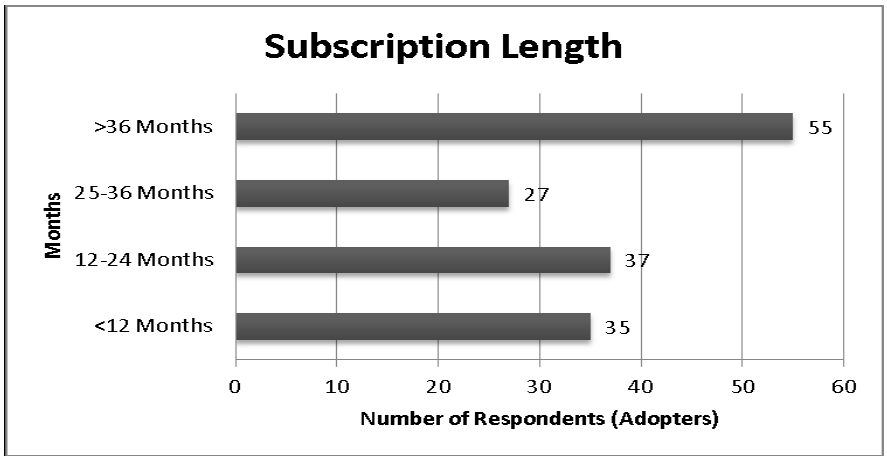

Figure 2: Length of broadband subscription

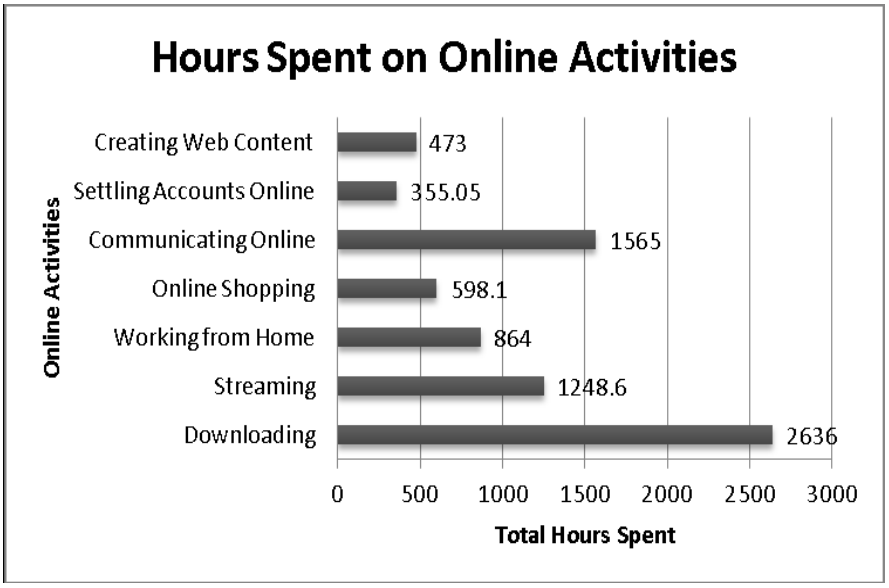

Figure 3: Hours spent on online activities by broadband consumers

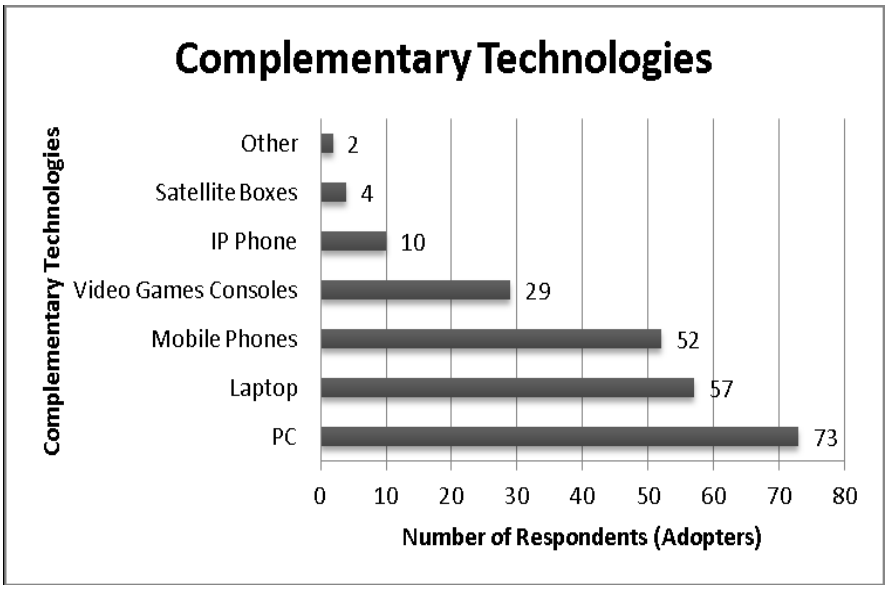

Figure 4: Complementary technologies used by broadband consumers

6.1 Usage patterns

The average rate of broadband use was calculated by counting the amount of hours that consumers had used their connection on average per week. These were then grouped into four categories in multiples of 56 hours per week. It should be noted that those respondents that used their subscription for more than 168 hours per week was due to their connection being always on and they had performed many different online activities concurrently. As a result the total hour for each respondent was an accumulation of the hours spent for each activity unless otherwise stated. The variety of use was calculated by counting the amount of technologies and online activities that consumers used with their broadband subscription. By utilising usage rate and variety of use, four possible types of use diffusion patterns can be identified (Shih and Venkatesh, 2004). Data gathered in the form of number of hours per week spent performing various online activities from South African consumers were grouped into the use diffusion patterns topology and shows that South African broadband users are classified predominantly as experimental users, with lesser intense users and a small percentage of limited users (Figure 5). One reason for users falling mostly within the experimental category is that broadband was a relatively new technology at the time, hence users may have been experimenting with the various online activities that could be performed with the technology.

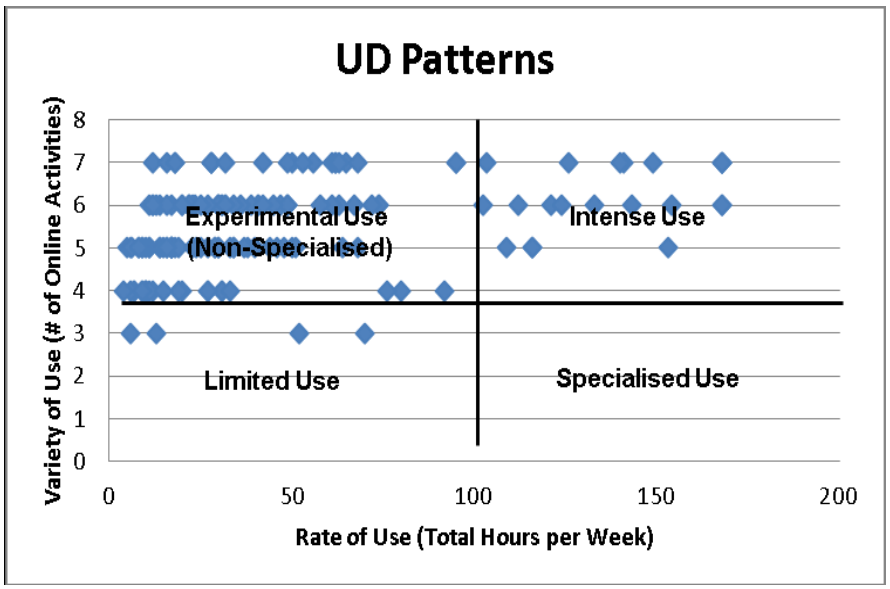

Figure 5: Use diffusion patterns of South African broadband adopters

7. Qualitative findings on impact of broadband usage

Qualitatively analysing the data acquired, the researcher attempted to expand and enhance the proposed model of broadband use and impact in the household. The responses of each consumer was analysed which determined the factors within each phase of the model. The results discussed are supported by occasional interview quotes.

Four lifestyle changes were identified in the interviews:

- Easier communication with the family,
- Saving on time to do more of other activities,
- Cost savings and
- Ease of working from home.

One respondent in particular mentioned that broadband has become such an integral part of his lifestyle that he doesn't go a day without performing e-activities:

> *"Broadband has a major impact on my lifestyle. I'm actually restless if I don't have internet access. In fact e-activities as I call it have become an integral part of life. I don't go a day without checking email, even on holiday" (C2).*
>
> In contrast to broadband users in the US (Mossberger, Tolber and McNell, 2008), no respondents mentioned using online education or accessing government services.

In terms of satisfaction, respondents felt that broadband allowed them to have more control over their lives, they were less frustrated than when they used the slower dial-up connections as it makes life easier and gets things done.

> *"It's just great to have that, but come to think of it perhaps it is. It's not frustrating. If you want to know something you can search for it" (U4).*

Five respondents showed interest in future technologies. This was mostly interest in faster connections as well as interest in wireless connections as respondents C3 and C5 mentions respectively:

> *"Well, I am a techno junkie. I would like to see what the future holds in terms of speed in terms of how fast the connections going to be in the future. If I had money right now I would get myself a 4Mb connection to see what is going on" (C3).*

> *"I wouldn't mind trying 3G. I would like to enquire more about it but about getting more knowledge about it. I think it needs to be more widely exposed here. It has taken off overseas but has taken us quite a while to adopt it here" (C5).*

One respondent, however, explained that she is satisfied with her current broadband service and that she currently has no interest in future technology:

> *"At the moment I don't need faster or other technologies as its suits me fine" (C1).*

From the interviews interest in the following six future technologies was identified:

- higher speed lines
- unlimited bandwidth
- IPTV
- High speed wireless
- VOIP
- Interactive online communication

8. Quantitative findings on impact of Broadband

The six hypotheses derived from the literature and the qualitative finds were:

- H_1: The greater a user's rate and variety of use, the easier it is for users to communicate with distant families. [Lifestyle: Communication]
- H_2: The greater a user's rate and variety of use, the more a user will be able to save time and hence commence with other life activities. [Lifestyle: Life Activities]
- H_3: The greater a user's rate and variety of use, the more a user will be able to save on costs. [Lifestyle: Costs]
- H_4: The greater a user's rate and variety of use, the easier a user will be able to perform work related activities at home. [Lifestyle: Work Activities]
- H_5: The greater a user's rate and variety of use, the more satisfied a user will be with the technology. [Satisfaction]
- H_6: The greater a user's rate and variety of use, the higher the level of interest in acquiring futuristic-oriented technologies. [Future technologies]

Table 3 and Table 4 present the means and standard deviations of aggregate measures for the quantitative analysis. Respondents seemed to have a medium agreement (scores between 5.5 and 6.5) with the satisfaction factor and two lifestyle factors, namely work activities and communication (Table 3). Respondents showed weak agreement for the remaining two lifestyle factors, cost and life activities. Respondents showed interest (scores greater than 3.5) in future technologies such as higher speed lines, unlimited bandwidth with no shaping, paradigm shift from traditional to IPTV and high speed wireless connections(Table 4). Respondents were somewhat interested (2.5 to 3.5) in VoIP and interactive online communication systems.

Table 3: Summary of descriptive statistics for lifestyle and satisfaction factors (items were scaled from 1 being strongly disagree to 7 being strongly agree)

Rank	Construct/Items	Items	Respondents	Mean	Standard deviation
1	Work Activities	1	154	5.84	1.4
2	Communication	1	154	5.75	1.5
3	Satisfaction	2	154	5.67	1.5
4	Costs	1	154	5.30	1.7
5	Life Activities	1	154	4.89	1.8

Table 4: Summary of descriptive statistics for interest in future technologies (items were scaled from 1 being not at all to 4 being very interested)

Rank	Construct/Items	Items	Respondents	Mean	Standard deviation
1	Higher speed lines	1	154	3.97	0.2
2	Unlimited bandwidth no shaping	1	154	3.95	0.3
3	Paradigm shift from traditional TV to IPTV	1	154	3.57	0.8
4	High speed wireless	1	154	3.56	0.8
5	Voice over IP	1	154	3.37	0.9
6	Interactive online communication systems	1	154	3.23	1.0

8.1 Hypothesis testing

The aim of the testing was to determine whether the UD patterns of consumers are able to predict the impact that broadband has on consumers lives. A Reliability Test (Cronbach Alpha) and Confirmatory Factor Analysis was used to validate the multi-item satisfaction construct. The Cronbach Alpha for both items yielded an alpha of 0.60 and loaded highly on component 1 with coefficients 0.83. Due to having moderate alpha and high loadings, both items were kept. To test whether the data collected was normally distributed; the Kolmogorov-Smirnov and Shapiro-Wilk tests were performed. Results showed that data was not normal and non-parametric tests were deemed appropriate. The non-parametric Spearman's Rho ($\mathbf{r_{s)}}$ test was deemed appropriate as it determines whether there is a relationship between the use diffusion patterns which are nominal (categorical) in nature and are made up of two categories (rate of use and variety of use) and the impact variables (the dependent variables) which are also ordinal in nature. The dependant variables included the four lifestyle factors, satisfaction and the six interests in future technology factors.

Four (H_2, H_4, H_5 and H_6) of the six hypotheses were partially supported by the data that explained broadband's impact on consumer's lives (Figure 6). The hypotheses that were partially supported were due to the data either only supporting a consumer's rate of use or variety of use. The supported results are listed below.

- Since variety of use has a significant relationship with consumers saving time and hence being able to commence with other life activities, the lifestyle impact hypothesis H_2 is partially accepted.
- The lifestyle impact hypothesis H_4 is partially accepted due to users having a high rate of use performing work related activities at home using their broadband subscription.
- Since there is a significant relationship between a consumer's rate of use and satisfaction with their broadband subscription, the satisfaction hypothesis H_5 is partially accepted.
- Since there is a significant relationship between a consumer's rate of use and interest in interactive online communication, higher speed wireless technologies, IPTV, VOIP and unlimited bandwidth, the hypothesis H_6 is partially accepted.

The results show that broadband usage impacted lifestyle, satisfaction and interest in future technologies. South African consumers perceive that they have a more comfortable lifestyle when using broadband, are more satisfied and show an interest in future-oriented communication technologies.

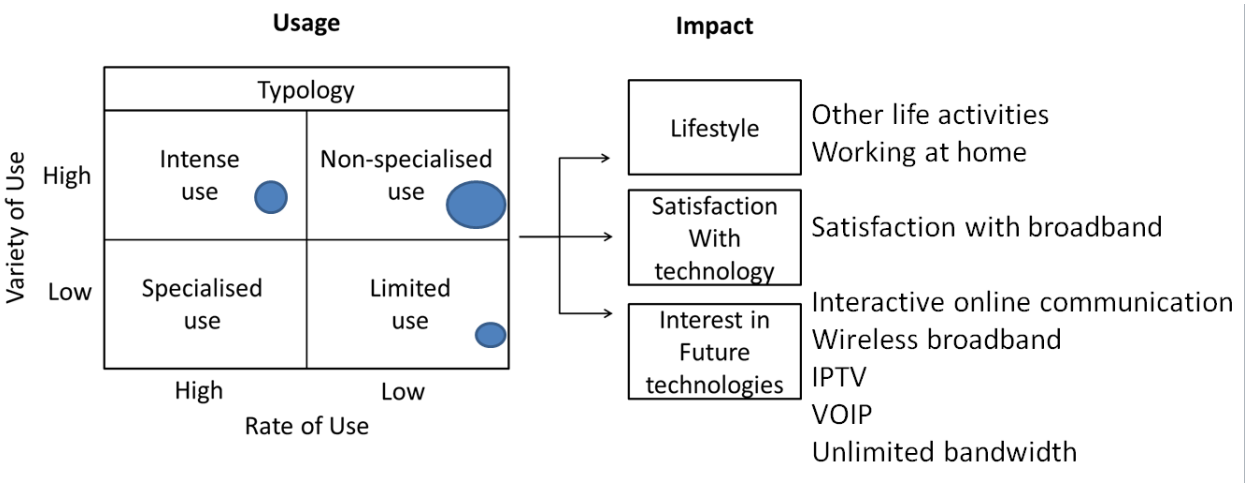

Figure 6: Overall impact of usage and impact factors

These results confirm that broadband consumers are able to have improved access to economic opportunities as they save time and can work from home. Moreover, in the near future, an increasing number of people will begin working from home and this may benefit the organisation through cost savings and the workers time savings providing better convenience and comfort (Dwivedi, 2008). However in contrast to other studies (Mossberger, Tolber and McNell, 2008), we were not able to confirm whether the South African broadband consumer is using broadband to access online education or government services.

Literature states that how consumers make use of technology directly impacts the nature and level of their perception regarding the technology. In terms of consequences of diffusion, intense users show a greater degree of satisfaction (Shih & Venkatesh, 2004). The quantitative study showed a significant relationship between a user's rate of use and satisfaction with the technology. This shows that consumers that are specialised and intense users are more satisfied with the technology. This is in line with the qualitative findings that suggested that consumers who use the technology more for a number of tasks and longer time are more satisfied with the technology

Literature states that intense use diffusion pattern will result in the highest level of interest in acquiring futuristic-oriented technologies, followed by experimental use. In addition, adopters with higher levels of use-diffusion are also more interested in adopting future technologies (Shih & Venkatesh, 2004). This study confirmed this with the strongest interest being shown for interactive online communication. This indicates that South African consumers are communication orientated. Since this study many of the future technologies, such as VOIP have had a strong uptake in South Africa, confirming the interest shown in this study (Reed, 2011). The exception is IPTV which has had a slow due to a lack of sufficient broadband and infrastructure. (Shibeshi, Terzoli and Bradshaw, 2011).

9. Conclusion

This research adds to the existing literature on broadband usage and impact and proposes and validates a model relevant to the South African context. The research built on the literature to further the understanding and successes of broadband use and its impact in residential households. The study extends the Shih and Venkatesh (2004) model of use diffusion that analysed post-adoption factors to determine broadband usage and impact. The Shih and Venkatesh (2004) study was based on semi-structured interviews. Their study recommended that researchers go one step further and employ a survey research for validating the diffusion model. This study not only responded to their call but also used interview analysis to inductively extend their proposed model. Although the constructs utilised in this study were adapted from prior models, the survey questionnaire to study broadband diffusion had not been developed or validated and this instrument therefore also contributions to scientific practice in the field (Straus et al., 2004) and can be used by further studies. Theoretical contributions can also be attributed to the utilisation of theoretical constructs such as the rate and variety of use of technologies that examine the usage patterns of broadband consumers. This study essentially addressed limitations of previous studies. Firstly, past studies lacked theoretical underpinnings as they were data driven and exploratory in nature (Dwivedi, 2008). Secondly, the Choudrie and Dwivedi (2004a, b) and Dwivedi (2008) studies only adapted usage constructs from the use diffusion model to examine the differences in use between broadband and narrowband users. In contrast, this study included the use diffusion model as a separate phase within the diffusion process

in order to examine the usage behaviour of consumers after they had adopted the technology. Due to time constraints a cross-sectional study was performed. It is therefore recommended that for future research a longitudinal study be performed. As a result, limitations to fully study the impact of broadband would be overcome. In particular the feedback loop which was out of scope of this research study. In addition, longitudinal research will also help in identifying in greater detail the actual usage habits of broadband users over time.

From a practical viewpoint this research provided an analysis into the usage of broadband in residential households that may be beneficial for various stakeholders such as government, Internet Service Providers (ISP), business consumers and public organisations. The categorising of adopters into the four use-diffusion categories provides an effective way to segment markets for high-tech products. South African consumers were still found to be experimental users.

Over the years the impact of broadband has become a very broad area of research, while much research has been done to look at the economic effects of broadband usage, this study looks at the impact on individuals. Broadband use was shown to enable working from home and resulted in increases in time saving; confirming previous studies on digital citizenship. However future research to assess whether consumers are starting to access online education and online government services would be valuable. There is also a need to research specific areas such as new communication applications and downloads and entertainment, in order to determine the real impact of broadband. Moreover, other specific areas such as the diffusion and sustainability of broadband technology, family and work life, social networks and online security and privacy will need to be explored.

Due to a high mobile phone penetration rate in South Africa, there are large number of people who are accessing mobile broadband data services in the rural areas of South Africa. These users may not have the same income and education levels as the sample of this study. As such, future research may be deemed important to investigate the use of mobile broadband data services in more rural parts of South Africa.

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