Investigating the Factors Affecting Broadband Adoption in Tanzania: A Case of Dares Salaam, Tanzania

Samson Nyondo
The University of Dodoma

Justinian Anatory
The University of Dodoma

Nixon Mtonyole
The University of Dodoma

ABSTRACT

Broadband access has become an important resource for individuals and communities. A high-speed connection to the internet provides opportunities for many economic, social and cultural benefits. Recent researches in developing countries points to the appalling broadband penetration rates in these countries. An understanding of the factors affecting broadband adoption in these countries is a key to any strategy to improve broadband penetration figures. This paper examined several attitudinal, normative and control factors as identified from literature to provide insights of broadband adopters and non-adopters in Tanzania. The findings suggested that the utilitarian outcomes and relative advantage were the major factors influencing consumers' decision to adopt broadband in Tanzania. The findings from regression analysis also showed that the relative advantage, utilitarian outcomes and self-efficacy factors were more significant in explaining consumers' behavioral intention to adopt broadband. On the other hand, the "expenses of broadband services" and "lack of appropriate equipment to access broadband", had the highest importance rating among the barriers to adopt broadband in Tanzania.

General Terms

Broadband adoption in Tanzania

Keywords

Acceptance Model, Broadband Adoption, Broadband availability, Regression, Tanzania, Technology.

1. INTRODUCTION

The internet over the past few years has given rise to many new "bandwidth hungry" internet applications [1]. Most internet websites have incorporated multimedia content such as voice and video [1]. All these new applications have resulted in the need to have higher access speed for individual subscribers [1]. Presently, broadband access has become an important resource for individuals and communities in both, developed and developing countries. Because of that, many governments around the world are increasingly committed to extending broadband networks to their citizens [2]. As an infrastructure, broadband networks can be seen in a similar way to the development of roads, railways, electricity and the way these networks have transformed economic activities for individuals, companies and governments [3].

The access to broadband services is changing the way societies, businesses and governments operate in Africa. In low and middle income countries a 10% increase in fixed line penetration was found to accelerate economic growth by 0.73%, mobile penetration by 0.81%, internet penetration by 1.12%, and broadband penetration by 1.38% [3]. The effect of broadband penetration in accelerating economic growth is greater in less developed countries like those in sub-Saharan Africa than in more developed countries and more than for fixed, mobile or internet penetration [4].

However, while sub-Saharan Africa has been very successful in increasing access to basic voice communications, and Africa's rapid adoption of the mobile phone is quickly closing the "digital divide" in voice services, the broadband access gap between the region and the rest of the world is getting wider [4].

On the other hand, broadband availability is not the same as broadband adoption [5]. Despite the importance of broadband to modern life as a transforming technology which is now becoming available in many developing countries, the levels of adoption among the population groups may cause them to fall behind economically, socially, and politically [6].

An analysis of the literature on broadband adoption and diffusion suggests that although studies have been conducted in order to understand the deployment and adoption of broadband in the developed world, fewer studies have focused upon this issue within the developing country context [7]. The reason for this lack of broadband adoption studies could be accredited to the late rollout of broadband services, slow infrastructure development, low tele-density and slow rate of adoption [8]. However, since there is scarce research evidence that illustrates the current state of broadband deployment and diffusion amongst developing countries; such potential explanations require further empirical support [8].

As a guideline to investigating the factors affecting broadband adoption in Tanzania, the study sought to answer the following questions;

1. What are the factors that influence consumers' decision in adopting broadband in Tanzania?

2. What relationship exists between the factors and the intention to adopt broadband among Tanzanians?

3. What are the barriers to adoption of broadband services in Tanzania?

2. THEORETICAL BASIS

This study utilized the Technology Acceptance Model (TAM), one of the well-known models related to technology acceptance and use [9]. The TAM model is a device designed to interpret and predict the influence of users' cognitive and emotional factors on their acceptance of technology [10]. The TAM model which investigates individual adoption is more favored than the Model for the Adoption of Technology in the Household (MATH), previously used in broadband studies in developed countries and which investigates adoption at household level [11]. The TAM model is more appropriate to developing countries studies due to increasing access to broadband in developing countries via mobile and nomadic devices [11].

The theoretical constructs included in this study were adapted from study by Mugeni et al. [11], were it was postulated that the behavioral intentions (BI) to adopt broadband are determined by the following constructs; Relative Advantage (RA), Utilitarian Outcomes (UO), Hedonic Outcomes (HO), Referents Influence (RI), Perceived Declining cost (PD),

Facilitating Conditions (FC), Perceived knowledge (PK), Self-Efficacy (SE), Perceived Ease of use (PE), and Social Outcomes (SO). The definitions of these constructs are given in Table 1.

Table 1: Definitions of constructs for broadband adoption

Construct	Definition
Behavioral Intention (BI)	Consumer's intention to subscribe (or intention to continue the current subscription) and make use of Broadband Internet in the future
Relative Advantage (RA)	The extent to which broadband is perceived as better or more advanced than narrowband internet
Utilitarian Outcomes (UO)	The enhancement factors contributed by the use of broadband
Hedonic Outcomes (HO)	Pleasurable gains due to the use of a technology i.e. broadband for entertainment etc.
Referents Influence (RI)	The influence perceived from friends, family, workmates, social media, campaigns and advertisements
Perceived Declining Cost (PD)	The extent to which declining cost to subscribe to broadband influences broadband intentions
Facilitating Conditions (FC)	The perceived level of resources available to subscribe to broadband
Perceived Knowledge (PK)	The level of knowledge that one perceives to have on broadband including benefits and risks
Self-Efficacy (SE)	The extent to which one can successfully operate new technology i.e. broadband access devices
Perceived Ease of Use (PE)	The extent to which the use of the new technology is free from effort
Social Outcomes (SO)	The increase in prestige or social status due to the use of the new technology

To make the study as inclusive as possible [11] all the above constructs from previous studies were included in this study.

3. METHODOLOGY

3.1 Study Area
The study was conducted in Dar es Salaam city. Dar es Salaam was the capital city of Tanzania before Dodoma became the capital in 1976. The city is also the cultural, political and commercial hub of Tanzania. The city is located between latitudes 6.36 degrees and 7.0 degrees to the south of equator and longitudes 39.0 and 33.33 to the east of Greenwich. It is bounded by the Indian Ocean on the east by the Coast Region on the other sides. The total surface area of Dar es Salaam City is 1800 square kilometers, comprising of 1393 square kilometers of land mass with eight offshore islands, which is about 0.19% of the entire Tanzania Mainland's area.

Broadband service deployment and adoption is still in its infancy stages in Tanzania. Therefore, the study focused on broadband services provision in the Dar es Salaam city which presents the best possible sample space for broadband investigation in Tanzania.

3.2 Research Design
To carry out this study, the survey was considered to be a suitable research method. The choice was based on similar study conducted by Mugeni et al., [11] in Kenya. Survey research can be specific and limited, or it can have more global, widespread goals. The goal of survey research is not to describe the sample, but the lager population [12].

3.3 Sample and Sampling Technique
Due to uncertainty regarding the identity of consumers currently using the broadband in Tanzania, the snowballing sampling technique was employed. Snowballing sampling is a method used with unknown or rare population. Members of these populations have not all been previously identified and are more difficult to locate or contact than known populations [13] [14] [15].

Therefore, initial respondents from the private sector, academic institutions, government, and the general public within Dar es Salaam city were first identified. These in turn referenced their friends and colleagues who utilized broadband. This progressively increased the sample size of potential broadband users to 200 users.

3.4 Data Collection Methods
A self-administered questionnaire was the primary survey instrument for data collection. Questionnaires address the issue of reliability of information by reducing and eliminating differences in the way the questions are asked, and how they are presented [16]. Furthermore, questionnaires facilitate the collection of data within a short period of time from the majority of respondents, which was a critical issue for this research [17].

Literature review on broadband adoption provided the basis for the development of the questionnaire. The questionnaire consisted of questions on broadband accessibility, demographic, and questions seeking reasons for having, subscribing or not subscribing to broadband services.

A total of 159 usable questionnaires were returned out of 200 sent out during June and July 2013 resulting in a 79.5% response rate. Out of these 159 questionnaires, 102 were from broadband users and users who intended to subscribe to broadband in the near future (64.15%) and 57 from non-broadband users those who had no intention to subscribe to broadband services in the near future (35.85%).

3.5 Validity and Reliability of Research Instrument
A trial study on 50 respondents was conducted on May 2013 to determine whether the format and the questions within the questionnaire were suitable in determining the factors affecting broadband adoption in Tanzania. All discrepancies were corrected before the final version of questionnaire was delivered to respondents.

3.6 Data Analysis Techniques and Tools

The study employed descriptive and inferential statistics in data analysis. The data analysis involved classifying and uniquely identifying the responses [18]. Using the Statistical Package for the Social Science version 20.0 (SPSS 20.0), descriptive statistics were generated and reliability tests and regression analysis conducted in order to analyze and present the research data obtained from the questionnaires.

The demographic features of all 159 respondents were first analyzed to identify the characteristics of the respondents in terms of gender, marital status, gender, employment status, education, and ability to use the internet.

Based on the conceptual framework adopted by this study, the Cronbach's alpha was calculated using SPSS 20.0 to test the reliability of the constructs used to determine the factors influencing the customers' decision to adopt broadband. Thereafter, the descriptive statistics on the constructs were generated to find out which constructs had more influence on customers' behavioral intention to adopt broadband in Tanzania. The respondent's questionnaires involved in this process were 102 from those respondents who had broadband or intended to subscribe to broadband services in the near future.

4. RESULTS AND DISCUSSIONS

4.1 Demographic features of respondents

Before analyzing the data based on the objectives, the study found that it was important to present the respondents' demographic characteristics in terms of gender, age, marital status, education level, employment status, and their ability to use the internet. This was done to determine whether the respondents decision to adopt broadband or not had any connection to their personal biographic status. Demographic features of respondents in this study are shown in Table 2.

Table 2: Demographic features of respondents

Gender	Male	Female				
	57%	43%				
Marital status	Married	Single				
	40%	60%				
Age (years)	Above 50	41≤age<50	31≤age≤40	18≤age≤30	Less than 18	
	4%	9%	28%	54%	5%	
Education level	Degree or above	secondary	Primary	Other		
	62%	20%	4%	14%		
Employment status	Employed	Self-employed	Student	other		
	49%	16%	23%	12%		
Ability to use the internet	Expert	High	Moderate	Low	Very low	Don't know
	18%	24%	26%	7%	15%	10%

4.2 Factors Influencing Broadband Adoption

Based on broadband study by Cresswell et al. [19], the study created a list of possible reasons for subscribing to broadband services and then asked the respondents if each was a major reason, minor reason, or not a reason at all in their decisions to adopt broadband services. To examine the factors influencing customers' decision to adopt broadband, the study analyzed the responses from 102 respondents who had broadband or intended to subscribe to broadband in the near future.

4.2.1 Reliability test

Cronbach's coefficient (α) was used to estimate the reliability of the constructs as shown in Table 3.

Straub et al. [20] suggested that, the reliability for an exploratory study should be equal to or above 0.60. Findings from Table 3 showed that, Cronbach's α varied between 0.847 for the utilitarian outcomes (UO) and 0.591 for social outcomes (SO).

Table 3: Reliability of measurements (n = 102)

Constructs	Cronbach's Alpha (α)
Relative Advantage (RA)	0.767
Utilitarian Outcomes (UO)	0.847
Hedonic Outcomes (HO)	0.745
Referents Influence (RI)	0.819
Facilitating Conditions (FC)	0.698
Perceived Knowledge (PK)	0.684
Self-Efficacy (SE)	0.724
Social Outcomes (SO)	0.591
Perceived Declining cost (PD)	0.695
Perceived Ease of use (PE)	0.791

The constructs utilitarian outcomes (UO) (α = 0.847), referents influence (RI) (α = 0.819), perceived ease of use hedonic outcomes (HO) (α = 0.745), and self-efficacy (SE) (α = 0.724) possessed high reliability, and the constructs facilitating conditions (FC) (α = 0.698) and perceived knowledge (PK) (α = 0.684) possessed moderate reliability. Lastly, the construct social outcomes (SO) (α = 0.591) possessed low reliability.

Therefore, of the ten constructs seven possessed high reliability, two possessed moderate reliability, and only one construct possessed reliability slightly below the recommended level of 0.60. These results suggest that the measures employed demonstrated an appropriate level of internal consistency.

4.2.2 Ranks of Factors Influencing Broadband Adoption

A summary of all factors and their ranks in influencing consumers' decision to adopt broadband in Tanzania is shown in Table 4.

Table 4: Ranks of factors influencing broadband adoption

Factors	Percentage	Rank
Relative Advantage (RA)	71%	2
Utilitarian Outcomes (UO)	88%	1
Hedonic Outcomes (HO)	39%	4
Referents Influence (RI)	26%	6
Facilitating Conditions (FC)	16%	7
Perceived Knowledge (PK)	27%	5
Self-Efficacy (SE)	44%	3
Social Outcomes (SO)	9%	8
Perceived Declining cost (PD)	27%	5
Perceived Ease of use (PE)	39%	4

4.2.3 Discussion

The findings from this study showed that the Utilitarian Outcomes (UO) factor had the greatest influence towards consumers' decisions

(PE) (α = 0.791), relative advantage (RA) (α = 0.767),

to adopt broadband in Tanzania with 88% of respondents listing it as a major reason to their decision to adopt broadband services, followed by Relative Advantage (RA) factor (71%) as shown in Table 4. On the other hand, the Facilitating Conditions (FC) (16%) and Social Outcomes (SO) (9%) factors had the least influence towards consumers' decision to adopt broadband in Tanzania. The relatively high proportion of respondents who listed Utilitarian Outcomes (UO) as a major reason in their decision to adopt broadband showed that, the majority of broadband users in Tanzania were using broadband to enhance the effectiveness of their activities such as, to find educational materials, distance learning, online shopping, and communicating better via email, chat, and Web Cam. Also, a large number of broadband users in Tanzania chose broadband because of the degree to which broadband internet is perceived as being better than its predecessor narrowband internet (i.e. Relative Advantage (RA)).

4.3 Relationship between Factors and Behavioral Intention to Adopt Broadband

4.3.1 Regression analysis

The analysis employed the ordinary least squares regression to fit a linear probability model [18]. The model summary is shown in Table 5. The values of the regression equation's coefficients and constants were determined by studying the values of regression coefficients as shown in Table 6.

Table 5: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.401a	.161	.160	.370
a. Predictors: (Constant), Perceived Ease of Use, Relative Advantage, Self Efficacy, Hedonic Outcomes, Utilitarian Outcomes, Facilitating Conditions, Referents Influence, Perceived Knowledge, Social Outcomes, Perceived Declining Cost				

Table 6: Regression coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.633	.224		2.821	.006
	Utilitarian Outcomes	.028	.083	.133	1.330	.042
	Relative Advantage	.115	.070	.165	1.630	.007
	Hedonic Outcomes	.091	.056	.170	1.641	.104
	Referents Influence	.072	.060	.133	1.190	.237
	Facilitating Conditions	.015	.059	.027	.255	.799
	Perceived Knowledge	-.096	.058	-.186	-1.650	.102
	Self-Efficacy	.117	.062	.195	1.894	.061
	Social Outcomes	-.051	.066	-.087	-.770	.443
	Perceived Declining Cost	.072	.062	.134	1.160	.249
	Perceived Ease of Use	-.022	.056	-.045	-.394	.694

a. Dependent Variable: Behavioral Intention

4.3.2 Discussion

The findings from the model summary in Table 5 showed that the value of R square was 0.161 and that of adjusted R square was 0.160. These values indicated that on average, 16% of the variation in dependent variable, Behavioral Intention (BI) could be explained by variability in the ten independent variables, the Perceived Ease of Use (PE), Relative Advantage (RA), Self Efficacy (SE), Hedonic Outcomes (HO), Utilitarian Outcomes (UO), Facilitating Conditions (FC), Referents Influence (RI), Perceived Knowledge (PK), Social Outcomes (SO), and Perceived Declining Cost (PD).

On the other hand, the findings from the regression coefficients in Table 6 showed that, three of predictor variables included in the analysis were found to be significant. These are relative advantage (RA) (β = 0.165, Significance =0.007), utilitarian outcomes (UO) (β = 0.133, Significance = 0.042) and self-efficacy (SE) (β = 0.195, Significance = 0.061). However other predictor variables: hedonic outcomes (HO), referents influence (RI), facilitating conditions (FC), perceived knowledge (PK), social outcomes (SO), perceived declining cost (PD) and perceived ease of use (PE) were insignificant.

The size of β (Beta) suggested that self-efficacy (SE) (β = 0.195) had the largest impact in explaining the variations of dependent variable, behavioral intention (BI), followed by relative advantage (RA) (β = 0.165) and then utilitarian outcomes (UO) (β =0.133) as shown in Table 6.

4.4 Barriers to Broadband Adoption

The barriers to broadband adoption come from the reasons non-adopters give for their decision not to adopt broadband services. Therefore, the study analyzed the responses from 57 non-broadband users who had no intention to subscribe to broadband in the near future. The study created a list of possible reasons for not subscribing to broadband services and then asked the respondents if each was a major reason, minor reason, or not a reason at all in their decisions to not to adopt broadband services. These reasons were grouped into three types: limited ability, insufficient incentive or reward, and high risk perception.

The limited ability group consisted of the following reasons: not knowing how to use the internet, physical inability to use the internet, and lack of good English skills. The insufficient incentive or reward group contained the following reasons: having no use of broadband, lack of appropriate equipment, expense of broadband services, and no time to use the internet.

On the other hand, the high risk perception group consisted of the following reasons: too much offensive materials online, danger of internet to children, cybercrimes and presence of viruses or other malicious software. The analyses on the responses for each reason are presented in Figure. 1.
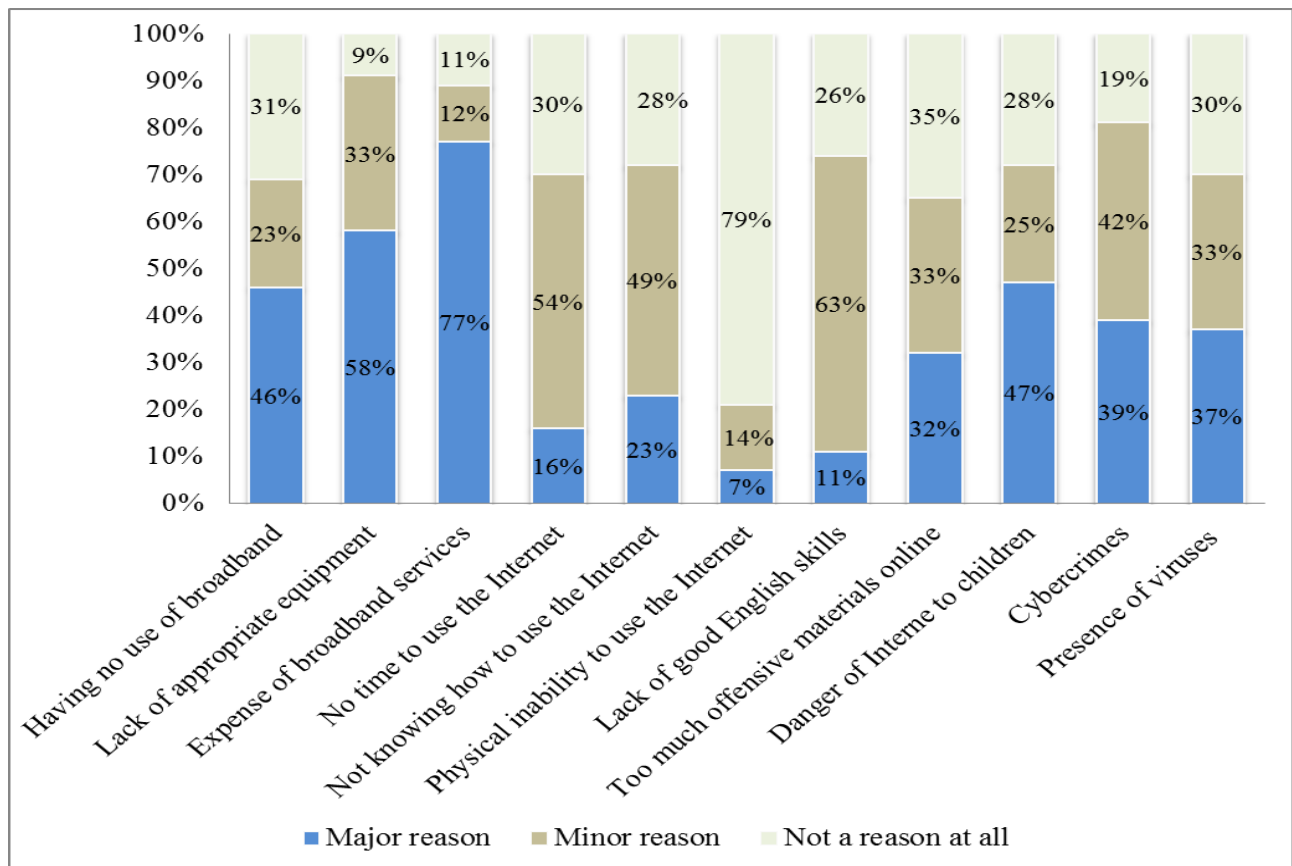

Fig 1: Barriers to broadband adoption

Generally, the results from this study revealed that the "expense of broadband services" factor had the highest importance rating among the barriers for non-adoption with 77% of non-broadband adopters listing it as a major reason for them not adopting broadband services, whereas, "physical inability to use the internet" factor had the lowest importance rating with 7% of non-adopters listing it as a major reason for them not adopting broadband services as shown in Figure 1.

5. CONCLUSION

In this study, ten influential constructs were identified to explain consumer's behavioral intention to adopt broadband in Tanzania as follows, relative advantage, utilitarian outcomes, hedonic outcomes, referents influence, facilitating conditions, perceived knowledge, self-efficacy, social outcomes, perceived declining cost, and perceived ease of use. Of these constructs, the utilitarian outcomes and relative advantage were identified as the major factors influencing consumers' decisions to adopt broadband in Tanzania, thus answering question one.

The results from the regression analysis revealed that out of the ten constructs only three constructs were significant in explaining the consumers' behavioral intention to adopt broadband in Tanzania as follows, Relative Advantage (RA), Utilitarian

Outcomes (UO) and Self efficacy (SE), thus answering question two.

A total of eleven barriers to broadband adoption have been presented by non-broadband adopters in this study as follows, not being interested or having no use of broadband services, lack of appropriate equipment such as personal computers or smart phones, the expense of broadband services, not having time to use the internet, not knowing how to use the internet, lack of good English skills, presence of too much offensive materials online, dangers of the internet to children, the ease with which someone can steal personal or financial information online (cybercrimes), and presence of viruses or other malicious software. Of these, "expense of broadband services" and "lack of appropriate equipment such as personal computers" factors had the highest importance rating among the barriers to broadband adoption in Tanzania, thus answering question three.

Broadband technologies enable a wide range of communication and internet services. Therefore, studying individual's broadband adoption provides a useful starting point for understanding the adoption of broadband services. Thus, this study presented one of the initial efforts towards understanding the broadband adoption behavior of consumers in Tanzania.

6. REFERENCES

[1] Infocomm Development Authority of Singapore (IDA) (2002),"Broadband Access, 4th Infocomm Technology Roadmap Report 2002-2007, Singapore", http://www.ida.gov.sg/~/media/Files/Infocomm%20Landscape/Technology/TechnologyRoadmap/ITR4Broadband.pdf, site visited on 9/7/2014.

[2] Broadband Advisory Group (BAG) (2003),"Australia's broadbandconnectivity",http://www.noie.gov.au/publications/NOIE/BAG/report/index.htm, site visited on 5/6/2014.

[3] World Bank (2009),"Information and Communications for Development 2009: Extending Reach and Increasing Impact" Chapter 3 – Economic Impacts of Broadband, Christine Zhen-Wei Qiang, Carlo M. Rossotto, Kaoro Kimura, the World Bank,http://siteresources.worldbank.org/EXTIC4D/Resources/IC4D_Broadband_35_50.pdf, site visited on 28/06/2013.

[4] Commonwealth Telecommunications Organization (CTO) (2012),"The Socio-Economic Impact of Broadband in sub-Saharan Africa: The Satellite Advantage", http://www.cto.int/wp-content/themes/solid/_layout/dc/ptojects/Socio-Economic_Impact_of_Broadband_The_Satellite_Advantage.pdf, site visited on 23/05/2014.

[5] Howick, S. and Whalley, J. (2007),"Understanding the drivers of broadband adoption: the case of rural and remote Scotland", Journal of the Operational Research Society, 1-13.

[6] Bates, K., Malakoff, L., Kane, S., and Pulidindi, J. (2012),"Closing the Digital Divide: Promoting Broadband Adoption among Underserved Populations, White Paper, ICF International", http://www.icfi.com/insights/white-papers/2012/closing-digital-divide-promoting-broadband-adoption-underserved-populations, site visited on 30/5/2013.

[7] Dwivedi, Y. K., Khan, N., and Papazafeiropoulou A. (2006),"Consumer Adoption and Usage of Broadband in Bangladesh", In the proceedings of the Twelfth Americas Conference on Information Systems, Acapulco, Mexico August 04th – 06th 2006.

[8] Dwivedi, Y. K., Williams, M. D., Lal, B., Weerakkody, V., Lal B., and Bhatt, S. (2007),"Understanding factors affecting consumer adoption of broadband in India: A pilot study", In proceedings of the 5th International Conference on E-Governance, Hyderabad, India, 28th -30th December 2007.

[9] Dwivedi, Y. K. (2005), Investigating Adoption, Usage and Impact of Broadband: UK Households, Unpublished PhD Thesis, DISC, Brunel University.

[10] Chen, M. L., Lu, T. E., Chen, K. J., and Liu, C. E. (2011), "A TAM-based study on senior citizens' digital learning and user behavioral intention toward use of broadband network technology services provided via television", African Journal of Business Management, Vol. 5, No. 16, 7099-7110.

[11] Mugeni, G. B., Wanyembi, G. W., Wafula, J. M (2012),"Evaluating Factors Affecting Broadband Adoption in Kenya", International Journal of Information and Communication Technology Research, Vol. 2, No. 10, 760-768.

[12] Shaughnessy J., Zechmeister E., and Jeanne Z. (2011), Research methods in psychology, 9th edition, McGraw Hill, New York.

[13] Coleman J. S. (1958), "Snowball sampling: Problems and techniques of chain referral sampling", Human Organization Vol. 17, 28-36.

[14] Goodman, L. A. (1961),"Snowball sampling", Annals of Mathematical Statistics Vol. 32, No. 1, 148-170.

[15] Spreen, M. (1992),"Rare populations, hidden populations and link-tracing designs: What and why?", Bulletin Methodologie Sociologique, Vol. 36, 34-58.

[16] Holliday, A. R. (2007), Doing and Writing Qualitative Research, 2nd Edition, Sage Publications Inc., London.

[17] Fowler, F. J. Jr. (2002), Survey research methods, SAGE Publications Inc., London.

[18] Holmstrom, J., Ketokivi, M., and Hameri, A. (2009), Bridging Practice and Theory: A design Science Approach, John Wiley & Sons, Inc.

[19] Cresswell, A. M., Huddy, L., Dadayan, L., and Montiel, L. (2011),"Broadband Internet Service Adoption and Use in New York State HouseHolds, Center for Technology in Government, University at Albany', http:// broadbandmap.ny.gov/documents/adoption-study/NYS-Broadband-Adoption-Study-BW.pdf, site visited on 22/5/2014.

[20] Straub, D. W., Boudreau, M. C, and Gefen, D. (2004),"Validation guidelines for IS positivist research", Communications of the Association for Information Systems, Vol. 13, 380-427.