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Evaluating Factors Affecting Broadband Intensity in Kenya

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ABSTRACT

The term “broadband intensity” emerged nearly a decade ago from the Organisation for Economic Co-operation and Development (OECD) as one the domains for the assessment of broadband markets. The other two domains were broadband “adoption” and “impact”, respectively. OECD then defined broadband intensity to include the “nature, value and volume of broadband transactions”. Over the years, there have been a number of both macro and micro level studies on broadband adoption and the economic benefits associated with broadband. However, not much study has been undertaken in the area of broadband intensity. In the recent past, the emergence of mobile broadband and the associated value added services (VAS) and applications (Apps) has re-kindled interest in the subject area of broadband intensity. This study[3] investigates factors affecting broadband intensity in a developing country context, in this instance Kenya. In view of the increasing access to broadband via mobile and nomadic devices in developing countries, access to and use of mobile broadband is included in the investigation to determine the demographic and control factors affecting broadband intensity in Kenya. The data on these variables was collected using a self-administered questionnaire approach. Data was tested for non-response bias and regression analysis conducted to test the role of the variables in influencing broadband intensity. The findings of this research suggest that age, level of education, income, awareness of mobile broadband, and mobile broadband use are key influencers of broadband intensity in Kenya. The paper proceeds to outline the research methodology, findings and recommendations.

Keywords: *Intensity, Broadband, Mobile Broadband, VAS &Apps, Kenya, Developing countries*

[3] This study is a product of on-going Ph. D research work entitled “A framework for broadband metrics for developing countries”, funded by the National Council for Science and Technology (NCST), Ministry of Higher Education, Science and Technology, Nairobi, Kenya.

1. INTRODUCTION

This study is based on an on-going research on the topic “A Framework for Broadband Metrics for Developing Countries”, based on a research model consisting of broadband readiness, intensity and adoption [1]. Studies on broadband readiness and adoption were already concluded. In order to comprehensively assess the state of broadband in a developing country context, [2] recommends that broadband be viewed as an ecosystem that includes networks, the services that the networks carry, the applications they deliver, and users. This three-domain research model of broadband readiness, intensity and adoption compliments the broadband eco-system suggested by [2].

Only a few studies have investigated broadband intensity [3][4] and therefore this study makes a significant contribution to the body of knowledge on broadband intensity within a developing country context. Based on the findings of this research, policy makers and ICT regulators will be able to more clearly and accurately identify un-served and underserved areas, and appropriately target investment and resources. Broadband service providers could employ the findings in modeling and forecasting projected demand and revenue strategies, as well as supporting their ability to meet evolving consumer and business demands.

As a guide to the evaluation of the factors affecting broadband intensity in Kenya, the study sought to answer the following questions.

1. What relationship exists between demographic factors and broadband intensity among Kenyans?
2. What factors have the greatest impact in explaining variations in broadband intensity in Kenya?

The rest of this paper is structured as follows: Section 2 gives a theoretical underpinning of the study, Section 3 provides a brief discussion of the research methodology. The findings are then presented and discussed in sections 4 and 5. Finally, a conclusion and recommendations of the research are provided in the last section.

2. THEORETICAL BASIS

Certain characteristics or variables associated with an individual’s innovativeness i.e demographics could be key in investigating the variations in the intensities of new technologies such as broadband. This study adopts three main approaches to investigating broadband intensity in Kenya, the theory of planned behavior (TPB) [5][6], the technology acceptance model (TAM) [7][8], and the diffusion of innovations theory (DOI) [9][10].The central factor in the theory of planned behaviour is the individual’s intention to perform a given behavior based on some motivational factors that influence the behavior [5]. The technology acceptance model is based on an individual’s formation of an intention to act [8] regardless of the constraints, whereas the diffusions of innovations theory is based on

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communicating an idea perceived as new by an individual through certain channels over time among the members of a social system [9]. It can be seen all the three models are based on an individual, and therefore are more suitable for investigating broadband intensity in developing countries given the increasing access to broadband in developing countries via mobile and nomadic devices[1][2][11]. Models which investigate households such as the model for the adoption of technology in the household (MATH), previously used in broadband studies in developed countries,[12] are increasingly viewed as inadequate for studies in developing countries[10][13].

The study postulates that broadband intensity is influenced by several independent variables which can be categorized into two groups.

i. **Demographic factors**, which are the socio-economic characteristics expressed statistically including gender, age, marital status, education level, income level, occupation, and employment.
ii. **Control factors,** such as broadband awareness, type of access technology, services provided, and use of broadband.

To gain an understanding into the status and use of mobile broadband in the country, a section was included in the questionnaire to gauge the respondents' awareness of mobile broadband and the associated services, especially Value Added Services (VAS) and Applications (Apps).

3. RESEARCH METHODOLOGY

Broadband intensity and broadband adoption data was collected at the same time using different sections of a self-administered questionnaire. This was a time saving strategy. Also, it would have been inconvenient to present two different questionnaires for the two studies to the same respondent. Questionnaires can cover a wide area of the target population and offer standardized forms of responses [14]. Questionnaires are also familiar to most people and generally do not make people apprehensive [15].They also reduce bias, and can be completed at the respondent's convenience within the allocated response time frame [16].

Due to the uncertainty regarding the identity of consumers currently utilising broadband, and the nomadic nature of access, the snowballing sampling technique [17][18][19] was employed. Initial respondents from academia, the private sector, Government, students and the general public within Nairobi city were first identified. These in turn referenced their friends and colleagues who utilized broadband. This progressively increased the sample size [20][21][22][23] to 400. The research was carried out in the months of June and July 2012.

The initial understanding from literature review on broadband provided the basis for the development of the questionnaire which consisted of two sections. The first section had nine questions on demographic factors. These questions were closed ended multiple choice in nature.

[19]. They were adopted from [24]. Section two had 53 questions on the use of broadband, awareness of mobile broadband, and use of mobile broadband. All the questions in this section were of five-point likert scale type in nature, ranging from strongly disagree to strongly agree with a neutral option. They were adopted from [25][26]. One of the questions was asked to rate the overall intention of continued broadband use by respondents [27].

Prior to the dissemination of the final questionnaire, a trial study was conducted in April 2012 in order to determine the response rate, time required to complete the questionnaire, and the suitability of the questions asked.

4. DATA ANALYSIS AND RESEARCH FINDINGS

A total of 162 responses were obtained from the 400 questionnaires sent out within the specified duration. Thus, a response rate of 40.5% was achieved. This response rate is comparable to response rates in recent studies on broadband adoption conducted in developing countries [17][18][20][21] in Pakistan, Bangladesh, Malaysia, and India respectively, and on broadband readiness in Kenya [1].

The data analysis involved classifying and uniquely identifying the responses [20][21]. Since the responses involved data on demographics, it was useful to first test for non-response bias [28]. Afterwards, SPSS (version17), was used to generate descriptive statistics. Reliability tests and regression analysis was then conducted in order to analyze and present the research data obtained from the questionnaires [29][30].

4.1 Demographic Characteristics of the Study Respondents

The demographic characteristics of the 162 study respondents is summarised in Table 1.

Table 1: Demographic Characteristics of Respondents N=162

Variable	Intermediate variables	No. of Respondents	Percent (%)
Gender (GE)	Male	75	46.3
	Female	87	53.7
Marital status (MA)	Single	99	61.5
	Married	63	39.5
Age (AG) in	Below 25	48	29.6

years	26-40	72	44.4
	41-55	30	18.5
	56-70	9	5.6
	Above 71	3	1.9
Employment (EM)	Not employed	18	11.1
	Student	33	20.4
	Self-employed	36	22.2
	Private sector	36	22.2
	Government/public service	39	24.1
Occupation (OC)	Academic	27	16.7
	Engineering	42	25.9
	ICT	41	25.3
	Medical	15	9.3
	Agriculture	15	9.3
	Others	22	13.6
Education Level (ED)	Below primary	9	5.5
	Primary school	13	8
	High school	21	13
	Post high school	75	46.3
	University degree	44	27.2
Av. Gross monthly income in Kenya shillings* (IN)	Up to 5,000	45	27.8
	5001-20,000	36	22.2
	20,001-100,000	57	35.2
	100,001-500,000	18	11.1
	Above 500,000	6	3.7
Broadband Access Technology (TE)	Mobile (including 3G & above)	66	40.7
	Nomadic including Wi-Fi	30	18.5
	Fixed wireless including Wi-max	13	8
	xDSL	32	19.8
	Cable modem	18	11.1
	Fibre Optic	3	1.9

*At the time of the study 1USD= 83 Kenya shillings (approx)

4.1.1 Testing for Non-Response Bias

Existence of non-response bias would result in data from the respondents being non- representative, and thus pose a threat to the external validity of the study's conclusions. Non-response bias testing typically involves a comparison of the characteristics of respondents who returned completed surveys and non-respondents [31]. A difference in means test, a t-test for independent samples or a chi-square goodness of fit test can be used for testing non response bias [28][32], among other methods.

[31] suggest three methods of handling non-response bias namely:-

i. Comparison of early to late respondents. The assumption here is that subjects who respond late are similar to non-respondents [33].
ii. "Days to respond" method. A procedure in which "days to respond" is coded as a continuous variable and is used as an independent variable in regression [31].
iii. Comparison of respondents to non-respondents by following up to get a given number of responses from the initial group of non-respondents, and then comparing their responses to the actual respondents [28][31][32].

In this study, the "Days to respond" technique was used to test for non-response bias, Table 6. It can be seen that the "days to respond" variable (CODED) produced non-significant results in the regression in terms of non-response bias (**t=-0.860, df=161,sig=0.391)**; this suggests that it is less likely that the findings of this study were affected due to non-response bias and hence the threat to external validity is eliminated.

Reference to Table 1 shows nearly equal proportion of respondents from both genders. This shows that gender is not a significant differentiator of broadband intensity in Kenya. Regarding marital status, out of the responses received, about 60 percent were single while nearly 40 percent were married. In the age domain, nearly three quarters of the respondents were below 40 years. This clearly explains the fact that the younger generation are "tech savvy", and early adopters of technologies. There were nearly equal responses from across all sectors of employment, including the unemployed, students and the self-employed (about 20 percent of the respondents in each category), hence employment may not be a very significant differentiator of broadband intensity. The same case applies to income. It was noted that over a quarter of the broadband users earned less than 5,000 Kenya shillings a month, and over half of the entire users earned less than 20,000 Kenya shillings. These are considered the "low income" groups. A large proportion of this category could have been students or the unemployed or self employed. Thus income is not a significant predictor of broadband intensity especially among the younger generation and points to possible additional support to use the broadband service from guardians or use of broadband services at the place of employment.

In the occupation category, the "hi-tech" fields including academics, engineering, and ICT accounted for nearly three-quarters of the broadband users. A significant differentiator among the respondents was the kind of technology utilized for broadband access. Wireless technologies (including 3G cellular, Wi-Fi and Wi-Max) accounted for nearly two-thirds of the broadband connections, while the other third was taken up by wire-line technologies including digital subscriber lines (xDSL), cable modem and fibre optic. Surprisingly, only 1.9% of the respondents had a fibre connection. This could be explained by the fact that to date, Government, corporate organizations ,

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companies, and SMEs have been the targets for fibre connections by service providers.

4.2 Control Factors

In order to address the second research question, the relevant data on control factors was analysed.

4.2.1 Reliability Test

Reliability of constructs was estimated using Cronbach's coefficient (alpha) values to examine the internal consistency of the measure (Table 2).

Table 2: Reliability Values N=162

CONSTRUCT	No. OF ITEMS	CRONBACH'S ALPHA α
BU: BROADBAND UTILISATION	20	0.931
MBA: MOBILE BROADBAND AWARENESS	2	0.863
MBAD: MOBILE BROADBAND ADVANTAGES	4	0.719
MBU:MOBILE BROADBAND UTILISATION	26	0.929

In general, the higher the Cronbach's α value of a construct, the higher the reliability in measuring the same construct. [29] suggest four ranges for the reliability coefficient α; excellent reliability (α >=0.90), high reliability (0.70 < α < 0.90), moderate reliability (0.50< α< 0.70), and low reliability (α<= 0.50).

In this study, Cronbach's α varied between 0.931 for the broadband use (BU) construct and 0.719 for the mobile broadband advantages (MBAD) construct. The mobile broadband use (MBU) construct expressed the second highest reliability (α =0.929), and third was the mobile broadband awareness (MBA) construct (α =0.863). Considering [29], the aforementioned values suggest that two constructs possessed excellent reliability and the remaining two constructs possessed high reliability. The implication is that all the four constructs were internally consistent. Consequently, all items of each construct measured the same content universe (i.e. construct). For example, all items of MBA measured the same content universe of mobile broadband awareness. Similarly, all items of BU measured the content universe of the broadband use construct and so on.

4.2.2 Descriptive Statistics

The means and standard deviations of the dependent variable, broadband intensity (BI) and the items related to the four constructs included in the study for the purpose of measuring factors affecting broadband intensity in Kenya are shown in Table 3.

Table 3: Descriptive Statistics for BI and the Four Constructs N=162

Factors	Detailed Factors	Mean	Std. Dev	Pos
BROADBAND INTENSITY (BI)	**Scale-BI**	**3.690**	**0.540**	
MBA(MOBILE BROADBAND AWARENESSS)	**Scale-MBA**	**3.259**	**1.141**	**4**
	MBA	3.390	1.197	
	MVP	3.130	1.237	
MBAD (MOBILE BROADBAND ADVANTAGES)	**Scale-MBAD**	**3.969**	**0.635**	**1**
	MBR	3.850	0.893	
	MBS	3.930	0.982	
	MBE	4.090	0.703	
	MBC	3.910	0.847	
BU (BROADBAND USE)	**Scale-BU**	**3.654**	**0.627**	**3**
	UEM	3.800	1.196	
	USN	1.810	0.750	
	UAV	4.040	0.965	
	UGS	4.000	1.040	
	UEG	4.200	0.850	
	UEC	3.800	1.196	
	UEH	1.810	0.750	
	UEL	4.040	0.965	
	UAP	4.040	1.040	
	UIP	4.200	0.750	
	UVC	3.800	1.196	
	USE	1.810	0.750	
	UBP	4.040	0.965	
	UCC	4.040	1.040	
	URI	4.200	0.850	
	USI	3.260	0.800	
	UET	4.060	0.782	
	UDT	4.150	0.707	
	UOG	3.440	0.788	
	UTP	4.060	0.806	
MBU(MOBILE BROADBAND USE)	**Scale-MBU**	**3.678**	**0.551**	**2**
	MBS	3.800	1.196	
	MBOG	3.440	0.788	
	MBTP	4.150	0.707	
	MBVC	4.060	0.806	
	MBSE	4.060	0.782	
	MBET	3.260	0.800	
	MBNP	4.200	0.850	
	MBRI	3.440	0.788	
	MBCC	4.150	0.707	
	MBAF	4.060	0.806	
	MBI	1.810	0.750	
	MBM	4.040	0.965	
	MBSN	4.040	1.040	

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	MBA	4.200	0.850	
	MBV	3.800	1.196	
	MBB	1.810	0.750	
	MBG	4.040	0.965	
	MBC	4.000	1.040	
	MBH	4.200	0.850	
	MBI	3.800	1.196	
	MBP	1.810	0.750	
	MBL	4.040	0.965	
	MBCV	4.000	1.040	
	MBHW	4.200	0.850	
	MBFP	3.260	0.800	
	MBVP	4.060	0.782	

With reference to Table 3, the mobile broadband advantages (MBAD) construct scored the highest average aggregate measure (M = 3.969, SD = 0.635). The respondents highly agreed to all the four items used to measure this construct namely, mobile broadband being less expensive than fixed broadband (MBE; M = 4.090, SD = 0.703), higher speed of mobile broadband (MBS; M = 3.930, SD = 0.982), better coverage, (MBC; M = 3.910, SD = 0.847), and higher reliability (MBR; M = 3.850, SD = 0.893).

The MBAD construct was followed by the mobile broadband use (MBU) (M = 3.678, SD = 0.551) construct. A total of 26 items were used to measure the construct. Among the highly agreed upon items in this construct include, the use of mobile broadband for audio streaming (MBA), Government services (MBG), Enterprise applications (MBAF), Cloud computing (MBCC), Self employment (MBSE), Multi-media Messaging (MBM), Social Networking (MBSN), Video streaming (MBV), M-Health (MBH), M-Commerce (MBC), Mobile Learning (MBL), Home working (MBHW), Information search (MBI), Research and Innovation (MBRI), and Entertainment (MBET), Table 3.

Third in order of agreement was the broadband use (BU) construct (M = 3.654, SD = 0.627). A total of 20 items were used to measure the construct. The responses for the items highly correlated with those of similar items in MBU above. Among the highly agreed upon items in this construct include, the use of broadband for audio/video streaming (UAV), Government services (UGS), E-Governance (UEG), E-Commerce (UEC), Business Process Outsourcing (BPO), Cloud computing (UCC), Video conferencing (UVC), E- Learning (UEL), Information search (USI), Research and Innovation (URI), Entertainment (UET), and Agricultural Productivity (UAP), Table 3.

The last in order of agreement was the mobile broadband awareness (MBA) construct (M = 3.259, SD = 1.141). Both items used to measure this construct namely mobile broadband awareness (MBA; M = 3.390, SD = 1.197) and mobile broadband VAS and Apps (MVP; M = 3.130, SD = 1.237), were fairly agreed upon.

4.3 Regression Analysis: Influence of Independent Variables on Broadband Intensity (BI)

Ordinary Least Squares Regression was employed to fit a linear probability model (Table 4). The regression analysis (Table 6) was performed with broadband intensity (BI) as the dependent variable and a total of five constructs (including one for testing non-response bias, CODED, representing "Days to respond" variable). These are, Broadband use (BU), Mobile broadband awareness (MBA), Mobile broadband advantages, (MBAD), and Mobile broadband use (MBU).

The adjusted R square of the emerging model (Table 5) was 0.780 ($F(5,161)=115.189$, $p<0.001$). Two of the predictor variables included in the analysis were found to be very significant (Table 6). These are mobile broadband use MBU (β = 0.728, p= 0.001), and mobile broadband awareness, MBA (β = 0.584, p< 0.001). The mobile broadband advantages construct MBAD (β = 0.267, p<0.001) was fairly significant while both broadband use BU (β = -0.220, p =0.298), and "days to respond" CODED (β = -0.032, p =0.391) predictors were found to be insignificant, Table 6.

The size of β suggests that the mobile broadband use construct had the largest impact in the explanation of variations of broadband intensity, followed by mobile broadband awareness. The mobile broadband advantages construct had moderate impact on the variation of BI while the broadband use predictor was found to have insignificant impact on the variation of broadband intensity BI.

Table 4. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.887[a]	.787	.780	.253

a. Predictors: (Constant), MBU, MBA, MBDAD, BU, CODED

Table 5. ANOVA[b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	36.892	4	7.388	115.189	.000[a]
	Residual	10.053	157	.064		
	Total	46.944	161			

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a. Predictors: (Constant), MBU, MBA, MBDAD, BU, CODED
b. Dependent Variable: BI

Table 6: Regression analysis: Coefficients (Dependent variable: Broadband Intensity)

Coefficients[a]						
Model		Unstd. Coef		Std.Coef		
		B	Std.Error	Beta	T	Sig.
1	(Constant)	-.18	.229		-.08	.018
	BU	-.189	.181	-.220	-1.044	.298
	MBA	.276	.018	.584	15.296	.000
	MBAD	.227	.033	.267	6.898	.000
	MBU	.713	.207	.728	3.443	.001
	CODED	-.012	.014	-.032	-.860	.391
a. Dependent Variable: BI						

5. DISCUSSION AND RECOMMENDATIONS

The findings of this study show that demographic characteristics of an individual are key to their ability to adopt new technologies such as broadband [6][7][9], therefore demographic factors could greatly impact variations in broadband intensity in Kenya. Further, the findings show that gender is not a major differentiator for broadband intensity. This is supported by findings of similar studies [4][34][35]. Thus service providers need not necessarily package their products, such as subscription plans based on gender, but should equally target all genders.

In this study, single respondents were about 60 percent of the total respondents. This clearly runs counter to common perception that married individuals are more likely to switch to new technologies than the unmarried [4]. In the age domain, studies have shown that the young people in the society are always the first adopters of new technology [8][9]. One explanation could be their "self- efficacy" or "perceived knowledge". Our study, in line with similar studies, [4][12] supports this view as nearly three quarters of those aged below 40 years were broadband users. In order to improve broadband intensity, service providers could target campaigns through popular social networking websites, such as Facebook, Twitter, You Tube and others where the younger generation visit frequently.

Employment and income were not found to be key differentiators of the variation in broadband intensity. In fact nearly half of the broadband users were either students or non –employed. Similarly, about half of the broadband users were in the lower income brackets, earning less than Kenya shillings 20,000 per month. It is possible that students and the unemployed could be supported financially and hence would actively engage in broadband use, notwithstanding the associated costs. Similarly, some low income employees could access broadband using facilities provided at their workplaces or even in cybercafés. Our findings on employment are supported by [4][12]. Education, in-line with recent studies elsewhere, [4][12][34][35] is found to be a key differentiator of broadband intensity in Kenya.

Education is known to influence "self- efficacy", "perceived knowledge" and other facilitating conditions leading to early adoption of technologies[5][6][8]. In the case of broadband, this would result in increased broadband intensity. Thus efforts to improve digital literacy would have positive results on broadband intensity, as our previous studies [1] have established. In the occupation category, it was found that those in the science and technology or " hi-tech" related professions had more access to broadband and had the potential to spur broadband intensity. The implication here is to promote science and technology related courses at all learning levels, in order to stimulate interest in broadband. However, this should not unduly overshadow the promotion of the adoption of broadband in other professions.

With regard to broadband access technologies, our findings are in line with recent studies in developing countries,[1][2][4][11][17][18][20][21] which find increasing access to broadband via mobile and nomadic devices. Although fibre connectivity is largely available within Nairobi city and other urban areas in Kenya [38], this research finds only about two percent of individual broadband users having a fibre connection. One reason could be due to the increasing "mobility" of the people, and the need to have broadband "on the move"[11]. Other areas that may need to be looked into to increase fibre uptake by individuals is for service providers to re-package suitable and cost effective broadband subscription plans geared towards the individual in addition to their current efforts to connect Government, corporate organizations, and SMEs'.

Nearly two-thirds of the respondents in this study accessed broadband via "wireless" means, notably using mobile and nomadic devices. Given mobile broadband data consumption is expected to increase nearly 20 fold by 2015 [36], Policy makers and ICT regulators need to reconsider their national ICT and broadband policies and strategies to promote mobile broadband. The factors to be considered here include the competition environment and the provision of suitable spectrum for mobile broadband. This will supplement the efforts being made on the mobile broadband technological front to develop heterogeneous wireless networks for seamless broadband connectivity to customers as the move towards the next generation mobile revolution, LTE/4G gains momentum. The techniques involve the use of Femto, Pico, Micro cells , and the use of "smart" antennas for both the transmitters (base stations) and receivers (mobile and nomadic devices such as laptops, tablets etc). However, access to broadband via various classes of digital subscriber line (xDSL) and cable modems accounted for about 30 percent of the total broadband connections. Promotion of the adoption of these technologies could also improve broadband intensity in Kenya.

Considering the results of the study on control factors, the appropriate level of internal consistency of the measures, and the ability of the constructs to measure the same content universe was demonstrated by the cronbach's α value of the various constructs ranging from 0.719 to 0.931, with all the four constructs possessing high and above reliability.

The predictive power of the regression model of the study, with adjusted R^2 of 0.780 (Table 4), suggests the appropriate level of explained variance [29]. This means that the independent variables considered in this study are important for understanding the variations in broadband intensity in Kenya.

The findings of this study therefore, generate a number of issues that could assist players in the ICT eco-system [2] i.e policy makers, ICT regulators, broadband service providers, academia, ICT experts and the general public in making informed decisions, and in assessing broadband intensity in Kenya [1][23].

Considering the study findings, it emerges that in order to improve broadband intensity in Kenya, innovative uses of broadband have to be explored [37]. Of particular interest is the emergency of the "mobile broadband" revolution as the solution to broadband connectivity and utilization. This is attested to by the two constructs found to be very significant for explaining broadband intensity. These are mobile broadband use, and mobile broadband awareness respectively. Recent national [38] and international reports [36] support our findings. Service providers could compensate the declining voice revenues, with increasing data revenue [39].They must deploy high speed networks, address exploding demand for capacity, deliver complementary services, improve quality of service and experience, and supply attractive and affordable access devices [40]. The Government could take the lead by supporting/ or facilitating 3G and 4G technology rollouts by availing the necessary frequency spectrum and formulating policies and regulations conducive to investment and operation in the sector. In order to enhance awareness of mobile broadband, a number of factors including improvement of digital literacy, subsidizing subscription costs and campaigns through the print and electronic media, including social networking will be helpful.

The use of mobile broadband use (MBU) construct was very significant in explaining the variation in broadband intensity. A key item in the mobile broadband use category was the Value added services and Applications (VAS & Apps) chain indicated in the study for measuring mobile broadband use. With mobile phone usage growth in the developing countries far outstripping that of the developed economies [36],VAS and Apps have become a significant differentiator across service providers and a determinant of consumer loyality to the operator [37][40]. Mobile VAS and Apps could be grouped into native based and web based [37]. Native VAS and Apps run on a handheld device which has a smart operating system and supports standalone software but can connect to the internet via Wi-Fi or other wireless means [40]. Native mobile apps are usually available for download from application (apps) stores such as the Apple store, the Android app store, Nokia suite etc and is "native" to only one of the mobile operating systems such as iOS, Android, Symbian, Windows Mobile, etc [39][40][41] .On the other hand, a mobile web app is software that uses technologies such as Javascript, HTML , among others to provide applications with interaction, navigation or customization capabilities. In this case, these apps run within the device's web browser and are not specific to any device type. They are delivered to the device via the internet and do not therefore reside on the user's mobile device [37][42].

In this study, the value added services and applications (VAS and Apps) items used to measure the mobile broadband use (MBU) construct and which were highly agreed upon are, audio streaming , Government services, enterprise applications, cloud computing , self employment , multi-media messaging , social networking , video streaming, M-Health, M-Commerce , M-Learning, home working, information search, research and innovation , and entertainment.

The findings suggest the need for service providers, content developers, content providers and aggregators to re-invent value added services (VAS) and applications (Apps), and package them for specific practical purposes. This will result in the quick adoption of the services in areas previously considered non-high tech like in agricultural productivity [41] and attract new application areas such as business process outsourcing, on-line gaming and M-governance [39][40]. For the consumer, Mobile VAS and Apps could provide the most affordable method to access entertainment, news, information, markets, finance, governance, and other services previously unavailable to them. The more benefits customers receive, the more likely they are to make new subscriptions or continue to use the broadband service and hence improve broadband intensity.

The above measures, if appropriately implemented, will improve broadband awareness and use, including that of mobile broadband. This can be further supplemented by Government

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intervention to facilitate affordable broadband services by formulating appropriate policies and strategies, in order to improve the state of broadband intensity.

6. LIMITATIONS AND FUTURE WORK

The sampling methodology was limited to snowballing technique because of the inability to have adequate advance information on broadband services users, especially due to increasing access through mobile and nomadic devices. Hence the homogeneity of target respondents may not necessarily be suitable to provide a complete picture to generalize for the Kenyan population as a whole. Future research, subject to the diffusion of broadband, could emphasize more on cross-country surveys.

Another limitation was the inability to supplement the questionnaire data with interviews or adopt a longitudinal approach to data collection, due to time and resource constraints, such limitations can be overcome in future research of a similar nature by considering a longer data collection period, supplemented by interviews.

7. CONCLUSION

This study examined the factors affecting broadband intensity in Kenya. Based on the findings and discussions above, both research questions were appropriately answered. In relation to the first research question, the study determined that a relationship exists between demographic factors and broadband intensity in Kenya. With regard to the second research question, age, level of education, income, awareness of mobile broadband, and mobile broadband use emerged as the influential constructs identified to explain variations in broadband intensity in Kenya.

Attention of all stake-holders in the broadband eco-system is drawn to the factors that are reported as significant in order to improve broadband intensity in Kenya.

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