EVALUATION OF FACTORS DRIVING BROADBAND DEMAND GAP AMONG SMALL AND MEDIUM ENTERPRISES IN SOUTHEAST NIGRIA

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CERTIFICATION

This is to certify that this work EVALUATION OF FACTORS DRIVING BROADBAND DEMAND GAP AMONG SMALL AND MEDIUM ENTERPRISES IN SOUTH EAST NIGERIA was carried out by AJUNWA INNOCENT HARVEY (20124761588) in partial fulfilment for the award of the degree of (M.Sc.) in Information Management Technology, in the department of information Management Technology of the Federal University of Technology Owerri.

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DEDICATION

To God be the glory for His immeasurable and exceeding abundant grace, giftedness and glory throughout the period of my research work.

I dedicate this work to my lovely wife, family members whose contribution and support words can't quantified, to Mr & Mrs Akwuegbu and my project supervisor Prof. B.C. Asiegbu for their love, support and care.

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ABSTRACT

High-speed, affordable broadband connectivity to the Internet is a foundation stone of modern society, offering widely recognized economic and social benefits. High-speed broadband is no longer just cutting-edge technology for an elite few; instead, the steady march of connectivity among the broader population is slowly but surely transforming our society with new ways of accessing services and information. Broadband does not just comprise infrastructure; today, widespread broadband connectivity offers the prospects of new services and an information revolution to change – and challenge – our very approach to development. This work, seeks to raise awareness and enhance understanding of the importance of broadband networks, services, applications and to evaluate factors that drive its demand gap at enterprise level in the South East Nigeria. The primary source of data used in this research work was questionnaire, while the secondary source of data includes data from; Nigeria Communication Commission (NCC), as well as data from researchers in related topical issues. The main quantitative approach used was factor and regression analysis and for the ease of handling the volume of data, the use of statistical package for social sciences [SPSS] software was used. It was discovered that ten factors drive the demand gap among SMEs: Economic Barrier(X_{1}), Limited technology Training(X_{2}), Slow Assimilation of broadband(X_{3}), Uneven distribution of Telecommunication Network Deployment(X_{4}), Low Knowledge of Market Opportunity(X_5), Customer Forces (X_6), Lack of Content Relevance or Interest(X_7), Epileptic Power Supply(X_8), Vision and Prospect of Broadband(X_9), Inefficient Access to Broadband(X_{10}). A predictive model was derived as: $\gamma = 19.165 + 2.912X_1 + 0.271X_2 + 0.216X_3 + 0.148X^4 + 0.243X_5$ -0.075X_6 + 0.003$X_7 + 0.076X_8 + 0.084X_9 - 0.008X_{10}$

Keywords: Broadband demand gap, Broadband diffusion; fixed broadband; mobile broadband.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF STUDY

The Internet developed from the ARPANET, which was funded by the US government to support projects within the government and at universities and research laboratories in the US – but grew over time to include most of the world's large universities and the research arms of many technology companies (Ben Segal, 1995). Use by a wider audience only came in 1995 when

restrictions on the use of the Internet to carry commercial traffic were lifted

(Harris and Elise, 1996)

In the early to mid-1980s, most Internet access was from personal computers and workstations directly connected to local area networks or from dial-up connections using modems and analog telephone lines. Local Area Networks (LANs) typically operated at 10 Mbit/s and grew to support 100 and

1000 Mbit/s, while modem data-rates grew from 1200 and 2400 bit/s in the 1980s, to 28 and 56 kbit/s by the mid to late 1990s. Initially dial-up connections were made from terminals or computers running terminal emulation software to terminal servers on Local Area Networks (LANs). These dial-up connections did not support end-to-end use of the Internet protocols and only provided terminal to host connections. The introduction of network access servers (NASs) supporting the Serial Line Internet Protocol (SLIP) and later the pointto-point protocol (PPP) extended the Internet protocols and made the full range of Internet services available to dial-up users, subject only to limitations imposed by the lower data rates available using dial-up (Harris and Elise, 1996).

Broadband is a high transmission technique using a wide range of frequencies, which enables a large number of messages to be communicated simultaneously.

Broadband Internet access, often shortened to just broadband and also known as high-speed Internet access are services that provide bit-rates considerably higher than that available using a 56 kbit/s modem. The Nigeria Communications Commission (NCC) defined broadband access as "Internet access that is always on and faster than the traditional dial-up access", (NCC, 2014).

Chinecherem et al., (2015) With growing mobile broadband internet in Nigeria, supported by the increased use of smartphones and other mobile devices to access mobile broadband, there is need for increase internet penetration by the process through fixed broadband access. Statistical report by the International Telecommunication Union in May 2014 indicates that penetration rate is low as and it stood at 6%. The Nigerian Communication Commission acknowledged the low penetration and announced in August 2014, the modalities to increase the penetration level from 6% to 30% by 2018.

The term "Broadband" is used to describe a high-speed communication network that connected end-users at a data transfer speed greater than 256kbit/s (kilobit per second) (Nigeria National Broadband Plan NNBP, 2013). Therefore, broadband within the Nigerian context refer to an experience where the end user can access the most demanding content in real time minimum speed of 1.5Mbit/s which are DSL and cable Modem amongst others (NNBP, 2013). Most broadband services provide a continuous "always on" connection; there is no dial-in process required, and it does not "hog" phone lines (Chris, 2008).

Broadband provides improved access to Internet services such as:

Faster World Wide Web browsing

Faster downloading of documents, photographs, videos, and other large files

Telephony, radio, television, and videoconferencing

Virtual private networks and remote system administration

Online gaming, especially massively multiplayer online role-playing games which are interaction-intensive (Chris, 2008).

In 2000, most Internet access to homes was provided using dial-up, while many businesses and schools were using broadband connections. In 2000, there were just fewer than 150 million dial-up subscriptions in the 34 Organization for Economic Co-Operation and Development (OECD) countries and fewer than 20 million broadband subscriptions. By 2004, broadband had grown and dial-up had declined so that the numbers of subscriptions were roughly equal at

130 million each. In 2010, in the Organization for Economic Co-Operation and Development (OECD) countries which is made up of 34 countries, over 90% of the Internet access subscriptions used broadband, broadband had grown to more than 300 million subscriptions, and dial-up subscriptions had declined to fewer than 30 million (OECD, 2011).

The broadband technologies in widest use are asymmetric digital subscriber line (ADSL) and cable Internet access. Newer technologies include very high bit rate digital subscriber line (VDSL) and optical fibre extended closer to the subscriber in both telephone and cable plants. Fibre-optic communication, while only recently being used in premises and to the curb schemes, has played a crucial role in enabling broadband Internet access by making transmission of information at very high data rates over longer distances much more cost-effective than copper wire technology (FCC, 2011).

In Europe, broadband is predominantly provided to households through copper and coaxial networks, wireless access networks such as 3G mobile communications and fixed wireless access. At the end of 2012, nearly all households in the European Union were able to access broadband connections through these technologies. More than 99% of households could access standard broadband services through fixed or mobile services and 54% of EU households were already covered by NGA services (OECD, 2011).

Information from the member states show that digital subscriber line (DSL) is by far the most important fixed line broadband technology in Europe today with 93% coverage of households, followed by standard cable with 42% household coverage. For wireless technologies, satellite ranks first with 98.6% coverage in total, followed by high speed packet access (HSPA) with 96.3% and the fast growing long term evolution (LTE) technology with a coverage rate of 27% of the respective total at the end of 2012 (Todd and Deborah, 2012).

The challenge remains to deliver EU-wide ultra-high-speed internet access (NGA) until 2020. Whilst results show positive records of an overall NGA coverage increase, there is still a long way to go, particularly in rural and peripheral areas of the European Union (OECD, 2011).

Information and Communication Technology (ICT) is an umbrella that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as videoconferencing and distance learning (Margaret, 2014). ICT promote social, economic and political accountability and improve the delivery of basic services, enhancing developmental opportunities in all spheres of life and indirectly adding to the Gross domestic product of the nation.

According to Chinecherem et al., (2015), "the world has identified the importance of ICT in driving the information society but there are gaps to be bridged, Nigeria irrespective of their African ranking have an urgent need of broadband Internet penetration in most areas. Most researchers have found out the gap in various areas of life endeavour as regards the use of ICT. The focus of this paper is to identify those limiting factors to broadband internet penetration in Nigeria at enterprise level.

Demand gap is defined as the difference between either households or individuals that could have access to broadband but do not acquire the service. This is not a statistic that is being tracked by either regulators or made public by operators. In recent years, however, policy makers, driven by the need to develop national broadband strategies and plans, have in some instances been able to estimate this metric (Kotelnikov, 2007). This present work is to develop a model that can be used to predict the effect of identified factors on the demand gap among SMEs in the South East of Nigeria.

According to Ndukwe (2008), academic literature you can download in one week say in the US, Canada or Europe will take you close to six months to download same in

Nigeria if you have regular power supply and link to the Internet. It may also be very costly. 10G per month by Glo Network costs N3500. The secret for the developed West is that there is high bandwidth deployment because they have been able to develop ICT infrastructure such as strong terrestrial telephone network, fibre optics backbone and communications satellites. You hardly will see RF and microwave antennas litter the ionosphere and landscape. This infrastructural base has given the developed west solid foundation for IT diffusion. This has also brought down the cost of bandwidth, and improved the speed and quality of service by operators. Most cities are linked by fibre optics rings and these countries rely less on wireless technology. The truth is that we are trying really to leapfrog even with bad legs – no electricity, no strong telephone infrastructure, no fibre optics ring, and no strong satellite capability! In the few short years of existence, the Internet has shown that despite security concerns and slow access, it can deliver on the long sought after goal of electronic commerce and global integration. For its ease of use, low cost and extensive world coverage, it has attained stunning and rapid success which no other system has come close to delivering these fundamentals in our time. The Internet has portrayed itself as a tool for educational development, a tool for technological emancipation. It has introduced many services which have galvanized our world into one virtual electronic village. One of the excellent services provided by the Internet is the email and associated services. Today the value of e-commerce trade is in the range of 240 billion US Dollars. The internet is hitherto the world's biggest market place and any nation that fails to capitalize on this economic enabler stands to be poor and doomed for life (Ndukwe, 2008). This explains why this thesis is significant.

What are the governments and the private sector doing to expand internet diffusion (density) and national bandwidth for delivery of Quality of Service?

Nigeria Communication Commission (NCC) and Radio Frequency Allocation in Nigeria, internet diffusion in and current situation telecommunication facilities in Nigeria were first established in 1886 by the colonial administration. At independence in 1960, with a population of roughly 40 million people, the country only had about 18,724 phone lines for use. This translated to a teledensity of about 0.5 telephone lines per 1,000 people. The telephone network consisted of 121 exchanges of which 116 were of the manual (magneto) type and only 5 were automatic (Ndukwe, 2008).

Bandwidth refers to the rate of data transfer that is, the capacity of the Internet connection that you use. The greater the capacity, the more speed of uploading and downloading of data. Low bandwidth slows down data transfer which can occur as a result of network overload (Ndukwe, 2008).

According to (NCC, 2014), Nigeria does not have a national network backbone. The South Atlantic 3/West Africa Submarine Cable (SAT-3/WASC) submarine cable project with a landing point in Bonny has been completed to develop an international fiber link to Lagos, but the lack of national network backbone infrastructure implies that more than 90 per cent of the country is currently left out. However in 2002, Nigeria added 1.3 million new mobile customers and reported the highest annual growth rate – 369 percent – in the world. During this period of telecom deregulation, Nigeria licensed another national carrier – Globacom – to compete with the incumbent national fixed line operator, Nitel, which is now moribund. Today other telecom companies like Glo, Mtn, Etisalat, Visaphone, Airtel provide telecom services which have provided a total active

Mobile line of: (GSM) 153,086,710, Mobile (CDMA) 224,447, Fixed 151,754, VoIP 31,166, Total 153,514,107. Providing a teledensity of 109.65% as at October 2016. The National Communications Commission (NCC) which is the Regulatory authority for licensing Telecom firms issued 25 Fixed Wireless Access to operators. Because of the near absence of telephone infrastructure, Internet distribution is highly skewed towards the major cities such as Owerri, Lagos, Port Harcourt, Ile-Ife, Abuja, Kano, Enugu, Owerri, Oshogbo and Kaduna (NCC, 2014).

In Nigeria, wireless technology is the dominant access medium for delivering broadband to most end users compared to cable based infrastructure. This is so because unlike the more advanced countries, Nigeria did not have extensive copper cable infrastructure and therefore did not benefit from broadband over ADSL. It is also true that the optic fibre infrastructure has not been extensive enough to deliver ubiquitous broadband to homes and office premises. For the foreseeable future, wireless technology will continue to play a dominant role in broadband infrastructure for Nigeria, particularly the last mile. It has been identified that Nigeria has the opportunity to leapfrog in terms of broadband experiences that can be supported by mobile broadband technology and an adequate definition of broadband has been crafted to reflect this (NCC, 2014).

The essence of this study is to evaluate the factors affecting the demand gap of broadband among SMEs within South East of Nigeria.

1.2 Statement of Problem

According to International Telecommunication Union statistics (ITU, 2010), the number of people using the internet has considerably increased, from less than 500,000 in 2000 to more than 2billion in 2010. At present in the world more than 30 people in every 100 persons are internet users. Despite this worldwide wave of internet diffusion adoption of broadband connections although increasing, is still far from being a reality for all internet users. At the same time, cross-country disparities in the use of broadband connection are particularly strong, and they also seem to be increasing. More than 23 persons per 100 inhabitants are fixed broadband users in developed countries (5.5 in all Asian countries, 1.9 in all Arab countries and 0.2 in all African countries). Considering mobile broadband connections provides a similar picture, with more than 45% of the population using mobile broadband in developed countries and only around 5% in developing countries.

In Nigeria, broadband access is gradually gaining acceptance but its wide adoption and utilization remain unevenly distributed, lagging considerably among low income groups, the elderly and people living in the rural communities (NNBP, 2013). This work is geared towards identifying and evaluating the factors causing broadband demand gap

1.3 Aim and Objectives

The aim of this study is to evaluate the factors affecting broadband demand gap among enterprises in South East Nigeria. The specific objectives include:

i. To identify factors affecting broadband adoption among small and medium scale enterprises (SME) ii. To evaluate the effect of each factors on broadband demand gap among SME

iii. To evaluate the factors collectively on broadband demand gap among

SME iv. To make policy recommendation based on finding of the study

1.4 Research Questions

On the basis of the specific objectives, the researcher poses the following questions to guide the study:

i. What are the factors affecting broadband demand gap at enterprise level ii. To what extent does each factors affect broadband demand gap at enterprise level iii. To what extent do the factors collective affect broadband demand gap at enterprise level

1.5 Research Hypothesis

H_{01}: The Overall factors have no significant effect on broadband demand gap at enterprise level

H_{a1}: The overall factors have significant effect on broadband demand gap at enterprise level

H_{02}: Each factor has no significant effect on broadband demand gap at enterprise level

H_{a2}: There is significant effect of each factor on broadband demand gap at enterprise level

1.6 Scope and Limitation of the Study

This study will investigate factors creating broadband demand gap at enterprise level in the South East of Nigeria. The findings from the investigation will add knowledge to the existing literatures on the level of broadband technology penetration in the South East of Nigeria. This study focus on factors creating broadband demand gap at enterprise level. However, the following limitations were encountered during the course of this research:

1. Attitude of Respondents: Collecting data through questionnaires or interviews can be very discouraging as a result of the attitude of some respondents. Some of these respondents were unwilling to share certain helpful information with the researcher while others were too busy to respond. Some other respondents most often misplace the questionnaires given to them.

2. Finance: The cost (especially for transportation and phone calls, as well as printing large volume of questionnaires) involved in the proper execution of this research was a major challenge.

3. Time: This was a major limiting factor. There was limited time to properly carry out an extensive research on a much larger scale.

Irrespective of these limitations, the researcher ensured that the findings of this research represent factors creating broadband demand gap at enterprise level in the South East of Nigeria.

1.7 Significance of the Study

This study will explore those factors creating broadband demand gap at enterprise level in the South Eastern Nigeria. The findings of this study will contribute to existing literatures on the subject matter by critically examining which individual and/or collective factor(s) plays an important role in creating broadband demand gap at enterprise level.

It is also pertinent to note that certain sectors of the Nigerian Economy will benefit immensely from the findings of this study.

1. Enriched Education – In addition to providing a stronger link to their own teachers and school resources, high speed broadband brings with it the ability to

video-link students to anywhere in the world. Video-conferencing breaks down the walls of the traditional educational system and takes students inside operating rooms, to engineering labs, or across the globe to speak with their peers in another country. These experiences will strengthen a region's workforce of tomorrow.

2. World-Class Healthcare – A robust broadband network helps medical professionals collaborate with the world's top medical doctors, in real time. Only through high speeds can medical images be shared in real time to enable telemedicine to work "side-by-side" with global specialists and deliver citizens the best care available.

3. Improved Public Services and Safety – The power of high speed broadband can help make streets safer and government services more efficient. Deploying Internet services in police cruisers, fire and safety vehicles provide professionals with the resources they need to better serve and protect citizens.

4. Internet of Things – You may have heard of this increasing trend as homes and appliances become "smart." Beyond smart-phones, tablets, watches, and computers, every day more and more connectivity is being developed into smart home electronics, applications and appliances.

5. Telework – Digital connectivity empowers rural professionals to telework, providing the opportunity to work for urban organizations anywhere in the world from a rural residence. Additionally, individual, small and home-based businesses can be established and grown with high-speed Internet connectivity.

1.8 Structure of the Work

This research work shall be divided into five chapters.

CHAPTER ONE: This chapter shall provide a background, problems, objectives and general description of the subject area.

CHAPTER TWO: This chapter shall present related literature concerning broadband technology, factors creating broadband demand gap at enterprise level, theories and model relevant to broadband demand gap

CHAPTER THREE: Research methodology and design including procedures

for processing collected data shall be outlined in this chapter.

CHAPTER FOUR: Presentation and analysis of data according to research questions and tests of hypothesis shall be presented and discussed in this chapter.

CHAPTER FIVE: Conclusions drawn from the findings including how the study has answered the research question and tested the hypothesis shall be outlined in this chapter.

CHAPTER TWO

Literature Review

2.1 Historical Development of Broadband in Telecommunication

The history of the Internet begins with the development of electronic computers in the 1950s. Initial concepts of packet networking originated in several computer science laboratories in the United States, Great Britain, and France. The US Department of Defense awarded contracts as early as the 1960s for packet network systems, including the development of the Advanced Research Projects Agency Network (ARPANET) (which would become the

first network to use the Internet Protocol.) The first message was sent over the ARPANET from computer science Professor Leonard Kleinrock's laboratory at University of California, Los Angeles (UCLA) to the second network node at Stanford Research Institute (SRI) (David, 1997).

Packet switching networks such as ARPANET, NPL network, CYCLADES, Merit Network, Tymnet, and Telenet, were developed in the late

1960s and early 1970s using a variety of communications protocols. Donald Davies was the first to put theory into practice by designing a packet-switched network at the National Physics Laboratory in the UK, the first of its kind in the world and the cornerstone for UK research for almost two decades (David, 1997). Following, ARPANET further led to the development of protocols for internetworking, in which multiple separate networks could be joined into a network of networks.

Telecommunication occurs when the exchange of information between two entities (communication) includes the use of technology. Communication technology uses channels to transmit information (as electrical signals), either over a physical medium (such as signal cables), or in the form of electromagnetic waves. (Vocabulary.com, 2013) the word is often used in its plural form, telecommunications, because it involves many different technologies.

Early means of communicating over a distance included visual signals, such as beacons, smoke signals, semaphore telegraphs, signal flags, and optical heliographs (Websters definition). Other examples of pre-modern long-distance communication included audio messages such as coded drumbeats, lung-blown horns, and loud whistles. Modern technologies for long-distance communication usually involve electrical and electromagnetic technologies, such as telegraph, telephone, and teleprinter, networks, radio, microwave transmission, fiber optics, and communications satellites.

Broadband Internet access, often shortened to \broadband Internet" or just \broad band", is a high data-transmission rate Internet connection. Broadband is often called high-speed Internet, because it usually has a high rate of data transmission. Yet there is no standard definition of the threshold speed for broadband. The U.S. Federal Communications Commission (FCC), established one of the first thresholds for reporting on the deployment of advanced telecommunications. FCC defines broadband as Internet connection at 200 kbit/s (0:2 Mbit/s) in one direction, whereas advanced broadband is at least 200 kbit/s in both directions. ITU Standardization Sector (ITU-T) instead considers broadband as a transmission capacity that is faster than primary rate ISDN, at 1:5 to 2 Mbit/s (ITU, 2014).

The OECD identifies broadband as data transmission at 256kbit/s in at least one direction. To make figures more comparable around the world, the OECD bit rate is generally taken as the common baseline and any connection to the customer at 256kbit/s (0:250 Mbit/s) or more is referred to as broadband Internet (OECD, 2011).

Different criteria for "broad" have been applied in different contexts and at different times. Its origin is in physics, acoustics, and radio systems engineering, where it had been used with a meaning similar to "wideband" (Attenborough, 1988).

Later, with the advent of digital telecommunications, the term was mainly used for transmission over multiple channels. Whereas a passband signal is also modulated so that it occupies higher frequencies (compared to a baseband signal which is bound to the lowest end of the spectrum), it is still occupying a single channel. The key difference is that what is typically considered a broadband signal in this sense is a signal that occupies multiple (non-masking, orthogonal) passbands, thus allowing for much higher throughput over a single medium but with additional complexity in the transmitter/receiver circuitry. The term became popularized through the 1990s as a marketing term for Internet access that was faster than dialup access, the original Internet access technology, which was limited to 56 kbit/s (ITU, 2010).

Analog telephone lines are digitally switched and transported inside a

Digital Signal 0 once reaching the telephone company's equipment. Digital Signal 0 is 64 kbit/s; therefore a 56 kbit/s connection is the highest that will ever be possible with analog phone lines (ITU, 2014).

Dial-up access is a transient connection, because either the user, ISP or phone company terminates the connection. Internet service providers will often set a limit on connection durations to allow sharing of resources, and will disconnect the user—requiring reconnection and the costs and delays associated with it.

Dial-up connections usually have latency as high as 150ms or even more; this is longer than for many forms of broadband, such as cable or DSL, but typically less than satellite connections. Longer latency can make video conferencing and online gaming difficult, if not impossible. An increasing amount of Internet content such as streaming media will not work at dial-up speeds (LaVallee and Andrew, 2009).

Modern dial-up modems typically have a maximum theoretical transfer speed of 56 kbit/s (using the V.90 or V.92 protocol), although in most cases 40– 50 kbit/s is the norm. Factors such as phone line noise as well as the quality of the modem itself play a large part in determining connection speeds. Some connections may be as low as 20 kbit/s in extremely "noisy" environments, such as in a hotel room where the phone line is shared with many extensions, or in a rural area, many miles from the phone exchange. Other things such as long loops, loading coils, pair gain, electric fences (usually in rural locations), and digital loop carriers can also slow connections to 20 kbit/s or lower (ITU, 2014).

Digital subscriber line (DSL; originally digital subscriber loop) is a family of technologies that are used to transmit digital data over telephone lines. In telecommunications marketing, the term DSL is widely understood to mean asymmetric digital subscriber line (ADSL), the most commonly installed DSL technology, for Internet access. DSL service can be delivered simultaneously with wired telephone service on the same telephone line. This is possible because DSL uses higher frequency bands for data. On the customer premises, a DSL filter on each non-DSL outlet blocks any high-frequency interference to enable simultaneous use of the voice and DSL services (Martin, 1987).

The bit rate of consumer DSL services typically ranges from 256 kbit/s to over 100 Mbit/s in the direction to the customer (downstream), depending on DSL technology, line conditions, and service-level implementation. Bit rates of 1 Gbit/s have been reached in trials (Schradie, 2011).But most homes are likely to be limited to 500-800 Mbit/s. In ADSL, the data throughput in the upstream direction (the direction to the service provider) is lower, hence the designation of asymmetric service. In symmetric digital subscriber line (SDSL) services, the downstream and upstream data rates are equal. Researchers at Bell Labs have reached speeds of 10 Gbit/s, while delivering 1 Gbit/s symmetrical broadband access services using traditional copper telephone lines (Owano and Brian, 2014).

Broadband Internet access (cable, DSL, satellite and FTTx) has been replacing dial-up access in many parts of the world for the following reasons which (Todd and Deborah, 2012) stated below;

I. Broadband connections typically offer speeds of 700 kbit/s or higher for two-thirds more than the price of dial-up on average.

II. Broadband connections are "always on", thus avoiding the need to connect and disconnect at the start and end of each session.

III. Broadband does not require exclusive use of a phone line and so one can access the Internet and at the same time make and receive voice phone calls without having a second phone line.

However, many rural areas still remain without high speed Internet despite the eagerness of potential customers. This can be attributed to population, location, or sometimes ISPs' lack of interest due to little chance of profitability and high costs to build the required infrastructure. Some dial-up ISPs have responded to the increased competition by lowering their rates and making dial-up an attractive option for those who merely want email access or basic web browsing (LaVallee and Andrew, 2009).

Dial-up Internet access has undergone a precipitous fall in usage, and potentially approaches extinction as modern users turn towards broadband. In contrast to the year 2000 when about 34% of Internet users used dial-up, this dropped to 3% in 2013 (Home Broadband, 2013).

Broadband is wide bandwidth data transmission with an ability to simultaneously transport multiple signals and traffic types. The wider (or broader) the bandwidth of a channel is, the greater the information-carrying capacity, given the same channel quality.

The medium can be:

I. Coaxial cable

II. Twisted pair

III. Optical fiber

IV. Wireless broadband (wireless broadband includes Mobile broadband).

V. Satellite

VI. Voice Over IP (VoIP)

These media have their advantages and limitation which will be discuss below.

2.1.1 Twisted Pair Cable

Twisted pair cables consist of one or more pairs of insulated copper wires that are twisted together and housed in a protective jacket. Like all copper cables, twisted pair

uses pulses of electricity to transmit data. Data transmission is sensitive to interference or noise, which can reduce the data rate that a cable can provide. A twisted pair cable is susceptible to electromagnetic interference
(EMI), a type of noise (CISCO, 2010).

A source of interference, known as crosstalk, occurs when cables are bundled together for long lengths. The signal from one cable can leak out and enter adjacent cables. When data transmission is corrupted due to interference such as crosstalk, the data must be retransmitted. This can degrade the data carrying capacity of the medium. In twisted pair cabling, the number of twists per unit length affects the amount of resistance that the cable has to interference. Twisted pair cable suitable for carrying telephone traffic, referred to as CAT3, has 3-4 turns per foot making it less resistant. Cable suitable for data transmission, known as CAT5, has 3-4 turns per inch, making it more resistant to interference. There are three types of twisted pair cable (CISCO, 2010):

I. Unshielded twisted pair,

II. Shielded twisted pair,

III. Screened twisted pair. (CISCO, 2010)

2.1.2 Coaxial cable

Like twisted pair, coaxial cable (or coax) also carries data in the form of electrical signals. It provides improved shielding compared to UTP, so has a lower signal-to-noise ratio and can therefore carry more data. It is often used to connect a TV set to the signal source, be it a cable TV outlet, satellite TV, or conventional antenna. It is also used at NOCs to connect to the cable modem termination system (CMTS) and to connect to some high-speed interfaces (CISCO, 2010).

Limitation of Coaxial Cable

Although coax has improved data carrying characteristics, twisted pair cabling has replaced coax in local area networking uses. Among the reasons for the replacement is that - compared to UTP - coax is physically harder to install, more expensive, and harder to troubleshoot (CISCO, 2010).

2.1.3 Fiber Optic Cable

Unlike TP and coax, fiber optic cables transmit data using pulses of light. Although not normally found in home or small business environments, fiber optic cabling is widely used in enterprise environments and large data centers. Fiber optic cable is constructed of either glass or plastic, neither of which conducts electricity. This means that it is immune to EMI and is suitable for installation in environments where interference is a problem. In addition to its resistance to EMI, fiber optic cables support a large amount of bandwidth making them ideally suited for high-speed data backbones. These features make it suitable to deploy broadband technology to obtain high quality of service. Fiber optic backbones are found in many corporations and are also used to connect ISPs on the Internet.

Each fiber optic circuit is actually two fiber cables. One is used to transmit data; the other is used to receive data (CISCO, 2010).

Advantages of Fibre Optic Cable

i. Bandwidth - Fibre optic cables have a much greater bandwidth than metal cables. The amount of information that can be transmitted per unit time of fibre over other transmission media is its most significant advantage. With the high performance single mode cable used by telephone industries for long distance telecommunication, the bandwidth surpasses the needs of today's applications and gives room for growth tomorrow. ii. Low Power Loss - An optical fibre offers low power loss. This allows for longer transmission distances. In comparison to copper; in a network, the longest recommended copper distance is 100m while with fibre, it is 2000m.

iii. Interference - Fibre optic cables are immune to electromagnetic interference. It can also be run in electrically noisy environments without concern as electrical noise will not affect fibre.

iv. Size - In comparison to copper, a fibre optic cable has nearly 4.5 times as much capacity as the wire cable has and a cross sectional area that is 30 times less.

v. Weight - Fibre optic cables are much thinner and lighter than metal wires. They also occupy less space with cables of the same information capacity. Lighter weight makes fibre easier to install.

vi. Safety - Since the fibre is a dielectric, it does not present a spark hazard.

vii. Security - Optical fibres are difficult to tap. As they do not radiate electromagnetic energy, emissions cannot be intercepted. As physically tapping the fibre takes great skill to do undetected, fibre is the most secure medium available for carrying sensitive data.

viii. Flexibility - An optical fibre has greater tensile strength than copper or steel fibres of the same diameter. It is flexible, bends easily and resists most corrosive elements that attack copper cable (CISCO, 2010).

Disadvantages of Optic Fibre

i. Cost - Cables are expensive to install but last longer than copper cables.

ii. Transmission - transmission on optical fibre requires repeating at distance intervals.

iii. Fragile - Fibres can be broken or have transmission loses when wrapped around curves of only a few centimetres radius. However by encasing fibres in a plastic sheath, it is difficult to bend the cable into a small enough radius to break the fibre.

iv. Protection - Optical fibres require more protection around the cable compared to copper (CISCO, 2010).

2.1.4 Wireless Broadband

Wireless broadband is high-speed Internet and data service delivered through a wireless local area network (WLAN) or wide area network (WWAN). As with other wireless service, wireless broadband may be either **fixed** or **mobile**.

A **fixed** wireless service provides wireless Internet for devices in relatively permanent locations, such as homes and offices. Fixed wireless broadband technologies include LMDS (Local Multipoint Distribution System) and MMDS (Multichannel Multipoint Distribution Service) systems for broadband microwave wireless transmission direct from a local antenna to homes and businesses within a line-of-sight radius. The service is similar to that provided through digital subscriber line (DSL) or cable modem but the method of transmission is wireless (Satellite Internet, 2013).

A **mobile** broadband service provides connectivity to users who may be in temporary locations, such as coffee shops. Mobile broadband works through a variety of devices, including portable modems and mobile phones, and a variety of technologies including

WiMAX, GPRS, and LTE. Mobile broadband does not rely on a clear line of sight because connectivity is through the mobile phone infrastructure. Mobile devices can connect from any location within the area of coverage. WiMAX supports both fixed and mobile wireless and is often predicted to become the standard for wireless broadband (Satellite Internet, 2013).

2.1.5 Satellite

Satellite Internet access is Internet access provided through communications satellites. Modern satellite Internet service is typically provided to users through geostationary satellites that can offer high data speeds (Jon, 2013). With newer satellites using K_a band to achieve downstream data speeds up to 50 Mbps (Satellite Internet, 2013).

Satellite Internet generally relies on three primary components: a satellite in geostationary orbit (sometimes referred to as a geosynchronous Earth orbit, or GEO), a number of ground stations known as gateways that relay Internet data to and from the satellite via radio waves (microwave), and a VSAT (verysmall-aperture terminal) dish antenna with a transceiver, located at the subscriber's premises. Other components of a satellite Internet system include a modem at the user end which links the user's network with the transceiver, and a centralized network operations center (NOC) for monitoring the entire system. Working in concert with a broadband gateway, the satellite operates a Star network topology where all network communication passes through the network's hub processor, which is at the center of the star. With this configuration, the number of remote VSATs that can be connected to the hub is virtually limitless (Satellite Internet, 2013).

The Role of satellite for Achieving Broadband for All Many modern broadband applications (such as multimedia videoconferencing and software distribution) are now based on distributing information to numerous widely dispersed sites. Satellites are well-suited for carrying these services, as they offer widespread service provision, and can be used to service many users and solve the expensive ‘last-mile’ issue. Satellites are attractive for the interconnection of high-speed networks over large geographical areas. While much broadband communication is currently carried via terrestrial links, satellites will play a greater role in future (Friedman, 1999).

Satellites are a powerful and relatively inexpensive tool, especially for video links between multiple users. Their costs are constantly decreasing and satellites are a tested and reliable means for broadband communication. Broadband satellite systems have developed enormously to meet fast-growing demand, and now play an important role in air-space-ground integrated communications networks (Tian, et al; 2014).

Table 2.1: Advances in Satellite Broadband Technologies

Timeline	**2005**	**2010**	**2015**	**2020**
Generation	Ku-band satellites	First generation multi beam Ka-band Satellites	Second generation multi beam Ka-band satellites	Third generation multi beam Ka-band Satellites
Service capability	Internet broadband	High speed Internet Broadband	Superfast Internet broadband	Very high speed Internet broadband
Maximum service rate	2-3 Mbps	10-2 Mbps	30-50 Mbps	100 Mbps
Capacity per satellite	5	50-100	150-200	>500
Users per Satellite	100,000	Several 100,000s	Up to 1 million	>1 million

Source: ISI European Technology Platform 2014

2.1.6 Voice Over IP (VoIP) is a methodology and group of technologies for the delivery of voice communications and multimedia sessions over Internet Protocol (IP) networks, such as the Internet. Other terms commonly associated with VoIP are IP telephony, Internet telephony, broadband telephony, and broadband phone service (CISCO, 2010). The term Internet telephony specifically refers to the provisioning of communications services (voice, fax, SMS, voice-messaging) over the public Internet, rather than via the public switched telephone network (PSTN). The steps and principles involved in originating VoIP telephone calls are similar to traditional digital telephony and involve signaling, channel setup, digitization of the analog voice signals, and encoding. Instead of being transmitted over a circuit-switched network, however, the digital information is packetized, and transmission occurs as IP packets over a packet-switched network. Such transmission entails careful considerations about resource management different from time-division multiplexing (TDM) networks (CISCO, 2010).

Early providers of voice-over-IP services offered business models and technical solutions that mirrored the architecture of the legacy telephone network. Second-generation providers, such as Skype, have built closed networks for private user bases, offering the benefit of free calls and convenience while potentially charging for access to other communication networks, such as the PSTN. This has limited the freedom of users to mix-andmatch third-party hardware and software. Third-generation providers, such as Google Talk, have adopted (XMPP Federation, 2000). The concept of federated VoIP is a departure from the architecture of the legacy networks. These solutions typically allow dynamic interconnection between users on any two domains on the Internet when a user wishes to place a call (Booth, 2010).

VoIP systems employ session control and signaling protocols to control the signaling, set-up, and tear-down of calls. They transport audio streams over IP networks using special media delivery protocols that encode voice, audio, video with audio codecs, and video codecs as Digital audio by streaming media. Various codecs exist that optimize the media stream based on application requirements and network bandwidth; some implementations rely on narrowband and compressed speech, while others support high fidelity stereo codecs. Some popular codecs include μ-law and a-law versions of G.711, G.722, a popular open source voice codec known as iLBC, a codec that only uses 8 kbit/s each way called G.729, and many others. VoIP is available on many smartphones, personal computers, and on Internet access devices. Calls and SMS text messages may be sent over 3G or Wi-Fi (Booth, 2010).

Adoption of VoIP by Consumers (SME)

A major development that started in 2004 was the introduction of mass market VoIP services that utilize existing broadband Internet access, by which subscribers place and receive telephone calls in much the same manner as they would via the public switched telephone network (PSTN). Full-service VoIP phone companies provide inbound and outbound service with direct inbound dialing. Many offer unlimited domestic calling for a flat monthly subscription fee. This sometimes includes international calls to certain countries. Phone calls between subscribers of the same provider are usually free when flat-fee service is not available. A VoIP phone is necessary to connect to a VoIP service provider. This can be implemented in several ways (Wikipedia)

Because of the bandwidth efficiency and low costs that VoIP technology can provide, businesses are migrating from traditional copper-wire telephone systems to VoIP systems to reduce their monthly phone costs. In 2008, 80% of all new Private branch exchange (PBX) lines installed internationally were VoIP (Dosch and Church, 2011).

VoIP solutions aimed at businesses have evolved into unified communications services that treat all communications—phone calls, faxes, voice mail, e-mail, Web conferences, and more—as discrete units that can all be delivered via any means and to any handset, including cellphones. Two kinds of competitors are competing in this space: one set is focused on VoIP for medium to large enterprises, while another is targeting the small-to-medium business (SMB) market (Callahan and Renee, 2008).

VoIP allows both voice and data communications to be run over a single network, which can significantly reduce infrastructure costs for SMEs (Korzeniowski and Peter, 2008). In contrast, baseband describes a communication system in which information is transported across a single channel (Carty, 2004).

2.2 Relevant Theories and Models

The theoretical basis for this study is outlined as follows:

A Mathematical Theory of Communication

Theory of Reasoned Action (TRA)

Theory of Planned Behavior (TPB)

Technology Acceptance Model (TAM)

Technology-Organisation-Environment (TOE) model

Information System Continuance Model (Post adoption Stage)

These theories and models are discussed below in relation to their importance in this study.

A Mathematical Theory of Communication

A Mathematical Theory of Communication is an influential 1948 article by mathematician Claude E. Shannon. It was renamed "The Mathematical Theory of Communication" in the book, (Shannon and Weaver, 1949), a small but significant title change after realizing the generality of the work.

The article was one of the founding works of the field of information theory. Shannon expanded the ideas of this article in a 1949 book with Warren Weaver titled The Mathematical Theory of Communication, which was published as a paperback in 1963. The book explains how the symbols of communication are transmitted, how the transmitted symbols convey meaning, and the effect of the received meaning. Shannon's article laid out the basic elements of communication as;

I. An information source that produces a message

II. A transmitter that operates on the message to create a signal which can be sent through a channel

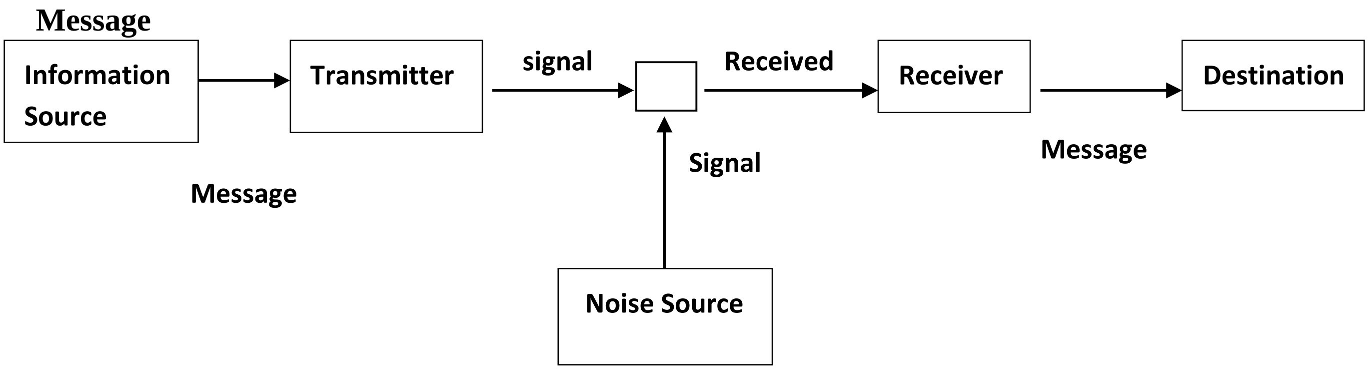
III. A channel, which is the medium over which the signal, carrying the information that composes the message, is sent

IV. A receiver, which transforms the signal back into the message intended for delivery

V. A destination, which can be a person or a machine, for whom or which the message is intended

It also developed the concepts of information entropy and redundancy, and introduced the term bit as a unit o

Understanding of this theory and its application enhanced communication technology. Broadband technology brings about seamless communication, by eliminating factors



that attenuate data transfer, and introducing efficiency to different components of communication system, is a developed technology from the understanding of the mathematical theory. This theory provides reason while SMEs should adopt broadband technology to enhance communication with their clients and with greater efficiency and capacity in service delivery.

Figure 2.1 Schematic Diagram of General Communication System

(Shannon, 1948).

Theory of Reasoned Action (TRA)

Embedded in the field of social psychology, the theory of reasoned action (TRA) was widely used in predicting behavior (Fishbein and Ajzen, 1975) and based on which Technology Acceptance Model (TAM) and Theory of Planned Behavior (TPB) models have developed.

AS shown in figure 2.2 below, TRA argues that behavioral intention (BI) is jointly determined by attitude towards behavior (A) and subjective norm (SN). BI is a measure of the strength of one's intention to perform a specified behavior (Davis et al., 1989) and SN refers to "the person's perception that most people who are important to him think he/she should or should not perform the behavior in question (Fishbein and Azjen, 1975). Any other factors that influence behavior intention do so only indirectly by influencing A, SN, or their relative weights.

This theory will explain the actual behavior of SMEs towards the adoption of broadband technology, which will be analyse by considering their motivation and attitude towards broadband technology adoption and application.

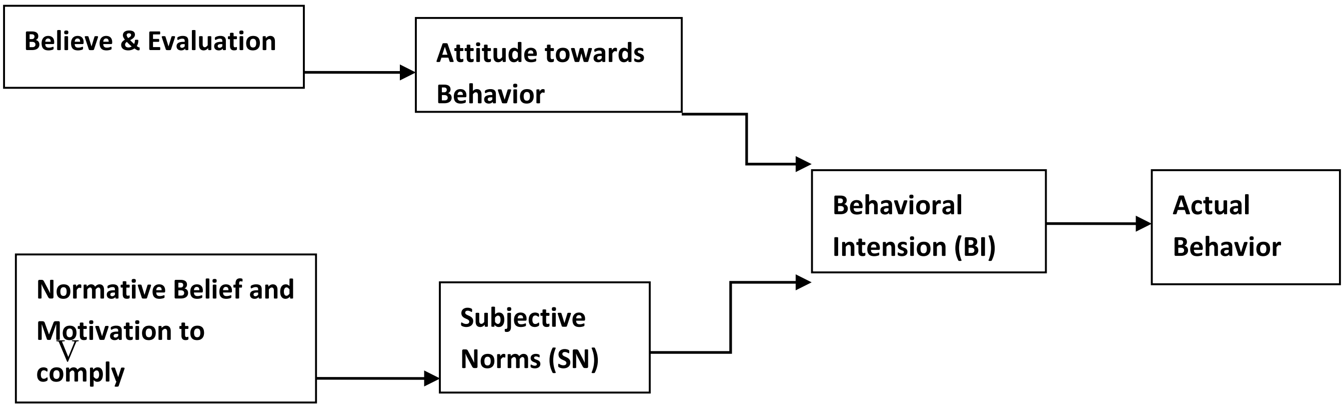


Figure 2.2 Theory of Reasoned Action (TRA) (RoyaGholami et al ., 2008) .

Theory of Planned Behavior (TPB)

To expand the scope of the TRA to become applicable for behaviors or situations in which there is low or no volitional control, Ajzen (1985, 1991) developed the theory of planned behavior. TPB modifies TRA by including the variable perceived behavioral control (PBC). This measures a person's perception of control over performing a given behavior. PBC was theorized to directly predict and explain both intention and behavior and was supposed to explain more variance than the TRA for behaviors not entirely under a person's volitional control (Ajzen, 1985).

TPB assumes that a person's intention to adopt ICT is determined by three factors: attitude (A), subjective norms (SN), and perceived behavioral control (PBC).

I. **Attitude** describes an individual's positive or negative perception towards ICT;

II. **Subjective Norms** describe the social influence that may affect a person's to use ICT;

III. **Perceived Behavioral Control** describes the beliefs about having the necessary resources and opportunities to adopt ICT.

As a general rule, the more favorable A and SN with respect to a behavior, and the greater the PBC, the stronger should be an individual's intent to perform the behavior under consideration (Ajzen, 1991). This theory (TPB) will be applicable in, considering and ascertaining the intent of SMEs in the

South-East Nigeria towards the adoption of broadband technology.

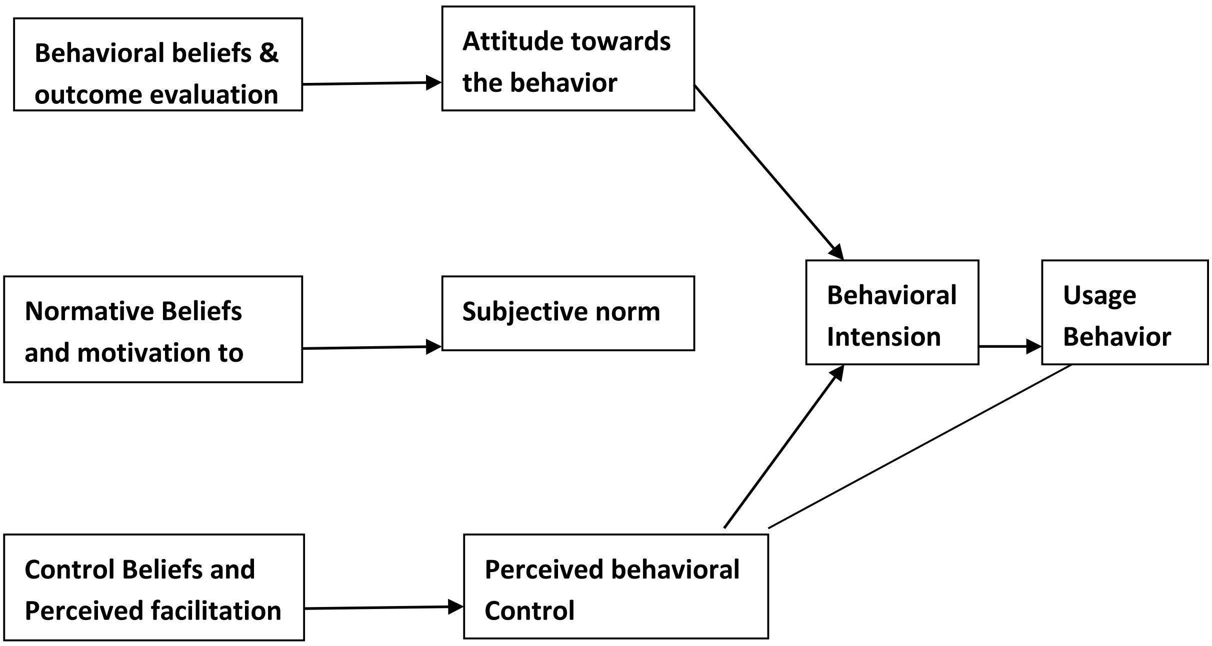


Figure 2.3 Theory of Planned Behavior (Ajzen, 1991)

Intention to adopt ICT, in return, is expected to affect the actual adoption of ICT (Figure 2.4). Although intention-based theories have been verified mostly within the context of individual decision-making, it has been shown that these models could also be applied to strategic decision making at organizational level as well (Harrison et al., 1997; Lim et al., 2002; Harrison et al., 2003). This is because individuals who typically make the decisions such as technology adoption and continuance are the top managers. Accordingly, it is important to investigate the decisions made by those in a position to influence technology adoption and usage for an entire organization.

This theory shades more light on the impact of decisions made by those in authority or position in adoption of broadband technology by SMEs.

Technology Acceptance Model (TAM)

TAM (Davis et al., 1989), was theoretically derived from TRA, but TAM is specifically meant to explain computer usage behavior (Davis et al.,1989).

TAM is "an adaptation of TRA specifically tailored for modeling user acceptance of information systems" (Davis et al., 1989). TAM focuses on only attitude by ignoring subjective norms intentionally due to SN uncertain theoretical and psychometric status (Davis et al., 1989).

This model uses two beliefs of the potential adopter, perceived usefulness (PU) and perceived ease of use (PEOU) of technology as the main determinants of the attitudes toward a new technology. PU is "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989), while PEOU is "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989). These two beliefs create a favorable disposition or intention toward using the IT

(e.g. broadband) that consequently affects its self-reported use (Davis et al., 1989). Comparing Figures 2.3 and 2.4 perceived usefulness (PU) and perceived ease of use (PEOU), are antecedents of A while PU and A jointly determine user's BI, whereas

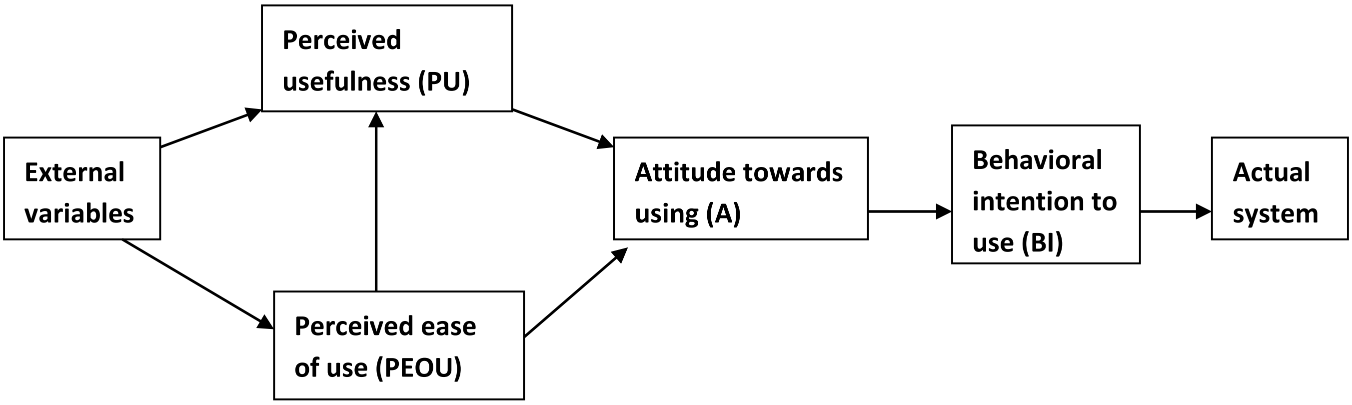


Figure 2.4 Technology Acceptance Model (TAM). (Roya Gholami et al., 2008)

PEOU also has an effect on PU. External variables influence user intentions only indirectly by influencing PU and PEOU or their relative weights. Studies that have investigated self-reported system usage and intended use have found that PU plays a significant role in determining such downstream effects. However, most of the studies, beginning with Davis himself, have not found a direct linkage between PEOU and ICT adoption. Indeed, Davis suggested that, "ease of use operates through usefulness." Not surprisingly, some research has questioned the overall importance of PEOU in ICT adoption (e.g., Keil et al., 1995). The role of PEOU in TAM, however, remains controversial in that some studies show that PEOU does directly affect either self-reported use or intended ICT use. However, TAM is still somehow incomplete. On one hand, its explanatory power is limited. Typically, TAM can account for 40% of variance in user intentions. Compared with other models, for example, TPB, TAM performs just slightly better (Taylor and Todd, 1995). On the other hand, the relationship within it is inconsistent, which means maybe TAM is unable to succeed across different contexts.

More and more researchers begin questioning the validity of TAM across different contexts.

This model shows how PEOU and PU affect the attitude of SMEs in adopting broadband technology through their behavioral intention of what the intended final system should be.

Technology-Organisation-Environment (TOE) model

Tornatzky and Fleischer (1990) suggested that the process of innovation adoption is influenced by three factors:

I. The external environmental context (with items such as competitive intensity, government support),

II. The technological context (with items such as compatibility, complexity), and

III. The organisational context (with items such as size, formalisation, centralisation and key individual behaviours).

Tornatzky and Fleischer (1990) thus proposed the Technology-OrganisationEnvironment (TOE) model. Ramdani et al. (2013), Ifinedo (2011), Tan (2010) and Li et al. (2010), who all extended work by Tornatzky and Fleischer (1990), suggest that the Technology-Organisation-Environment model is an integrative schema depicting normative and attitudinal behaviour toward technology adoption for an organisation, including characteristics of the technology, contingent organisational factors, and elements from the macro-environment

(see Figure 2.5).

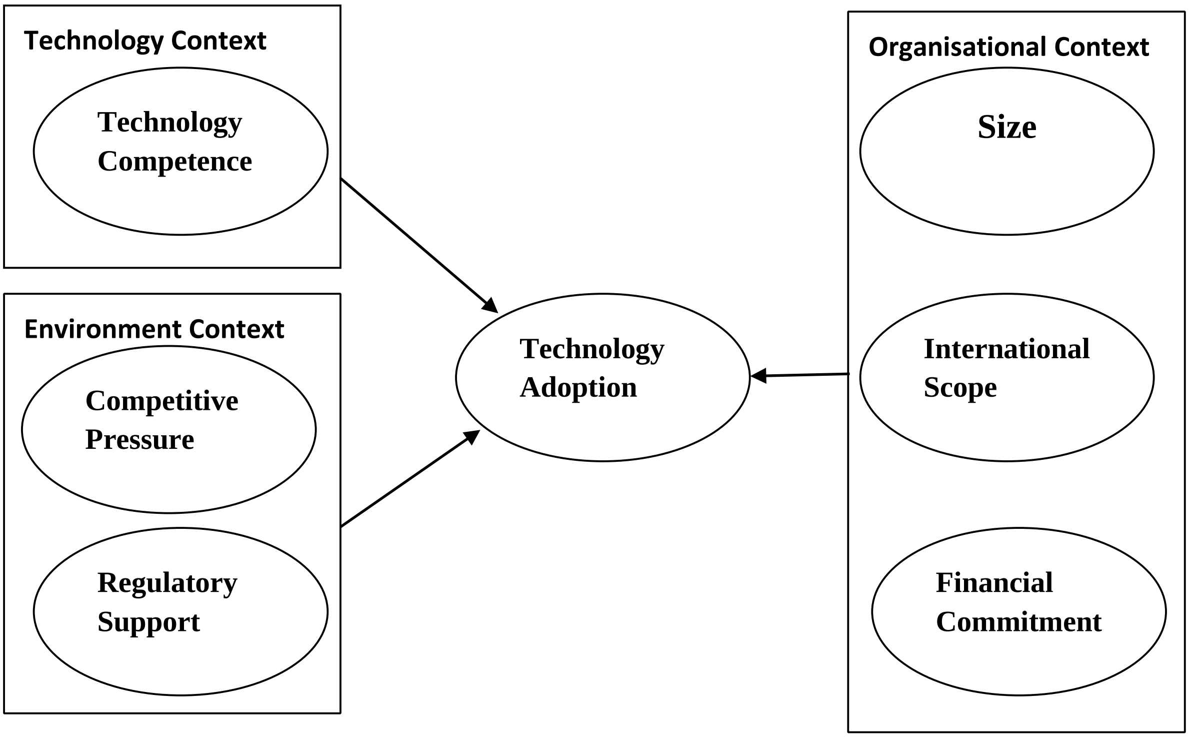


Figure 2.5: TOE Research Model first proposed by (Tornatzky and Fleischer, 1990)

I. Tornatzky and Fleischer (1990) suggested that the process of innovation adoption is influenced by three elements:

II. The external environmental context (for example, market uncertainty, competitive intensity, government support),

III. The technological context (forexample, compatibility, complexity), and

IV. The organisational context (for example, size,formalisation, centralisation and key individual behaviours).

This is confirmed by Ramdani et al. (2013) and Tan (2010), who suggests that one needs to find a suitable linkage between the influences of various stakeholders for the particular unit of study, in a particular market and relate it to technology to be tested. Awa et al. (2012), Baker (2012), Oliveira and Martins (2010) and Boateng et al. (2009)

all contributed to the definition for each context, relating to organisational settings, paraphrased by the researcher to be:

1. Technology context applies to both technology infrastructure and IT human resources. This relates to introduction of new technology, and integration to existing technologies. Technology integration applies to both internal and external technologies that are relevant to an organisation in facilitating its business processes and creating value, for example, to improve firm performance by reduced cycle time across the value chain, improved customer service and lower procurement costs. Generally, it encapsulates to perceived direct and indirect benefits of technology.

2. Organisational context relates firm characteristics to management and their structure, firm size, global scope, enterprise integration, availability of human resources for technology use, perceived benefits or the appropriateness of technology to an organisation, top management commitment / support and financial resources availability and the availability of funds. Fund availability and willingness to adopt may hinder technology integration. Fund availability, suggested by Zhou (2010), is directly related to perceived cost of technology.

3. Environmental context measures the adoption and diffusion of technology based on influence of change agents and facilitating conditions at a macro level, such as social referral and competitive pressure to adopt, and external ICT support to implement technology. This includes industry and perceived government pressure and the readiness of resources provided

by the institutional foundations such as policies, economic and infrastructure.

Information System Continuance Model (Postadoption Stage)

Simply studying the decision to adopt a technology is not enough, since it is followed by a process of deeper evaluation through use that may or may not result in continuance. The gap between expectations before adoption and evaluation after experience influence decision. Recent studies show that people continue using technologies only when they add value to their lives (Carroll et al., 2002). Innovation diffusion theory, in its five-stage adoption decision process suggests that adopters reevaluate their earlier acceptance decision during a final confirmation stage and decide whether to continue or discontinue using an innovation (Rogers, 1995). However, these studies view continuance as an extension of acceptance behaviors (Davis et al., 1989; Karahanna et al.,1999), and are therefore unable to explain why some users discontinue IS use after accepting it initially (Bhattacherjee, 2001).

Bhattacherjee (2001), has shown that circumstances of IS continuance differ significantly from those of initial adoption behavior. Based on the expectation confirmation theory (ECT) (Oliver, 1980) widely used in the consumer behavior literature to study consumer satisfaction and post-purchase behavior (Churchill and Surprenant, 1982; Spreng et al., 1996; Tse and Wilton, 1988). In this model, intention is positively related to both satisfaction and perceived usefulness. Satisfaction and perceived usefulness are in turn positively related to the degree with which the user's expectation about IS are confirmed.

IS researchers have continued to examine user satisfaction in part because it has been widely adopted as an important determinant of IS success (DeLone and McLean, 1992, 2003; Rai et al. 2002; Wixom & Todd, 2005; Zviran and Erlich, 2003). The intention and influences for SMEs to use technology can be different for the near-term and the long-term. Thus, the meaning of the adoption and postadoption may differ. Adoption refers to the initial encounter with a technology by the user, while postadoption refers to the situation in which an individual/organization (SMEs) has used the technology for a while. Therefore, the dependent variables are broadband initial usage in the adoption stage and continuance in the postadoption stage. Understanding factors influencing broadband adoption by SMEs and its continuance is major feature of this study.

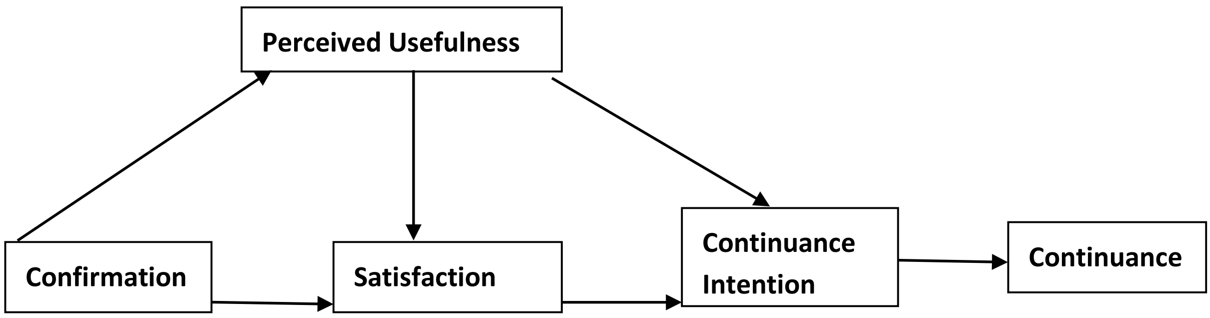


Fig. 2.6: Post-acceptance model of IS continuance. (RoyaGholami et al., 2008)

2.3 Contributions of Related Works and Research Gap

There is no generally acceptable definition of SME (Altman et al., 2008; Henschel, 2009).This is because there are no uniform criteria to measure them in terms of capital outlay, number of employees, sales turnover, fixed capital investment, available plant and machinery, market share, level of development and even nomenclature (Ogechukwu, 2011). These differences are from country to country, industry to industry, school to school and author to author (Fatai, 2010). This present work considered SMEs in terms of their capital outlay.

Berisha-Namani (2009) suggests that the ability of SMEs to realise their goals depends on how well the company acquires, interprets, synthesises, evaluates and understands information and how well its information channels supports organisational processes. The advancement in internet-based ICT technology is evolving SME business models to facilitate interactivity, flexibility, cheaper business transactions and interconnection with business partners and its customers. Internet-based ICT is seen as an accelerant to the advancement in business software and content delivery (Colombo et al., 2012). This present work seek to find out factors that create a demand gap among SMEs in South East in adopting broadband technology which is an accelerant of business advancement.

Chibelushi and Costello (2009) suggest that internet based Information and Communications Technologies (ICT) is a critical resource toward SME growth and survival. However, the rate of adoption of broadband in Nigeria seems to be increasing at a slower pace than most other developing markets (ITU-T, 2013a), and mostly for SMEs on mobile-based internet [rather than fixed broadband] (Esselaar, 2008). Hence, we sought to identify those items that drives broadband demand gap among SMEs in South East of Nigeria.

Previous studies analyzed the most significant factors which influence SMEs adoption of internet and broadband, highlighting that SMEs may encounter severe obstacles mainly related to firm specifics and environmental specific characteristics (Amdore and

Ordanini, 2006; Mehrtens, 2001). In particular, managers' IT knowledge, as well as firm size, seems to be positively affecting SMEs adoption of broadband technologies. For what concerns environmental factors, external pressure on the organization (from customers or trading partners) to adopt the technology, are likely to have positive effects on firms are located further influences availability of broadband connection and consequently SMEs decision to adopt (Prieger, 2003).

Moreover, the adoption by SMEs of broadband connection is likely to have negligible economic impact at firm level by and of itself. In order to generate positive feedback, firm productivity and, more generally, on firm performances, it has to be associated with the adoption of complementary advanced communication (e.g., virtual private network, Voice over Internet Protocol (VoIP), video-conference) and management (e.g., customer relationship management, supply chain management, human resource, and administration management systems) applications that allow firms to radically change the way they do business. In fact, broadband access like other ICTs, is a general-purpose and enabling technology (Bresnahan and Trajtenberg, 1995) whose benefits can be fully captured only if it is used by adopting SMEs both to carry out the same transaction or activities in a more efficient way and also as an instrument means to generate and develop new transactions and activities (Bertschek and Kaiser, 2004; Preissl, 1995). In turn, for most economic organization a necessary condition for an effective deployment of the above mention applications involves deep changes in their management. It follows that as interesting as the analysis of the determinants of the adoption by SMEs of internet broadband access is, the study of the factors that foster or hinders firms' adoption of broadband-based applications, including firm's ability to transform their organization structure and managerial practices.

This present work investigates the factors affecting the adoption of broadband connection by SMEs. The study focuses on the South Eastern Nigeria where SMEs traditionally account for most of the wealth produced in the national economic system and GDP growth (CBN, 2010).

Nkanu et al. (2010), sees ICT as tool for bridging the gap in digital divide phenomenon in Nigerian libraries and recommends that Administrators of Nigerian libraries should collaborate with their parent institutions to re-order their priorities through a major policy shift in order to provide full internet connectivity in their libraries. This present work is to investigate factors driving the demand gap in adopting broadband technology by SMEs in South East of Nigeria.

Hilbert, (2011), discussed the main approaches researchers have taken to conceptualize the digital divide among individuals and countries. The result is a common framework that addresses the questions of who (e.g. divide between individuals, countries, etc.). This present work is to investigate factors driving the demand gap in adopting broadband technology by SMEs in South East of Nigeria.

Horrigan (2009) estimated that, 50% of non_broadband households linked non_adoption to "lack of relevance/interest." In the survey, lack of relevance was driven by "no interest", "busy conducting other tasks", or other unspecified reasons. Interestingly enough, the percentage of non_adopting households citing lack of relevance (50%) was higher than the percentage citing affordability (35%). In a study conducted in 2011, the non_broadband adopting households that provided the "lack of relevance" explanation only decreased to 47%, while affordability dropped to 24% (NTIA, 2011). When disaggregating non_ broadband households between those that have or do not own a computer, “lack of relevance” jumps to 52%, and affordability drops to 21%. This present work is to evaluate how lack of relevance have driven demand gap among SMEs in the South East of Nigeria.

Okon et al. (2007), showed the prevalence of digital divide in gender, age, marital status and educational level among individuals as regards internet usage in Calabar. They suggested the federal/state governments as well as university managements in Nigeria should formulate relevant policies to reduce various forms of digital divide that are prevalent in the Nigeria. Their work did not capture demand gap among SMEs in adoption of broadband technology which this present work is to establish.

Lucky and Achebe (2013), evaluated the effect of digital divide on information accessibility among undergraduate students and established that ICT are not readily available to most undergraduate students and the necessity to bridge the gap between the haves and the have not, the institution’s management will need to ensure that the class rooms are internet connected and made available in every department to provide easy access to digital information especially to those who are financially incapacitated. This present work is to expand on how this gap in broadband technology affects SMEs in the South East of Nigeria.

Akanbi and Akanbi (2012), examined the gap in access to Information and Communication Technology (ICT) and its linkages to poverty in Nigeria.

They found that the contributions of access to the use of ICTs to poverty in Nigeria has been marginal and the contributing factors are poor quality of service caused primarily by network capacity constraints, lack of physical and transmission infrastructure, scarce spectrum resources, unreliable electric supply. This present work is to assess how some of these factors identified by Akanbi and Akanbi, create a demand gap on broadband technology by SMEs in the South East of Nigeria.

Levy et al. (2002), states that SMEs vary in size and nature depending on their area of business. In the same way, their attitudes differ when it comes to the adoption of new technologies. In some cases, SMEs are keen to accept new technologies while in other situations, they are not. There are many reasons why SMEs may decide to adopt new technologies. These reasons could be related to the desire for business growth. In other instances it could be as a result of a desire for better communications (Chappell et al., 2002).Unfortunately, the diffusion of new technologies to SMEs is not always straightforward and simple. According to Kalakota and Robinson (2001), the main barriers to information technology (IT) and electronic commerce (e-commerce) adoption by SMEs appear to be the managers‟ unwillingness to take risks when it comes to technological change. One of such technological changes in recent times is the use of broadband. Prior to using broadband for browsing the Internet, many SMEs used dial-up connection. This present work is to investigate factors driving the demand gap in adopting broadband technology by SMEs

Osuagwuet al. (2013), suggested that the bandwidth size available is a major problem hindering broadband diffusion in Nigeria. They suggested that National Bandwidth capacity can be increased via expansion of broadband access such as WiMix and Free Space Optics Technology (FSO), deployment of Fibre optics ring backbone, launch of additional communications satellites in the orbit and expansion of submarine cables

(Osuagwu et al., 2013). They identify bandwidth as one factor that affects diffusion of broadband in Nigeria. The present work tend to evaluates others factors apart from bandwidth size that affects broadband adoption by SMEs in South East of Nigeria.

Olise et al. (2014), examined the determinants of ICT adoption for improved small medium enterprises (SME's) performance in Anambra State, Nigeria. They provided empirical evidence on levels of awareness and adoption patterns of ICT facilities among SMEs; which evaluates factors influencing ICT adoption in the SMEs sector; and also assesses the impact of ICT adoption on SMEs performance. The simple percentage, mean, standard deviation, t-test statistics, and regression analysis were used to conduct the various analysis of their study. Findings reveled that there is significant difference in the levels of awareness and adoption patterns of ICT facilities among SMEs. Their finding from the research shows that broadband diffusion has significant effects on small medium enterprises which is what this present work is evaluating but will go further to examine different factors affecting broadband adoption in the South East of Nigeria which will go a long way to show its impact on different phases of the society.

Illoanusi et al. (2005), said investments been made in ICT, administrative and financial transactions, wireless and mobile communications have promising results. However, investments in ICT in Nigerian tertiary education have not yielded reasonable expectations. In most educational institutions, especially higher institutions, the mode of delivery of knowledge and curriculum are not yet ICT-enhanced. ICT in education is therefore in its infancy in Nigeria. Although there is great scope for improvement, the modest efficiencies recorded represent great achievements. Their paper discusses ICT in its dimensions; how it transforms education; its status in Nigerian educational institutions and the limitations to its infusion in the Nigerian educational system and suggests ways of improvement. Their work failed to cover the difficulties telecomm and ICT providers face in providing the broadband diffusion in Nigeria. The main crux of this present work discusses the difficulties telecomm and ICT provider encounter, measures taken to improve the situation and impact it has on SMEs adopting broadband. Papacharissi and Zaks (2006), analyzed policy issues surrounding residential broadband technology, discusses how broadband extends Internet capabilities and at what cost, and makes recommendations for future applications of broadband. It focuses on residential broadband access, and in examining the future of broadband, it identifies three areas of concern:

a) Regulatory tendencies and tensions in the United States of America (USA),

b) International diffusion of broadband,

c) Overall consumer appeal of broadband content.

Specific policy recommendations center on providing regulation that guarantees open access, enforces reasonable pricing plans, and encourages innovative content. They highlights how policies and regulations affect broadband diffusion, examines the policy issues surrounding residential broadband technology. But the work fails to capture other factors which this present work will close up the gap.

Beneke (2008), Said, South Africa has fallen behind its international peers—both developing and developed markets—in the race to rollout

broadband services. In fact, even within the African continent, it is neither the broadband leader nor progressive in comparison to its Northern African counterparts.

He explores the development of broadband services in South Africa, as well as to touch upon the challenges faced in bringing this phenomenon into the mainstream. Reasons for the lack of diffusion and adoption of such services point to the high end user cost of the service, a very limited geographical footprint of both fixed line and mobile broadband infrastructure, as well as a lack of computer literacy and an understanding of what broadband is able to offer. He continues to look at possible solutions, including introducing a greater degree of competition into the market to facilitate downward pressure on prices, as well as providing cost based access to international submarine fiber cable and unbundling of the local loop to further this objective. This research work is evaluating how some of these factors enumerated by Justin Henley are affecting the broadband adoption within the South-East Nigeria context and constraints.

GholamiIn et al. (2008), stated that in spite of the increasing significance of broadband internet, there are not many research papers explicitly addressing issues pertaining to its adoption and postadoption. They said previous research on broadband has mainly focused on the supply side aspect at the national level (Singapore), ignoring the importance of the demand side which may involve looking more deeply into the use, as well as factors impacting organizational and individual uptake. In an attempt to fill this gap, their work empirically verifies and integrated theoretical model compromising the theory of planned behavior and the IS (Information System) continuance model to examine factors influencing broadband internet adoption and postadoption behavior of some 1,500 organizations in Singapore. Overall, strong support for the integrated model has been manifested by their results providing insight into the influential factors. At the adoption stage, perceived behavioral control has the greatest impact on behavioral intention. Their findings also suggest that, as compared to attitude, subjective norms and perceived behavioral control more significantly affect the broadband internet adoption decision. At the pastadoption stage, intention is no longer the only determinant of broadband internet continuance; rather usage was found to significantly affect broadband internet continuance. This present study examine the factors that influencing the adoption and of broadband technology at enterprise and how attitude, planned behavior studied by Gholamiln et al. (2008), affects adoption of broadband by (SME) in the South East of Nigeria

Oluwasola and Anastasia (2008), stated that, broadband is a relatively new technology and its adoption in the United Kingdom has been an issue due to its perceived benefits for businesses and more so for small/medium size enterprises (SMEs). They argue that previous research focuses on home uses of broadband, particularly for educational purposes with little attention to its adoption by SMEs. They argue that the existing diffusion of innovation theories is inadequate for the study of broadband diffusion and they propose a more sociotechnical approach for this purpose. Their study can be useful for SMEs considering adoption of new technologies such as broadband as well as policy makers that seek to apply effective technological adoption policies. Their work fail to capture the difficulties SMEs in rural area face to adopt broadband technology which this present work will incorporate using the South-Eastern Nigeria as a case study.

ITU, UNESCO (2010) survey report states that in China, for instance, every 10 percent increase in broadband penetration could contribute an extra 2.5 percent to GDP growth. A number of studies have linked the expansion of broadband networks, services and applications to global GDP growth. This present study is to evaluate factors creating demand gap in broadband adoption by SMEs in South East of Nigeria.

ITU, UNESCO (2011) Research report done by the World Bank indicates that for high income countries, a 10 percent rise in broadband penetration adds a 1.21 percent rise in economic growth, or 1.38 percentages for low- and middle income countries. This present work tends to investigate the impact of broadband demand gab on the economic growth among SMEs in the South East of Nigeria.

United Nations Millennium Declaration (2000), the potential in several countries and regions such as India, China or Africa to harness broadband to meet the Millennium Development Goals (MDGs3) while leapfrogging to and moving towards a low-carbon economy is especially significant. This present work is to assess demand gab of broadband adoption among SMEs in the South East of Nigeria.

Kotelnikov (2007), states that, while ICT can benefit SMEs in multiple ways, SMEs within the Asia-Pacific region have been slow to adopt ICT as they face major constraints such as limited technology training, economic barrier, and a slow assimilation of broadband. To remove these constraints, governments need to do more than merely improving ICT national policy and promoting SMEs in the ICT sector. Instead, governments should embed ICT components into overall SME policy in a comprehensive and focused manner. However, this does not mean that SME policy should be the same for all industries. SMEs in different sectors use ICT differently and will adopt them at a different pace. Additionally, SMEs need help in translating the benefits of ICT to their core business. The willingness of SMEs to integrate e-business practices depends on how much it can directly improve their core business and how much the potential benefits outweigh the definite costs. This present work is to assess the following factors; slow assimilation of broadband, limited technology training and economic barrier, identified by Kotelnikov, on how they affect broadband demand gap among SMEs in the South East of Nigeria.

Prashil Pravin Gareeb and Visvanathan Naicker, (2015) states that direct or indirect demands from customers of businesses to interface via electronic means, through advertising, information sharing etc., tend to force SMEs to adopt Broadband Technology. In Nigeria the number of customers that demand for online services varies, it high in the urban cities when compared to rural areas where there is little or no interest in the use of online services. This present study is to evaluate how customer demand for broadband service affect demand gap among SMEs in the South East of Nigeria

Horiggan 2009, Stated that since broadband is a platform used to access Internet content, applications, and services, the relevance of such content offers an incentive to purchase a subscription. Conversely, the lack of cultural relevance could serve as a barrier to adoption. Cultural relevance could be conceptualized either in terms of content suited to the interests of the adopting population or in terms of language used for interacting with applications/services or consuming content. This present study is to evaluate how lack of content relevance or interest drives broadband demand gap among SMEs in the South East of Nigeria.

Ukeoma P.E (2016) identified in her research factors that act as inhibitors to demand of broadband technology at residential level. This present work solely concentrated on factors that create demand gap among SMEs in the South East of Nigeria.

Obasi and Kalejayi (2013) stated in their research that irrespective of power sector privatization, Nigerians have continued to lament about the poor state of power supply and the negative impact it is having in their businesses and living. Power Supply affects every sphere of living of which installation and management of telecommunication infrastructure are inclusive. The cost used in running generators to operate business and provide services increases the overhead cost thereby affecting productivity. This present work seek to find out how epileptic power supply drives broadband demand gap among SMEs in the South East of Nigeria,

Full understanding of the market opportunities for broadband is often limited, since it requires industries to think beyond their traditional business models. In just one example, there is too little incentive for the risk-averse, fragmented electricity industry to invest in the possibilities offered by smart grids. As utilities are not responsible for contributing to national climate change goals, this hampers more rapid deployment of broadband solutions. (ITU, UNESCO, 2012). This present work seeks to establish how the grasp or understanding of market opportunity which broadband technology provide affects its demand among SMEs in the South East of Nigeria.

Without a clear strategy and shared objectives for national broadband development, getting all the pieces of the puzzle together is impossible. A strong vision is needed to anchor ICT policy and frame works, steer investment and unite the various players around a common goal (ITU, UNESCO, 2012). This present work seek to find out how clear vision or lack of it from policy makers drives broadband demand gap among SMEs in the South East of Nigeria

Gaps in broadband penetration and affordability persist not only among countries, but also between rural and urban areas within a nation. The digital divide remains a stubborn obstacle to progress. By 2010, nearly a quarter of people in developed countries had fixed broadband access, and more than half had access to mobile broadband. The corresponding figures for developing countries are estimated at 4.4% and 5.4% respectively—although penetration is significantly higher than this in urban areas in India, for example (ITU, UNESCO, 2011). This present study is to establish how access to broadband technology drives its demand gap among SMEs in the South East of Nigeria.

2.4 Factors Creating Broadband Demand Gap at Enterprise Level

In this research thesis, an extensive study was carried out on various related literatures and journals to uncover 46 (forty six) factors that affect broadband demand gap among SMEs (Obasi and Kalejayi 2013, Horiggan 2009, Prashil Pravin Gareeb and Visvanathan Naicker 2015, Kotelnikov 2007, ITU, UNESCO 2011, Oluwasola and Anastasia 2008, GholamiIn et al., 2008, Beneke 2008 Papacharissi and Zaks 2006, Illoanusi et al., 2005, Olise et al., 2014, Osuagwu et al., 2013; Levy et al., 2002; Akanbi and Akanbi 2012; Lucky and Achebe 2013; Prieger, 2003) Factor Analysis was used to summarize the factors that create demand gap among SMEs so that relationships and patterns amongst them can be easily interpreted and understood. The factors and their category is summarised in table below:

Table 2.2: 46 Factors Creating broadband demand gap from literatures analysed using Factor Analysis

1. Nature of Business
2. Cost of router
3. Vandalization of power stations
4. Quality of service
5. Shared values and norms
6. Overall cost saving
7. Irregularities in power rate charge
8. Installed capacity of operators
9. Technical skills and expertise
10. Security
11. Relationship b/w operators & SMEs
12. Scarce spectrum
13. Language skills
14. Absorptive capacity
15. Cost of training staff
16. High cost of energy
17. 3G services available in urban areas
18. Lack of technological advancement
19. Economic environment
20. High cost of fuel for generator set

21. Inefficient LTE services
22. High cost of web hosting
23. Limited knowledge of market importance
24. Insufficient knowledge of online business
25. Behavior and attitude
26. Customer participation
27. Risk sharing/management
28. Investment climate
29. Bandwidth size
30. Understanding of broadband technology
31. Team leader competence & expertise
32. High cost of personal computers
33. Inadequate power supply
34. Quality of information delivery
35. Requirement uncertainty
36. High technology cost
37. Management level of knowledge
38. Running cost
39. Service charge
40. Trust
41. Business modernization
42. Applications
43. Regulatory and demographic changes

44. Training
45. Cultural intelligence
46. Payment plan

2.5 Final Factors That Create Broadband Demand Gap at Enterprise Level

Principal Component Factor Analysis with Oblimin rotation method was performed on all 46 factors, in order to reduce them to a considerable number to be used in our research, and to eliminate collinearity between them. In addition, Monte Carlo PCA for Parallel Analysis was used to compare and validate the result from the Principal Component factor analysis. After 34 iterations, the 46 factors were reduced to 10 factors as listed below:

Table 2.3 Final Factors that create Broadband Demand Gap at Enterprise Level

Factor No:	**Items**	**Summarised Broadband Demand Gap Factors**
1	Cost of training staff High Cost of personal computers Payment plan Cost of router High technology cost Economic environment Overall cost saving	Economic Barrier

	Insufficient knowledge of online business Running cost Irregularities in power rate charge	
2	Language skills, Understanding of broadband tech, Training, Technical skills and expertise Insufficient knowledge of online bus, Running cost, High cost of web hosting	Limited Technological Training
3	Cultural intelligence Team leader competence & expertise Absorptive capacity Nature of Business Requirement uncertainty Lack of technological advancement Shared values and norms	Slow Assimilation of Broadband
4	Quality of service Quality of information delivery 3G services available in urban areas Inefficient LTE services	Uneven Telecom Network Deployment

	Installed capacity of operators	
5	Limited knowledge of market importance Management level of knowledge Insufficient knowledge of online bus Running cost High cost of web hosting	Low Knowledge of Market Opportunity
6	Customer participation Trust Behavior and attitude Service charge	Customer Forces
7	Investment climate, Relationship b/w operators & SMEs, Application	Lack of Content Relevance or Interest
8	High cost of energy Inadequate power supply Vandalization of power stations High cost of fuel for generator set Irregularities in power rate charge	Epileptic Power Supply
9	Business modernization, Risk sharing/management, Security	Lack of Vision and Prospect of Broadband

10	Regulatory and demographic changes Scarce spectrum Bandwidth size	Inefficient Access to Broadband

Factors 6, 8, and 9 were identified by Horigan (2009), Obasi and Kalejayi (2013) Prashil Pravin Gareeb and Visvanathan Naicker (2015) respectively. This present work is in synchronism with work of Kotelnikov (2007) which identified slow assimilation of broadband, economic barrier, and limited technology training as factors that create broadband demand gap at enterprise level. This present research work is in contrast with Ukeoma (2016) which identified Affordability barrier, limited broadband internet coverage, lack of interest on broadband, digital illiteracy and Epileptic electricity supply as inhibitors to broadband demand at residential level.

2.6 Research Model

In this research thesis, an extensive study was carried out on various related literatures and journals to uncover 46 (forty six) drivers of broadband demand gap at enterprise level (Obasi and Kalejayi 2013, Horiggan 2009, Prashil Pravin Gareeb and Visvanathan Naicker 2015, Kotelnikov 2007, ITU, UNESCO 2011, Oluwasola and Anastasia 2008, GholamiIn et al., 2008, Beneke 2008, Papacharissi and Zaks 2006, Illoanusi et al., 2005, Olise et al., 2014, Osuagwu et al., 2013, Levy et al., 2002, Akanbi and Akanbi 2012, Lucky and Achebe 2013, Prieger, 2003). Factor Analysis was used to summarize these factors so that relationships and patterns amongst them can be easily interpreted and understood.

The Technology Acceptance Model (TAM) highlights Perceived ease of use and perceived usefulness as the two determinants for accepting and adopting Information Technology components (Davis (1989). In criticism, Goparaju (2013) and Patel et al. (2009) posit that other factors such as cost benefits, technical knowledge and trust must be considered beyond usefulness and ease of use in determining the acceptance and integration of information technology and broadband. Their findings reveal that cost, technical knowledge and perceived usefulness and factors that create demand gap of broadband technology.

On the premise of the theoretical framework identified above, the researcher intend to carry out a further study on those factors that create broadband demand gap at enterprise level (in South Eastern Nigeria); while postulating a model using the multiple regression analysis, that will guide both organizations and further researches in determining factors that create broadband demand gap at enterprise level.

A holistic Constructive Overview of the understudied broadband demand models, critical factors that create broadband demand gap and a clinical chronological empirical data will help in providing a sound and strong foundation for a well-articulated and result oriented data design, analysis and evaluation

The Multiple Regression Model will be of the form:

$$\gamma = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta n X n + \epsilon_1$$

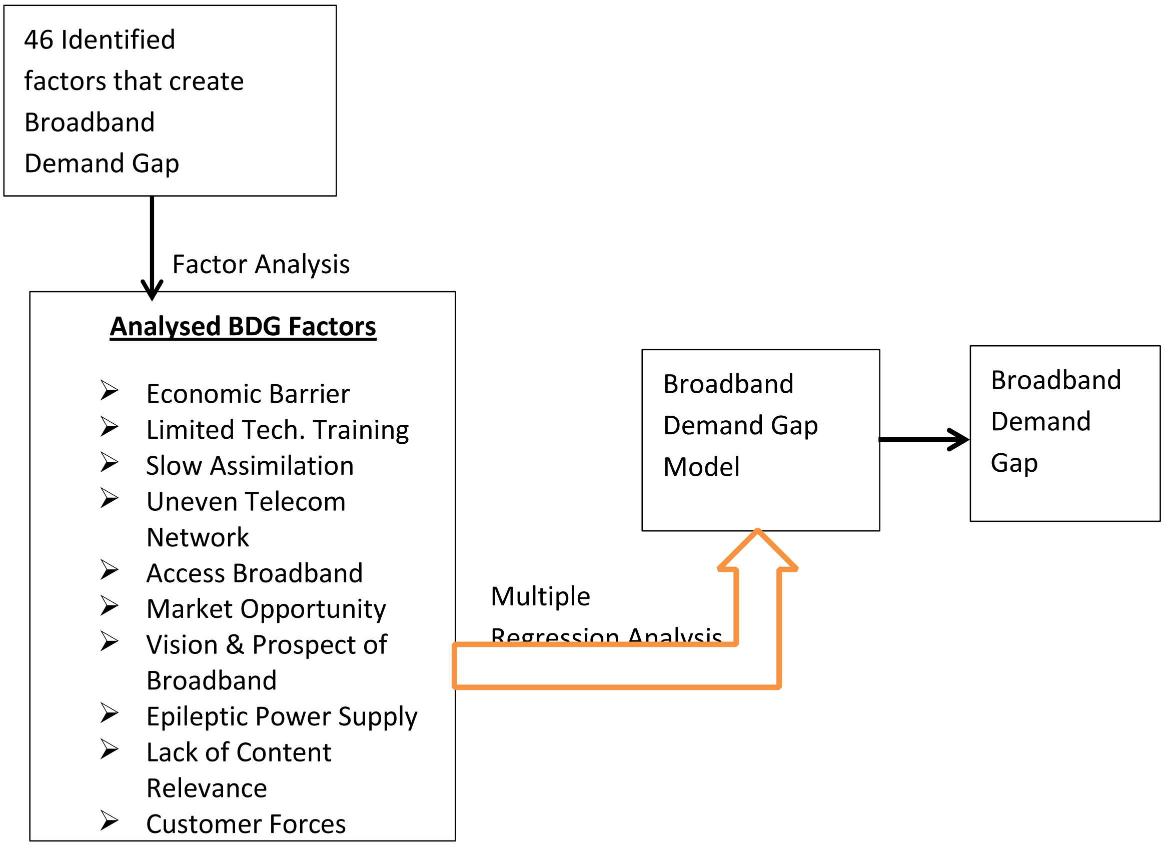


Figure 2.7 Proposed Research Model

CHAPTER THREE

METHODOLOGY

3.1 Research Design

This research work took the form of a survey research of the explanatory type. The researcher is interested in observing what is happening to sample subjects or variables without any attempt to manipulate or control them **(Asika, 1991).** It involves a one- time observation of independent and none manipulate variables. Three approaches exist for conducting explanatory research namely: literature search, experience survey and analysis of insight stimulating examples **(Selltis, 1965)**. In the immediate preceding chapter, past literatures on the subject were reviewed. The requirements of exploratory and explanatory survey will be fulfilled through the use of questionnaire instrument.

3.2 Restatement of Research Problems and Hypothesis

3.2.1 Statement of Problem

According to International Telecommunication Unit statistics (ITU, 2010), the number of people using the internet has considerably increased, from less than 500,000 in 2000 to more than 2billion in 2010. At present in the world more than 30 people in every 100 persons are internet users. Despite this worldwide wave of internet diffusion adoption of broadband connections although increasing, is still far from being a reality for all internet users. At the same time, cross-country disparities in the use of broadband connection are particularly strong, and they also seem to be increasing. More than 23 persons per 100 inhabitants are fixed broadband users in developed countries (5.5 in all Asian countries, 1.9 in all Arab countries and 0.2 in all African countries). Considering mobile broadband connections provides a similar picture, with more than 45% of the population using mobile broadband in developed countries and only around 5% in developing countries.

In Nigeria, broadband access is gradually gaining acceptance but its wide adoption and utilization remain unevenly distributed, lagging considerably among low income groups, the elderly and people living in the rural communities (NNBP, 2013). This work is geared towards identifying these factors affecting broadband adoption and evaluates their effects.

In narrowing down the theoretical framework of the study, the drivers of broadband demand gap at level of SMEs are considered here in relation to their effects and as extracted from the literature review. These drivers are discussed below.

1. The Economic Barrier

The affordability barrier is not only important for individual consumers, but also relevant in the case of SMEs, although this variable tends to be more important in the case of microenterprises. In a survey conducted in Colombia among SMEs, 12.9 % of surveyed firms indicated that they did not have the economic means to pay for broadband service, while 9.3 % would like to buy broadband because of its utility, but found the service pricing to be too high. While the research does not break down the answers by size of firm, broadband adoption numbers help determine that most of the firms mentioning affordability as a barrier are concentrated among microenterprises: broadband penetration among firms with 11–50 employees is 79 %, while adoption among firms with less than 11 employees is only 7 % (National Department of Statistics 2010).

2. Limited Technology Training

The difficulties encountered in recruiting staff with technical skills to select, purchase, and operate ICT infrastructure serves as a critical limitation for adopting broadband. This factor was measured in a survey regarding the difficulty to recruit ICT trained personnel conducted among SME managers in Latin America Katz (2009), also identified the problem in field research conducted in other countries such as Uruguay and Chile. The constraint in recruiting technical personnel is due to the fact that the educational system does not generate enough graduates in ICT-related disciplines. In that context, salary inflation ‘‘prices out’’ SMEs when it comes to attracting graduates, which end up working for large enterprises.

In developing countries, the problem is not exclusive to smaller businesses. South Africa faces a similar situation. In 2012, the country reported an unemployment rate of 25 %, with more than 4.2 million adult citizens actively searching for employment to no avail. While the government attempted to address the situation by ‘‘creating jobs,’’ a more in-depth analysis demonstrated that a lack of qualified workers contributed more to the problem than did a lack of available jobs. In fact, the country’s business organizations reported more than 800,000 vacant positions, the majority of which were found in high-skilled industries such as information technology, engineering, and finance.

A 2012 survey of Malaysian CIOs concluded that the low digital literacy skills of organization executives negatively impacted business capabilities

(Vanson, 2012). The CIOs ‘‘feared senior-level digital illiteracy is causing a lack of market responsiveness, missed business and investment opportunities, poor competitiveness and slower time to market.’’ This sentiment was felt across many Asian markets, where business leaders appeared to fall behind their peers in more developed economies.

3. Slow Assimilation of Broadband

In order to increase efficiency and output, the adoption of information and communication technologies by enterprises requires the introduction of a number of processes and organizational changes. These changes, as well as training and other cultural factors (such as entrepreneurial spirit, willingness to take risks in an organizational transformation), are referred to as the

‘‘accumulation of intangible capital.’’(CGI, 2012). Broadband alone does not have an economic impact. It rather enables the adoption of e-business processes that result in increased efficiency (such as streamlined access to raw materials and management of the supply chain, or better market access). Intangible capital accumulation and the adoption of e-business processes delay the full economic impact of broadband.

This gradual process of technology adoption and assimilation can be studied in the aggregate for economies as a whole. Certain companies, by virtue of the innovativeness of their management and their willingness to transform their enterprises, are the leaders that will initially reap the benefits of ICT (Kotelnikov, 2007).

The second wave of adoption is concentrated on industrial sectors whose structure and value chains tend to result in higher transaction costs. These network- oriented industries are concentrated in financial services,

transportation, or retail distribution sectors. In these industries, complexity costs are so high that, in addition to increasing the number of information workers, they need to adopt technology to improve their productivity. This wave represents a move from firm related adoption drivers to industry structure and economics. It is only in those economies that Jorgenson et al. (2007), call ‘‘IT intensive’’, where the concentration of industrial sectors more prone to adopt ICT is higher, that we can see the macro-impact of ICT on productivity.

Small and medium enterprises tend to adopt broadband in the third wave, after they have been able to make the necessary process and organizational changes needed to assimilate broadband-enabled applications. In light of this effect, these firms will naturally lag in the assimilation of broadband technology. The public policy implications of this effect cannot be understated.

To achieve full economic benefit of broadband deployment, governments need to emphasize the implementation of training programs and, in the case of SMEs, offer consulting services that help firms capture the full benefit of the technology (Kotelnikov, 2007).

4. Uneven Telecommunications Network Deployment

SMEs that operate in urban centers tend to have better access to broadband infrastructure and technological capital, whereas those that operate outside of such areas are marginalized (Broadband Series, 2012).

The fast pace of change in Nigeria’s broadband sector has seen considerable consolidation among players, from over 400 ISPs in 2012 to around 1000 by early 2015. A number of operators from the fixed-wireless and mobile sectors have entered the market. The delivery of broadband services is dominated by mobile services, principally from GSM and 3G networks, though there are a number of WiMAX operators which have found niche markets. The Internet Protocol (IP)-based next generation networks currently being rolled out are enabling converged voice, data/internet and video services. Voice over IP

(VoIP) is carrying the bulk of Nigeria's international voice traffic. The arrival of additional international submarine fibre-optic cables since 2009 (Glo-1, MainOne, WACS and ACE) broke the monopoly held by Nitel via its SAT-3/WASC cable, and continues to revolutionise the market. The cost of international bandwidth has been reduced by up to 90%, while improved domestic fibre cabling has also helped reduce the cost of broadband services for consumers. Supported by the expansion of competing national fibre backbone networks, applications such as e-commerce, online banking and e-payments, e-health, elearning and e-government are rapidly evolving. The government in early 2015 also committed to increasing broadband penetration from about 8% to 36% by 2018. This led to explosive growth of mobile broadband subscriptions; more bandwidth from new international submarine fibre optic cables; rapidly evolving digital media and digital economy; government devising strategy to increase broadband penetration to 36% by 2018 (NCC, 2013).

According to NCC fixed-line voice and data services are only available to a tenth of the population, whereas 3G services (mobile broadband) coverage is very limited in terms of its geographic footprint. Broadband coverage outside metropolitan areas in Nigeria is virtually nonexistent. This is an inhibitor to the broadband demand South East of Nigeria (NCC, 2013).

5. Low Knowledge of Market Opportunity

Full understanding of the market opportunities for broadband is often limited, since it requires industries to think beyond their traditional business models. In just one

example, there is too little incentive for the risk-averse, fragmented electricity industry to invest in the possibilities offered by smart grids. As utilities are not responsible for contributing to national climate change goals, this hampers more rapid deployment of broadband solutions. (ITU,
UNESCO, 2012)

6. Customer Forces

Prashil Pravin Gareeb and Visvanathan Naicker, (2015) states that direct or indirect demands from customers of businesses to interface via electronic means, through advertising, information sharing etc., tend to force SMEs to adopt Broadband Technology. In Nigeria the number of customers that demand for online services varies, it high in the urban cities when compared to rural areas where there is little or no interest in the use of online services.

7. Lack of Content Relevance or Interest

Since broadband is a platform used to access Internet content, applications, and services, the relevance of such content offers an incentive to purchase a subscription. Conversely, the lack of cultural relevance could serve as a barrier to adoption. Cultural relevance could be conceptualized either in terms of content suited to the interests of the adopting population or in terms of language used for interacting with applications/services or consuming content. (Horiggan, 2009). This can be mapped to technological context in terms of applicability to specific organisations.

8. Epileptic Power Supply

Obasi and Kalejayi (2013), irrespective of power sector privatization, Nigerians have continued to lament about the poor state of power supply and the negative impact it is having in their businesses and living. Power Supply affects every sphere of living of which installation and management of telecommunication infrastructure are inclusive. The cost used in running generators to operate business and provide services increases the overhead cost thereby affecting productivity.

9. Lack of Vision and Prospect of Broadband

Without a clear strategy and shared objectives for national broadband development, getting all the pieces of the puzzle together is impossible. A strong vision is needed to anchor ICT policy and frame works, steer investment and unite the various players around a common goal. (ITU, UNESCO, 2012)

10. Inefficient Access Broadband

Gaps in broadband penetration and affordability persist not only among countries, but also between rural and urban areas within a nation. The digital divide remains a stubborn obstacle to progress. By 2010, nearly a quarter of people in developed countries had fixed broadband access, and more than half had access to mobile broadband. The corresponding figures for developing countries are estimated at 4.4% and 5.4% respectively—although penetration is significantly higher than this in urban areas in India, for example. (ITU,
UNESCO, 2011)

3.2.1 Research Hypothesis

H_{01}: The Overall factors have no significant effect on broadband demand gap at enterprise level

H_{a1}: The overall factors have significant effect on broadband demand gap at enterprise level

H_{02}: Each factor has no significant effect on broadband demand gap at enterprise level

H_{a2}: There is significant effect of each factor on broadband demand gap at enterprise level

3.3 Validation of the Instrument

Seltiz, (1979), opined that all data measuring instruments particularly in the social science contain some degree of errors no matter how precise and cautious the effort of the observation. To ensure the validity of the instruments, the researcher subjected the instruments to face-to-face validity by giving it to professional statisticians and scholars. They examined the items contained in the questionnaire and ensure that they were in line with the objectives of the study. The structure and language of the questionnaire were also modified as necessary to reflect their corrections. The design instruments were structured in such a way as to minimize the effect of errors of inconsistency and ambiguity.

3.4 Population of Study and Data Collection Instrument

The sample data was restricted among SMEs in the South East region of Nigeria. This was done because the essence of this research is to get feedback from respondents who has the full grasp of what broadband technology is all about and which response can be used for policy formulation. The data collection instrument used was questionnaire. The primary data used in our analysis were generated from administering a well-structured and standardised questionnaire on the factors that create Broad Band Demand Gap among SMEs in South of Nigeria. The questionnaire is based on Likert five-point ordinal scale (ranging from "Strongly Agree to Strongly Disagree"). **Table 3.1: Likert five grade scales**

Views	**Grade points**
Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

A total of 400 questionnaires were randomly distributed to these target population; 346 questionnaires were correctly filled and returned. These alternative set of answers, were outlined in five grade points (1-5); with 1 being

Strongly Disagree and 5 being Strongly Agree.

Based on the administered questionnaires, relevant information about the SMEs which include type of organization, job title, job type, educational status, etc. were extracted. A pilot survey of 50 questionnaires was randomly distributed to IT experts that have adopted broadband technology in their SMEs. The data were collated, analyzed and evaluated to ascertain response level of respondents and consistency of result before embarking of the main survey.

3.5 Sampling Design and Procedure

A sample is a representative part of a population. If we want to make inferences about a population, based on observations made upon a sample, we need to develop a theory which relates our sample statistics to the corresponding population parameters (Sam, 1990). More precisely, every possible sample of a given size has an equal chance of being drawn from a population. According to Nworuh G.E (2004), a good sample must be a good representative of the population and this is directly related to:

Absence of systematic variance or sampling bias which is caused by some known or unknown influences that cause the scores to tend more to one side than the other. Precision by which we ensure that random fluctuations or sampling error is minimal.

A population size of about 210456 was targeted; this reflects the number of SMEs in the South East of Nigeria as at 2017 by data request gotten from National Bureau of Statistic. Since this number is an unrealistic target, we calculated using a 95% confidence level (5% significance interval), a realistic sample target size that was used in this research work. This sample size equate to the number of questionnaire that we distributed.

In carrying out factor analysis on these 46 factors that create broadband demand gap at enterprise level, an initial pilot survey was designed and distributed to

100 respondents. The respondents were chosen to cut across the South Eastern States in Nigeria used in the research; care was ensured to identify respondents with good knowledge of broadband technology to provide a high degree of accuracy in the data collected. Out of the 100 pilot surveys distributed, all the 100 surveys were returned. This represents a 100% return from the experts.

In order to calculate the sample size for questionnaire distribution, the Yamane Taro (1967:886) formula for finite population was applied as stated below:

$$n = \frac{N}{1+N\,(e)^2} \qquad \text{Equation 3.1}$$

Where

1 = Constant Value *N = Population size* *n = Sample Size*

$e = co - efficient\ of\ confidence\ or\ margin\ of\ error\ or\ level\ of\ confidence$

$$n = \frac{N}{1 + N\,(e)^2}$$

$$n = \frac{210456}{1 + 210456\,(0.05)^2}$$

n = 400

What this implies is that a total of 400 respondents will be targeted in this research work. The questionnaire was formulated in a simple manner for clarity sake base in analyzing factors which create broadband demand gap at enterprise level in the South East of Nigeria which was the objective of this research. It was further prepared in multiple choice form for the purpose of providing alternative sets of answers that will best represent the actual perception and situation on ground.

3.6 Method of Data Analysis

Tsun et al. (2008) defined data analysis as those techniques with which the investigator extracts from the data, information that was not apparently there before and which would enable a summary description of the subject studied to be made. The data for this project is generated from primary and secondary source. The primary sources of data for this research work consist of oral interviews and use of questionnaire. The secondary data was derived from extensively reviewing related literature, books and journals.

In this study, the instrument of data analysis used include

1. Factor Analysis.
2. Multiple Regression Analysis.

3.6.1 Factor Analysis

Factor analysis operates on the notion that measurable and observable variables can be reduced to fewer latent variables that share a common variance and are unobservable, which is known as reducing dimensionality (Bartholomew, Knott, & Moustaki, 2011). These unobservable factors are not directly measured but are essentially hypothetical constructs that are used to represent variables (Cattell, 1973).

Why Use Factor Analysis?

Large datasets that consist of several variables can be reduced by observing 'groups' of variables (i.e., factors) – that is, factor analysis assembles common variables into descriptive categories. Factor analysis is useful for studies that involve a few or hundreds of variables, items from questionnaires, or a battery of tests which can be reduced to a smaller set, to get at an underlying concept, and to facilitate interpretations (Rummel, 1970). It is easier to focus on some key factors rather than having to consider too many variables that may be trivial, and so factor analysis is useful for placing variables into meaningful categories. Many other uses of factor analysis include data transformation, hypothesis-testing, mapping, and scaling (Rummel, 1970).

What are the Requirements for Factor Analysis?

To perform a factor analysis, there has to be univariate and multivariate normality within the data (Child, 2006). It is also important that there is an absence of univariate and multivariate outliers (Field, 2009). Also, a determining factor is based on the assumption that there is a linear relationship between the factors and the variables when computing the correlations (Gorsuch, 1983). A factor with 2 variables is only considered reliable when the variables are highly correlated with each another ($r > .60$) but fairly uncorrelated with other variables.

The recommended sample size is at least 300 participants, and the variables that are subjected to factor analysis each should have at least 5 to 10 observations (Comrey & Lee, 1992).

Likert Scale

Berbard Philip (in:Asika, 1991), defined scale as a 'procedure for the assignment of numbers (or other symbols) to a property of objects in order to impart some of the characteristics of numbers to the properties in question. The assignment of the numbers depends on the individual's or object's possession of what the scale is expected to measure.

The type of scale used in this research is called summated rating scale of Likert type scale. Likert scale measures the intensity or degree of agreement by the respondent to a statement that describes a situation, phenomenon, item or a treatment. Likert scale varies from 3 points to as high as 7 points. The commonest Likert scale has 5 points (Asika, 1991).

The advantages of Likert scale are as follows:

a. The scale easily transforms feelings into a seemingly interval scale which is amenable to statistical analysis.

b. It is flexible and consequently can be used to measure in minute detail, the degree of intensity of feeling or attitudes.

c. Likert scale, though an elegant attitudinal measuring scale, it is very easy to construct and also easy to interpret.

For the purpose of this study, this will be used

Strongly Disagree (SD)	**Disagree (D)**	**Neither Agree nor Disagree (N)**	**Agree (A)**	**Strongly Agree (SA)**
1	2	3	4	5

The Likert summated rating will be used to elicit responses to questions, capture information and measure data dealing with the extent of agreement or disagreement on the variables namely:

Considering the large volume of data to be gathered, and the need for accuracy and precision in calculations, the study will avoid the use of manual approach to the analysis. The methods of factor analysis will therefore be used to establish the relationship between variables (factors affecting broadband diffusion) and their aggregate and disaggregate effect on broadband diffusion.

46 variables creating broadband demand gap among SMEs in South of Nigeria were identified from existing literature. Factor analysis – a data reduction technique, was used to take that large number of observations and qualitative variables, and resolve them

into distinct pattern of occurrence. It looks at pattern in relationships, and group them based on certain similarities. The correlated variables were reduced into smaller set of uncorrelated factor scores.

In determining the number of factors to retain from the 10 correlated and continuous variables, three procedures were adopted:

Kaiser's criterion

One of the most commonly used techniques is known as Kaiser's criterion, or the eigenvalue rule. Using this rule, only factors with an eigenvalue of 1.0 or more are retained for further investigation. The eigenvalue of a factor represents the amount of the total variance explained by that factor. This study will considered only those factors with Eigen values of 1 or greater than 1.

Scree Test

Another approach that can be used is Catell's scree test (Catell 1966). This involves plotting each of the eigenvalues of the factors and inspecting the plot to find a point at which the shape of the curve changes direction and becomes horizontal. Catell recommends retaining all factors above the elbow, or break in the plot, as these factors contribute the most to the explanation of the variance in the data set.

Parallel Analysis

Parallel analysis involves comparing the size of the eigenvalues with those obtained from a randomly generated data set of the same size. Only those eigenvalues that exceed the corresponding values from the random data set are retained. This approach to identifying the correct number of components to retain has been shown to be the most accurate, with both Kaiser's criterion and

Catell's scree test tending to overestimate the number of components (Hubbard & Allen 1987; Zwick & Velicer 1986).

3.6.2 Multiple Regression and Correlation Analysis

This method would be able to capture analysis which could not be carried out by the use of percentage or averages. The multiple regression measures the relationship existing between three or more variables. It also helps to examine the nature of the relationship between a given dependent variable and two or more independent variables in a regression function.

The Analysis of variance is a technique of partitioning the total variation of our data into useful components, which provide means of measuring different source of variation. However, the procedures for testing the equality of three or more means were done via SPSS statistical tool to ascertain the combine effect of the identified factors that create broadband demand gap in South East of Nigeria. They also help to ascertain the tenability of the null hypothesis formulated for study at 0.05 level of probability (Nworuh, 2014).

Table 3.2: Variance Table

Source of Variation	Sum of square	D,F	M,S	F-ratio
Regression groups	SSR	K	MSR = SSR/K	F =MSR/MSE
Error	SSE=SST-SSR $= \sum y^2(1-R^2)$	n-k-1	MSE = SSE/n-k-1	
Total	SST = y^2	n-1	-	-

The following calculations are carried out in ANOVA multiple regression.

SSR = Sum of squares of Regression

SSE = Sum of square Error

SST = Sum of Squares of Total variation (Y) or dependent variables.

K = Number of independent Variables ($X_{1\text{--}}$ X_k) n = Number of observation

In multiple regressions, the ***F-test*** **statistic (F=MSR/MSE)** is used in testing the equality of group (respondent) means which under the null hypothesis Ho has F (K, n-k-1) F-distribution critical value based on the chosen α level with k degrees of freedom DFR and DFE.

The null hypothesis states that $Ho_1 = H_{A2} = ... = H_k = 0$,

And the alternative hypothesis simply states that at least one of the parameters large values of the test statistic provide evidence against the null hypothesis.

$H_j \neq 0$, j = 1, 2, ,,, *k*.

Ho is accepted at the significant level if F < Fi – α (k, n-k-1) otherwise, H_o is rejected in favour of H_A: F1-α (k, n-k-1) from the statistical table.

However, the F test does not indicate which of the parameter $Hs_j \neq$ is not equal to zero, only that at least one of them is linearly related to the response variable.

$\gamma = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta n X n + \epsilon_1$ Equation 3.2

γ = Dependent variable

$X_1, X_2, \ldots, Xn$ are the independent variables

β_o = a constant value of γ when all X values are 0

$\beta_1, \beta_2, \ldots, \beta n$ are net regression coefficients

For instance, β_o measures the change in X_1 while holding the other values constant.

ϵ_1

= independent and normally distributed random error term with mean zero

While correlation analysis will be used to determine the degree of relationship between the dependent and independent variables stated above. In the analysis there exists a correlation coefficient which measures the strength and direction between the variables. Correlation coefficient can range from -1.00 to +1.00. A correlation of 1.00 indicates that changes in one variable are always matched by changes in the other or a correlation of -1.00 shows that increase in one variable is matched by decrease in the other variables. For a simple regression analysis, the correlation coefficient between two variables can be computed using the equation

Coefficient Of Correlation R = $\sqrt{\frac{n\,(\sum xy) - (\sum x)\,(\sum y)}{N(\sum x^2) - (\sum x)^2\; n(\sum y^2) - (\sum y)^2}}$ Equation 3.3

Where γ is the dependent variable, X is the independent variable and n is the number the number of paired observations.

The square of the correlation coefficient r^2 provides a measure of percentage of variability in the value of γ that is explained by the independent variables, it is called the coefficient of determination. The possible value of r^2 ranges from 0 to 1.00. The closer r^2 is to 1.00 the closer the percentage of explained variation. A high value of r^2, say 0.8 or more would indicate that the independent variables are good predictors of the dependent variable. A value of say 0.25 or less would indicate a poor indicator, and a value of 0.25 to 0.8 would indicate a moderate predictor.

For the purpose of this study:

X1 Economic Barrier

X2 Limited Technology Training

X3 Slow Assimilation of Broadband

X4 Uneven Telecommunication Network Deployment

X5 Low Knowledge of Market Opportunity

X6 Customer Forces

X7 Lack of Content Relevance or Interest

X8 Epileptic Power Supply

X9 Vision and Prospect of Broadband

X10 Inefficient Access to Broadband

The aim is to statistically and quantitatively establish the contribution of each of the identified factors affecting broadband gap at enterprise level in the South

East of Nigeria.

CHAPTER FOUR

ANALYSIS OF RESULTS AND DISCUSSION

4.1 Introduction

This chapter focuses on the presentation, analysis and description of data collected based on the feedback obtained from the copies of the questionnaire distributed. The result was presented in order of the research questions and hypothesis. Multiple regression analyses, analysis of variance and Pearson's Product Moment Correlation were used to analyze the data collected.

4.2 Factor Analysis Result Interpretation

Table 4.1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	**.701**
Bartlett's Test of Sphericity Approx. Chi-Square	**656.941**
df	**45**
Sig.	**.000**

46 variables that create broadband demand gap were subjected to principal components analysis (PCA) using SPSS version 17. Prior to performing PCA, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of .3 and above.

The Kaiser-Meyer-Olkin value was .701, exceeding the recommended value of .6 (Kaiser 1970, 1974) and Bartlett's Test of Sphericity (Bartlett 1954) reached statistical significance (**$p < 0.5$**), supporting the factorability of the correlation matrix as shown below in Table 4.1

Table 4.2 Initial Component Matrix[a]

	Component											
	1	2	3	4	5	6	7	8	9	10	11	12
Nature of Business	.750		-.400					-.329				
Cost of router	.742		-.414					-.323				
Vandalization of power stations	.742		-.414					-.323				
Quality of service	.742		-.414					-.323				
Shared values and norms	.699		-.345									
Overall cost saving	.680		-.310									
Irregularities in power rate charge	.660		-.323									
Installed capacity of operators	.660		-.323									
Technical skills and expertise	.590					-.306	.382	.471				

Security	.590					-.306	.382	.471				
Relationship b/w operators & SMEs	.578						.452	.446				
Scarce spectrum	.509		-.322		-.475							
Language skills	.509		-.322		-.475							
Absorptive capacity	.506							.466				
Cost of training staff	.492											
High cost of energy	.398				.348					.367		-.374
3G services available in urban areas	.323	.733								-.301	.376	
Lack of technological advancement	.323	.733								-.301	.376	
Economic environment	.323	.733								-.301	.376	
High cost of fuel for generator set		.664										
Inefficient LTE services		.650			.305				.501			

High cost of web hosting		.650			.305				.501			
Limited knowledge of market importance		.650			.305				.501			
Insufficient knowledge of online business	.443	.612							-.463			
Behavior and attitude	.443	.612							-.463			
Customer participation	.443	.612							-.463			
Risk sharing/management	.474		.661	-.322								
Investment climate	.441		.580									
Bandwidth size	.441		.580									
Understanding of broadband technology	.472	-.358	.565	-.418								
Team leader competence & expertise	.472	-.358	.565	-.418								

High cost of personal computers	.472	-.358	.565	-.418								
Inadequate power supply			.439	.306								
Quality of information delivery	.330		.401	.763								
Requirement uncertainty	.330		.401	.763								
High technology cost	.330		.401	.763								
Management level of knowledge	.345		.352	.632								
Running cost	.302				.745							
Service charge	.302				.745							
Trust	.402					.657				-.369		
Nature of Business	.402					.657				-.369		
Cost of router	.317					.555		.473				.403
Vandalization of power stations	.317					.555		.473				.403
Quality of service		.517			-.354		.623					

Shared values and norms		.517			-.354		.623					
Overall cost saving		.517			-.354		.623					

Extraction Method: Principal Component Analysis.

a. 12 components extracted.

Table 4.2 shows the unrotated loadings of each of the factors and the default retained factors. We see items load strongly on the first ten factors, and only three number of items load on factors 11 to 12 components. The strong interrelationship among the first 10 factors tells us that these 10 factors have the strongest and the best interrelationships among these different items, so we want to stick with the number of factors with strongest and best interrelationship.

This further confirms that the first 10 items are probably the most appropriate.

Table 4.3: Monte Carlo PCA Parallel Analysis

Monte Carlo PCA for Parallel Analysis

Version .

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Number of variables: 46

Number of subjects: 369

Number of replications: 100

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Eigenvalue #	Random Eigenvalue	Standard Dev
1	1.7570	.0449
2	1.6767	.0372
3	1.6203	.0341
4	1.5625	.0286
5	1.5188	.0280
6	1.4757	.0197
7	1.4407	.0209
8	1.4022	.0182
9	1.3647	.0197
10	1.3294	.0192
11	1.2982	.0183
12	1.2650	.0178
13	1.2370	.0159

1.2066	.0159
1.1761	.0160
1.1479	.0144
1.1213	.0154
1.0963	.0155
1.0714	.0132
1.0451	.0137
1.0185	.0137
0.9960	.0130
0.9716	.0122
0.9477	.0121
0.9230	.0151
0.9000	.0127
0.8776	.0129
0.8569	.0129
0.8337	.0128
0.8111	.0125
0.7912	.0125
0.7697	.0133
0.7488	.0142
0.7269	.0129
0.7064	.0150
0.6866	.0116

37	0.6660	.0119			
38	0.6447	.0118			
39	0.6232	.0130			
40	0.6013	.0142			
41	0.5766	.0145			
42	0.5534	.0150	43	0.5298	.0142
44	0.5063	.0149			
45	0.4762	.0189			
46	0.4439	.0203			

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Monte Carlo PCA for Parallel Analysis

****

Twelve factors have been extracted when considering Eigen values greater than 1; and realistically, we can further reduce these numbers of factors into a smaller number. As a result Monte Carlo PCA was used as a quality control check to cut down the number of retained factors. We compared the output from Initial Total Variance explained to the parallel analysis output. The idea is to select only those factors whose Eigen values in Initial Total Variance Explained in **Table 4.2** are greater than the random Eigen values from the parallel analysis of **Table 4.3**. Comparing the two results, only 10 factors have

Total initial Eigen values greater, so we should ideally retain 10 factors. The 2 comparisons used above seem to agree with each other very well. To this end we carried out a second rotation using Direct Oblimin, forcing the factor analysis to load and retain only 10 factors. Direct Oblimin rotation technique is used because our 46 variables are quite correlated and somewhat similar. For Uncorrelated variables, Varimax rotation should be used.

Table 4.4 Comparing the Actual Eigen Value from PCA and Criterion Value from Parallel Analysis

Component Number	Actual Eigen Value from PCA	Criterion Value From Parallel Analysis	Decision
01	10.067	1.7570	Accept
02	6.346	1.6767	Accept
03	4.762	1.6203	Accept
04	3.649	1.5625	Accept
05	2.795	1.5188	Accept
06	2.679	1.4757	Accept
07	2.542	1.4407	Accept
08	2.467	1.4022	Accept
09	1.841	1.3647	Accept
10	1.417	1.3294	Accept
11	1.255	1.2982	Reject
12	1.075	1.2650	Reject

From the comparison table 4.4 above, it could be observed that the 10 retained factors have Actual Eigen values from PCA greater than the random Eigen values from the parallel analysis.

Total 4.5 Final Total Variance Explained

Extraction Method: Principal Component Analysis.

No	Components	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
		Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	Nature of Business	10.067	21.885	21.885	10.067	21.885	21.885	7.617
2	Cost of router	6.346	13.795	35.680	6.346	13.795	35.680	2.924
3	Vandalization of power stations	4.762	10.353	46.033	4.762	10.353	46.033	5.968
4	Quality of service	3.649	7.933	53.966	3.649	7.933	53.966	4.845
5	Shared values and norms	2.795	6.076	60.042	2.795	6.076	60.042	2.779
6	Overall cost saving	2.679	5.824	65.866	2.679	5.824	65.866	3.680
7	Irregularities in power rate charge	2.542	5.527	71.393	2.542	5.527	71.393	3.698
8	Installed capacity of operators	2.467	5.363	76.756	2.467	5.363	76.756	5.596
9	Technical skills and expertise	1.841	4.002	80.758	1.841	4.002	80.758	5.110
10	Security	1.417	3.080	83.838	1.417	3.080	83.838	5.387
11	Relationship b/w operators & SMEs	1.255	2.728	86.567				

12	Scarce spectrum	1.075	2.337	88.904				
13	Language skills	.976	2.121	91.025				
14	Absorptive capacity	.832	1.810	92.835				
15	Cost of training staff	.700	1.522	94.357				
16	High cost of energy	.550	1.195	95.552				
17	3G services available in urban areas	.443	.964	96.516				
18	Lack of technological advancement	.404	.878	97.394				
19	Economic environment	.371	.806	98.200				
20	High cost of fuel for generator set	.301	.654	98.853				
21	Inefficient LTE services	.257	.558	99.412				
22	High cost of web hosting	.166	.362	99.773				
23	Limited knowledge of market importance	.078	.169	99.942				

24	Insufficient knowledge of online business	.026	.058	100.000					
25	Behavior and attitude	3.565E-16	7.751E-16	100.000					
26	Customer participation	1.993E-16	4.332E-16	100.000					
27 28	Risk sharing/management	1.715E-16	3.728E-16	100.000					
	Investment climate	1.080E-16	2.348E-16	100.000					
29	Bandwidth size	9.352E-17	2.033E-16	100.000					
30	Understanding of broadband technology	7.299E-17	1.587E-16	100.000					
31	Team leader competence & expertise	4.556E-17	9.903E-17	100.000					
32	High cost of personal computers	2.985E-17	6.489E-17	100.000					
33	Inadequate power supply	7.886E-18	1.714E-17	100.000					
34				100.000					

	Quality of information delivery	-5.489E-18	-1.193E-17					
35	Requirement uncertainty	-3.257E-17	-7.080E-17	100.000				
36	High technology cost	-4.146E-17	-9.012E-17	100.000				
37	Management level of knowledge	-4.978E-17	-1.082E-16	100.000				
38	Running cost	-8.138E-17	-1.769E-16	100.000				
39	Service charge	-9.877E-17	-2.147E-16	100.000				
40	Trust	-1.118E-16	-2.430E-16	100.000				
41	Nature of Business	-1.478E-16	-3.214E-16	100.000				

42 43	Cost of router	-1.670E-16	-3.629E-16	100.000				
	Vandalization of power stations	-1.947E-16	-4.233E-16	100.000				
44	Quality of service	-2.692E-16	-5.851E-16	100.000				
45	Shared values and norms	-3.239E-16	-7.042E-16	100.000				
46	Overall cost saving	-2.367E-15	-5.145E-15	100.000				

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Table 4.5 above shows the Final Total Variance explained after a second rotation, with factor analysis retaining only 10 factors. Now, we have 83.838% variance explained by the 10 factors as against the 88.904% explained by the initial 12 factor solution. The percentage variance explained is still very high and okay

Table 4.6 Component Correlation Matrix

Component	1	2	3	4	5	6	7	8	9	10
1	1.000	-.181	.175	.137	.048	.136	.024	.364	.180	.136
2	-.181	1.000	-.049	.002	.036	-.060	.157	-.104	.095	.135
3	.175	-.049	1.000	.183	.071	.179	-.033	.129	-.026	.116
4	.137	.002	.183	1.000	.044	.134	.006	.183	.035	.204
5	.048	.036	.071	.044	1.000	.021	-.044	.015	.002	-.075
6	.136	-.060	.179	.134	.021	1.000	.052	.096	.069	.179
7	.024	.157	-.033	.006	-.044	.052	1.000	.020	.183	.166

8	.364	-.104	.129	.183	.015	.096	.020	1.000	.123	.116
9	.180	.095	-.026	.035	.002	.069	.183	.123	1.000	.074
10	.136	.135	.116	.204	-.075	.179	.166	.116	.274	1.000

Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.

Component correlation matrix on Table 4.6 shows the strength of the relationship between the 10 retained factors. We see from the table that correlations among the 10 factors are quite low. Only two of them loaded above the threshold of 0.3, meaning that they are very independent of each other and does not have the issue of multicollinearity. Since none of the factors are strongly correlated among themselves, we won't find discrepancies in our

result.

Table 4.7 Pattern Matrix[a]

		Component

		1	2	3	4	5	6	7	8	9	10
15	Cost of training staff	.970									
32	High Cost of personal computers	.970									
46	Payment plan	.970									
02	Cost of router	.966									
36	High technology cost	.735									
19	Economic environment	.735									
06	Overall cost saving	.659									
13	Language skills		.565								
30	Understanding of broadband tech.		.565								
44	Training		.565								
09	Technical skills and expertise		.416								
45	Cultural intelligence			.964							
31	Team leader competence & expertise			.964							
14	Absorptive capacity			.964							

01	Nature of Business			.949							
35	Requirement uncertainty			.770							
18	Lack of technological advancement			.770							
05	Shared values and norms			.433							
04	Quality of service				.995						
34	Quality of information delivery				.995						
17	3G services available in urban areas				.995						
21	Inefficient LTE services				.806						
08	Installed capacity of operators				.471						
23	Limited knowledge of market importance					.874					

37	Management level of knowledge					.874					
24	Insufficient knowledge of online bus	.325	-.413			-.491					
38	Running cost	.325	-.413			-.491					
22	High cost of web hosting		-.326			.454					
26	Customer participation						.841				
40	Trust						.841				
25	Behavior and attitude						.775				
39	Service charge						.775				
28	Investment climate							.981			
11	Relationship b/w operators & SMEs							.981			
42	Application							.981			
16	High cost of energy								.975		
33	Inadequate power supply								.975		

03	Vandalization of power stations								.970		
20	High cost of fuel for generator set								.747		
07	Irregularities in power rate charge	.410							.549		
41	Business modernization									.976	
27	Risk sharing/management									.976	
10	Security									.976	
43	Regulatory and demographic changes										.969
12	Scarce spectrum										.969
29	Bandwidth size										.969

Extraction Method: Principal Component Analysis.

Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 23 iterations.

Pattern matrix on table 4.7 shows the factor loading of each of the items. What we did was to look for and group the higher loadings on each of the 10 factors.

The top 10 items and their scores loaded on each factor are summarized below:

Table 4.8: Factor Scores and Summarised Factors that affect Broadband Demand gap

Factor No:	Items	Scores	Summarised Broadband Demand Gap Factors
1	Cost of training staff High Cost of personal computers Payment plan Cost of router High technology cost Economic environment Overall cost saving Insufficient knowledge of online business Running cost Irregularities in power rate charge	.970 .970 .970 .966 .735 .735 .659 .325 .325 .410	Economic Barrier
2	Language skills Understanding of broadband tech. Training Technical skills and expertise Insufficient knowledge of online bus	.565 .565 .565 .416 -.413	Limited Technological Training

	Running cost High cost of web hosting	-.413 -.326	
3	Cultural intelligence Team leader competence & expertise Absorptive capacity Nature of Business Requirement uncertainty Lack of technological advancement Shared values and norms	.964 .964 .964 .949 .770 .770 .433	Slow Assimilation of Broadband
4	Quality of service Quality of information delivery 3G services available in urban areas Inefficient LTE services	.995 .995 .995 .806	Uneven Telecom Network Deployment
	Installed capacity of operators	.471	
5	Limited knowledge of market importance Management level of knowledge Insufficient knowledge of online bus Running cost High cost of web hosting	.874 .874 -.491 -.491 .454	Low Knowledge of Market Opportunity

6	Customer participation Trust Behavior and attitude Service charge	.841 .841 .775 .775	Customer Forces
7	Investment climate Relationship b/w operators & SMEs Application	.981 .981 .981	Lack of Content Relevance or Interest
8	High cost of energy Inadequate power supply Vandalization of power stations High cost of fuel for generator set Irregularities in power rate charge	.975 .975 .970 .747 .549	Epileptic Power Supply
9	Business modernization Risk sharing/management Security	.976 .976 .976	Lack of Vision and Prospect of Broadband
10	Regulatory and demographic changes Scarce spectrum Bandwidth size	.969 .969 .969	Inefficient Access to Broadband

Table 4.9Communalities

	Initial	Extraction

Nature of Business	1.000	.932
Cost of router	1.000	.944
Vandalization of power stations	1.000	.950
Quality of service	1.000	.953
Shared values and norms	1.000	.385
Overall cost saving	1.000	.648
Irregularities in power rate charge	1.000	.738
Installed capacity of operators	1.000	.469
Technical skills and expertise	1.000	.598
Security	1.000	.933
Relationship b/w operators & SMEs	1.000	.978
Scarce spectrum	1.000	.939
Language skills	1.000	.847
Absorptive capacity	1.000	.923
Cost of training staff	1.000	.948
High cost of energy	1.000	.948
3G services available in urban areas	1.000	.953
Lack of technological advancement	1.000	.728
Economic environment	1.000	.804
High cost of fuel for generator set	1.000	.710
Inefficient LTE services	1.000	.686
High cost of web hosting	1.000	.477

Limited knowledge of market importance	1.000	.861
Insufficient knowledge of online business	1.000	.807
Behavior and attitude	1.000	.772
Customer participation	1.000	.812
Risk sharing/management	1.000	.933
Investment climate	1.000	.978
Bandwidth size	1.000	.939
Understanding of broadband technology	1.000	.847
Team leader competence & expertise	1.000	.923
High cost of personal computers	1.000	.948
Inadequate power supply	1.000	.948
Quality of information delivery	1.000	.953
Requirement uncertainty	1.000	.728
High technology cost	1.000	.804
Management level of knowledge	1.000	.861
Running cost	1.000	.807
Service charge	1.000	.772
Trust	1.000	.812

Business modernization	1.000	.933
Application	1.000	.978
Regulatory and demographic changes	1.000	.939
Training	1.000	.847
Cultural intelligence	1.000	.923
Payment plan	1.000	.948

Extraction Method: Principal Component Analysis.

Table 4.9 describes how much of the variance in each item was explained, and how well each item represented in the Total Explained Variance Table. Low value (usually below 0.3) on an item means that the item does not fit well with other items in the component. Items with low loading should also show low loading in the pattern matrix table, while those with high loading will give a high loading in the pattern matrix table.

The items we have chosen and used in formulating our factors that create broadband demand gap at enterprise level are those with the highest loadings in the Communality table. This means that our result is as accurate as possible.

4.3 Model Estimation and Hypothesis Testing

4.3.1 Testing the strength of Independent Variables correlation combined with the Dependent variable

Table 4.10 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.971[a]	.944	.942	.72545

a. Predictors: (Constant), X10, X5, X8, X7, X3, X2, X6, X4, X9, X1

b. Dependent Variable: Y

Source SPSS 17

From table 4.11 above, the study found out that the independent variables combined were in a relationship with the dependent variable of 0.971 which is a very strong relationship. The R Square value tells us how much of the variance in the dependent variable is explained by the model (the predictors). Explicitly, it explains how much the independent variables explain the dependent variable. What this means is that our model, using **Economic Barrier, Limited Technological Training, Slow Assimilation of Broadband, Uneven Telecommunication Network Deployment, Low Knowledge of Market**

Opportunity, Customer Forces, Lack of Content Relevance/Interest, Epileptic Power Supply, Lack of Vision and Prospect of Broadband, Inefficient Access to Broadband explains about 94.4% of the variance in **Factors Creating Broadband Demand Gap at Enterprise Level**. This is a very high percentage. It shows that much of the independent variables (Economic Barrier, Limited Technological Training, Slow Assimilation of Broadband, Uneven Telecommunication Network, Market Opportunity, Customer Forces, Lack of Content Relevance/Interest, Power, Lack of Vision and Prospect of Broadband, Inefficient Access to Broadband) explain the dependent variable

(Broadband Demand Gap); and only 5.6% is probably explained by other things. This indicates that our model is a good fit in determining the dependent variable.

Sometimes, the R squared coefficient could be a bit overestimated. It is therefore best to report the adjusted R Squared value. The adjusted R Square statistics corrects this over-estimation in the R Square value to provide a better estimate of how much the independent variables predicts and explains the dependent variable. In this case, it is 94.2%.

Table 4.11 ANOVA[b]

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	3156.508	10	315.651	599.778	.000[a]
Residual	188.408	358	.526		
Total	3344.916	368			

a. Predictors: (Constant), X10, X5, X8, X7, X3, X2, X6, X4, X9, X1

b. Dependent Variable: Y Source SPSS 17

To assess the statistical significance of our result, we ask the following; is the model a statistical significant predictor of the outcome? Does it make accurate predictions in the way we can say this is a true prediction of what happens in the population? Table 4.11 represents the ANOVA report on the general model for Broadband Demand Gap. In this ANOVA table, we have an outcome with the Probability value less that 0.05; we would thus say that there is a statistical significance for this model. Thus, the combination of all the variables significantly predicts the dependent variable ($F=599.778$; $P=0.000<0.05$). We thus conclude from this model that the collective Broadband Demand Gap Factors (Economic Barrier, Limited Technological Training, Slow Assimilation of Broadband, Uneven Telecommunication Network, Market Opportunity, Customer Forces, Lack of Content Relevance/Interest, Power, Lack of Vision and Prospect of Broadband, Inefficient Access to Broadband) contributes critically to **Broadband Demand Gap in the South East of Nigeria at**

Enterprise Level. It indicates that the specified model and variables are good fit in explaining the factors that create Broadband Demand Gap at enterprise Level in South East of Nigeria.

4.3.2 Testing for relative contributions of the individual independent variables

Table 4.12 Coefficients[a]

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.

1	(Constant)	19.165	.038		507.482	.000
	X1	2.912	.042	.966	68.745	.000
	X2	.271	.040	.090	6.839	.000
	X3	.216	.040	.072	5.445	.000
	X4	-.148	.040	-.049	-3.706	.066
	X5	.243	.038	.081	6.354	.000
	X6	-.075	.039	-.025	-1.914	.056
	X7	.003	.039	.001	.071	.943
	X8	.076	.041	.025	1.846	.000
	X9	-.084	.042	-.028	-2.013	.045
	X10	-.008	.043	-.003	-.183	.855

a. Dependent Variable: Y **Source SPSS**

The required Regression Model is expressed as:

$\gamma = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta n X n + \epsilon_1$ ……………………… Eq. 4.1

From table 4.27 above,

β_o = 19.165; β_1 = 2.912; β_2 = 0.271; β_3 = 0.216; β_4 = -.146; β_5 = 0.243; β_6 =

-0.075; β_7 = .003; β_8 = 0.076; β_9 = -0.084; β_{10} = -0.008

Therefore the estimated (fitted) regression model is:

$\gamma = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 +$

$\beta_9 X_9 + \beta_{10} X_{10} + \epsilon_1$ .... Eq. 4.2

The coefficient table shown in table 4.13 evaluates each of the independent variables. We want to know which of the variables in the model contributed most of the prediction of the outcome (Dependent variable). The beta values in the unstandardized coefficient will be used to derive the multiple regression model as shown in equation 4.2 above. The standardized beta value means these values of the variables under the unstandardized beta have been converted to the same scale so that we can easily compare them. From table 4.13, the result shows that independent variable X_1 have the highest coefficient value, followed by X_2, then X_5, X_3, $X_{8,}$ X_7, X_{10}, $X_{6,}$ X_9, and lastly X_4. This means that **Economic Barrier ($\boldsymbol{\beta_1}$ = 2.912, t = 68.745, P<0.05)** makes the strongest critical contribution to creating Broadband demand Gap. Next, **Limited Technological Training** (**$\boldsymbol{\beta_2}$ = 0.076, t = 6.839, P<0.05)** makes the next strongest factor in creating Broadband Demand Gap. **Market Opportunity** (**$\boldsymbol{\beta_5}$= 0.243 t = 6.354, P<0.05)** makes the third strongest factor in creating Broadband Demand Gap. **Slow Assimilation of Broadband** (**$\boldsymbol{\beta_3}$ = 0.216, t = 5.445, P<0.05)** makes the fourth strongest contribution in creating Broadband Demand Gap. **Epileptic Power** (**$\boldsymbol{\beta_8}$ = 0.216, t = 1.846, P<0.05)** makes the fifth strongest critical contribution in creating Broadband Demand Gap. What this means is that Economic Barrier, Limited Technological Training, Market Opportunity, Slow Assimilation of Technology, Epileptic Power respectively affects Broadband Demand Gap at enterprise level in the South East of Nigeria by **291.2%, 27.1%,**

24.3%, 21.6% and **7.6%** The resulting multiple regression equation is given as:

$$\boldsymbol{Y} = \mathbf{19.165} + \mathbf{2.912}\boldsymbol{X_1} + \mathbf{0.271}\boldsymbol{X_2} + \mathbf{0.216}\boldsymbol{X_3} - \mathbf{0.148}\boldsymbol{X^4} + \mathbf{0.243}\boldsymbol{X_5} - \mathbf{0.075}\boldsymbol{X_6} + \mathbf{0.003}\boldsymbol{X_7} + \mathbf{0.076}\boldsymbol{X_8} + \mathbf{0.084}\boldsymbol{X_9} - \mathbf{0.008}\boldsymbol{X_{10}}$$

The equation can thus be readily used to predict Factors that create Broad Band Demand Gap in South East of Nigeria

4.3.3 Hypothesis Testing

In order to test our hypothesis, it is important to refer to the tables below at 0.05 level of significance.

Table 4.11: Summary of Multiple Regression Analysis of the collective independent variables on broadband demand gap in South East at enterprise level.

R=0.971; R Square=0.944; Adjusted R Square=0.942; Standard Error of the Estimate=0.72545

ANOVA[b]

Model	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1 Regression	3156.508	10	315.651		.000[a]
Residual	188.408	35 8	.526	599.778	

Total	3344.916	368			

a. Predictors: (Constant), X10, X5, X8, X7, X3, X2, X6, X4, X9, X1

b. Dependent Variable: Y Source SPSS

Hypothesis One

HO_1: The overall factors have no significant effect on Broadband demand gap at SME Level

HA_1: The overall factors have significant effect on Broadband Demand gap at SME Level

F-test was carried out using the decision rule stated in chapter three. From Table 4.11(ANOVA Table), it was observed that at the F calculated value of 599.778 and testing at the significant level of 5%, the P-value of 0.000 is less than 0.05 (**i.e $p < 0.05$**). On this basis, the HO_1 was rejected and HA_1 accepted. We concluded that the overall factors have significant effect on Broadband demand gap at enterprise level Level.

Hypothesis Two

HO_2: Each factor has no significant effect on Broadband demand gap at SME level

HA_2: Each factor has significant effect on Broadband demand gap at SME level The hypothesis was restated for each factor specifically and a t-test was carried out as presented below.

Hypothesis Two (a)

$HO_{2(a)}$:Economic Barrier has no significant effect on Broadband demand gap at SME Level in South East Nigeria

$HA_{2(a)}$:Economic Barrier has significant effect on Broadband demand gap at SME Level in South East of Nigeria

The t-test was carried out using the decision rule stated in chapter three. From Table 4.13, it was observed that at the t calculated value of 68.745 and testing at the significant level of 5%, the P-value of 0.000 is less than 0.05 (i.e $p < 0.05$). On this basis, the **HO_2** was rejected and **HA_2** accepted. We concluded that the **Economic Barrier** has significant effect on Broadband demand gap at SME Level in South East of Nigeria.

Hypothesis Two (b)

$HO_{2(b)}$:Limited Technological Training has no significant effect on Broadband demand gap at SME Level in South East Nigeria

$HA_{2(b)}$: Limited Technological Training has significant effect on Broadband demand gap at SME Level in South East of Nigeria

The t-test was carried out using the decision rule stated in chapter three. From Table 4.13, it was observed that at the t calculated value of 6.839 and testing at the significant level of 5%, the P-value of 0.000 is less than 0.05 (i.e $p < 0.05$). On this basis, the **HO_2** was rejected and **HA_2** accepted. We concluded that the **Limited Technological Training** has significant effect on Broadband demand gap at SME Level in South East of Nigeria.

Hypothesis Two (c)

$HO_{2(c)}$: Slow Assimilation of Broadband has no significant effect on Broadband demand gap at SME Level in South East Nigeria

$HA_{2(c)}$: Slow Assimilation of Broadband has significant effect on Broadband demand gap at SME Level in South East of Nigeria

The t-test was carried out using the decision rule stated in chapter three. From Table 4.13, it was observed that at the t calculated value of 5.445 and testing at the significant level of 5%, the P-value of 0.000 is less than 0.05 (i.e $p < 0.05$). On this basis, the **HO_2** was rejected and **HA_2** accepted. We concluded that the **Slow Assimilation of Broadband** has significant effect on Broadband demand gap at SME Level in South East of Nigeria.

Hypothesis Two (d)

$HO_{2(d)}$:Uneven Telecom Network Deployment has no significant effect on Broadband demand gap at SME Level in South East Nigeria

$HA_{2(d)}$:Uneven Telecom Network Deployment has significant effect on Broadband demand gap at SME Level in South East of Nigeria

The t-test was carried out using the decision rule stated in chapter three. From Table 4.13, it was observed that at the t calculated value of -3.706 and testing at the significant level of 5%, the P-value of 0.066 is greater than 0.05 (i.e $p > 0.05$). On this basis, the **HO_2** was accepted and **HA_2** rejected. We concluded that the **Uneven Telecom Network Deployment** has no significant effect on Broadband demand gap at SME Level in South East of Nigeria.

Hypothesis Two (e)

$HO_{2(e)}$: Market Opportunity has no significant effect on Broadband demand gap at SME Level in South East Nigeria

$HA_{2(e)}$: Market Opportunity has significant effect on Broadband demand gap at SME Level in South East of Nigeria

The t-test was carried out using the decision rule stated in chapter three. From Table 4.13, it was observed that at the t calculated value of 6.354 and testing at the significant level of 5%, the P-value of 0.000 is less than 0.05 (i.e $p < 0.05$). On this basis, the **HO_2** was rejected and **HA_2** accepted. We concluded that the **Market Opportunity** has significant effect on Broadband demand gap at SME Level in South East of Nigeria.

Hypothesis Two (f)

$HO_{2(f)}$:Customer Forces has no significant effect on Broadband demand gap at SME Level in South East Nigeria

$HA_{2(f)}$:Customer Forces has significant effect on Broadband demand gap at SME Level in South East of Nigeria

The t-test was carried out using the decision rule stated in chapter three. From Table 4.13, it was observed that at the t calculated value of -1.914 and testing at the significant level of 5%, the P-value of 0.056 is greater than 0.05 (i.e $p > 0.05$). On this basis, the **HO_2** was accepted and **HA_2** rejected. We concluded that the **Customer Forces** has no significant effect on Broadband demand gap at SME Level in South East of Nigeria.

Hypothesis Two (g)

$HO_{2(g)}$:Lack of Content Relevance or Interest has no significant effect on Broadband demand gap at SME Level in South East Nigeria

$HA_{2(g)}$: Lack of Content Relevance or Interest has significant effect on Broadband demand gap at SME Level in South East of Nigeria

The t-test was carried out using the decision rule stated in chapter three. From Table 4.13, it was observed that at the t calculated value of 0.071 and testing at the significant level of 5%, the P-value of 0.943 is greater than 0.05 (i.e $p > 0.05$). On this basis, the **HO_2** was accepted and **HA_2** rejected. We concluded that the **Lack of Content Relevance or Interest** has no significant effect on Broadband demand gap at SME Level in South East of Nigeria

Hypothesis Two (h)

$HO_{2(h)}$: Epileptic Power has no significant effect on Broadband demand gap at SME Level in South East Nigeria

$HA_{2(h)}$: Epileptic Power has significant effect on Broadband demand gap at SME Level in South East of Nigeria

The t-test was carried out using the decision rule stated in chapter three. From Table 4.13, it was observed that at the t calculated value of 1.846 and testing at the significant level of 5%, the P-value of 0.000 is less than 0.05 (i.e $p < 0.05$). On this basis, the **HO_2** was rejected and **HA_2** accepted. We concluded that the **Market Opportunity** has significant effect on Broadband demand gap at SME Level in South East of Nigeria.

Hypothesis Two (i)

$HO_{2(i)}$:Lack of Vision and Prospect of Broadband has no significant effect on Broadband demand gap at SME Level in South East Nigeria

$HA_{2(i)}$: Lack of Vision and Prospect of Broadband has significant effect on Broadband demand gap at SME Level in South East of Nigeria

The t-test was carried out using the decision rule stated in chapter three. From Table 4.13, it was observed that at the t calculated value of -2.013 and testing at the significant level of 5%, the P-value of 0.045 is greater than 0.05 (i.e $p > 0.05$). On this basis, the **HO_2** was accepted and **HA_2** rejected. We concluded that the **Lack of Content Relevance or Interest** has no significant effect on Broadband demand gap at SME Level in South East of Nigeria.

Hypothesis Two (j)

$HO_{2(j)}$:Inefficient Access to Broadband has no significant effect on Broadband demand gap at SME Level in South East Nigeria

$HA_{2(j)}$:Inefficient Access to Broadband has significant effect on Broadband demand gap at SME Level in South East of Nigeria

The t-test was carried out using the decision rule stated in chapter three. From Table 4.13, it was observed that at the t calculated value of -0.183 and testing at the significant level of 5%, the P-value of 0.855 is greater than 0.05 (i.e $p > 0.05$). On this basis, the **HO_2** was accepted and **HA_2** rejected. We concluded that the **Lack of Content Relevance or Interest** has no significant effect on Broadband demand gap at SME Level in South East of Nigeria

4.3.4 Hypothesis Testing

Hypotheses of the study were tested as shown below.

Hypothesis One

HO_1: The overall factors have no significant effect on Broadband demand gap at SME Level

HA_1: The overall factors have significant effect on Broadband Demand gap at SME Level

F-test was carried out using the decision rule stated in chapter three. From Table 4.9, it was observed that at the F calculated value of 196.222 and testing at the significant level of 5%, the P-value of 0.000 is less than 0.05 (**i.e $p < 0.05$**). On this basis, the HO_1 was rejected and HA_1 accepted. We concluded that the overall factors have significant effect on Broadband demand gap at SME Level.

Hypothesis Two

HO_2: Each factor has no significant effect on Broadband demand gap at SME level

HA_2: Each factor has significant effect on Broadband demand gap at SME level The hypothesis was restated for each factor specifically and a t-test was carried out as presented below.

4.4 Result Discussion

Results are discussed here in the context of research questions.

1. **What are the factors affecting broadband demand gap at SME Level?**

From the literature review as well as the results of test carried out, several factors were discovered to drive broadband demand gap among SME. The factors identified in this study were as follows: economic barrier (such as, pricing, cost of computer systems), limited technology training, low assimilation, uneven telecommunication network deployment and epileptic

(power) supply. The results obtained are in agreement with the works of Kotelnikov (2007), who found out that broadband demand gap at SME level is a function economic barrier, limited technology training, and low assimilation.

This present work is also in agreement with Obasi and Kalejayi (2013) which stated that epileptic (power) supply are factor affecting broadband demand gap in Nigeria.

2. To what extent does each factor affect broadband demand gap at enterprise level?

This question was broken down to specific questions reflecting each factor as follows:

2a. To what extent does **Economic Barrier** affect broadband demand gap at SME level in South East of Nigeria?

2b. To what extent does **Limited Technology Training** affect broadband demand gap at SME level in South East of Nigeria?

2c. To what extent does **Slow Assimilation of Broadband** affect broadband demand gap at SME level in South East of Nigeria?

2d. To what extent does **Uneven Telecom Network Deployment** affect broadband demand gap at SME level in South East of Nigeria?

2e. To what extent does **Low Knowledge of Market Opportunity** affect broadband demand gap at SME level in South East of Nigeria?

2f. To what extent does **Customer Forces** affect broadband demand gap at SME level in South East of Nigeria?

2g. To what extent does **Lack of Content Relevance or Interest** affect broadband demand gap at SME level in South East of Nigeria?

2h. To what extent does **Epileptic Power** affect broadband demand gap at SME level in South East of Nigeria?

2i. To what extent does **Lack of Vision and Prospect of Broadband** affect broadband demand gap at SME level in South East of Nigeria?

2j. To what extent does **Inefficient Access to Broadband** affect broadband demand gap at SME level in South East of Nigeria?

These specified questions are now discussed below:

2a.*To what extent does Economic Barrier, affect broadband demand gap at SME level in South East of Nigeria?*

The test of hypothesis on this research question showed that **Economic Barrier** has significant effect on Broadband demand gap at SME level in South East Nigeria. The conclusion was drawn from testing at the significant level of 5%, when the t-calculated is 68.745 and it was observed that the P-value of 0.000 is less than 0.05 (i.e p >0.05). This implies in reality that **Economic Barrier** has significantly affected broadband demand gap at SME level in south east, Nigeria, which is in agreement with Kotelnikov (2007)

2b.*To what extent does Limited Technology Training affect broadband demand gap at SME level in South East of Nigeria?*

The test of hypothesis on this research question showed that **Limited technology Training** has significant effect on Broadband demand gap at SME level in South East Nigeria. The conclusion was drawn from testing at the significant level of 5%, when the t-calculated is 6.839 and it was observed that the P-value of 0.000 is less than 0.05 (i.e p <0.05). This implies in reality that **Limited Technology Training** has significantly affected broadband demand gap at SME level in south east, Nigeria which is in agreement with the work of Kotelnikov (2007) .

2c.*To what extent does Slow Assimilation of Broadband affect broadband demand gap at SME level in South East of Nigeria?*

The test of hypothesis on this research question showed that **Slow Assimilation of Broadband** has significant effect on Broadband demand gap at SME level in South East Nigeria. The conclusion was drawn from testing at the significant level of 5%, when the t-calculated is 5.445 and it was observed that the P-value of 0.000 is less than 0.05 (i.e p <0.05). This implies in reality that **Slow Assimilation of Broadband** has significantly affected broadband demand gap at SME level in south east, Nigeria which is in agreement with the report of NCC 2013 .

2d.*To what extent does Uneven Telecom Network Deployment affect broadband demand gap at SME level in South East of Nigeria?*

The test of hypothesis on this research question showed that **Uneven Telecom Network Deployment** has no significant effect on Broadband demand gap at SME level in South East Nigeria. The conclusion was drawn from testing at the significant level of 5%, when the t-calculated is -3.706 and it was observed that the P-value of 0.066 is greater than 0.05 (i.e p <0.05). This implies in reality that **Uneven Telecom Network Deployment** has not significantly affected broadband demand gap at SME level in south east, Nigeria. This result does not agree with Broadband Series (2012), which states that SMEs that operate in urban centers tend to have better access to broadband infrastructure and technological capital, whereas those that operate outside of such areas are marginalized.

2e.*To what extent does Low knowledge of Market Opportunity affect broadband demand gap at SME level in South East of Nigeria?*

The test of hypothesis on this research question showed that **Low knowledge of Market Opportunity** has significant effect on Broadband demand gap at SME level in South East Nigeria. The conclusion was drawn from testing at the significant level of 5%, when the t-calculated is 6.354 and it was observed that the P-value of 0.000 is less than 0.05 (i.e $p < 0.05$). This implies in reality that **Low knowledge of Market Opportunity** has significantly affected broadband demand gap at SME level in south east, Nigeria which is in agreement with the work of ITU, UNESCO (2012) which conclude that, full understanding of the market opportunities for broadband is often limited, since it requires industries to think beyond their traditional business models.

2f.*To what extent does Customer Forces affect broadband demand gap at SME level in South East of Nigeria?*

The test of hypothesis on this research question showed that **Customer Forces** has no significant effect on Broadband demand gap at SME level in South East Nigeria. The conclusion was drawn from testing at the significant level of 5%, when the t-calculated is -1.914 and it was observed that the P-value of 0.056 is greater than 0.05 (i.e $p < 0.05$). This implies in reality that **Customer Forces** has no significant effect on broadband demand gap at SME level in south east, Nigeria. This result does not agree with Prashil Pravin Gareeb and Visvanathan Naicker, (2015) which states that direct or indirect demands from customers of businesses to interface via electronic means, through advertising, information sharing etc., tend to force SMEs to adopt Broadband Technology.

2g.*To what extent does Lack of Content Relevance or Interest affect broadband demand gap at SME level in South East of Nigeria?*

The test of hypothesis on this research question showed that **Lack of Content Relevance or Interest** has no significant effect on Broadband demand gap at SME level in South East Nigeria. The conclusion was drawn from testing at the significant level of 5%, when the t-calculated is 0.071 and it was observed that the P-value of 0.943 is greater than 0.05 (i.e $p <0.05$). This implies in reality that **Customer Forces** has no significant effect on broadband demand gap at SME level in south east, Nigeria. This result does not agree with Horiggan (2009) which states that broadband is a platform used to access Internet content, applications, and services, the relevance of such content offers an incentive to purchase a subscription. Conversely, the lack of cultural relevance could serve as a barrier to adoption.

2h.*To what extent does Epileptic Power Supply affect broadband demand gap at SME level in South East of Nigeria?*

The test of hypothesis on this research question showed that **Epileptic Power Supply** has significant effect on Broadband demand gap at SME level in South East Nigeria. The conclusion was drawn from testing at the significant level of 5%, when the t-calculated is 1.846 and it was observed that the P-value of 0.000 is less than 0.05 (i.e $p <0.05$). This implies in reality that **Epileptic Power Supply** has significantly affected broadband demand gap at SME level in south east, Nigeria which is in agreement with the work of Obasi and Kalejayi (2013).

2i.*To what extent does Lack of Vision and Prospect of Broadband affect broadband demand gap at SME level in South East of Nigeria?*

The test of hypothesis on this research question showed that **Lack of Vision and Prospect of Broadband** has no significant effect on Broadband demand gap at SME level in South East Nigeria. The conclusion was drawn from testing at the significant level of 5%, when the t-calculated is -2.013 and it was observed that the P-value of 0.045 is greater than 0.05 (i.e $p < 0.05$). This implies in reality that **Customer Forces** has no significant effect on broadband demand gap at SME level in south east, Nigeria. This result does not agree with the report of ITU, UNESCO, (2012)

2j.*To what extent does Lack of Inefficient Access to Broadband affect broadband demand gap at SME level in South East of Nigeria?*

The test of hypothesis on this research question showed that **Inefficient Access to Broadband** has no significant effect on Broadband demand gap at SME level in South East Nigeria. The conclusion was drawn from testing at the significant level of 5%, when the t-calculated is -0.183 and it was observed that the P-value of 0.855 is greater than 0.05 (i.e $p < 0.05$). This implies in reality that **Inefficient**

Access to Broadband has no significant effect on broadband demand gap at

SME level in south east, Nigeria. This result does not agree with the report of ITU, UNESCO, (2011).

3. To what extent do the factors collective affect broadband demand gap at enterprise level?

The factors collectively accounted for over 94.4% (adjusted R^2 = 0.944) impact on the broadband demand gap among SMEs.

Also, from the F-test analysis in Table 4.10, it is obvious that all the factors (namely, **Economic Barrier, Limited Technology Training, Slow Assimilation of Broadband, Uneven Telecom Network Deployment, Low Knowledge of Market Opportunity, Customer Forces, Lack of Content Relevance or Interest, Epileptic Power Supply, Lack of Vision and Prospect of Broadband, Inefficient Access to Broadband**) significantly affect Broadband Demand Gap since $P<0.05$.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings and Conclusion

Principal Component Factor Analysis with Oblimin rotation method was performed on all 46 identified variables, in order to reduce them to a considerable number to be used in our research, and to eliminate collinearity between them. In addition, Monte Carlo PCA for Parallel Analysis was used to compare and validate the result from the Principal Component factor analysis.

After 3 iterations, the 46 variables were reduced to 10 factors as listed below:

1. Economic Barrier,
2. Limited Technology Training
3. Slow Assimilation of Broadband
4. Uneven Telecom Network Deployment
5. Low Knowledge of Market Opportunity
6. Customer Forces,
7. Lack of Content Relevance or Interest
8. Epileptic Power Supply
9. Lack of Vision and Prospect of Broadband
10. Inefficient Access to Broadband

Further test was conducted on the ten extracted factors using Regression

Analysis and the result obtained shows that has **Economic Barrier, Limited Technology Training, Slow Assimilation of Broadband, Low Knowledge of Market Opportunity, Epileptic Power Supply** most significant effect on broadband Demand gap at SMEs levels while **Uneven Telecom Network Deployment, Customer Forces, Lack of Content Relevance or Interest, Lack of Vision and Prospect of Broadband, Inefficient Access to**

Broadband, has no significant effect.

Factors 1, 2, and 3 are identified as factor that influence Broadband demand gap among SMEs by (Kotelnikov, 2007). Epileptic Power is also identified as factor affecting broadband demand gap by Obasi and Kalejayi (2013).

5.2 Recommendations

Based on the summary of findings, the following recommendations were made:

i. SME must take proper steps to train their staff and update them on the latest technology since it was found that Limited Technological Training has significant effect on Broadband demand gap. This can be done in the following ways

a. Employ the services of IT professional to acquaint them with the knowledge of broadband

b. Provide the necessary facilities/infrastructure which staff can learn and deploy broadband technology

c. Encourage the use of ICT in primary, secondary and tertiary institutions

d. Increase the number of skilled Nigerians in telecom sector.

ii. SMEs should liase with government to make commitment to building efficient, reliable and cheap power supply system to curb the effect of epileptic power supply.

iii. SMEs should liase with proper bodies Computers professional association of Nigeria (CPN), Nigeria Communication Commission (NCC), Telecoms operating companies) to quicken assimilation of broadband technology through

a. Education and deployment of broadband facilities.

b. Subsidies and incentives to encourage rapid deployment of fiber transmission cables

c. To stimulate demand for internet services, and drive affordable home broadband iv. SMEs should liaise with government to make commitment to building an ever-present broadband infrastructure that will facilitate innovation and entrepreneurship in South East Nigeria

v. Further study should be carried out to ascertain other factors that determine broadband demand gap among SMEs in South East of

Nigeria. Also, similar research should be carried out in other zones of

the country to confirm that the conclusions drawn from this work are true reflections of the Nigerian situation.

5.3 LIMITATIONS AND FUTURE DIRECTIONS

Like other empirical studies, this study is not without its limitations. Our sample consisted of SMEs in South East of Nigeria may limit the generalizability of the results. The sample size itself is relatively small; the study can be strengthened by increasing the sample size and including participants in other geographical areas. With an increased sample size, a more detailed empirical analysis among the independent variables and the variables that have multiple categories can be performed.

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