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AN EVALUATION OF COST OF DIGITAL INFRASTRUCTURE ON COVERAGE OF DIGITAL TELEVISION SERVICES IN UGANDA

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Abstract

The study set out to investigate the influence of cost of digital infrastructure on coverage of digital TV services in Uganda. The study employed a correlational cross-sectional survey design to collect the data. Semi-structured questionnaires and interview guides were used to collect data from a sample of TV owners. Data was analyzed using the narrative, descriptive, Pearson correlation and regression analyses. The findings indicate that cost of digital infrastructure significantly influence coverage of digital TV services in Uganda. Digital received is due to excellent infrastructure laid down by government. Budgeting and planning of infrastructure is crucial and government should mitigate and lower costs of setting up infrastructure as well as early identification of cost centres to help in speeding up the migration process from analogue to digital broadcasting.

Keywords: Digital migration, Cost of digital infrastructure, Information Society Theory, television sets, Coverage of digital TV services, Uganda

INTRODUCTION

The paper explores how digital migration particularly the cost of digital infrastructure influences coverage of digital TV services in Uganda given that access to information and knowledge is widely believed to be a considerable stepping stone on the road to social and economic development and can culminate in the country's quest to achieve the Sustainable Development Goals (Dahlman, Mealy and Wermelinger, 2016). Accessibility to information and knowledge among other factors depends on coverage of digital Television services which is the geographical area covered with digital TV signals streaming in the right broadcast quality (Wangalwa, 2015). It is generally the area in which a station's signal strength is sufficient for most receivers to decode it and the principal service area is the one served by a station's stoutest signal (Gong, 2016; Sussan & Acs, 2017). In this study cost of digital infrastructure was operationalized as the initial purchase cost, availability of digital equipment and indirect costs. On the other hand coverage of digital TV services was operationalized in terms of number of sites in the country; radius of coverage of each site; active number of pay TV subscribers; availability of STBs and type of digital content being broadcasted.

In recognition of the above phenomenon (coverage of digital TV services) in 2012, the government of Uganda made a clear attempt to increase coverage of digital TV services through operationalization of digital migration (which among other things involves cost of digital infrastructure) by moving from analogue to digital broadcasting. This happened after government appreciated the importance and advantages that accrue to a country, after increase of coverage of digital TV services as indicated in the Uganda communication commissions 2nd National Electronic Media performance study (2012). This process among other things focused on acquiring digital infrastructure and ensuring availability of different content providers in different regions. Digital broadcasting was expected to ensure improved picture and sound quality, quality and quantity of signals and spectrum efficiency. However, digital migration did not progress according to plan in a multiplicity of reports (MoICT annual report, 2017/2018, Internal Auditors report, 2017 and Auditor General's Annual report 2017/2018). The reports also confirm that only a few phases of the migration process were completed and that only 18 out of 135 districts reached completion by 2017, further confirming that only 13.3% of the country was receiving complete digital TV services. The reports further revealed that 11 remote sites had antennas whose configuration and alignment only allowed coverage of a radius of 20-40 kilometers depending on terrain and weather conditions. This results in a situation where 86.3% of Uganda remains in partial darkness or not effectively receiving digital TV services. The content delivered to the public is not as diverse as initially planned because the number of content providers remains few. The standard digital signal remains inferior compared to global

standards. If these shortcomings' as mentioned above are not effectively and efficiently addressed, the situation may worsen and eventually lead to the stalling of the expected progress of access to digital services. While several studies (e.g Obonyo, 2016, Oluka 2011 and Tsebee, 2014) have documented low levels of coverage of digital services in Uganda, none looked into reasons why, yet if coverage of digital services is to be enhanced, factors affecting it, have to be identified. While there could be several contributing factors, cost of digital infrastructure may be playing a big role. Hence the need for this study evaluating the cost of digital infrastructure on coverage of digital television services in Uganda. Therefore the objective of the study was to establish the influence of cost of digital infrastructure on coverage of digital TV services in Uganda. The null hypothesis tested in line with this objective was that there is no significance influence of cost of digital infrastructure n coverage of digital TV services in Uganda.

LITERATURE REVIEW

Digital migration policy in Uganda

The Digital migration Policy delimits the parameters of Migrating Uganda's broadcasting sector from analogue to digital terrestrial broadcasting. The implementation of the migration policy is in conformity with the National Development Plan (MOICT, 2012).

The migration policy expressly aimed to generate and separate the market segment into manageable infrastructure services provision and Content services provision to ensure equitable growth (Ministerial Policy Statement- Ministry of ICT & National Guidance, 2021/22).

The policy further aimed to guarantee equitable access to quality broadcasting services to current and future stakeholders sustainably stretching into the immediate and foreseeable future (Ministerial Policy Statement- Ministry of ICT & National Guidance, 2021/22).

The migration policy distinctly aimed to ensure efficient use of Radio spectrum. Digital migration aimed at freeing up the radio frequency spectrum by using advanced compression and multiplexing technologies afforded by a digital platform. This would create an opportunity to provide extra services and applications such as mobile telephony, wireless broadband and e-services (MOICT, 2012).

The policy additionally aimed to protect the general public against unfair practices during the transition and beyond. In order to operationalize this policy objective Government aimed to Prioritize consumer awareness and skills development to assist in access and utilisation of digital broadcasting systems as well as guarding against consumer exploitation through unfair market practices. The authorities aimed at Ensuring accessibility of affordable digital receivers and set-top boxes through fiscal policy measures during the transition period. Government in

collaboration with UNBS aimed at defining minimum Standards and specifications for the set-top boxes to be used in Uganda (Ministerial Policy Statement- Ministry of ICT & National Guidance, 2019/20).

Government through the digital migration policy aimed at ensuring environmental protection during the transition and beyond through collaboration with NEMA by devising suitable measures to be taken to ensure safe disposal of disused analogue transmission and reception equipment. Further, the policy stipulates that to avoid duplication of services try as much as feasible to make use of existing analogue infrastructure for digital transmission as well as encourage the use of the National Data Transmission Backbone Infrastructure for broadcasting during the transition period and beyond. Government further aimed at establishing a policy on infrastructure sharing such that existing infrastructure owners and new entrants can easily integrate their facilities into the distribution network (MOICT, 2012).

The digital migration policy aimed at promoting local content development by developing human resource skills necessary for the digital transition and the foreseeable future. The policy further aimed at putting in place appropriate policies on the production, access, use and distribution of content in the diverse digital services environment in a bid to address copyright issues. The migration policy further planned to establish a body entrusted with the responsibility of promoting diverse content development by providing financial and other support to the local content development industry (Ministerial Policy Statement- Ministry of ICT & National Guidance, 2019/20).

Theoretical Review

This study is grounded on the Information society theory. Much of the pioneering work was done by Fritz Machlup in 1962. The insightful, intense and focused analysis plus critique of Information Society Theory has been moved from the periphery and moved very much to the centre by scholars of Information and communication technology (Webster, 2015).The Information Society Theory raises questions which are unavoidable for anyone who wishes to understand the relationship between the structures and processes of social communication such as digital migration and social structure and processes that are made possible by coverage of digital TV services. The theory helps expound the role played by information and information technology in society (Ponzanesi & Leurs, 2014). The Information Society Theory took centre stage to throw light on the shift from analogue into digital technologies also known as digital migration and helps explain dispersion of information through coverage of digital TV services (Calhoun, 2014).

In recent years, World powers are grappling to bend the evolution of the information society preferably in their direction.US-companies such as Microsoft and Oracle Corporation have down the years succeeded in creating huge markets for new services and technologies such as digital TV technologies (Mansell & Steinmuller, 2000). There is real fear that Europe and other regions, could in the long run, be kicked out by being leveraged out by the strategy employed by US-companies (Van Audenhove, Burgelman, Nulens & Cammaerts, 2014).

Much as the Information Society Theory explains many aspects of how digital migration and other ICT advancements have shaped society, a number of questions remain that this study hopes to address. For example, how much advance in terms of ICT advancement like migration should happen for Uganda to qualify for information society status? Is this advancement in ICT is required in order to identify an information society qualitative, quantitative or both? Will coverage of digital TV services happen when all Ugandans own a digital television? Currently scholars like Dertouzos(1997); Negroponte (1995); Kranich (2004); who champion the notion that technology such as digital migration is central to Information Society Theory are not able to furnish us with anything approaching the answers we seek. The study hopes to bridge these gaps. Theoretical knowledge may not be a new way to try to explain research problems, but it is arguable that its significance has accelerated in recent times and therefore we base this study on the Information society theory.

Conceptual Review

Cost of Digital Infrastructure

Digital infrastructure costs are the overheads associated with the physical infrastructure that carries digital data between devices, data infrastructure and services. These investments in Digital infrastructure are needed to operationalize digital services which in turn depend on infrastructure to act as a backbone. Digital infrastructure costs are incurred while paying for equipment to enable connectivity, storage, processing, terminals, devices, services and applications. A fully equipped broadcaster incurs additional costs in form of transmitters, special cables, backup generators and encoding equipment to convert the signal (Tilson, Lyytinen & Sørensen, 2015).

Cost of Digital Infrastructure and coverage of Digital Television services

The migration process from analogue broadcasting to digital broadcasting is known as digital transition, it attracts hefty costs both explicitly and implicitly ranging from broadcasting equipment related cost incurred by broadcasters to equipment used by consumers to receive the new digital signals on their televisions at home (Berger, 2010). The study by Berger (2010)

employed the longitudinal research design and adopted stakeholders' involvement and viewer's satisfaction as predictor variables. This study noted that while (Berger, 2010) pointed out the significant costs, risks and opportunities associated with the costs of digital infrastructure the study findings do not map out a course of cost mitigation nor does it consider viable alternatives to costly infrastructure. This created a conceptual gap as the study only considered two predictor variables which limited its scope. As such the inability to provide mitigation of costs strategy, it was found ideal to address this issue in this study.

Worldwide, the requirements needed for a standard digital station to achieve the ability broadcast satisfactorily require a number of items most of which are well beyond the reach of broadcasters in the developing world (UNCTAD, 2017). The transition to digital broadcasting involved procurement, purchase and installation of new transmitters; though in the case of United States and Western Europe the new transmitters were added to existing towers as there was room for expansion; unlike in the case of most developing countries don't have room for expansion (Alexander & Cunningham, 2014). These studies utilised a hybrid correlational and cross-sectional study design. A further gap in the body of published literature observed was in study findings by Alexander & Cunningham (2014) which concluded that cost of digital infrastructure could be brought down by simply adding transmitters to existing towers. However these are silent on alternative technological solutions in case of need room for expansion is limited. The study used the findings to fill this contextual and conceptual knowledge gap.

Further costs involved installation of special cables that conduct signals from studio to tower. In addition, complementary equipment for example backup generators had to be purchased. A further cost in some countries involved acquisition of some new land (Todreas, 2013).Broadcasters had to acquire intricate computerized equipment needed to encode programming into digital format from analogue which is an elaborate, complex and expensive to say the very least (Bajon & Villaret, 2014).Last but not least their staff must be retooled and retrained to enable the smooth transition to the new digital technologies (Shapiro & Varian, 2015). For broadcasters in the developing countries, this is an added, unwelcome but unavoidable cost (European Commission, 2013). The study findings by Todreas (2013); Bajon & Villaret (2014) and Shapiro & Varian, (2015) indicate that cost of digital infrastructure was inevitable but these study findings were not specific in revealing the estimated increase in coverage of digital TV services the new equipment will bring about and were more concerned in identifying the cost centres. The above studies were done in a short period of time and were limited in scope; this might have impacted on the results of the study. This temporal gap in the published literature was filled by the study findings.

The digital migration process in the United States of America was originally envisaged to proceed with few hitches as it progressed (Einstein, 2015). According to figures available at the U.S. National Association of Broadcasters, infrastructure installation and adaptation cost about$5 billion to cater for roughly 1,750 full-power stations. While this appears an astronomical amount, thirty seven (37) U.S. commercial stations absorbed this cost while the public commercial stations received grants from the federally funded Corporation for Public Broadcasting and individual federal states (FCC, 2016). Einstein (2015) argued that it remained unclear how aspects of costs met by commercial broadcasters could have been underwritten by the Federal government. The geographical scope covered by the above study was a bit large and would perhaps have benefited from a case study design which would have been more focused. Given that the study focuses on coverage of digital TV services in Uganda which entrusted the whole process to the state broadcaster the Uganda Broadcasting Company (UBC) and SIGNET, this contextual gap was be bridged.

Kapteina (2017) conducted a study on how cost of digital infrastructure affects coverage of digital TV services and contends that escalating costs of the infrastructure negatively impacts coverage and deepens the preexisting digital divide and information inequality that has constrained progress and development on several fronts. However, this study is compiled from a comparative literature review from studies across Europe acting as a secondary data source. This invariably creates a geographical and methodological gap. Angelopulo & Potgieter (2017) conducted a similar study on cost of digital infrastructure and its contribution to coverage of digital TV services. The study findings were not in agreement with study findings by Ahmad & Ribarsky (2018) as they contend that coverage of digital TV services spans many other domains and the study must incorporate more concepts for a more wholesome picture as indicated by the situation concerning digital migration in Republic of South Africa, given that in South Africa, Giant Telecoms like Vodafone were largely responsible for paying digital infrastructure being set up around the country. The study's data source was a rapid assessment survey. This created a contextual and methodological survey. Theses gaps were addressed in the present study and workable policy alternatives suggested.

Halfpenny & Proctor (2018) study findings seek to correlate cost of digital infrastructure and coverage of digital TV services in Wales. They established a strong correlation as the Welsh government was solely responsible for setting up and paying for the infrastructure. The study however didn't give alternatives for future support of constructing new infrastructure as the government only committed to absorb the cost of digital infrastructure for a ten year period. This created a knowledge gap in the published literature. Schaar-Mitrea & With (2013) on the subject of cost of digital infrastructure contend that the costs need to be deconstructed into

initial costs, current costs and future costs to cater for emerging technologies. They also adopted a case study research design and collected data over a longitudinal period. This created a conceptual and methodological gap. Leurs & Smets (2018) studying digital migration in Eastern Europe disagreed with all previous studies on the subject matter. In former Eastern Europe, the migration process was forced with little debate and input from the public. Government technocrats were responsible for ensuring Government absorbs costs of digital infrastructure. However the specifics of how costs could be taken up by government are not provided creating a conceptual gap. Furthermore, answers of how governments in developing countries could learn from this experience are not provided creating a further contextual gap. The study was able to address all these gaps and provide workable solutions in the recommendation section of the study.

Ponzanesi & Leurs (2014) while discussing cost of digital infrastructure and coverage of digital TV services in Southern Europe were of the view that costs were initially high and limited coverage of digital TV services for many years before dropping sharply with government subsidies especially in Italy. However, the study noted the cost of new 5 G technologies saw increases in costs of setting up the new digital infrastructure. The study does not attempt to explain why the European countries failed to budget for technological advancements given that the new technologies were spearheaded by Huawei Technologies a firm owned by the Chinese state which charges high premiums for setting up 5G infrastructure. This created a conceptual gap. Brooker, Barnett & Cribbin (2016) while conducting comparative studies on costs of digital infrastructure in all the Home Nations in the British isles disagreed with study findings of the study by Ponzanesi & Leurs (2014) in that the British Government wasn't responsible for paying for many of the costs of setting up digital infrastructure; a private-public partnership model was adopted in the British Isles. This created a methodological gap as in Uganda's case, the costs were mainly borne by the Uganda government with little contribution by the public sector. The study was able to fill in this gap with the study findings in form of concrete policy suggestions and recommendations.

Wall, Campbell & Janbek (2017) conducted a study on the Syrian digital migration processes. The study identified other factors in conjunction with costs of infrastructure as a determinant of coverage of digital signal dispersion in the country. The study is grounded in the institution theory which the study feels is not entirely suited for purpose. This created a theoretical gap. The fact the study was situated in Syria creates a geographical gap that needs addressing. Other predictors included in the study further create a conceptual gap that needs to be filled. Costa (2016) conducted another study on digital migration in Turkey. The study findings disagree with the findings by the previous study by Wall, Campbell & Janbek (2017) as

they identify cost of digital infrastructure as a key determinant of coverage of digital TV services. The study further pegs the delay in digital migration in Turkey on the huge cost of digital infrastructure. The study used mainly secondary data extracted from records in the Turkish Ministry of Information. This creates a methodological gap as studies whose findings are rooted in secondary data tend to lack authenticity in academies. Furthermore, the situation in Turkey may have few lessons for Uganda. This created a contextual gap. The study filled in the above gaps and the details are included in the recommendations of the study.

McGregor & Siegel (2018) whose study noted that digital migration in Scotland had a number of challenges stemming from disagreement the country on who was to foot the costs. The Government only paid for the initial costs but only agreed to complete paying for additional costs of infrastructure to complete the digital migration process which slightly overshot the set deadline. The study did not clearly reveal the ideal public private partnership ratio which could better inform the Ugandan authorities creating a knowledge and conceptual gap. Gordano (2018) discussed the impact cost of digital infrastructure had on coverage of digital TV services in Greece by explaining how the costs ultimately dictated the pace of digital migration. The study used a comparative study design and lacked the requisite detail to inform the current study. This created a conceptual and methodological gap that needs to be bridged. The study used Telecom annual reports as secondary data which created a further methodological gap. The study findings filled in the identified gap and details are available in the recommendations section.

Deuze (2016) study findings centering on costs of digital infrastructure influencing coverage of digital TV services by directly influencing the speed with which coverage of digital TV of was accomplished in France. The study was grounded in the agency theory and sampled the principalities in the country and omitted the countryside. This created a theoretical and methodological gap. The study was centered purely on costs of digital infrastructure and completely ignored other predictors of coverage of digital TV services. This further created a conceptual gap that the study needs to be addressed. Alinejad (2015) conducted a study that underscores the role played by cost of digital infrastructure in determining the coverage of digital TV services in Finland. The study used a small sample and a longitudinal secondary data set. This created a methodological gap that needs to be comprehensively addressed. The study is grounded in the communication theory which study felt was not entirely suited for purpose. This further created a theoretical gap that needs requisite attention. The study further created a contextual gap that will further filled. The study addressed all the gaps identified early through the study findings and recommendations.

Malcalm & Agyemang (2018) examined cost of digital infrastructure in Ghana. The study noted that only two out of the expected forty two transmission sites were up and running by 2018. The study blames financial difficulties and shortage of personnel needed to make coverage of digital TV services fully operational. The sampling technique used in the study was purposive and snowballing. However, the data collected using these techniques cannot be completely disassociated from bias. Further methodological gaps were created by the choice of data analysis. Qualitative data analysis was used exclusively in the study. This means that the study only estimated the degree of coverage and not in any quantifiable form. This limits the degree to which findings in the report can be generalized and replicated in other areas.

Akinola-Badmus & Ojebuy (2019) discussed the state of preparedness for digital migration in Oyo state in Nigeria in general and cost of digital infrastructure specifically. The study concluded that to date, much of the equipment required for digital switch on to be fully operational was yet to be procured. However, the study purposively and conveniently sampled 300 respondents from 10 media houses. Further still, the response rate was less than 70 percent. This created a methodological gap as the response rate was not ideal and convenience and convenient sampling carry an inherent bias. Endong (2015) while examining the state of digitization in Nigeria arrived at similar conclusions arrived at by Akinola-Badmus & Ojebuy (2019) by outlining shortage in funding and a lack of enthusiasm on the part of the Nigerian authorities that has impeded the acquisition of digital infrastructure. However, the study was anchored by the mediamorphis and the modernization theories. This created a theoretical gap as the two theories are not quite suited to such as study and the current study was grounded in the information society theory to improve the study foundation.

In Kenya, the new digital TVs that conformed to the technical standard and can receive DVB-T signals directly were priced at approx. US$1,000. Very few Kenyans outside big urban centres like Nairobi and Mombasa could afford TV's at that price. This meant that Kenyans had to resort to the relatively less costly set-top boxes which act as an adapter for an analog TV to receive digital broadcasts (Mansell, 2014). Study findings by Noam (2016) and Levy, Ford-Livene& Levine (2013) do not offer any practical answers because they limited the main studies to Lang'ata Sub-County and Machakos Town Constituency and are often contradictory and are vague on why coverage of digital TV services in Kenya remained so limited. These contradictory perspectives call for a more detailed study to fill the methodological gap as well as the inconsistencies in the findings in the published literature.

Migration of TV transmission from analogue to digital in Uganda was met with challenges like pricing of set top box (STB) that ranged from Ushs120,000 (US$40) for a low quality set to Ushs 180,000 (US$60) for a better quality set top box (STB). The majority of Ugandans earned

less than US$ 1 per day so they were priced out and yet prior to digital migration TV owners in the country are estimated to be close to 4 million (Obonyo, 2016). In response to this the Pay TV service providers drastically lowered prices for their decoders in an attempt to encourage more Ugandans to subscribe through a huge media campaign. Recent surveys in the country showed that of the 4 million TV owners in the country, only about 10 per cent of those can afford pay TV (Imaka, 2011). The above study utilised accessibility of different media stations, broadcasters Content broadcasted and viewership as independent variables. Underlying questions linger as to why even after reducing prices, the number of people purchasing these gadgets remained low. The independent variables had a high degree of multicollinearity; however it is noted that multicollinearity among independent variables may result in less reliable statistical inferences (Obonyo, 2016). The study provided some answers and filled the methodological and temporal gaps.

The study gap of this study objective is premised under the question why the majority of the populace in Uganda is not able to access digital TV services. As mentioned by Alexander & Cunningham (2014) the cost of digital infrastructure could be brought down by simply adding transmitters to existing towers. However these are silent on alternative technological solutions in case of need room for expansion is limited. Under digital broadcasting, it is not necessary for every TV station to set up their own masts; all that is required is for them to prepare and package their content provided it is digitally compliant that will be distributed by a single service provider, in the case of Uganda, Signet. Albeit, Uganda Broadcasting Corporation (UBC) has some infrastructure in form of masts and plenty of land to erect these masts but, most of their equipment and facilities are obsolete and needed to be replaced (Oluka, 2011). The study used a correlational study design. The current study hoped to employ a multi-pronged study design and triangulate the findings for better clarity. Cost of providing the signal infrastructure is estimated at the cost of $40 million to $50 million. This is over and above what the state broadcaster can invest (Bourgault, 2015). The study filled the resultant methodological and conceptual gaps.

Summary of Literature

From the above review it can be seen that few studies have been conducted on cost of digital infrastructure and coverage of digital TV services. The majority of the reviewed published literature examined some aspects of cost of digital infrastructure but not in the variable's entirety. A number of gaps were identified as few studies in the literature reviewed indicate that cost of digital infrastructure affects coverage of digital TV services. Temporal gaps were identified where a number of studies were several years out of date and the study hopes to

close that gap. Conceptual gaps were noted in the published literature with most studies not including all the sub variables in cost of infrastructure. Most of the theories that anchored previous studies were unsuited to the study besides the Information Society Theory creating a theoretical gap. Methodological gaps were noted in a number of studies with some studies adopting research designs not entirely suited to the subject matter; other study findings were based on secondary data and others were based purely on literature review as a basis for drawing up conclusions. Contextual gaps were identified as many of the previous studies were centered in developed countries, outside sub Saharan Africa and Asia and little material on Uganda.

METHODOLOGY

Research Design

The study utilized a correlational cross-sectional survey design. A correlational design was selected so as to test the relationship between the independent variable (cost of digital infrastructure) and the dependent variable (Coverage of Digital TV Services). The study was cross-sectional because it was conducted across participants at a point in time and picked only some representative sample elements of the cross section population. It did not compel the researcher to make follow up on the participants. It was utilised on account of its rapid turnaround in data collection as Amin (2005) advises.

A survey design enabled the collection of data from a large number of respondents. It was a preferable method of choice because the researcher intended to generalize from the sample used extracted from the whole target population in Uganda (Cooper & Schindler, 2003). Surveys are particularly invaluable when it comes to rapid informational analysis and were comparatively easy to administer and manage (Kothari, 2004). Generally, data was collected using a cross sectional design because respondents were selected from different regions (Cooper & Schindler, 2003). The above quantitative designs were used in order to describe the current conditions and investigate the relationship, including cause and effect relationships (Amin, 2005). The study in addition employed both quantitative and qualitative approaches of data collection and analysis. The qualitative approaches helped in collection of data using views, comments and judgment of selected respondents on the various themes the study brought up. In addition the quantitative approaches were employed because it was based on testing theories which consist of variables to be measured with numbers and analysed with informational procedures to determine whether the predictive generalisation of the theories held true (Cooper & Schindler, 2003).

Study area and population

The study was in coverage of digital TV services in Uganda. For this study revolving around cost of digital infrastructure and coverage of digital TV services, the targeted populations were households that own television sets. According to Uganda National Household Survey 2016/17 Commissioned by the national bureau of information, about 3,770,000 television sets are owned by Ugandan households. The population of the study was 3,770,000 television owners.

Study sample

The total population of television owners is 3,770,000. This is too big a population to be involved in the research. For that matter a minimum sample size was determined. In advanced research like the current one, it is recommended (Saunders, Lewis & Thornhill, 2012, Sekaran &Bougie, 2010) that the minimum sample be calculated specifically for the study. So the "estimate" was 95% accurate. This corresponded to a z score of 1.96. The minimum margin of error was therefore 5%. In this study, the z score was used to estimate the proportions of accuracy and minimum margin of error as far as responses were concerned.

It was presumed that at least 60% of the selected respondents will answer fully the items on the questionnaire and suggested that 40% may not be able to. Using the formula popularized by de Vaus, 1991, Saunders, Lewis & Thornhill, 2012). The minimum sample size was computed using confidence level of 95% as follows.

Sample size was determined in two steps:

1. Calculated the sample size for infinite population.
2. Adjusted the sample size to the required population.

$S = Z_2 * P * (1-P) / M_2$

S = Sample size for infinite population

Z = Z score

P = population proportion (assumed to be 60% = 0.6)

M = margin of error

Z score was determined based on confidence level.

Confidence level: The probability that the value of the parameter falls within a specified range of values

Confidence Level	Z- Value
90%	1.645
95%	1.960
99%	2.576

The study took 95% confidence level then Z score as 1.96. Margin of error was a small amount that is allowed for in case of miscalculation or change of circumstances. Generally we took margin of error as 5%

M = 0.05

Z- Score = 1.96

P = 0.6

M = 0.05

S= (Z-Score) ^{2} * P * (1-P) / (Margin of error) ^{2}

S = $(1.96)^2$ * 0.6 * (1 – 0.6) / $(0.05)^2$

S = 3.8416 * 0.24 / 0.0025

S = 368.7936

So, sample size for infinite population is 368.7936.

Now, we adjusted the sample size to the required population. In this instance, the study adjusted the sample size to 369 television owners in Uganda.

The study put to use the following formula for adjusted sample size as recommended by Saunders et al (2009);

Adjusted sample size = (S) / 1 + [(S - 1) / Population]

Adjusted S = 368.7936 / 1 + [(368.7936 - 1) / 3,770,000]

Adjusted S = 368.7936 / 1.000102

Adjusted S = 368.756 approximately 369

The sample size therefore for 3,770,000 is 369

So the desired sample size used to complete the main research instrument, that is, the questionnaire was 369.

To compute the proportionate sample per category of the population by region, the study used the regions categorized in the Uganda National Household Survey 2016/2017. The study employed the proportionate allocation sampling by Kothari (2004) based on a target population of 369 using the formula below:

ni = $\frac{n * ni}{N}$

ni = Sample Size of each category within the study area

n = Desired Sample size computed above

nj = Number of population in each category

N = Total number of respondents in the study area

Kampala = 1,654,047 * 369 = 161.8948 approx. (162)
3,770,000

Busoga = 465,789 * 369 = 45.59049 approx. (46)
3,770,000

Bukedi = 116,178 * 369 = 11.37127 approx. (11)
3,770,000

Elgon = 119,963 * 369 = 11.77356 approx. (12)
3,770,000

Teso = 117,147 * 369 = 11.74174 approx. (12)
3,770,000

Karamoja = 87,146 * 369 = 8.529675 approx. (9)
3,770,000

Lango = 104,783 * 369 = 10.25595 approx. (10)
3,770,000

Acholi = 107,265 * 369 = 10.49888 approx. (10)
3,770,000

West Nile = 102,584 * 369 = 10.04072 approx. (10)
3,770,000

Bunyoro = 100,348 * 369 = 9.82186 approx. (10)
3,770,000

Tooro = 209,473 * 369 = 20.50279 approx. (20)
3,770,000

Ankole = 396,199 * 369 = 38.77916 approx. (39)
3,770,000

Kigezi = 189,078 * 369 = 18.50657 approx. (18)
3,770,000

Sampling Design for Heads of Households

Simple random sampling design was used in this investigation to select samples of heads of households. The systematic sampling will then be applied to select respondents from the various strata. This design is chosen for this study because it gives each element in the population an equal chance of being included in the sample.

Table 1: Sample Size of Respondents and Sampling Techniques

Category of Population(By Region)	**Population Size**	**Sample Size**	**Sampling Technique**
Kampala	1,654,047	162	Simple random sampling
Busoga	465,789	46	Simple random sampling
Bukedi	116,178	11	Simple random sampling
Elgon	119,963	12	Simple random sampling
Teso	117,147	12	Simple random sampling
Karamoja	87,146	9	Simple random sampling
Lango	104,783	10	Simple random sampling
Acholi	107,265	10	Simple random sampling
West Nile	102,584	10	Simple random sampling
Bunyoro	100,348	10	Simple random sampling
Tooro	209,473	20	Simple random sampling
Ankole	396,199	39	Simple random sampling
Kigezi	189,078	18	Simple random sampling
Total	**3,770,000**	**369**	

Source: Uganda National Household Survey 2016/17

Sampling Procedure for Heads of Households

Probability based sampling employed the simple random sampling technique. The researcher opts for the use of simple random sampling techniques for purposes of having all categories in television owners involved in the study. The names of the 369 heads of households will be listed and assigned numbers from 1 to 369 and each number will be written on a different piece of paper, folded and put in a box. The box will then be shaken carefully and

a piece of paper picked randomly without replacement. The procedure was repeated until the entire listed household heads (369 in number) were got. The names of household heads randomly picked from the box will listed as respondents to be given questionnaires.

Sampling Design for Key informants through Focused Group Discussions

Census and purposive sampling design was used in this research to select samples of key informants. For purposive sampling, carefully chosen respondents from various regions will be chosen. This design is chosen for this study because key informants possess rich knowledge on the subject matter and have been identified beforehand.

Table 2: Sample Size of Respondents and Sampling Techniques

Category of Population	Population Size	Sample Size	Sampling Technique
CEO SIGNET (U)	1	1	Census sampling
CEO UBC	1	1	Census sampling
CEO Multichoice Uganda	1	1	Census sampling
CEO Startimes Uganda Ltd	1	1	Census sampling
Retired Broadcasting Engineers from each region	13	5	Purposive sampling
Retired Broadcasting journalists from each region	13	5	Purposive sampling
Retired Broadcasting station managers from each region	13	5	Purposive sampling
Selected Members of the UBC Board	10	3	Purposive sampling
Selected Commissioners ICT Ministry	8	3	Purposive sampling
Total	**61**	**25**	

Sampling Procedure for Key informants

Non Probability based sampling employed census and purposive sampling techniques. The researcher opts for the use of census and purposive sampling techniques for purposes of having all qualified and experienced key informants to be interviewed.

Data collection

Questionnaire

Self-administered questionnaires were administered to 370 respondents for the express purpose of getting primary data. The questionnaire used in the study was self-designed.

Questionnaires were a tool of choice as they made it possible to ask specific questions that focused on the subject matter with no danger of being diverted outside the area of study. Previous studies found questionnaires quite popular because the respondents were usually able to fill them in at their own convenience and further still this tool was appropriate for a sample of this size. Questionnaires in addition provided the respondents with privacy to freely express their feelings on the subject matter because basically, respondents were not required to append their names on the tools.

Interview guide

The study used a semi-structured interview guide to conduct interviews with the following stakeholders in the broadcast industry: CEO SIGNET (U), CEO UBC, CEO Multichoice Uganda, and CEO Startimes Uganda Ltd. In addition, retired broadcasting engineers, journalists, station managers, select members of the UBC Board and Commissioners ICT Ministry were interviewed. Interviews as a tool were chosen because they made it easy to fully understand an interviewee's points of view or unique perspectives, or learn more about their answers as compared to questionnaires. According to Mugenda & Mugenda (2003), interviews are good in that unlike questionnaires, they provide more detailed information.

Documentary review check list

The researcher developed a list of secondary sources of information that were reviewed. Several documents reviewed about the study included Ministry of ICT minutes of meetings, journals on digital migration and coverage of digital TV services, digital migration text books, dissertations on digital migration, abstracts, coverage of digital TV services consultants' reports and other related digital migration and coverage of digital TV services documents. Burns (2016) asserted that primary data alone cannot provide a comprehensive construct of the study problem, as it should be supplemented by secondary sources of data.

Data processing and Analysis

After collection, data was compiled, sorted, reviewed, edited and coded. The editing was meant to remove any corrupted or erroneous data provided by the different respondents and the coding helped in quickening the process of data input.

Quantitative Data Analysis

Collected quantitative data was coded, entered into IBM SPSS© 26 program and analyzed, based on the research objectives. IBM SPSS© 26 program was used to generate demographic and descriptive characteristics of the sample to be studied. In addition, Pearson's correlation coefficient analysis and linear regression to establish the relationship between variables and the regression analysis was done to establish the variations that the independent variable (cost of digital infrastructure) accounted for in the dependent variable (coverage of digital TV services).

Qualitative Data Analysis

All the qualitative data that was collected through interviews and scrutiny of documents were categorized, organized and analyzed along the themes of the major variables. This was done to triangulate and marry the findings obtained through quantitative analysis.

Ethical Considerations

Ethics is the basis for conducting effective and significant studies and as such ethical concerns will be addressed by the study. The following ethical issues were prioritised as suggested by Saunders, Lewis & Thornhill (2012): Guarantees and honesty were key; whereby the purpose of the study and anything to be gained from it was clearly explained to respondents; confidentiality which requires that confidentiality and anonymity will be unreservedly and profusely guaranteed; identity of respondents as well as information obtained during the study was kept confidential unless otherwise agreed upon with the respondents; informed consent whereby all aspects and intentions of the study were clearly explained to the respondents to protect their welfare and dignity; and protection of respondents from any physical or mental harm arising out of the study. As suggested by Ghauri & Grönhaug (2005), respondents were not exposed to risks greater than, or additional to those encountered in their ordinary lives.

FINDINGS AND DISCUSSION

Descriptive analysis

Both cost of digital infrastructure and coverage of digital TV services were described. Respondents rated themselves on the different measures of the variables in question on a 5 point Linkert Scale (1 = strongly disagree; 2 = disagree; 3 = not sure; 4 = Agree and 5 = strongly agree). Results were categorized according to their means, standard deviations and t-values. For the means to be significant, the t-values should be equal to or greater than the conventional

significance levels of 10%, 5% and 1%. Table 3, shows the summary descriptive statistics of both cost of digital infrastructure and coverage of digital TV services.

Table 3: Summary Descriptive statistics of cost of Digital Infrastructure and Coverage of Digital TV services.

	Aspect/Variable	Mean	Standard dev.	t-value
1	Cost of overall average on cost of digital infrastructure	3.06	1.165	2.65
2.	Coverage of digital TV services			
(i)	Number of sites in the country	3.72	1.084	3.45
(ii)	Radius of coverage of each site	3.53	1.091	3.24
(iii)	Active number of pay TV subscribers	3.38	1.096	3.55
(iv)	Availability of STBs	3.48	1.193	2.92
(v)	Type of digital content being broadcast	3.59	1.193	3.13
	Overall average on coverage of digital TV services	3.36	1.131	3.26

Cost of digital infrastructure was operationalized as initial purchase cost, availability of digital equipment and indirect costs. Coverage of digital TV services was operationalized as: number of sites in the country; radius of coverage of each site; active number of pay TV subscribers; availability of STBs and types of digital content being broadcasted.

According to summary results in table 3, respondents rated themselves high on a scale of 5 on all aspects of cost of digital infrastructure according to the overall mean (mean = 3.06; std = 1.165 and t-value = 2.65). Further, results indicate that overall, respondents also rated themselves high on all aspects of coverage of digital TV services as shown by the overall mean (mean 3.63; std = 1.131; t-value = 3.26). All the overall means of both cost of digital infrastructure and coverage of digital TV services were significant at 1% or 0.01.

Testing of the hypothesis

The study sought to test the following hypothesis; Ho1; that, there is no significant influence of cost of digital infrastructure on coverage of digital TV services in Uganda.

Correlation results

In conformity with the research design utilized in this study, an effort was made to establish whether there was an associative relationship between cost of digital infrastructure and coverage of digital TV services in Uganda.

A bivariate analysis was conducted using Pearson's correlation methods. The correlation coefficients are between (-1) and (+1). Positive correlation means both the independent and dependent variables move in the same direction, while negative correlation, the two variables

move in opposite directions. The strengths of the correlation were interpreted on the following basis: 1.00 means perfect relationships; 0.90 – 0.99 very high; 0.70 – 0.89 high; 0.50 – 0.69 moderate; 0.30 – 0.49, low; 0.01 – 0.29 very low and 0.00 translates to a non-existent relationship. Correlation results are presented in Table 4.

Table 4: Correlation between cost of Digital infrastructure and coverage of Digital TV services in Uganda

		Cost of digital infrastructure	**Coverage of digital TV services**
Cost of digital infrastructure	Person Correlation	1	0.573**
	Sig (2-tailed		0.000
	N		307
Coverage of digital TV services	Pearson Correlation	0.573**	
	Sig (2-tailed)	0.000	
	N	307	

** Correlation is significant at the 0.01 level (2-tailed)

Correlation results in Table 4 indicate that there is a moderate positive associative relationship between cost of digital infrastructure and coverage of digital TV services in Uganda. (r=0.573, Sig 0.000) at 0.01 or 1% level of significance. If the relationship is predictive, it means that, cost of digital infrastructure is improved, coverage of digital TV services also improves. However, there was need to run simple regression analysis to confirm whether the relationship was predictive or not as illustrated below.

Simple Linear Regression results of cost of Digital Infrastructure and Coverage of Digital TV services

The null hypothesis stating, “There is no significant relationship between cost of digital infrastructure and coverage of digital TV services in Uganda” was also subjected to a simple linear regression test.

Table 5: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.573[a]	.328	.326	.5058

a. Predictors: (Constant), Cost Digital Infrastructure

Table 5 depicts the model summary that shows the value of R, R Squared, Adjusted R Square and Std. Error of the Estimate. The Adjusted R square value of 0.326 accounts for the variations noted in coverage of digital TV services in Uganda by 32.6% (at 100% test level). The remaining variations (67.4%) in coverage of digital TV services in Uganda are accounted for by other factors.

Table 6: Analysis of Variance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	38.167	1	38.167	149.201	.000[a]
	Residual	78.022	305	.256		
	Total	116.189	306			

a. Predictors: (Constant), Cost Digital Infrastructure

b. Dependent Variable: Coverage Digital Services

Results in table 6 show that all factors considered for cost of digital infrastructure are collectively explanatory variables of coverage of digital TV services in Uganda (F = 149.201, Sig. = 0.00). The contribution of 33% of cost of digital infrastructure to variations in coverage of digital TV services is also supported by the regression value 38.167 and residual value of 78.022, meaning that there are other factors that are strongly related to coverage of digital TV services. Further, Table 6 contains the sum of squares, degrees of freedom, mean square, the f statistic and its level of significance. The sum of squares in statistics gauges the nonconformity of data points as one travels away from the mean value. A total of sum of squares stands at 116.189 indicates that the data does not vary greatly from the mean value. A moderate residual sum of squares of 78.022 (given that regression sum of squares stands at a small 38.167) suggests the model fits the data moderately. Degrees of freedom (df) which are values that have the freedom to vary in the data sample stand at (1,305) suggest a significant result. The Regression Mean Squared value that measures how close a fitted line is to data points stands at 38.167 is moderate in size.

The p-value associated with this F value is very small (0.0000) which is typically (P<.05) which signifies that the R Square value is significantly different from zero. The null hypothesis was rejected to the effect that cost of digital infrastructure is significantly related to coverage of digital TV services in Uganda.

Discussion of findings

This segment delivers a detailed discussion showing a connection between the findings and the literature that was reviewed, the Digital Migration Policy for Television Broadcasting in Uganda as well as the Information Society Theory which underpinned the study.

In this study, the cost of infrastructure was analyzed along the following domains: initial purchase cost, availability of digital equipment and indirect costs. Study results largely agree that digital infrastructure acts as the backbone of digital services. The study findings are supported by a number of publications. Cases in point include Wangalwa (2015), who argues that without proper budgeting and planning revolving around concept of cost of digital infrastructure is crucial to the rate of digital migration; Adda & Ottaviani (2015) weighed in with several suggestions on how best to mitigate and lower costs of setting up infrastructure. Tsebee (2014) while studying challenges and prospects involved in digital broadcast migration in Nigeria suggested that quick identification of cost centres that may keep shifting may quicken the migration process. The cost of digital infrastructure is covered under Broadcasting Infrastructure and Technology legislation covered under digital migration policy for television broadcasting in Uganda. The study finding can be logically illustrated by key tenets of the Information Society Theory that include simplistic technological determinism that is incumbent upon mitigation of operating costs that include digital infrastructure operating costs.

The study established that Government did not fully pay for equipment to enable connectivity, storage, processing, terminals, devices, services and applications in all regions of the country. This is largely contrary to published literature. For instance study findings by Boateng et al (2017) argue for the invariably crucial played by governments in Africa to operationalize digital migration by fully funding the exercise because other players in the broadcasting fraternity did not possess the financial muscle to do so. Xing, Hanhui & Chong (2009) reveal the inimitable role played by the Chinese government in the transition to digital TV by shouldering most of the costs and absorbing big losses in the process. Dahlman, Mealy, & Wermelinger (2016) whose study revolved around harnessing the digital economy for developing countries argue strongly for government involvement and support in the digital migration process. Under the Digital Migration Policy for Television Broadcasting in Uganda, government is duty bound to ensure smooth Digital Migration so that it can act as a catalyst for The National Development Agenda. This finding partly contravenes the Information Society Theory that binds government authorities to help explain the role of information and information technology in society.

The study established that the new digital signals received television sets at home was due to infrastructure in place. This finding is in line with Siwei (2013) whose study established

that digital TV signals received in rural china and neighboring countries was down to the excellent infrastructure laid down by the Authorities. Friederici, Wahome & Graham (2018) assert that the excellent digital signals received in many parts of Southern Africa are in this position because of the cutting edge technology infrastructure that has been functional for a number of years. Ngcaba (2012) while discussing the building of a digital life for all South Africans by building an ICT Ecosystem lauded the excellent TV signal received by all TV owners in South Africa. Under the Digital Migration Policy for Television Broadcasting in Uganda, government is responsible for the rollout of digital television infrastructure and set top boxes countrywide. This finding is backed by the Information Society Theory inspired remarkable technological innovations like digital migration and its multitude of benefits contained therein.

The findings of the study support the notion that Government has always considered viable alternatives to costly infrastructure. This conclusion is similar to that arrived at by Levy, Ford-Livene & Levine (2013) who argue that broadcast television Surviving in a sea of competition consideration of alternatives is important if firms are to continue operating. Kapteina (2017) who when discussing how organizations manage innovation underscores the importance of having several choices and options especially when it comes to costs of equipment that have a tendency to escalate. Bhat (2012) decried escalating costs in running Television stations in India and advised that during the migration process, the logical starting point for digital switchover was overhead reduction strategies. Under the Digital Migration Policy for Television Broadcasting in Uganda, the Authorities offer guidance on how to receive government assistance in a bid to provide workable alternative options to those already on offer. This finding is backed by the Information Society Theory that espouses the notion that information science like culture is dynamic and always evolving. This gives a leeway to consider alternatives in case the available options are prohibitively costly.

Study findings fairly disagreed indicated by a mean score of 2.98 that Government installed special cables that conduct signals from studio to tower and complementary equipment like backup generators. This finding is not completely in line with Tilson et al (2015) who while studying digital infrastructures considered the logistics involved in successful broadcasting; including institutional support in form of subsidies covering equipment required to run the stations. Goodwin (2015) conducted a study that considered digital terrestrial television growth and development in Europe in general and the United Kingdom in particular; he attributed the remarkable progress achieved to government support in installing the requisite equipment. Under the Digital Migration Policy for Television Broadcasting in Uganda, the government was charged with Establishment of the Digital Migration Task Force which among other things was expected to help install masts, cabling and miscellaneous broadcast equipment. During the

development of the information society theory, Webster (2015) pointed out the need of government support the world over in actualizing the spread of information and in this case would support the for Government installed special cables that conduct signals from studio to tower and complementary equipment.

Study findings established that Television owners did not pay for training on how to operate their digital television evidenced by a mean of 2.07. This conclusion is dissimilar to that arrived at by Adda & Ottaviani (2015) whose study revolved around the transition to digital television and suggest that orientation of users of the new technologies was central to the successful transition to the digital technologies. Galperin (2014) while presenting findings on the transition to digital TV in the United States and Britain argues that raising competence in utility of digital technologies would go a long way in ensuring faster uptake of the said technologies. Kumabe (2012) while discussing findings of adoption of digital television and specifically DTT switchover argued that this initiative could only gain currency through trainings of how TV owners could best utilise the said technologies if digital migration was to be accomplished in most areas of Japan. Under the Digital Migration Policy for Television Broadcasting in Uganda, the government was charged with consumer awareness which involves orientations and trainings of how to best utilise the new technologies. Linkage or lack thereof between this finding and the Information Society Theory is perhaps best illustrated by the theory that explains transmission of information between data points. This can be best illuminated by the importance presented by training on how to operate digital television sets.

Study findings indicated by a mean of 2.84 further revealed that Government of Uganda did not retool and retrain staff to enable the smooth transition to the new technologies. This position is contrary to many scholars on this subject. Montero et.al (2013) as part of their study findings pointed out the value of preparedness as being central to the success of transition from analogue to digital technologies. They underline the importance of retraining and reorientation of the technical staff. Noam (2016) attributed the slow dissemination of digital technologies in areas like Montana and Colorado to the slow shift of focus by broadcasters from analogue to digital as they left this to pay TV and cable providers which was responsible for the slowing down of the transition process. Quinones, Heeks & Nicholson (2017) in their study findings blame slow adoption of digital technologies in South America on lack of investment in this area by respective Latin American governments. Under the Digital Migration Policy for Television Broadcasting in Uganda, the government was charged with rollout of digital television infrastructure as well as roles of different stakeholders that includes but is not limited to retooling of broadcasting technical staff. Linkage between this finding and the Information Society Theory is the emphasis to create a conduit for the spread of communication which can be best enabled

by retooling and retention of staff by broadcasters. The importance of this initiative cannot be overemphasized or roundly discounted as it directly leads to the success r limiting of success of the entire enterprise.

Study findings supported by a mean score of 3.03 ably established that the Government of Uganda resorted to the relatively less costly set- top- boxes which act as an adapter from an analogue TV to receive digital broadcasts. This conclusion is not diametrically and wholly opposed to study findings by Sussan & Acs (2017) who while discussing the digital entrepreneurial ecosystem point out the value of immediately adopting the most easily accessible digital technologies and for developing countries like Uganda it involved importing relatively affordable STBs which the government could afford at the time. Gong (2016) emphasised the usefulness of cost effective technologies that can act as the backbone to internet technologies and other digital platforms. In Uganda's case, the government had to make do with what was within the resource envelope at the time. Under the Digital Migration Policy for Television Broadcasting in Uganda, the government was charged with a stringent Implementation time frame which gave them little room to maneuver ad as a result resorted to the relatively less costly set- top- boxes which act as an adapter from an analogue TV to receive digital broadcasts. Linkage between this finding and the Information Society Theory is the need to smoothen the transmission of data which communication between data points is so dependent on which the theory is at pains to rationalize.

Study findings demonstrated that television owners faced challenges of cost of set- top- boxes (STB) for quality STBs. This finding was largely in sync with a number of publications. For instance Friederici, Wahome & Graham (2018) while presenting study findings of digital entrepreneurship in Africa identified cost of set- top- boxes in many parts of Africa in the absence of subsidized gadgets was proving an obstacle of note that stood in the way of digital content producers and marketers as the market was not growing at the expected rate and demand for digital content had stagnated in recent times Hsu et al. (2013) while studying expansion of digital broadcasting cited cost of STBs and other decoders on the market as a bottleneck constraining the growth of digital market and many investors in development of digital content were failing to breakeven which was a problem given that a number of them depend on banking financing to be operational. Under the Digital Migration Policy for Television Broadcasting in Uganda, the government was charged with planning the roll out of digital technologies that contains a financing component. Linkage between this finding and the Information Society Theory is the theory's basis founded on diffusion of information which can feasibly take place given the existence of a vehicle to enable the movement of information which affordable set- top- boxes (STB) would go a long way to enable.

The study findings with a mean of 2.82 illustrated the fact that broadcasters have few masts and limited land to erect these masts. This finding is not supported by a number of scholars who propose enabling technologies to help boost digital migration like broadcast masts. Tsebee (2014) while disclosing findings challenges and prospects for developing digital technologies in Nigeria pointed out the limitations to expanding existing broadcast and that included investing in land purchase that is currently prohibitively expensive. Afolabi et al. (2018) while discussing study findings concerning evolution of wireless networks technologies, their history and emerging technology of 5G wireless network zeroed in on the constraints in many parts of the developing world which included limited ability to construct the kind of masts needed to host newer technologies like 5G wireless network. Under the Digital Migration Policy for Television Broadcasting in Uganda, the government was charged with providing the backbone to enable smooth ASO which included provision of extra masts as an enabling factor; unfortunately the country is behind schedule due to limited number of compliant masts and part of the reason is limited availability of land for expansion. Linkage between this finding and the Information Society Theory is the theory's basis for movement of information between nodes and platforms which erection of masts would enable.

The study was able to establish the fact that most of the broadcaster's equipment and facilities are obsolete and need to be replaced; indicated by a mean of 3.13. This finding is partly supported by a number of scholars whose publications suggested otherwise. Armstrong & Collins (2011) while discussing digital turmoil for South African TV blamed many of the failings witnessed on failure to replace in a timely manner the broadcasting equipment that could not feasibly host digital technologies and this has effectively slowed down digital migration and coverage of digital television in the republic of South Africa. Ndemo & Weiss (2017) while discussing constraints to digital migration in Kenya pointed out legal constraints as the main obstacle, closely followed by slow installation of masts especially in remote parts of the country as a key impediment to better coverage of the digital television signal all over the country. Under the Digital Migration Policy for Television Broadcasting in Uganda, the government was charged with ensuring an enabling environment and that refers to replacement of obsolete equipment. Linkage between this finding and the Information Society Theory is the theory's foundation which is embedded in dissemination of information as a vehicle of progress which can only feasibly happen with the right equipment.

The study findings established that the cost of providing the signal infrastructure is over and above what the state broadcaster can invest (mean of 3.18). This finding is not completely new as it was identified by a number of authors as a key impediment to digital migration. Siwei (2013) noted that broadcasting and television digitization strategy in China was wholly founded

on funding from the state as the cost is beyond what most private broadcasters can afford; the Chinese government absorbed most of the outstanding costs involved. Richer et al (2019) noted that costs involved in providing signal infrastructure is beyond many members of the European Union and would need help from more economically robust members of the EU like Germany. Under the Digital Migration Policy for Television Broadcasting in Uganda, the government was expected to complement efforts and resources by private broadcasters by building extra signal infrastructure which it has not fully done leading to the digital deficits experienced in the country. Linkage between this finding and the Information Society Theory is the theory's actualization being incumbent upon enablers like robust signal infrastructure to facilitate movement of information.

CONCLUSIONS AND RECOMMENDATIONS

The study focused on assessing the influence of cost of digital infrastructure on coverage of digital TV services in Uganda. The study concludes that cost of digital infrastructure aspects are influential factors of coverage of digital TV services in Uganda. Digital TV received is due to excellent infrastructure laid down by government. Budgeting and planning cost of infrastructure is crucial and government should mitigate and lower costs of setting up infrastructure as well as quick identification of cost centres to help in speeding up the migration process. Government must play a big role in the transition of digital TV by shouldering most of the costs and absorbing big losses in the process. Government is responsible for the roll-out of digital television infrastructure and set up top boxes country wide and have several choices and options especially when it comes to costs of equipment that have a tendency of escalate. Raising competence in utility of digital technologies would go a long way in ensuring faster uptake of the said technologies.

Although this study increases our understanding of factors that explain coverage of digital TV services in Uganda it has some limitations and therefore findings should be used with caution. These limitations among others include the following;

There were few variables included in the model. Both cost of digital infrastructure and coverage of digital TV services could have been measured by many other variables in addition to the ones we used. The study was also essentially cross-sectional that examined the influence of cost of digital infrastructure on coverage of digital TV services at a point in time. This may not give a complete picture of the phenomenon studied and limits some of the conclusions made. Further, majority of the questionnaire items were closed-ended, hence the likelihood that some pertinent views and experiences might have been left out although interviews and scrutiny of documents were made.

In view of the above limitations, the study opens up areas for further research. One, more variables should be added in the model based on literature and be tested empirically to increase our understanding of coverage of digital TV services in Uganda. Secondly, future studies should explore appropriate econometric methods that improve the understanding of cost of digital infrastructure and coverage of digital TV services in Uganda.

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