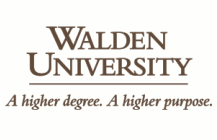

2016

Innovation Difussion of Smartphone in Nigeria

Olukunle Ariyo Iyanda
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This is to certify that the doctoral dissertation by

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has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

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2016

Abstract

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by

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Dissertation Submitted in Partial Fulfillment

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Abstract

Rapid diffusion and use of smartphones in Africa are challenging, given the state of its infrastructural facilities. The problem addressed was a lack of information on the adoption behavior and the sociodevelopmental effect of smartphone acceptance among rural and urban users in Nigeria. The purpose of this study was to examine the adoption behavior and the sociodevelopmental effect of smartphone acceptance among rural and urban residents. Research questions examined the relationship of performance expectancy, social influence, price value, and habit on adopters' intentions to use smartphones, continued use of smartphones, and the sociodevelopmental effect on smartphone users lives and standard of living. The theoretical foundation of the study was based on the unified theory of acceptance and use of technology, and expectation confirmation theory. A nonexperimental cross-sectional survey design was used to collect and analyze data obtained from the target population of approximately 14 million with a sample size of 385 based on 95% confidence level. Survey data were collected using a research instrument developed by Bhattacherjee, Venkatesh, and others and analyzed via multivariate regression. Findings indicated that the positive effect of performance expectancy on intent to use smartphones was stronger among urban than among rural dwellers. No other location-moderated relationships were found. There was a strong positive correlation ($\beta = .761$, $p < .001$) between intent to use smartphones and continued use of smartphones. The findings of this study may promote social change by providing valuable data to service providers and regulators for realignment of investment strategies and the reevaluation of national policies on communication technology development.

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Dedication

I dedicate this dissertation to almighty God and to the loving memory of my late parents, James Olalekan and Ruth Adesola Iyanda. It is a pity you are not here to witness this occasion, but I am proud to say that your immeasurable lessons continue to guide me through various phases of life.

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Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction to the Study

The smartphone revolution is underhyped. More people have access to phones than access to running water. Andreessen (2012) noted that we have never seen anything like this. The statement by Andreessen regarding the effect of smartphones was echoed by Rosen (2012), who observed, "technology is changing our world more than ever before. The catalyst now is the Smartphone" (p. 82). In its 2013 report, Microsoft indicated that fewer than 25 million mobile phones were in use in the entire continent of Africa in 2001, compared to the 650 million phones currently found in Africa (Parr, 2013). Microsoft concluded that there are more mobile phones in Africa than in the United States or the European Union.

The introduction and acceptance of wireless technologies have had a rapid diffusion rate, exhibiting a technology leapfrogging effect throughout the world. In this study, I examined the adoption behavior and the sociodevelopmental effects of the diffusion of smartphone mobile technologies among rural and urban users in Nigeria. The theoretical foundation was the unified theory of acceptance and use of technology (UTAUT) and the expectation confirmation theory (ECT) to answer the research questions posed for the study and to meet the research objectives. This chapter includes the background of the study, the problem and purpose statements, research questions, hypotheses, nature of the study, definitions, assumptions, delimitations, limitations, and implications for social change.

Background of the Study

Innovation is a driving force for technological advancement and economic development. It is an attempt to try out new or improved products, processes, or ways to do things (Fagerberg, Srholec, & Verspagen, 2010). Landline telephony was the most used form of communication before the advent of mobile phones. However, the technology was available only to the powerful and the privileged; access was, therefore, abysmally low in Africa. The advent of mobile phones as a disruptive innovation led to a worldwide acceptance of the technology both by the privileged few and ordinary citizens regardless of location and status. The innovation diffusion of mobile phones has affected the lives of ordinary people positively more than any other technology (Agwu & Carter, 2014). This diffusion process is what Schumpeter considered in 1942 to be an integral part of the invention-innovation-diffusion trilogy, where diffusion denoted the process through which new technologies trigger economic growth and alter the sociodevelopmental structure of society.

Smartphones, as the latest generation of mobile technology, enhance access to the Internet network and significantly change the way humans interact with each other. The number of devices connected to the Internet through personal computers and smartphones in 2003, was 500 million in a world population of 6.3 billion. However, by the year 2011, the number of devices connected to the Internet had risen to 12.5 billion, compared to a rise in population to 7 billion.

Mobile telephony has brought new possibilities for reducing the urban/rural and rich/poor divides. Mobile phones connect individuals to other individuals, information,

markets, and services. Adopters of information and communication technology (ICT) in Africa connect to the Internet mainly through smartphone mobile technologies because other forms of connections are nonexistent or still in their infancy. Development of information and communication technologies are closely linked to economic growth, noted Gruber & Koutroumpis (2011); however, they observed that the economic growth for low penetration rate countries is smaller in comparison with countries with high penetration rate. Therefore, countries with high penetration rate experience increasing returns from mobile adoption and use.

Africa is the second largest and second most populous continent with approximately 1 billion people, yet its infrastructure investments rank among the lowest in the world. Only 29% of roads are paved, barely a quarter of the population has access to electricity, and fewer than three landlines are available per 100 people (International Telecommunication Union [ITU], 2012; World Bank, 2008). The infrastructure challenges notwithstanding, access to the use of mobile telephony in sub-Saharan Africa continues to increase dramatically. There are 10 times as many mobile phones as landlines in sub-Saharan Africa (ITU, 2012), and 60% of the population has mobile phone coverage. In terms of population, Nigeria is the largest country in Africa, and mobile phone subscriptions currently stand at 114 million. That raised mobile penetration to 96%, as of September 2014 (Nigerian Communications Commission [NCC], 2014). Mobile penetration across the African continent currently stands at 80%, and more than 60% of Africans still rely on basic 2G and SMS services, making text messaging a powerful content delivery method (Visiongain, 2013). Smartphone penetration in Africa

stands at approximately 20%, with only 11% of Africans having 3G access based on wideband code division multiple access (WCDMA) or code division multiple access 2000 (CDMA2000) technologies. Nigeria, South Africa, and Egypt are the fastest growing markets for mobile phones. I focused on Nigeria because this country has the largest economy, the largest population, and the largest contingent of mobile phone users in all of Africa.

Scholarly claims about the nature of technology infrastructure and the adoption rates of mobile technologies in Africa provided the strong basis for this study. I measured the uses and the effect of smartphone technologies on rural and urban people in Africa. I evaluated performance expectation for smartphone mobile technologies among rural and urban adopters and explored the users' intention to use the technology. The successful completion of this study may contribute positively to social change through proper understanding of adopters' preferences and the formulation of policies that leverage the potential of mobile technologies in the service of sociodevelopment.

There are currently 6.9 billion mobile phone subscribers in a world population of more than 7 billion (ITU, 2014). Mobile telecommunication is rapidly becoming an indispensable part of economic growth and social transformation. According to the ITU (2014), the widespread diffusion of broadband encourages innovation, contributes to productivity and growth, and attracts foreign direct investment.

The first mobile phone call in Africa was made in 1987 in the Democratic Republic of Congo. Since then, mobile phone diffusion in Africa has continued to spread quickly. Mobile phone subscription in Africa has surpassed all known types of mobile

phone adoption (Etzo & Collender, 2010). President Kagame of the Republic of Rwanda (as cited in Aker & Mbiti, 2010) said, "In 10 short years, what was once an object of luxury and privilege, the mobile phone, has become a basic necessity in Africa" (p. 208). Africa's population currently stands at approximately 1 billion with active mobile phone subscribers at 629 million (ITU, 2014). These statistics present a paradox that most Africans are still living without access to basic amenities such as water, electricity, good roads, hospitals, and good schools. The mobile penetration rate stands at 61%, as of May 2013, compared to a 5% fixed telephone line penetration rate (GSMA Intelligence, 2013). Confronted with the same described infrastructural problems, Nigeria, with a population of 178 million, has had an interesting mobile penetration statistic: Teledensity stood at 92.42%, as of July 2014 (NCC, 2014), an astonishing rise from the figure of 0.04%, in 1999.

The adoption rate of mobile phones in Africa was completely unanticipated, given the general reputation of the continent with respect to wars, crises, and extreme poverty. Currently, the continent is the fastest growing region in the global telecommunication market (Chavula, 2013). Etzo and Collender (2010) reported that mobile phone technology was diffusing rapidly throughout the continent and that the diffusion had sparked a great deal of optimism about the potential influence of these technologies. Aker and Mbiti (2010) noted that the technology has had an extraordinary effect on the rural residents of Africa whose choice of modern technology and infrastructure may actually be the mobile phone. However, there is lack of comparative study that compares the effect of the adoption between the two groups of adopters: rural and urban. This study is

needed therefore, because comparative studies on the pre- and postadoption behavior of users are lacking. In addition, there has been a lack of empirical evidence to support the sociodevelopmental claim of the adoption on rural and urban adopters in Nigeria.

Problem Statement

The problem addressed in this study was a lack of information on the adoption behavior and the sociodevelopmental effect of mobile technology acceptance of rural and urban adopters in Nigeria. Poor infrastructure and high poverty rates notwithstanding, the rapid diffusion of mobile phones throughout Africa is incontrovertible. This situation raises optimism regarding the potential effect of the technology as a major driver for socioeconomic transformation (ITU, 2011). Aker and Mbiti (2010) argued that mobile telephony brings new possibilities for bridging the urban/rural and rich/poor divides and for broadening economic development. Other scholarly studies explored the adoption and the influence of mobile phones (Agwu & Carter, 2014; Aker & Mbiti, 2010). However, information on the comparative effect of the technology on urban and rural adopters has not yet been explored.

A review of 342 scholarly articles also disclosed the lack of application of a combination of the UTAUT and the ECT for gaining a better understanding of the adoption behaviors of potential users. Therefore, I conducted this quantitative study to fill a gap in the professional literature and provide useful information to service providers. Smartphone subscribers in the rural and urban areas of Lagos State, Nigeria, were the target population for this cross-sectional survey research. A survey was the primary data

collection instrument, based on a stratified random sampling procedure, with the goal of achieving the most comprehensive answers to the research questions.

Purpose of the Study

The purpose of this quantitative cross-sectional survey study was to examine the adoption behavior and the sociodevelopmental effect of smartphone acceptance among rural and urban residents of Nigeria. This overall purpose had three subsections: first, an examination of the correlation, if any, in the orientation of urban and rural dwellers toward technology acceptance; second, an exploration of the pre- and postadoption behaviors of smartphone users with respect to intention to use and the continued usage of smartphone technologies; third, I wanted to determine a potential sociodevelopmental impact of smartphone adoption between the two groups of adopters.

Information is a critical resource for social development and mitigation of sociodevelopmental problems, which is enhanced through mobile communication (Aker & Mbiti, 2010). The target population for this study was smartphone users in Nigeria. According to the NCC (2015), mobile phones subscriptions in Nigeria stood at 180 million as of November 2014, and 25% (or n = 45 million) of this figure pertained to smartphones (Adebayo, 2014).

Purposive sampling focused on smartphone users in Nigeria's cosmopolitan state of Lagos. The independent variables for the study were performance expectancy, social influence, price value, habit, and perceived usefulness and confirmation, whereas the dependent variables were intention to use, actual usage, and continued use.

Research Questions and Hypotheses

Creswell (2009) explained that research questions are interrogative statements or questions that the investigator seeks to answer. They are a means of guiding and directing the researcher's thinking (Leedy & Ormrod, 2010). The research questions for this study were as follows:

Research Questions

Research Question 1 (RQ1): What is the relationship between performance expectancy and rural and urban adopters' intention to use smartphone technologies?

Independent Variable (IV) = performance expectancy

Dependent Variable (DV) = intention to use (IU)

Moderators = location and economic status

Research Question 2 (RQ2): What is the relationship between social influence and rural and urban adopters' intention to use smartphone technologies?

IV = social influence

DV = intention to use (IU)

Moderators = location and economic status

Research Question 3 (RQ3): What is the relationship between price value and rural and urban adopters' intention to use smartphone technologies?

IV = price value (PV)

DV = intention to use (IU)

Moderators = location and economic status

Research Question 4 (RQ4): What is the relationship between habit and rural and urban adopters' intention to use smartphone technologies?

IV = habit

DV = intention to use (IU)

Moderators = location and economic status

Research Question 5 (RQ5): What is the relationship between adopters' initial intention to use smartphone and the subsequent continued intention to use smartphones?

IV = intention to use (IU)

DV = continued usage (CU)

Research Question 6 (RQ6): What is the relationship between adopters' continued usage of smartphone and their satisfaction with their smartphones?

IV = continued usage (CU)

DV = satisfaction

Research Question 7 (RQ7): What is the relationship between rural and urban dwellers' continued use of smartphones and their sociodevelopment status?

IV = continued usage

DV = socioeconomic growth

Hypotheses

The formulation of the following hypotheses was with the intent that their testing should provide the answers to the research questions. They took into account the tenets of the unified theory of technology acceptance and use of technology 2 (UTAUT-2) and ECT. These theories underscored the core determinants that predicted the intention to

use, actual usage, continued usage, and postadoption behaviors of users with respect to innovative technologies. In addition, these theories enabled me to investigate agents that could have expanded or diminished the effects of the core determinants. The null and alternative hypotheses were as follows:

H_{01}: Adopters locale will not influence performance expectancy on intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

H_{a1}: Adopters locale will influence performance expectancy on intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

H_{02}: Adopters locale will not affect social influence on intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

H_{a2}: Adopters locale will affect social influence on intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

H_{o3}: Adopters locale will not influence price value with respect to intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

H_{a3}: Adopters locale will influence price value with respect to intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

H_{o4}: Adopters locale will not influence their habit with respect to intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

H_{a4}: Adopters locale will influence their habit with respect to intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

H_{05}: There is no difference between adopters' initial intention to use smartphones and the subsequent continued intention to use a smartphone?

H_{a5}: There is a difference between adopters' initial intention to use a smartphones and the subsequent continued intention to use a smartphone.

H_{06}: Rural and urban dwellers' user satisfaction with smartphones will not be positively related to continued intention to use the technology, and the level of satisfaction will be the same among the adopters.

H_{a6}: Rural and urban dwellers' user satisfaction with smartphones will be positively related to continued intention to use the technology, and the level of satisfaction will not the same among the adopters.

H_{o7}: Intention to use smartphones will not be positively related to rural and urban adopters' sociodevelopment status, and the intent to use will be the same between the two groups of adopters.

H_{a7}: Intention to use smartphones will be positively related to rural and urban adopters' sociodevelopment status, and the intent to use is not the same between the two groups of adopters.

Theoretical Foundation

Individual acceptance and use of information and telecommunication studies have received considerable scholarly attention resulting in the development of several theoretical models on technology acceptance and usage. Some of the notable models that laid the foundation for the understanding of technology acceptance include the technology acceptance model (TAM) (Davis, 1989), the theory of reasoned action (TRA) by Ajzen and Fishbein (1980), and the theory of planned behavior (TPB) by Ajzen (1991). A review and synthesis of eight of these theories resulted in the development of a UTAUT (Venkatesh, Thong, & Xu, 2012). This theory is a comprehensive synthesis of prior research on technology acceptance, based on critical factors and contingencies relating to the prediction of intention to use the technology within the context of consumer location. Extensive replications, applications, extensions, and integrations of the UTAUT have made an important contribution to the understanding of technology adoption and extended the theoretical boundaries of the theory.

According to the UTAUT-2, performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, and habit influence the intention to use and the continued usage of technological products or services. The ECT, on the other hand, posits that expectations, coupled with perceived performance, will lead to postpurchase satisfaction and that this effect is mediated through positive or negative disconfirmation between expectations and performance. The implication is that consumers first form expectations about a product or service before a purchase decision

is made. Afterward, they build their perceptions regarding the performance of the product upon their adoption experiences (Lin, Wu, Hsu, & Chou, 2012).

However, the UTAUT has been modified and extended to accommodate a broader perspective. The UTAUT, which served as an overarching model for this study, examined the use of technology acceptance and continued use of technology from three new contexts: new technologies, new user populations, and new cultural settings. Equally critical to the study is the ECT, developed because notable deficiencies had been observed in prior research with respect to technology adoption because the difference between pre- and postadoption had not been taken into account. The ECT posits that expectations, coupled with perceived performance, will lead to postpurchase satisfaction and that the effect is mediated through confirmation or disconfirmation that performance meets expectation.

These theories underscore the core determinants that predict the intention to use, actual usage, continued usage, and postadoption behavior of users with respect to innovative technology. In addition, the theories enable researchers to investigate agents that would expand or contract the effects of the core determinants. The two theories have been empirically tested and proven worthy; therefore, they were chosen to form the foundation for this study.

Nature of the Study

This study was analytical in nature and used a quantitative, cross-sectional survey design, to critically analyze the research questions regarding the lack of information on the sociodevelopment effect of mobile technology acceptance on rural and urban adopters

in Nigeria. The research problem was addressed through a postpositivist view, which empirically applied the UTAUT-2 and the ECT to further the understanding of pre- and postadoption behaviors of users on the intention to use and the continued usage of smartphones in the rural and urban communities of a developing society such as Nigeria. A critical review of existing literature provided a framework for the general approach to the study. The following rationale presents some of the critical considerations for the design of the study: the epistemology that informs the research (e.g., objectivism or subjectivism); the theoretical perspective behind the methodology; the methodology that governs the chosen method; and the methods proposed for use in this study (Creswell, 2009; Crotty, 1998).

A survey was the data collection instrument for assembling primary data from the local government agencies in Nigeria's commercial capital, Lagos. Although various methods are available and could have been applied in this study, a cross-sectional survey method was considered best suited owing to its robustness in assembling data that need to be analyzed statistically and appropriated for testing theories over a short time frame (Creswell, 2009). This method is useful when two or more variables covary, in which variations in one variable relate to changes in another variable. Numeric measure of observations and studying the behavior of individuals became critical to postpositivists (Creswell, 2009). An interview or focus group method could have been applied to this study to gain in-depth understanding of adopters' lived experiences. However, there could have been a generalization issue because the outcome of the research was applied to a large population. The qualitative method is useful for indepth study of a limited

number of cases; however, it is difficult to test theories or hypotheses when dealing with a large population sample, such as the one in this study.

Definitions of Terms

Certain words and phrases should be contextualized and defined as used in this study to remove ambiguity within the context of information technology and management. The following terms are defined to enhance understanding of their use in the study:

Business ecosystem: A number of firms-competitors and complementors that work together to create a new market and produce goods and services of value to customers (Hazlett, Teece, & Waverman, 2011).

Digital divide: The gap between those who have access to a particular technology and those who do not (Curwen & Whalley, 2010).

GSMA intelligence: The definitive source of global mobile operator data, analysis, and forecasts and a publisher of authoritative industry reports and research (GSMA Intelligence, 2013).

Latent variables: Variables that are not directly measured but might exert an influence (Carvalho & Chima, 2014).

Moderating variables: Variables that influence the relationship between other variables and produce an interaction effect (Venkatesh, Morris, & Davis, 2003).

Smartphone: A high-end mobile phone that offers more advanced computing ability and connectivity. It runs an open and complete mobile operating system;

widespread examples are Symbian OS, Blackberry OS, Windows mobile, Apple iOS, Google Android, and other embedded Linux distributions (Zeng, 2012).

Technology leapfrogging: *Leapfrogging* refers to the adoption of advanced or state-of-the-art technology of an application in an area where immediate prior technology had not been adopted (Napoli & Obar, 2013).

Teledensity: A term commonly used to describe the number of telephone lines per some unit population (Sife, Kiondo, & Lyimo-Macha, 2010).

Assumptions

Leedy and Ormrod (2010) stated, "Assumptions are so basic that, without them, the research problem itself could not exist" (p. 62). Three assumptions made in this study to enable proper evaluation of the findings are the following:

1. The expected performance threshold for mobile phone services is different among users due to their locational base, level of education, and sociodevelopment status.
2. Performance expectancy and satisfaction are critical factors that moderate the pre- and postadoption experiences of users regardless of their location, be it urban or rural.
3. Sociodevelopment status is a major determinant in the adopters' data plan, types of phones acquired, and usage of the technology.

Scope and Delimitations

The focal points of this study were the innovation diffusion of mobile technology, the intention to use mobile technology and its continued usage, and the

sociodevelopmental effect of the adoption on rural and urban users in Nigeria. The study population comprised individuals who owned a smartphone in Nigeria. Studies on the adoption of mobile technology are broad and widely dispersed; therefore, this study focused on the various issues raised in the Problem Statement section regarding the intention of adopters and the sociodevelopmental effect of smartphone mobile technologies on the rural and urban populations in Nigeria. Not considered in this study were the following issues:

1. Specific intention and influence of the technology on specific segments of the economy such as health care, education, real estate, stock exchange, or agriculture.
2. Testing of all the variables associated with the UTAUT-2 and ECT. I considered the six variables in this study as the most relevant within the context of this research. Variables not covered were effort expectancy, hedonic motivation, and facilitating conditions.
3. Although various languages and dialects are spoken in Lagos, this survey research was only conducted in English, which is Nigeria's official language. Effectively excluded from this cross-sectional survey research were thus anyone younger than 18 years, illiterate persons, and non-English speakers.
4. Completion time for the survey was limited to 12 minutes so that participants' patience did not wear out and to avoid reducing the response rate of the survey.

Limitations

The major limitations in this research were as follows:

1. A cross-sectional approach was used where data were collected over a short period, rather than a longitudinal method, which might have investigated the adopters' behaviors over a longer time frame and shown that individuals' usage behavior tends to vary over time.
2. Taking into consideration the size and the demographics of the population, a multistage random-sampling method was considered most suitable for this study. The sample size was 385 participants. The confidence level was set at 95% with a 1% to 5% margin of error. Data were collected in the local government agencies and the urban and rural communities with smartphone networks in Lagos. Patterns obtained from study participants with respect to their intention to use and the sociodevelopmental effect of mobile phones may adequately represent the experiences reported in other nations on the African continent. They are, however, likely to vary somewhat from those found on other continents with different sociodevelopmental structures from those of Africa.
3. Discovered patterns cannot serve as reliable predictors of users' behavior with regard to future mobile applications.

Significance of the Study

The findings from this study may be beneficial across three levels: individual, organizational, and national. The individual level comprises the academic community and

adopters of mobile technologies. The organizational level focuses on management and leadership and comprises more specifically private telecom operators (PTOs) and consumer-rights organizations. The national level includes government agencies saddled with the responsibility of policy formulation for ICT. Increasing evidence is supporting the continuous interest in mobile technology acceptance; mobile phones spread ubiquitously across the continent because of their contribution to social development (Aker & Mbiti, 2010). The major significance of this study arises from the lack of comparative empirical studies on the effects of this technology on urban and rural adopters and the lack of comparative evidence on the pre- and postadoption behavioral attitudes of these urban and rural adopters.

Prior studies on the sociodevelopmental significance revealed that the extra 10 phones per 100 people in a typical developing country boost GDP growth by 0.8% (World Bank, 2009). The *Economist* (2011) captured the expected effect of mobile technology succinctly by describing the mobile phone as once the toys of "rich yuppies;" yet, mobile phones have evolved in only a few years to become tools of economic empowerment for the world's poorest people. These phones compensate for inadequate infrastructure such as bad roads and slow postal services, allowing information to move more freely, making markets more efficient and unleashing entrepreneurship. Rapid diffusion of smartphone mobile technologies and innovations that come with them generate significant and widespread societal gains in poor areas as stronger economic recovery enhanced public safety management of crisis situations (e.g., natural disasters), health care delivery, and the distribution and use of energy (Shapiro & Hassett, 2012).

Sampath (2002) noted that, as urban areas become crowded and saturated, smaller towns are showing increased potential for growth and development. Sampath emphasized that an investment in people in smaller towns and the placement of industries and knowledge-based centers in rural areas will promote and balance the economic growth of villages, the country as a whole, and neighboring countries alike. However, despite these high hopes for using communication technology to revive the rural economy, no empirical evidence exists to show how the rural population is using the mobile technology and whether its use is directed toward economic development or limited to other purposes. I undertook this study to reduce this gap in the professional literature.

In Nigeria, as in other emerging economies, connectivity and infrastructure divides exist between urban and rural areas. Sixty one percent of Africa's population resides in rural and semirural areas (Pyramid Research, 2010), which makes this segment of the population a sizeable addressable market for mobile services. This information makes this study critical for academic discourse in the context of intention, usage trends, and the effect of the technologies on rural and urban adopters in Nigeria.

Significance for Theory

For academia, this study contributes to the existing body of knowledge with respect to the UTAUT and ECT, especially in the context of the rural/urban dichotomy of a developing economy. The study also helps answer the concerns raised by Ha, Okigbo, and Igboaka (2008) about who uses the technology the most to sustain innovation. Further, the completion of this study facilitates further discourse in the field of diffusion

of innovation, particularly the growing field of smartphone mobile technologies in Africa.

Significance for Management and Leadership in Government Agencies

This research presents opportunities to service providers for understanding the relationship between pre- and postadoption behavior of mobile phones subscribers in rural and urban communities. Practitioners and policy makers may also find the outcome of this study critical to policy formulation and strategy design and execution with a view toward improving customer satisfaction, ensuring custom-made services based on customer preferences, facilitating social change, and enhancing economic growth through appropriate deployment of business-driven innovations.

Proper use of mobile technologies for social development is of national concern, and findings from this study can benefit government at various levels. The study outcome may deepen regulators' understanding of the relationship between mobile phone diffusion and sociodevelopmental growth. Further, the research outcome may be a useful tool in the reevaluation of national policies on ICT development and assist governmental agencies in policy formulations that enhance millennium development goals (MDGs) and strategies.

Significance for Social Change

The following are the expected social-change effects of this study: (a) adopters could become more informed about the use of the technology and use it to enhance their sociodevelopment status, and (b) they may experience improved services and increased

levels of satisfaction as a result of probable policy changes by regulatory agencies and telecom providers.

The main value of this study lies in its expected and direct effect upon improving the human condition by enhancing knowledge in the field of technology adoption. The concept of social change leads researchers to apply the skills and knowledge they possess to make a positive difference in their own lives and the lives of their communities. This study has several implications for the people of Nigeria in particular, but also for Africa as a whole and for other developing nations with a clear divide between rural and urban populations. Knowledge gained from this study could lead to an overhaul of mobile-network deployment strategies with respect to the services provided to the two distinct groups of adopters. Telecom companies collect feedback on what constitutes postadoption satisfaction among users and what to do to remove any possible disconfirmation among users. Regulatory authorities could use the findings on postadoption confirmation or disconfirmation of the technology to formulate policies that improve customer satisfactions and enhance continuous diffusion of other emerging technologies. Findings of this study could also be used by regulatory authorities to formulate policies that particularly enhance the sociodevelopmental contributions to rural communities through the appropriate deployment of the technology. A clearer understanding of the benefits derived from the adoption and appropriate usage of mobile technology could enable users to put the technology to more advantageous use, enhance their productivity, and boost the social development of their communities.

Summary and Transition

This chapter included an introduction to the study, the background of the research problem, and a statement of the problem. I explained the purpose of the study, its theoretical framework, and the significance of the results for various beneficiaries, which highlight some important positive social changes that can be expected from this new knowledge about innovation diffusion of smartphone mobile technologies among the rural and urban population of Nigeria. Chapter 2 includes a review of the literature and the theoretical foundation for the study. Chapter 3 includes the research methods used for the study, including a description of the population, the sampling procedures, and data collection and data analysis procedures. I also discuss validity and reliability in research and measures taken for the ethical protection of the participants. Chapter 4 includes the results of the study and Chapter 5 includes conclusions based on the findings and recommendations for practical application and further research on the topic.

Chapter 2: Literature Review

This chapter includes a review of current literature with relevance to the research questions and objectives regarding the innovation diffusion of smartphones among rural and urban adopters in Nigeria. The purpose of the review is to provide a better understanding of the situation and a general overview of the scholarly work in the field of innovation diffusion and technology acceptance. The problem was a lack of information on the adoption behavior and the sociodevelopmental effect of mobile technology acceptance of rural and urban adopters in Nigeria. Major themes covered in the review are (a) innovation diffusion theory (IDT), (b) TAM with a particular focus on the UTAUT and the ECT, (c) the evolution of mobile technology, and (d) the sociodevelopmental impact of mobile technology adoption.

Literature Search Strategy

Access to the Walden online library and Google Scholar facilitated a comprehensive review of existing studies, published articles, and other scholarly works. The starting point for the search was to determine if studies of a similar nature as the one I planned to conduct had already been undertaken. The search results revealed an absence of research studies in the area of my stated purpose. The next step was to search for dissertations and articles in the areas of innovation diffusion, technology adoption, and mobile technologies and consumer behavior. Google Scholar and the Walden library were used to search for peer-reviewed articles. Google Scholar proved to be helpful in providing links to some of the most widely referenced seminal works and articles in the fields of technology adoption, innovation diffusion, and mobile technology.

To collect adequate references for this study, publications were accessed from the following venues: peer-reviewed journals, industry publications, books, periodicals, and conference proceedings. Keywords used in the search were *innovation diffusion, disruptive innovations, technology adoption, technology acceptance, 4G network, smartphone, UTAUT, technology acceptance model,* and *expectation confirmation theory*.

With these keywords, I searched through the information systems and technology databases and the business and management databases in the Walden online library. The information systems and technology databases included ACM Digital Library, Computers and Applied Sciences Complete, IEEE Xplore Digital Library, ScienceDirect, and Safari Tech Books. Two of the databases proved to be especially useful: ACM Digital Library and ScienceDirect. Searches in the business and management databases were limited to Business Source Complete, ABI/INFORM Complete, and Emerald Management Journals.

The research articles were reviewed for relevance, and there were instances when articles were eliminated based on abstract or content of the article. After the elimination, 196 articles were eventually cited in this study. A total of 155 of the 196 references (79.08%) where published within the last 5 years, whereas 130 (83.33 %) of 156 of the peer-reviewed journals referenced were published within the last 5 years. The references include five groups: peer-reviewed articles, books, conference proceeding, industry research, and government searches and statistics. The peer-reviewed journals were obtained mostly through the Walden online library by specifying a certain period (i.e., 2009–2014). The books referenced in this study belong to two major groups: classic

works in management and prominent books in research design and methodology. The classic books laid a solid foundation for this study in the area of consumer behavior, innovation diffusion and management, and technology advancement and acceptance. The following authors wrote some of the classic works cited in this study: Christensen (1997), Rogers (2003), and Schumpeter (1942). Books on research methods included works by Creswell (2009), Frankfort-Nachmias and Nachmias (2008), and Leedy and Ormrod (2010). To create a framework for this study, I consulted the following seminal works: Agarwal and Prasad (1999), Davis (1989), Ajzen and Fishbein (1980), Oliver (1980), and Venkatesh et al. (2003). A doctoral dissertation was also referenced in this study (Igboaka, 2010).

Theoretical Foundation

Smartphones have continued to enjoy tremendous growth' hence, there has been series of research studies designed to investigate smartphones adoption and usage, and predict users' behavior (Lo, van Breukelen, Peters & Kok, 2014; Shareef, Kumar, Kumar, & Hasin, 2013; Soper, Turel, & Geri, 2014). However, there is a lack of universalism in terms of consumer preferences and perceptions of mobile technology (Al-Debei and Al-Lozi, 2014). Ha, Kim, Libaque-Saenz and Park (2015) believed that the wide penetration of smartphones continued to increase market competitiveness of mobile technology. The enhancement and the ability of manufacturers of mobile technologies to meet and be ahead of consumers' expectations rather than responding to demands have accelerated the individual's interests and usage of these technologies (Al-Debei & Al-Lozi, 2014; Chiyangwa & Alexander, 2015). It is for these reasons that information systems scholars

continue to show interest in broadening the understanding of factors that influence technology adoption and the continued use of technological innovations by individuals and organizations.

Researchers developed several theories and models to understand, test, or expand on existing technology adoption models. Some of the prominent models and theories are the TAM (Davis, 1989), the IDT (Rogers, 2003), the theory of reasoned action (Ajzen & Fishbein, 1980); the expectation confirmation theory (Oliver, 1980); the social cognitive theory (LaRose, Demaaagd, Chew, Tsai, Steinfield, & Wildman, 2012), and the unified theory of acceptance and use of technology (Venkatesh et al., 2003, 2012). These models enjoy wide recognition in the field of information systems (IS) and technology management. They have contributed considerably to the understanding of technology acceptance both at the initial adoption stage and at the postadoption stage. The major constructs derived from these models are perceived usefulness (PU), perceived ease of use (PEU), attitude (AT), behavioral intention (BI), and actual usage (AU). Sun and Zhang (2006) observed that, of all the constructs, subjective norm (SN) is the least studied in the field of IS research.

The focus of this study was limited to the UTAUT and ECT. The reason for this choice was two-fold: First, the UTAUT was developed as a unified theory that integrated other constructs into its model; and second, it proved critical to the understanding of users' BI and attitude regarding continued use. In the second part of this study, I examined the postadoption behavior of users. The ECT was, therefore, chosen for explaining users' satisfaction and gaining insight into the continued use of information

technology (Bhattacherjee, 2001; Halilovic & Cicic, 2013; Oghuma, Libaque-Saenz, Wong, & Chang, 2015; Venkatesh, Thong, Chan, Hu, & Brown, 2011). The rationale for this choice was that the ECT is one of the most widely used and tested postadoption theory. These two combined models shed light upon and provide greater insight into the research problem of this study regarding pre- and postadoption behavior of smartphone users and the sociodevelopmental effect of the adoption on the users.

Preadoption Theories

As previously explained, notable theories and models exist that have been widely used, tested, and enhanced in the study of individual attitudes toward adoption of innovations. For example, two theories include the IDT and the TAM. A general overview of some of the adoption theories is presented in the following sections.

Innovation Diffusion Theory

The seminal work of Rogers (2003) on innovation diffusion laid the foundation for current scholarly studies on adoption and diffusion of innovations. Agarwal and Prasad (1998) stressed the critical nature of the theory and posited that IDT is consistently used to explain and predict adoption and diffusion behavior.

The primary aim of IDT is to understand the adoption of innovation from the perspective of four elements of the diffusion: innovation, time, communication channels, and social systems. The five central constructs of IDT are relative advantage, compatibility, complexity, observability, and trialability. These variables were found to have a positive correlation with other technology adoption factors. Agarwal and Prasad (2000) found a link between relative advantage (RA) and attitude (AT). Other authors

found compatibility with influencing PEU (Hernandez, Jimenez, & Martin, 2010), AT (Agarwal & Prasad, 2000), and BI (Ozbek et al., 2014).

Technological Acceptance Model

TAM is the most widely applied and referenced adoption model, some of the application areas include: advertising (Huarng, Yu, & Huang, 2010), health care (Yun & Park, 2010), information management (Berrend, Wiebe, London, & Johnson, 2011, marketing (Lee & Qualls, 2010) and new media (Hopp & Gangadharbatla, 2014). Davis (1986) proposed the theory in his doctoral thesis at MIT Sloan School of Management. The major proposition of the theory is that technology adoption could be explained or predicted by understanding user motivation, which, in turn, is induced by external stimuli and consists of actual systems features and capabilities. Davis refined the model, using TRA/TPB as a framework, to conclude that users are motivated to adopt the technology because of PE, PEU, and AT. He posited that attitude of the user toward an innovation is a major determinant of the decision to accept or reject the system. PEU and PU have been empirically validated by various researchers, they believed that the two constructs are the primary factors that determine users' decision to adopt technology and that the intention to use and the perceived usefulness will produce a more significant result than attitude (Artega-Sanchez & Duarte-Hueros, 2010; Saade, Nebebe & Mark, 2011; Teo, 2011; Barrette, 2015). These studies were conducted by Ozbek, Almacik, Koc, Akkilic, and Kas (2014), and nevertheless, established that personality trait and attitude may influence intention and behavior of individuals to adopt an innovation.

Agarwal and Prasad (1998) criticized the TAM because of the absence of moderating influences; they enhanced the model by adding the construct of compatibility. Agarwal and Karahanna (2000) introduced other variables, namely cognitive adoption, playfulness, and self-efficacy. Venkatesh and Davis (2000); however, expanded the model by adding another construct known as subjective norms (SN).

Theory of Reasoned Action

In 1975, Ajzen and Fishbein developed the TRA, a theory that has been widely applied. Davis (1989) used it as a dominant theoretical framework for TAM. Although developed on a background of social psychology, the theory has nonetheless been widely employed in IS/IT to understand the adoption behavior of ICT users. Ajzen and Fishbein (2000) posited that human behavior is determined by BI and that the BI is signified by AT and influenced by SN.

Theory of Planned Behavior

The TPB, just like the TRA, can trace its origins to social psychology, and Davis (1989) used it to support his TAM model. The major construct added by TPB to the study of human behavior is perceived behavioral control (PBC). As Kim, Ham, Yang, & Choi (2013) noted, "identifying and measuring the actual resources and opportunities encountered when performing a particular behavior is difficult," which has led researchers to evaluate participants' perception of a behavior's ease or difficulty to perform. Kim and Crowston (2011) highlighted the fundamental assumption of TRA and TPB as people's ability consciously to determine whether to engage in or not to engage in a particular behavior.

Social Cognitive Theory

SCT posits that people acquire and maintain certain behavioral patterns based on the knowledge gained from other persons (LaRose et al., 2012). This observational learning, LaRose et al. (2012) note, causes people to "reflect and describe what they have experienced and evaluate the benefits of an innovation." Under the SCT, behavior is influenced by both the outcome expectation and self-efficacy, and these are influenced by prior behavior (Kim & Crowston, 2011). IS researchers found a positive correlation between self-efficacy and other adoption determinants such as PEU (Venkatesh & Davis, 1996) however Chiyangwa and Alexander's (2015) study did not find any positive correlation between PEU and the adoption of mobile phone. Other studies established a positive correlation between PU and perceived enjoyment (Agarwal & Karahanna, 2000; Barnes & Vidgen, 2014; Chiyangwa &Alexandra, 2015; Chong, 2013; Kim & Ammeter, 2014; Zhou, 2011). Subjective norms were also found to influence self-efficacy, which, could be described as the key determinant of PEU (Hopp & Gangadharbatla, 2014).

Technology Adoption Variables

The common variables in technology adoption include:

Perceived usefulness: Davis (1989) posited that the BI to use technology is determined by two factors: PU and PEU, Hopp and Gangadharbatla (2014) described the two factors as the extent to which a person believes that using a technology will enhance his or her performance on task or series of activities. They argued, both of these factors have direct and indirect effect on the adopters. A scholarly consensus appears to exist regarding the critical importance of PU in determining users' adoption of technology.

Sun and Zhang (2006) observed that, despite the existence of several similar constructs (e.g., outcome expectation in the computer self-efficacy model or extrinsic motivation in the motivational model), these models confirm merely from different angles that PU plays a critical role in forming the user's AT or BI in other models.

Perceived ease of use: is "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320). Sun and Zhang (2006) observed that the impact of PEU on AT, BI, and usage is inconsistent, and the inconsistencies suggested that other factors may moderate the relationships between PEU and the other three constructs, namely, AT, BI, and usage. Ozbek et al. (2014) in their study established that PEU positively influences PU, PEU positively influences BI, and PU positively influences BI.

Behavioral intention and attitude: BI has consistently been shown to be a better predictor of technology adoption than other competing constructs such as realism of expectations, motivational force, value, and user satisfaction (Venkatesh & Davis, 1996). BI is a better predictor because a positive perception of an innovation by potential adopters will enhance their BI to use the technology. This may be the reason why Davis (1989) omitted the construct as one of the variables in the modified TAM. Sun and Zhang (2006) believed that AT is a complex construct with multiple components and that this was the reason for its omission from the work of Davis in 1989.

Subjective norm: Ajzen and Fishbein (1980) described SN as a user's perception that most people who are important to him or her think he or she should, or alternatively should not, perform the behavior in question. SI in the form of subjective norms played a

critical role in the decision to adopt any technology and as users become progressively familiar with technology, their beliefs regarding its usefulness and usability become influenced by perceptions related to the beliefs of significant others (Hopp & Gangadharbatla, 2014). SN has three major mechanisms through which it exerts its influence: compliance, internalization, and identification (Sun & Zhang, 2006). Other constructs such as good image and social standing (Chiyangwa & Alexander, 2015) and perceived usefulness (Venkatesh & Davis, 2000) also influence SN.

Unified Theory of Acceptance and Use of Technology

UTAUT derives from the seminal work of Venkatesh et al. (2003). It came into being through synthesis of eight major theories, tested on real-world datasets based on critical factors and contingencies relating to the prediction of intention to use the technology. In a search conducted by Williams, Rana, and Dwivedi (2015), they discovered that the theory has been widely applied across 174 research journals and conferences. It has appeared more frequently in journal such as: *Computers in Human Behavior*, *Computers & Education of the Association for Information Systems*, *Decision Support Systems*, *Expert Systems with Applications,* and *MIS Quarterly.*

UTAUT refined how determinants of intention to use a technology are expressed over time; the major constructs in the model are performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC) according to Venkatesh et al. (2003). The enhanced UTAUT added habit, hedonic motivation (HM), and price value to the previous four constructs to bring the number of constructs under UTAUT to seven. The constructs are moderated by age, gender, experience, and

voluntariness. Gender, omitted from IT behavioral research, was found to have a significant effect on technology adoption. Venkatesh and Morris (2000) posited that women and men are different in terms of information processing; they use different socially constructed cognitive structures. The authors argued that men are more driven by PU, whereas women are more influenced by PEU and SN. They also posited that gender might influence the association between PU and BI, PEU and BI, and SN and BI.

Age is the third moderating factor in Venkatesh et al.'s (2003) research, when compared to gender and experience; it received fewer mentions in scholarly work. However, the seminal work of Venkatesh et al. on the UTAUT established a relationship between age and BI. According to Venkatesh et al., young users placed more emphasis on extrinsic rewards, which he regarded as an equivalent of PU. Furthermore, the authors stated, "increased age has been shown to be associated with difficulty in processing complex stimuli and allocating attention to information on the job" (p. 450). From this, one might deduce that PEU is a stronger determinant of BI in older users (Sun & Zhang, 2006).

Kim and Crowston (2011) linked some of the UTAUT variables with similar constructs in the adoption studies construct. They argued that PE in the UTAUT is similar to behavioral beliefs in TRA and TPB, perceived usefulness in TAM and TAM-2, relative advantage in IDT, and outcome expectations in SCT. They also reversed their argument and posited that many of the variables in other adoption studies could be linked to the UTAUT model. For instance, the EE construct for technology adoption is similar to PEU in TAM, PBC in TPB, complexity in IDT, and self-efficacy in SCT. Kang, Seo, and

Hong (2011), however, pointed out a gap in the UTAUT; they argued that the noninclusion of culture presents a major weakness in the model.

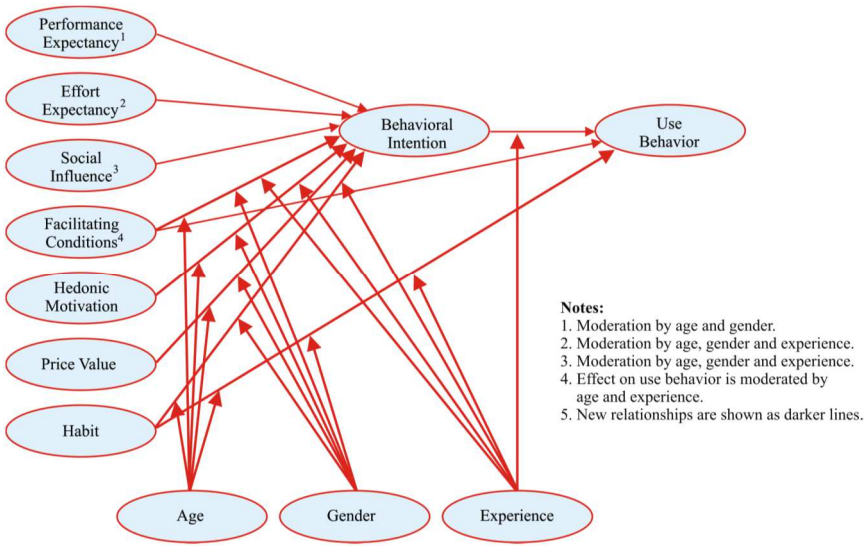

Figure 1. UTAUT-2 model depicting constructs that influence behavioral intention to use technology.

Adapted from "Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology," by V. Venkatesh, J.Y.L. Thong, and X. Xu, 2012, *MIS Quarterly, 36*(1), p. 158. Copyright 2012byVenkatesh, J.Y.L., Thong, and X. Xu. Reprinted with permission.

Postadoption Theories

Before the advent of the ECT, most of the adoption theories focused on users' behavioral attitude toward the initial adoption of innovation. Kim and Crowston (2011) justified the need for postadoption theories to capture the dynamics of the postadoption behavior of technology use. The authors observed that the current postadoption theories examined postadoption from the perspective of a cognitive adoption model where people

consciously examined their technologies during the usage stage. Recent postadoption studies have applied new theoretical frameworks and addressed postpurchase changes in the user's perception (Kim & Crowston, 2011). Such theories include the ECT by Oliver (1980) and the information systems continuance model (Venkatesh et al., 2011).

Expectation Confirmation Theory

ECT was derived from the research work of Oliver in 1980. My principal aim was to account for a substantial gap between initial adoption and postadoption behavior. Expectation of technology is seen as an important predictive factor with respect of perceived performance, disconfirmation of expectations, and satisfaction and usage continuance intention. Islam (2014) posited that the ECT hypothesizes that the "level of satisfaction a consumer has with a product or service determines their repurchase plan" (p. 250), and that dissatisfaction occur when buyer expectations are not met, resulting in the discontinuation of the product or service. Aizstrauta, Ginters, and Eroles (2015), argued the theory is exploitative in nature and deal with prediction and modeling of users behavior in the decision to adopt or reject a particular technology. This could also mean that consumers' perception is formed when they compared their original expectation with their initial consumption (Halilovic & Cicic, 2013). This implies that consumers first form some expectations about a product or service before they make a purchase decision. Thereafter, they build their perceptions upon the performance of the product, or their adoption experiences (Lin et al., 2012).

Rationale for Choosing UTAUT and ECT for This Study

Most of the adoption theories focused on the initial adoption of the technology with little attention paid to the users' behavioral attitude after the initial adoption and usage. With this comparative study, I aimed for a better understanding of the intention to use and continue to use smartphones among urban and rural adopters in Nigeria. An integration of a pre- and postadoption theories are considered most suitable for this study, the outcome of which may represent a comprehensive phenomenon in the field of IS research. Venkatesh et al. (2011) recognized the significance of the integration; thus, they incorporated three constructs (FC, EE, and SI) into the enhanced UTAUT in order to facilitate better understanding of IS usage, compared with what could be obtained with the UTAUT or ECT alone.

These theories are particularly relevant to this study because it is focused on a new context from the perspective of new technologies such as smartphone technologies, a new user population (i.e., consumers in less technologically advanced countries, particularly Nigeria in sub-Saharan Africa), and new cultural settings (i.e., urban and rural dwellers in Africa). The three contexts integrate into five out of the seven constructs under the enhanced UTAUT: PE, EE, SI, price, and habit.

Study Framework

In Figure 2, I depict the framework for this study, which represents a synthesis of the literature review. The independent variables were obtained from a combination of the constructs of the UTAUT and the ECT: expectations, PE, EE, SI, PV, habit, satisfaction, and confirmation.

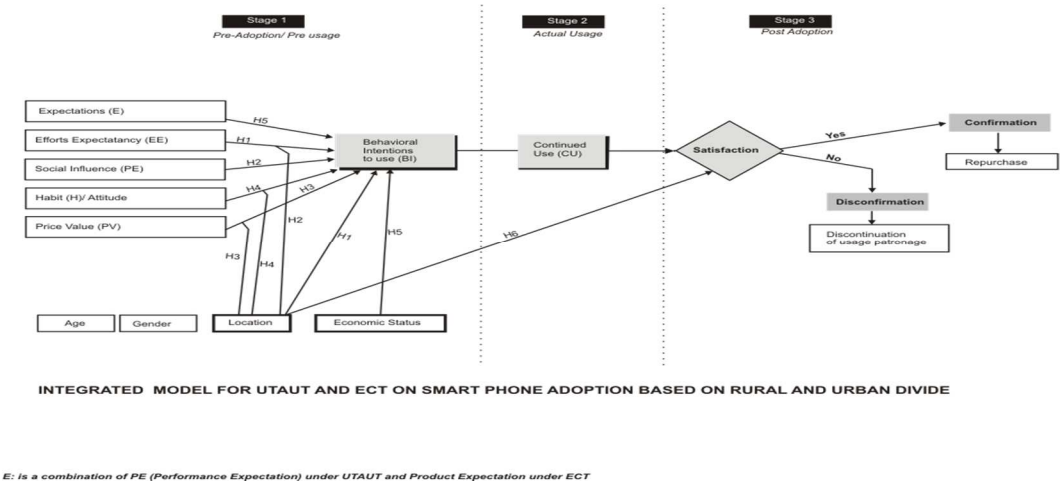

Figure 2. Theoretical framework for smartphone pre-and postadoption behavior based on the rural/urban divide.

Literature Review

The research effort on ICT should be concerned with how the technology could continually contribute to a better world, where everyone has the opportunity and the ability to use technologies to provide a better life for themselves, their communities and the world in general (Pereira. et al., 2015; Walsham, 2012). Information and communication technology (ICT) continue to reshape the social scenery of human life (Pereira, Oliveria & Testa, 2015), and it has grown to become a major enabler for national progress and social transformation (Majchrzak, Markus, & Wareham, 2014). Organizations and individual use ICT technology for different purposes such as information, entertainment, social support, leisure, work, and relationship maintenance (Volkom, Stapley, & Malter, 2013).

Magsamen-Conrad, Upadhyaya, Joa, and Dowd (2015) captured the effect of ICT and posited that ICT has become an integral part of the lives of people who use them.

From organizational perspectives, Wu and Chiu (2014) noted that ICT is a source of firms' competitive performance when evaluated from a strategic viewpoint. Magsamen-Conrad et al. believed that when ICT is selectively adopted and purposefully used, it could enhance the quality of life of the individual. Sey (2011) linked ICT with hope for the present and the future; he saw ICT as the harbinger of hope that may transform the fortune of the poor in the developing countries.

ICT involves all digital technology that facilitates individuals, businesses, and organizational use of the information for decision-making. It involves any product that could "store, retrieve, manipulate, transmit, or receive information electronically in a digital form (Tella, Adaraloye, & Akanbi, 2014, p. 10). Lin (2015) traced the advent of ICT to the era when the telegraph was invented in the developed countries. Today, the technology has a global spread that transcends the original telegraph capability. ICT products now currently include: video/DVD technology, multimessaging services, satellite delivered broadcast, computer mediated communication (CMC), and mobile technology. Mobile technology began with the introduction of feature phone; however, today, smartphone technology has changed the landscape of mobile industry.

Smartphone technology is a major part of ICT, and it is currently ubiquitous in both developed and developing countries, and has developed to become an increasingly integral, and habitual, part of modern life (Oulasvirta, Rattenbury, Ma, & Raita, 2012). Since the introduction of the technology, smartphone technology has become the standard configuration for mobile devices and it is currently the fastest growing market segment in the telecom industry (Cecere, Corrocher, & Battaglia, 2014). The critical effect of the

technology has been variously captured by some of the big player in the ICT industry, Napoli and Obar (2014) quoted Brin the cofounder of Google at his 2013 TED talk, who referred to smartphone as the ultimate future of how to connect with other people. Mobile internet diffusion through the smartphone continue to outpace the fixed, personal computer (PC) based internet access, according to Bold and Davidson (2012) in 2010 the number of broadband internet subscriptions over mobile technologies was more than the number of fixed, PC based Internet based subscription. The global sales of the smartphone applications are predicted to reach US $38 billion by 2015 (Bilton, 2011; Lessin & Ante, 2013). Bold and Davidson (2012) predicted that mobile Internet subscription would rise from 61% of all broadband connection in developing countries to 84% in the year 2016. This wide penetration of the technology is believed to have altered the way individuals interact with information on a routine basis (Kim, Briley, & Ocepek, 2015), work, play, and stay informed with world events anywhere and anytime (Oulasvirta, Rattenbury, Ma, & Raita, 2012). The technology is gaining ground as an interactive medium that benefits both businesses and consumers (Kim, Chang, Park, & Lee, 2015).

Empirical studies predicted that the emerging smartphone technology would be leapfrogging over earlier technologies in developing countries and that this could be the catalyst to bridge the digital divide, launching unprecedented economic development and wealth creation (Napoli & Obar, 2013; 2014). Technology leapfrogging occurs when a population adopts a new technological innovation without ever having adopted the preceding technology. Fixed wired telephone technology preceded the mobile

technology; thus, communication technology was almost nonexistent in Africa. Technology leapfrogging increases the pace of a country's economic development, thereby narrowing the gap between developed and developing nations (Napoli & Obar, 2013). The technology leapfrogging effect of smartphones was documented in several empirical studies: Tseng and Chiang (2013) described consumers' upgrading intentions to a mobile phone multigenerational high-tech product, and Juwaheer, Vencatachellum, Pudaruth, Ramasawmy, and Ponnusami (2014) discussed mobile phones among young customers. Chief Strategy Officer at GSMA Hyunmi Yang stated,

> The smartphone has sparked a wave of global innovation that has brought new services to millions and efficiencies to businesses of every type. . . .Smartphones will be the driving force of mobile-industry growth over the next 6 years, with 1 billion new smartphone connections expected over the next 18 months alone. (GSMA Intelligence, 2014, para. 2)

As of November 2014, there were 1.76 billion smartphones in use worldwide with the projection that the figure would reach 2.73 billion by 2018 (Statista, 2014). Rushton (2012) corroborated the figure projected by Statista of 2.04 billion smartphone users in the year 2015, when he posited that smartphone users would exceed the 2 billion mark in 2015. Jyoti, Sutee, Efpraxia, and George (2014), equally observed the rapid diffusion of smartphone, they posited that the smartphone is the fastest growing novel technology in the mobile phone market.

Smartphone technologies are innovative products with tremendous benefits to users with respect to access and management of information. Dawson (2013) observed

that the influence of mobile phones on the continent of Africa transcends any other known technical innovation; it has improved prosperity, business, and innovation. Hyde-Clark and Van Tonder (2011) also observed the introduction of mobile technology has leapfrogged stages of development and continues to transform Africa into an information society.

Napoli and Obar (2013) pointed out the potential benefits of technology leapfrogging for developing countries. When a developing country leapfrogs to a newly emerged ICT, it may record unprecedented growth, alleviate poverty, secure economic growth, and possibly surpass developed countries in economic development. The study conducted by The Earth Institute (GSMA Intelligence, 2014) found that a 10% increase in mobile penetration led to 1.2% increase in GDP in Nigeria, Ghana, Kenya, and Tanzania. GSMA Intelligence (2014) posited that, in the hands of consumers, these devices are improving the standard of living and changing lives, especially in developing markets, while contributing to growing economies by stimulating entrepreneurship.

Though the widespread diffusion of smartphone in Africa has been applauded, Kim, Briley, and Ocepek (2015) observed a considerable difference in respect of individual demographic and psychological characteristics. They argued there are a number of important demographic or socioeconomic factors that would likely influence smartphone adoption. Chief among these factors is the cost of acquiring and maintaining smartphones, for instance in a study conducted by Smith (2013) from the sample size of 2252, he discovered the following: 59% men were more likely to own a smartphone compared to 53% of women who are willing to posses a smartphone. Eighty one percent

of the individuals within the age bracket of 25–34 were more likely to have a smartphone compared to 39% of those within the age bracket of 55–64. Educational qualification and earning power are also a major predictor for smartphones adoption, 70% of those with academic degree are likely to posses a smartphone however only 46% of those without college degree will own a smartphone. 78% of individuals that make over $75,000 a year will posses a smartphone while on 43% of individuals that make less than $30,000 will posses a smartphone. Kim, Briley, and Ocepek (2015) observed a structural obstacle to smartphone usage (e.g., comparatively higher costs and fees of smartphone usage), cohort effects (e.g., higher rates of adoption among the younger population), and the influence of lifestyle factors (e.g., use by highly educated individuals). They therefore concluded that sociodemographics were the strongest predictor of smartphone and application use.

Napoli and Obar (2014) raised other concerns in respect of smartphone adoption, they posited that many of the mobile only users in developing countries are first time users of Internet; this category of users, experienced technology leapfrogging because they had no prior access to PC based Internet connection. The leapfrog therefore created a skill gap and increased their learning curves. Hyde-Clark and Van Tonder (2011) observed that Internet users who already experienced a PC based Internet access have acquired necessary knowledge and skills to operate their newly acquired mobile devices, therefore they had little problem navigating through their smartphones. Zainudeen and Ratnadiwakara's (2011) findings revealed that the single best predictor of usage of Internet services on smartphone is past experience gained on PC based Internet connectivity. Other studies have revealed "consistent evidence that the amount of prior

Internet experience and range of Internet-related skill sets" acquired using a "PC based internet connection is positively related to the range of functionalities that these individuals utilize on their mobile devices" (Napoli & Obar, 2014). Therefore, the concern that mobile devices could exacerbate digital inequalities and contribute to increasing disparities (Napoli & Obar, 2014) that Horigan referred to as referred to as digital readiness (Stewart, 2013).

There are various empirical evidences to support the observed challenges with smartphone adoption among the mobile only user. In a study conducted on the low income residents of Cape Town, South Africa, users were confronted with some technical challenges such as setup effort, security settings, menu navigation and dearth of mobile ready online content in native language (Gitau, Marsden, & Donner, 2010; Napoli & Obar, 2014). The above observed challenges led Gitau, Marsden, and Donner (2010) to conclude that the manufacturers of smartphone devices must have wrongly assumed that all users have prior knowledge with PC based Internet access. In the same manner, a multinational study conducted on novice and low literacy mobile users in the countries of India, the Philippines and Kenya discovered different usage barriers such as understanding or using hierarchical structures, soft keys, scroll bars, nonnumeric inputs and specialized terminology (Medhi, Patnaik, Brunskill, Nagsena, Thies, & Kentaro 2011). The recent findings from the study conducted by Wijetunga (2014) on the young people in the Republic of Sri Lanka, revealed that under privileged youth used a smaller part of their smartphone capabilities and that most of them only use their smartphone for voice calls than those youth from the higher socioeconomic status in the country.

Napoli and Obar (2014) argued, findings like those above are reflective of the increasing awareness among scholars, policy advocates and policymakers of the second-level digital divide (Epstein, Nisbet, & Gillespie 2011). The second-level digital divide is described as the gaps in relevant technology usage skill sets that can persist even after disparities in technology access have been addressed (Napoli & Obar, 2014). "The rapid evolution of mobile communication technology creates new affordances for people to be connected and informed; however it also poses new challenges for those with lower levels of technological fluency, and this can have a detrimental effect on one's ability to maximize benefits of mobile communication technology" (Campbell & Kwak, 2010, p. 548).

General Overview of Innovation Diffusion

Diffusion of innovative technology has received wide coverage in the science and management literature; the growing interest in innovation management is attributable to the critical importance of innovation for organizational survival (Kotsemir & Meissner, 2013). The smartphone technology is a novel innovation developed by telecom companies to improve accessibilities and ensure their continuous growth and survival. Innovation is the heart of organizational survival, and it is not an easy process as many organizations have witnessed through a multitude of failed innovation projects (Kotsemir & Meissner, 2013). In his seminal work, Christensen (1997) introduced the theory of disruptive technology and argued that disruptive innovations have rendered established technologies obsolete, thus destroying the value of investment that established (large) firms have made in these technologies, thereby displacing established firms and

incapacitating them to the point of being incapable to compete in the new market. In the Schumpeterian economic theory, innovation is referred to as *creative destruction*, which occurs when an innovation causes disruptions in the economy and acts as the catalyst that triggers the creation of new markets and the destruction of the old ones. Islam and Ozcan (2012) observed the similarities between the analysis made by Schumpeter's (1942) creative destruction and Christensen's (1997) disruptive technology. They argued that both scholars believed that the previous market is destroyed because of superior innovative strategy from the new entrants. Shi, Fernandes, and Chumnumpan (2013) observed this tendency from the perceptive of new generations of products and opined that successful products create new markets and substitute newer products for older generations of products, thus offering more advanced attributes. Examples abound with respect to the new generations of consumer technology such as television (Tsai, 2013), and video game consoles (Cenamor, Usero, & Fernández, 2013). The introduction of smartphone technology has created new markets, a new culture, and a new economy, and in the process it is destroying the incumbent fixed wired telephone market.

New generations of consumer technology highlighted in the previous sections are successful because the market accepts them. This shows that a successful innovation creates products that are acceptable to the consumers. Understanding how new products or ideas are communicated and accepted by the target audience has been widely studied in various fields. Innovation is crucial to any meaningful development. Schumpeter (1942) believed that innovation is the primary generator of economic growth; he stated that innovation is "the outstanding fact in the economic history of capitalist society or in

what is purely economic in that history, and it is widely responsible for what we at first sight attribute to other factors" (p. 86) such as industrial processes. This view, expressed by Schumpeter as well as Christensen (1997), emanated from the innovators' perspective, whereas Rogers's (2003) view represented the adopters' perspective on innovation diffusion. It is for this reason that Rogers's model was considered appropriate for this study. Rogers (2003) believed that innovation is any object, idea, technology, or practice that is new; it may include tangible objects such as a mobile phone or an intangible object such as new design methodology or software that runs the application inside a smartphone. Rogers's definition of innovation is broad and effectively dissolves the barriers between various scholarly disciplines regarding the definition of innovation.

Innovation can be viewed from different perspectives; however, in this study, the view is limited to two broad categories: degree of newness and successful adoption by the intended adopters. From the newness perspectives, innovation could mean a cutting-edge technology for those in the high-tech industry, or it could be as simple as the ability to send SMS from a mobile phone by those living in remote villages of the developing world. Others may see playing games on mobile devices or navigating through various applications on mobile devices to be quite innovative. Navigation through various application on their mobile phones, tablets, or laptops could appear quite new to the adult population. However, this may not be so perceived by a generation born into the information age, whose major ways of communicating has always been through various applications on mobile devices. Rogers (2003) defined innovation as "an idea, practice, or project that is perceived as new by an individual or another unit of adoption" (p. 12).

Tully (2015) argued against the concept of newness of an innovation and posited that, from Rogers's definition of innovation it follows, that an innovation does not necessarily have to be new; it only needs to be perceived as new by the would-be adopters.

The second category considered in this study was the degree of success achieved by the technology. Lee, Hwang, and Choi (2012) believed that successful innovation is the creation and implementation of new processes, products, services, and methods of delivery that result in significant improvement in outcomes, efficiency, effectiveness, or quality. Lee, Hwang, and Choi (2012) argued that an innovation becomes successful when it results in significant improvement in outcomes. Innovation must be seen to add value to both the proponent and the beneficiary or the adopters; therefore, Porter and Kramer (2011) believed that the purpose of an organization is to redefine shared value which, is necessary to drive the next wave of innovation and productivity growth in the new global economy.

Innovation Decision Process

Diffusion of innovation (DOI) is the process by which innovation is communicated through certain channels over time among the members of a social system (Rogers, 2003). Those who wish to adopt an innovation must face five decision processes: the general knowledge stage; the persuasion stage; the decision stage; the implementation stage; and, finally, the confirmation or disconfirmation stage. These decision processes are described in more detail.

General knowledge stage. The general knowledge stage, according to Sahin (2006), is the stage where the potential adopter learns about the existence of an

innovation and seeks information about it. What, how, and why question are the critical enquiries during the knowledge phase. At this stage, the individual attempts to determine what the innovation is, how and why it works, and what it could do for him or her (Rogers, 2003).

Persuasion stage. The persuasion stage is the second phase of the diffusion decision process. Persuasion is required to shift the cognitive knowledge of the individual into acceptance of the innovation. Sahin (2006) believed that persuasion is required for a person to develop a positive or negative attitude toward the innovation. Rogers (2003) argued that the formation of a favorable or unfavorable attitude toward an innovation does not always lead directly or indirectly to adoption or rejection. He further posited that, while the knowledge stage is more cognitively centered, the persuasion stage is more effect centered.

Decision stage. After the persuasion stage comes the decision stage. Rogers (2003) described acceptance as the full use of an innovation as the best course of action available; rejection means not to adopt an innovation. Sahin (2006) believed that an innovation on a partial trial basis receives rapid adoption because individuals can try out the innovation in their own situation and then make up their minds about approval or rejection. Rogers (2003) classified rejection into two forms: active and passive rejection. Active rejection occurs when an individual thinks about adopting an innovation but later rejects it. Passive rejection, on the other hand, occurs when a person does not give much consideration to adopting the innovation in whatever form.

Implementation stage. This is the stage at which an individual puts innovation into practice. However, because there is always a degree of uncertainty in innovation diffusion, Rogers (2003) argued that uncertainty could pose a problem at the implementation stage. Therefore, an implementer may require the technical assistance of a change agent (Sahin, 2006).

Confirmation or disconfirmation stage. The confirmation or disconfirmation stage is the last step in the innovation decision process. At this stage, the adopter seeks support for his or her decision (Sahin, 2006). The decision to adopt could also be reversed if the individual is exposed to conflicting messages about the innovation (Rogers, 2003). Figure 3 depicts the innovation decision process as identified by Rogers.

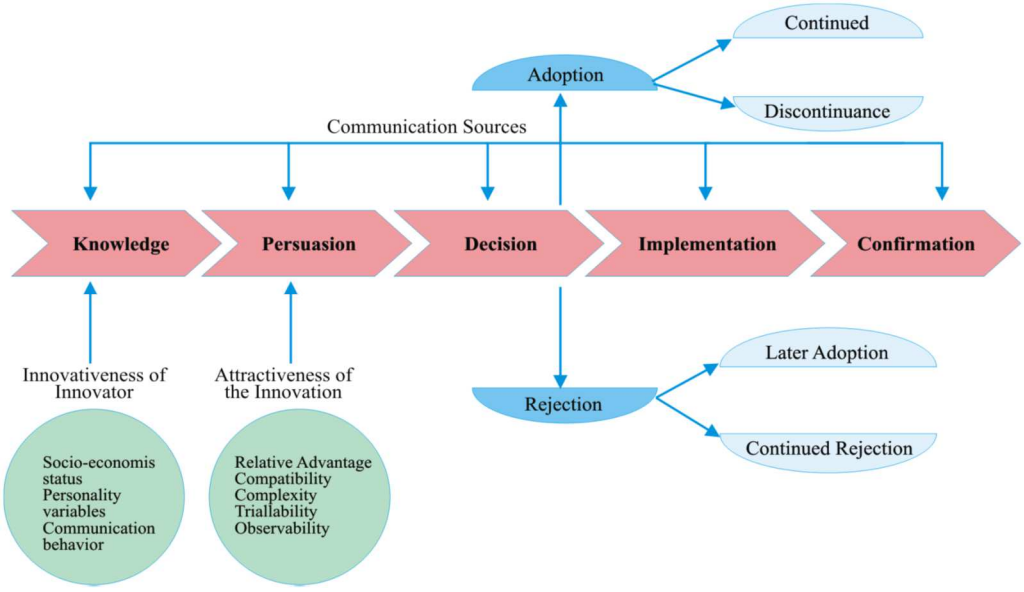

Figure 3. Rogers's innovation decision process of technology adoption.

Adapted from *Diffusion of Innovations* (3rd ed.), by E. M. Rogers, 1983, p. 165.

Persuasion as an Attribute of Innovation

According to Rogers's (2003) DOI, persuasion strategy can be divided into five aspects: relative advantage, comparability, complexity, trialability, and observability. Under Davis's (1989) TAM, persuasion is the stage where individuals weigh PU, PEU, and PR against the perceived benefits associated with adopting a smartphone. Venkatesh et al. (2012) viewed the persuasion stage as having seven constructs: performance expectancy, effort expectancy, facilitating condition, social influence, hedonic motivation, habit, and price value. The potential adopter is expected to consider those factors before the adoption decision and the outcome of the consideration leads to acceptance or rejection of the product.

Components of Diffusion of Innovation

Rogers (2003) identified four critical components of diffusion of innovation: (a) the innovation itself, (b) communication channels, (c) social system in which the innovation is situated, and (d) length of time since the innovation has been introduced. He stated that there could be no diffusion of innovation without innovation. The second element is communication, a process in which participants create and share information with one another in order to reach a mutual understanding; communication occurs through channels between sources, and Rogers defined the sources as an individual or institution that originates the message. The channel is the means by which a message gets from the source to the receiver. Rogers emphasized the critical role of interpersonal channels and argued that interpersonal channels are more powerful than any other means in creating or changing strongly held attitudes of people. Time is the fourth element in the

DOI, and Rogers believed that it is, perhaps, the most critical aspects of diffusion. The diffusion-of-innovation adoption-curve is bell shaped (see Figure 4).

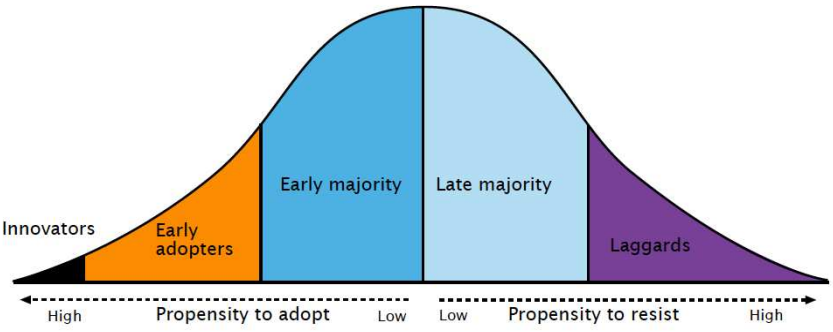

Figure 4. The diffusion of innovation process depicted as a bell-shaped curve showing the five categories of adopters, the first of which comprises the innovators and the last the so-called laggards.

Adapted from *Diffusion of Innovations* (3rd ed.), by E. M. Rogers, 2003, p. 247. Copyright 2003 by The Free Press, a division of Macmillan Publishing. Reprinted with permission.

From the bell-shaped figure, one can deduce that innovators are most likely the first to accept the innovation. They are active information seekers about new ideas, who usually have a high degree of mass media exposure, and their interpersonal networks extend over a wide area, often reaching well beyond their local system. “Innovators are able to cope with higher levels of uncertainty about an innovation than are those in other adopter categories” (Rogers, 2003, p. 22). Early adopters are down to earth and often respected by their constituencies, due to these characteristics; early adopters influence others to adopt an innovation (Tully, 2015). Early majority adopters are frequently status-motivated to adopt innovations (Sahin, 2006); though conservative, they are always open

to new ideas. They are active in their community with the power to influence, especially to influence the late majority and the laggards. Late majority, according to Sahin (2006), usually constitutes one third of all members of a social system; they adopt innovations when their peers have done so. They are known skeptics, driven to embrace innovation because of economic necessity and peer pressure. Rogers (2003) observed that peer persuasion leads the late majority to feel safe and less uncertain about the innovative product. Laggards (or those who never adopt) are the last group of adopters. They hold a traditional view and are often more skeptical about new ideas, innovations, and change agents than the late majority (Rogers, 2003). Laggards always want to make sure that the innovation works before they adopt.

Innovators, early adopters, and early majority adopters possess the propensity to adopt the innovation, whereas the late majority and laggards have the propensity to reject innovations (see Figure 3). The five categories notwithstanding, Rogers (2003) believed that adopters could generally be classified into two basic groups: earlier adopters and late adopters. Chang, Li, & Kim (2014) described the last four categories of adopters shown in Figure 4 (i.e., early adopters, early majority, late majority, and laggards) as imitators. The Bass model supports this argument and statistically proved the existence of similar adoption patterns among the four groups of adopters. The adoption model can be expressed with the following mathematical equations:

$$S(T)=pm+(q-p)Y(T)-q/mY2(T)$$

$$S(T)=p(m-Y(T))+q/mY(T)(m-Y(T))$$

Variables in these equations are as follows: T = time, ST = number of adopters, P = probability of adoption by the innovators, m = initial purchases of the product, q = probability of an imitator's adopting the technology, Y(T) = the number of previous adopters. Tully (2015) corroborated the importance of the time element introduced by Rogers, noting that diffusion takes place over time, with antecedent conditions and consequences.

The last element in the DOI is social systems. According to Rogers (2003), it is a set of interrelated units engaged in joint problem solving to accomplish a common goal. Since the diffusion of innovations takes place in a social system, it is influenced by the social structure of the social system (Sahin, 2006). According to Hopp and Gangadharbatla (2014) there is a counterintuitive measures that suggest that users are increasingly willing to deemphasize their own first-hand experience in favor of reliance on (perceived) pressures exerted by significant others. Rogers (2003) defined this structure as the patterned arrangements of the units in the system. Muller (2014) added the concept of market penetration to the definition; he believed that diffusion of innovation is a process that involves market penetration of new products and services, which is driven by social influences. His basic argument was that the social influences include all of the interdependencies among consumers that affect various market players with or without their explicit knowledge. Tully (2015) also believed that one way in which a social system influences the diffusion process is through social structures and communication channels within those structures.

Hutto, Trewhitt, and Briscoe (2011) held that other factors also facilitate innovation diffusion of new technology such as type of technology, context, or culture in which the technology is introduced, and individual decisions by people within that culture. Figure 5 depicts the five attributes of innovation, the communication channel, and the nature of social systems, which are usually measured by the promotional effort of the change agent.

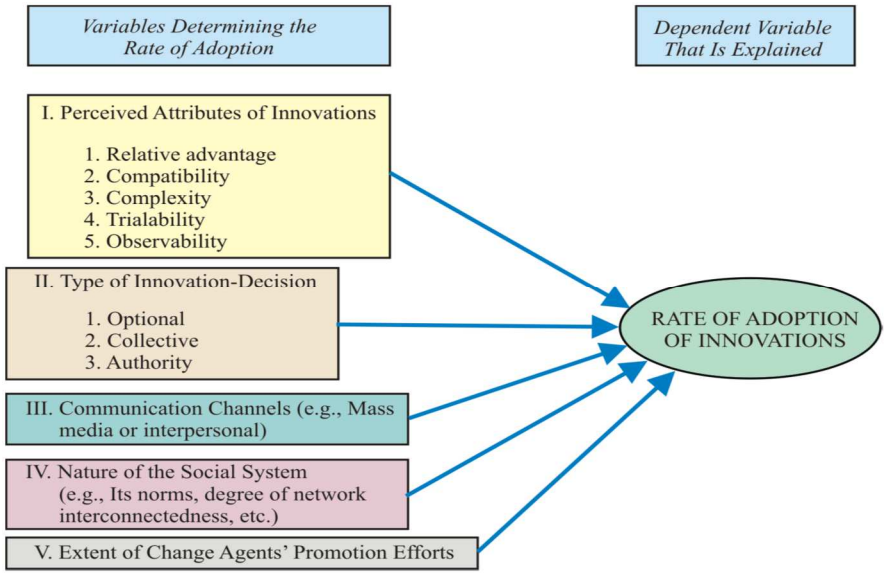

Figure 5. Variables determining the rate of adoption of innovations.

Adapted from *Diffusion of Innovations* (4th ed.), by E. M. Rogers, 2003, p. 207.

Uncertainties in the Diffusion Process

Uncertainties with respect to market acceptance of new innovative products are one of the major challenges that confront innovators; they usually appear as unexpected consequences in the minds of the adopters. According to Rogers (2003), innovation uncertainties result in consequences, which he defined as the "changes that occur in an

individual or social system as a result of the adoption or rejection of an innovation" (p. 436). He believed that uncertainty about the performance of an innovative product is reduced in the mind of adopters when the information embodied in the technological innovation itself represents the possible efficacy of the innovation in solving an individual's felt need or perceived problem. He posited further that this advantage provides the motivation that impels an individual to exert effort in order to learn about the innovation (Rogers, 2003). This view aligned with the technology acceptance construct of EE and PE in Venkatesh et al.'s (2012) seminal work on the UTAUT. Muller's (2014) research also lends credence to Rogers's view of uncertainties. The researcher saw change as an obstacle to the adoption of innovations.

To reduce uncertainty in the adoption of innovation, Sahin (2006) posited that individuals should be informed and be made aware of the advantages and disadvantages and the consequences of adoption of the innovative products. Adopters' education and product-awareness creation mitigates innovation results. Rogers (2003) classified innovation consequences into three broad categories: (a) desirable versus undesirable, (b) direct versus indirect, and (c) anticipated versus unanticipated. Sahin (2006), on the other hand, examined classes of innovations from the following perspectives: functional or dysfunctional desirable vs. undesirable), immediate result or result of the immediate effect (direct vs. indirect), and recognized and intended or not recognized and unintended (anticipated vs. unanticipated). Muller (2014) observed that the consequence of mobile technology is rapid and immediate; hence, the full and rapid diffusion of mobile technology within few years of its emergence. Mobile penetration rate currently exceeds

100% in some developed countries, and developing countries are also adopting the technology at an incredibly rapid rate. In most developing nations, adopters possess more than one handset, more than one phone number, and possibly even more than one mobile network.

Facilitating Condition and Behavioral Intention to Use Smartphones

FC is the degree to which an individual believes that organisational and technical infrastructures exist to support the impact of smartphone use (Venkatesh et al., 2003). An example of FC for smartphone adoption is the technical support provided by network and telecom operators. FC is therefore, beliefs related to one's control over the use of a smartphone. FC could also become an inhibitor of the intention to use a smartphone. Venkatesh et al. (2003) used the theory of cognitive dissonance to provide an answer. The authors believed that, whenever facilitating conditions work against adoption, individuals might adjust their attitudes negatively to be in alignment with that situation. However, if the condition is positive, an individual reacts positively and becomes motivated to adopt the technology.

Social Influence and Intention to Use Smartphones

Social influence in the UTAUT is the SN under TRA, TAM2 and TPB, and C-TAM-TPB, social factors in MPCU, and image in IDT (Yu, 2012). Venkatesh et al. (2003) defined SI as the extent to which individuals sense that a person who is important to them thinks that they should use the new system. Venkatesh et al. (2003) arranged the information gleaned from past studies by various authors into three subdimensions: (a)

SN (TRA, TAM2, TPB, and TAM/TPB), (b) social factors (MPCU), and (c) public image (IDT).

Habit and the Intention to Use Smartphones

Staying faithful to TPB, the instant activation perspectives (IAP) assumes that repeated performance of a behavior can result in well-established attitudes and intentions that can be triggered by objects or cues in the environment (Ajzen & Fishbein, 2000). Venkatesh et al. (2012) illustrated habit formation in consumers when they posited that extended periods of repeated checking of e-mail on mobile devices during commuting may motivate a consumer to have a positive attitude toward mobile Internet technology (e.g., checking e-mail using mobile Internet during commuting is useful). Additionally they noted an associated behavioral intention (e.g., I will check my e-mail using mobile Internet during my commute). This intention is thus stored in the conscious mind of the consumer.

Price Value and Intention to Use Smartphones

Venkatesh, Thong, and Xu (2012) determined that cost and pricing structure were significant predictors of BI and, then, CU of a technology. Further, PV appears to be moderated by age and gender. The authors defined PV as the cognitive trade-off between perceived benefits of the application and the monetary cost of using it. For instance, Venkatesh, Thong, & Xu (2012) posited that SMS became popular due to its low pricing structure compared to other types of mobile Internet applications. Abu's (2010) study examined the diffusion of 3G mobile phones in Japan and discovered that pricing strategies played a significant role in technology adoption. Mobile number portability

(MNP), introduced in Japan by MIC in October 2006, was designed to increase competition, and lower prices led to higher quality and greater range of service (Abu, 2010). The finding by Abu in respect of the effect of MNP in Japan was empirically validated. Park (2011) discovered that wireless prices decrease in response to number portability, though the decrease was not uniform across all plans he however established that price dispersion across telephone operators in the U.S. declined and that the decline was greater for higher volume users.

Value is established when perceived benefits (PB) of the product outweigh its cost (Schumpeter, 1942). Perceived benefits of products, like mobile phones, arise from a consumer's cultural values and norms alongside external factors (Gummerus, 2013).

Innovation Diffusion of Mobile Technologies: 1G to 4G Smartphone

Mobile technology affects all spheres of human activity. The pervasiveness of the technology on how it affect economic activity suggests that mobile technology has a feature of a general-purpose technology (GPT) with significant effects on ability to drive innovation and facilitate sociodevelopmental structures and cultures at both macro and micro level (Gruber & Koutroumpis, 2011). Zhong (2013) observed that the devices not only strengthen social bonds, but they also alter the way people interact with one another.

Mobile technologies have evolved over time and across different social, economic, and cultural settings. Ling (2012) noted that mobile phones diffused in a relatively integrated way that reflects a close correspondence between the technological, economic, and social vectors of diffusion. He posited further that it was not until the late 1990s, that the thrust of technological innovation separated economic and geographical

sectors, a situation that led to a surge in the number of mobile phone subscribers; this number currently stands at 6.915 billion (ITU, 2014). Gruber, and Koutroumpis (2011) believed that the diffusion of mobile telecommunication-technology generations could be identified by specific improvements in service capabilities. Unlike other products, mobile technologies have undergone a number of product-related and technological changes, which saw the mobile phone evolve from the bulky, multicomponent devices embedded in automobiles to sleek gadgets that can be easily transported in pockets and purses (Ling, 2012).

Mobile technology generations are typically divided into four groups: 1G to 4G. They are distinguished by specific improvements in service capabilities (Gruber & Koutroumpis, 2011). The mobile telecommunication market is made up of a large number of submarkets, with each submarket involving a family of products and services (Ling, 2012). The products are classified by generations of mobile technologies, which began with 1G and currently are 4G networks. The technology is not limited to mobile phones but includes every portable device that can be connected to the Internet to ensure personal communication (Zhong, 2013). Figure 6 shows more than a decade of global ICT development (1G Mobile System).

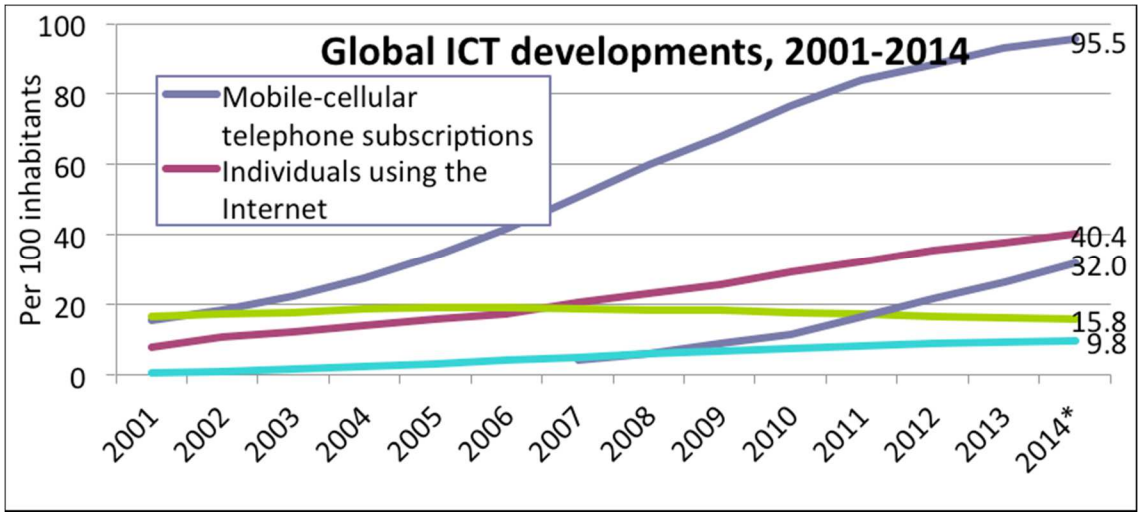

Figure 6. Global ICT developments 2001-2014.

Adapted from "ICT Statistics News log-Africa: Mobile Operators Hail to Meet QoS Requirements," by International Telecommunication Union, 2014. Copyright 2014 by International Telecommunication Union. Used with permission.

The 2001-2011 smartphone global ICT development depicted in Figure 6 shows that mobile phones, which had an approximate penetration rate of 15.5% in 2001, had moved to a penetration rate of 95.5% by 2011. Fixed telephone subscription, which stood at 18.8% in 2001, had dropped to 16.6% by 2014; fixed wired broadband subscription, which stood at 0.6% in 2001, had progressed to 9.8%, with individuals using the Internet from 8% in 2001 to 40.4% in 2014 (ITU, 2014).

The 1G mobile telecommunication technologies came into being in the early 1980s with the capacity to offer voice services based on analog technology. The first operational cellular communication system was deployed in Norway in 1981 and was followed by similar systems in the United States and the United Kingdom (Pereira et al., 2015). The 1G systems were based on analog frequency modulation (FM) and

predominantly operated in the 450-MHz radio-frequency (RF) band (Hanzo et al., 2012). The 1G mobile technology system provided voice services to users through 900MHz and analogue modulation. Gruber & Koutroumpis, (2011) explained that the systems were based on seven mutually incompatible national standards. This incompatibility hampered the exploitation of economies of scale and impeded reductions in equipment costs and development of innovative services such as international roaming. The authors further observed that the development of numerous national mobile phone systems that relied on FM in the 1980s made it impossible to employ or make use of digital error correction codes.

2G Mobile Technologies

Unlike the 1G systems, the second-generation (2G) wireless systems made use of digital transmission (Hanzo et al., 2012). This provided the benefit of using error correction codes; however, the services offered by 2G cellular systems were also predominantly voice. The multiple access technology comprises both time division multiple access (TDMA) and code division multiple access (CDMA). Although, the 2G wireless systems offered higher transmission rates with greater flexibility than the 1G systems, they were, nevertheless, narrowband systems because they were designed chiefly for voice communication. These technologies were introduced in the first half of the 1990s; they began to improve voice services while developing new data services. With better coordination, particularly in Europe with the setting of the Global System for Mobile Communications (GSM) standard, the number of different systems installed worldwide was reduced to four (Gruber & Koutroumpis, 2011).

3G Mobile Technologies

The 3G mobile technologies are different from the first and second-generation mobile telecommunications systems, which were designed mainly for voice transmission. The telecom market evolved and introduced increased performance of the mobile devices with capacity for data transmission such as e-mail, paging systems, and Web browsing. Gruber & Koutroumpis, (2011) noted that the 3G systems were designed largely to increase data transmission rates that allowed for high-bandwidth multimedia applications (i.e., digital data & voice, video & remote-control systems) and other services. Other services offered by the 3G systems included speedy wireless communication, which supported services that added video and multimedia service to data and voice (Alomary & Kostanic, 2013). Another feature of 3G technologies included the provision of flexibility for routing (repeaters, satellites, LANs, and more), extensive bandwidth, and high-speed capability.

Table 1

Comparison of 1G, 2G, and 3G Wireless Communication

Generation	Technology	Features
1st generation (1G)	AMPS (Advanced Mobile Phone Service)	Support voice services: Analog, data services: none.
	CDMA (Code Division Multiple Access)	Analog Cellular (discontinued) Speed: 9.2-kbits/sec
2nd generation (2G)	TDMA (Time Division Multiple Access)	PDC & TDMA (only support is one-way data transmission).
	PDC (Personal Digital Cellular)	Offers advance calling options as caller ID not constantly on data
	CDMA (Code Division Multiple Access)	CDMA carriers in Nigeria: Multichoice, Visafone Technology: 1xRTT Digital voice service Speed: 128-Kbits/sec
	GSM (Global System for Mobile Communications)	GSM carriers in Nigeria: Glo, MTN, Airtel, Etisalat Technology: GPRS, EDGE, UMTS Speed: 40-160-kbits/sec
3rd generation (3G)	WCDMA (Wideband Code Division Multiple Access)	Technology: UMTS Excellent voice qualities. About 2-Mbits/s. Constantly on data connection.
	CDMA-2000	CDMA carriers: Multichoice and Visafone Technology: EV-DO Speed: 500-700-kbits/sec
	TD-SCDMA (Time-Division Synchronous Code Division Multiple Access)	Based on the Interim Standards Supports broad-band data services (such as multimedia & video). Improved roaming features

Table 2

Comparisons of 3G and 4G Technologies

Key Parameters	3rd Generation (3G)	4th Generation (4G) (smartphone)
Speed	3G uses circuit/packet data at higher bit rates: 144 kb/s or higher in high capacity vehicular traffic. 384 kb/s for pedestrian traffic. 2 Mb/s or greater for indoor-traffic.	Support data rates up to 20 to 100 Mbps in mobile mode. A developed wireless corporation NTT-DoCoMo is evaluating 4G tech over 100 Mb/s (when moving)& 1 Gbit/s (when it is still).
Access technologies	3G utilize CDMA-2000 & WCDMA as access technologies. WCDMA offers speeds b/w 384kb/s & 2Mb/s. If this protocol is deployed over a WAN, the maximum-speed is 384kb/s. If it is employed in a LAN, the upper-speed is 2Mb/s. It is approved also by the ITU. The others important 3G standards are CDMA2000, that is, the initial 2G CDMA IS-95 standards. The different transmission technologies utilized in CDMA2000 are 1xRTT, CDMA-2000-1xEV_DV & 1xEV_DO.	Based on OFDM/OFDMA, 4G uses OFDM/OFDMA better to distribute network resources among the available users. Enables equipment permit to utilize available bandwidth and to make utilizing multiple channels parallel. In OFDM, pulse making task & modulation can be done via an easy IDFT that can be deployed as well as that of IFFT. Thus, in the receiver requires only a FFT for reversing this process.
Network Architecture	Cell-Based Wide-Area (WAN).	Wireless LANs Hybrid Integrations (WiFi/Bluetooth) & Wide Area.

(table continues)

Key Parameters	3rd Generation (3G)	4th Generation (4G) (smartphone)
Major requirement Driving architecture	Predominantly voice-driven. Data were constantly add-on.	Converged data & VoIP (Voice Over IP).
Market overview	(a) Lack of Demand: 3G-service market-diffusion has been slower than initially estimated, because of fewer demands for developed services, lately exploitation by the service providers & challenges relevant to QoS and convergence. (b) Other Challenges: Other challenges are operational costs that are considerably higher than in a 2G/2.5G operation and shed doubt on the demand for nonvoice services and their quality	(a) High-Speed Multimedia Service Demand (b) Fixed-Mobile Convergence (c) Issues of Spectrum (d) Issues of Standards and Certification (e) Technological Challenges (f) Alternative Services/Applications for smartphone
Cost Comparison	Its working costs are considerably higher than for 2G-2.5G systems and shed doubt on the viability of the estimate for nonvoice services.	At this phase, no certified smartphone network devices have been commercialised; that is why costs are not determined. Although it is sensible to guess that unverified latest technologies will initially be a focus for less demand, costs will be comparatively high and will be reduced only slowly as demand increases. Because of the beginning price of CPEs, smartphone vendors are assuming to provide leasing contracts.

Note. WAN = Cell-based wide-area.

4G and Smartphone Mobile Technologies

The radical nature of mobile technology and constant change in consumer demands gave birth to 4G mobile technologies and the development of the smartphone. People desire to communicate with each other and gain access to critical information regardless of their location. Smartphone is an innovative and sophisticated solution with the capacity to install applications (Jyoti et al., 2014). According to GSMA Intelligence (2014), smartphones continue to improve living standards, stimulate entrepreneurship, and change lives of adopters in the developing countries. This research shows that, as the mobile industry evolves, smartphone has created lifestyle hubs that are offering opportunities for mobile industry players in vertical markets such as financial services, health care, home automation, and transport.

According to Lee and Lee (2014), smartphones offer consumers advanced computing ability with a choice of diverse applications that foster creativity and customization. The empirical analysis by Cecere, Corrocher, and Battaglia (2014) revealed that the number of new products on the smartphone market has increased tremendously due to the entrance of new companies that came from outside the telecom sector. Their entrance led to hyper-competition, which, in turn, considerably improved smartphone technology both in software and hardware. The advanced computing capability of smartphones has contributed to its radical expansion in market share with over 1 billion subscribers. Gartner (2013) observed a 42.9% growth between 2012 and 2013, with smartphone sales totaling 210 million in the first quarter of 2013. Zeng (2011) perceived innovation as the essential property at the basis of the smartphone diffusion

and argued that, without the perceived innovation features, smartphones would not diffuse as they are doing, no matter how successfully the corporations implemented marketing strategies.

Fourth generation is the latest generation of mobile technologies and a major facilitator in the rapid diffusion of smartphones. According to Eizan-Azira and Omar (2013), *4G* is a broadly used term that includes several types of broadband wireless access communication systems, not only cellular telephone systems. It offers a more enhanced version of the capabilities of 3G (e.g., improved multimedia, video streaming, global access, and worldwide portability; Alomary & Kostanic, 2013). The 4G protocol was developed as an improvement over the 3G network; it is based on packet switching only and not on a mixture of circuit switching and packet switching.

Features of Smartphone Technologies

The features of smartphone technology were detailed in a study conducted by Zeng (2011). He linked the characteristics of DOI and smartphone by highlighting several features in particular: (a) relative advantage, (b) compatibility, (c) complexity, and (d) observability. Zeng posited that smartphone diffusion took very few years because the technology was highly innovative and equipped with the aforementioned features.

Relative Advantage. On the individual adoption level, Zeng (2011) argued that relative advantage is the extent to which an innovation is perceived as better than the idea or product it replaces; in this instance, the feature phone was superior to landline, and the smartphone was superior to the feature phone that had replaced landline. Zeng argued in

favor of the capabilities of smartphone; he thought that "it's got everything we need: Multitasking, networking, power management, graphics, security, video, graphics [sic], audio core animation . . . " (p. 432). Smartphone allows users to install and use applications on their own, based on their needs and interests (Dennison, Morrison, Conway, & Yardley, 2013).

Compatibility. Compatibility was the second feature of DOI linked with smartphone that Zeng (2011) lauded in his study. It is the extent to which innovation is perceived to be in accord with preceding values, past experiences, or needs of potential adopters. Applications are easily installed and uninstalled in the smartphone.

Complexity. Complexity will affect intention to use a technology. The smartphone is simple to use and operate. It was designed from the user's perspective rather than from the vantage point of computer programmers or engineers (Zeng, 2011).

Observability. Observability is the degree to which the results of an innovation are visible to others. Zeng (2011) reported that the smartphone diffusion is tied to celebrities in China. Chinese individuals saw the results of this innovation in the hands of celebrities thanks to the mass media, and this led to the rapid diffusion of iPhones in China.

Factors That Affect Smartphone Diffusion

Various researchers have studied the rapid diffusion of smartphones. GSMA Intelligence (2014) identified nine factors that have assisted the global diffusion of smartphone: (a) Rapid erosion of the average selling price (ASP) of smartphones encouraged users to migrate from basic and feature phones to smartphones. (b) Increased

demand for low-end smartphones drove volume growth (some smartphones currently sell for less than $50. (c) Operator-brand smartphones sold via operator retail channels drove the low-end segment. (d) Subsidies from PTOs drove the adoption of high-end devices, but they are being scaled back to lower-price tiers;(e) Availability of 4G-LTE smartphones is believed to have influenced the pace of allocation and assignment of 4G spectrums by regulators around the world. (f) Availability of data-centric services and tariffs continue to promote the adoption of smartphones in both developed and developing economies. (g) Data tariff offered by operators is driving the adoption of smartphones in the developing world, because smartphone is the most affordable and available way of connecting to the Internet. (h) Taxation negatively affects smartphone growth, especially in a price-sensitive operating environment. Lastly, (i) GSMA Intelligence (2014) saw a correlation between an increase in smartphone adoption and an increase in mobile broadband connections.

Diffusion of Smartphone Technology and Platform Competition

The emergence of smartphones presented a momentous change in the mobile phone industry in terms of technological innovations and industrial dynamics (Cecere, Corrocher, & Battaglia, 2014). The dynamics is seen in the level of competition that currently characterize the industry, according to Kim et al. (2015) platform competition of smartphones are melodramatically reshaping competition within the mobile industry because wireless delivery of applications and content is dependent on the platform on which the smartphone is run. They argued further that user choice of a smartphone might

not be based on the network it runs on or its functional capability but on the types of applications that will run on it.

Some of the industry dynamics include mobile service platform competition, which Nikou and Bouwman (2012) believed to be increasingly important due to the exponential growth of mobile services and applications. The growth in the industry facilitates different forms of competition such as platform competition. Smartphone platforms are generally divided into two: open versus a closed platform. Kim and Chang (2011) observed that iPhone platform is a closed system whose entire ecosystem is under the control of one company; however Android is an open system that enables software developers to build relatively free and innovative application. An open development platform is therefore as a good omen for adopters because it has challenged the walled-garden strategy of the network operators (Hazlett et al., 2011). This is made possible by the entrance of device manufacturers such as Apple and full IP-based companies, for example, Google in the mobile service provisioning market (Nikou & Bouwman, 2012). Diverse mobile network standards such as LTE, CDMA 2000 1_ EV-DO, CDMA 2000 1, and W-CDMA HSXPA were adopted by different countries (Lee & Lee, 2014). Lee, Marcu, and Lee (2011) identified mobile broadband-standards competition as LTE, WiMAX, CDMA 2000 1_ EV-DO, and W-CDMA. Lee and Lee (2014) believed that the existence of diverse broadband standards led to improved speed and service and to various multimedia applications for smartphones. Platform competition also led to a reduction in price, improved the quality of services, increased the customer base, and promoted investment in innovation (ITU, 2012).

The operating system of smartphones is categorized by five names: Android, iOS, Windows, Blackberry, and other OS. Android remains the leading operating system, according to Gartner (2014). The Android operating system increased market share from 66.4%, in 2012, to 78.4%, in 2013. Apple has the second largest market share; however, it dropped from 19.1%, in 2012, to 15.6%, in 2013.The Windows phone recorded a slight increase in market share from 2.5%, in 2012, to 3.2%, in 2013. The worst hit affected the Blackberry operating system; it dropped in market share from 5%, in 2012, to 1.9%, in 2013.

Table 3

2012–2013 Worldwide Smartphone Operating System by Market Share

Operating System	2013 sales (‘000)	2013 Market share	2012 Sales (‘000)	2012 Market share
Android	758,719.9	78.4	451,621.0	66.4
iOS	150,785.9	15.6	130,133.2	19.1
Windows	30,842.9	3,2	16,940.7	2.5
Blackberry	18,605.9	1.9	34,210.3	5.0
Other OS	8,821.2	0.9	47,203.0	6.9

Note. Adapted from “*Gartner Says Annual Smartphone Sales Surpassed Sales of Feature Phones for the First Time in 2013*,” by Gartner Inc., 2014. Used with permission.

A graphic representation of the 2012-2013-market share by various platform providers is depicted in Figure 7. Android market share increased from 66.4% in 2012 to 78.4% in 2013. iOS is the second largest operator by market share; however, there was a dip in its share from 19.1% in 2012 to 15.6% in 2013.

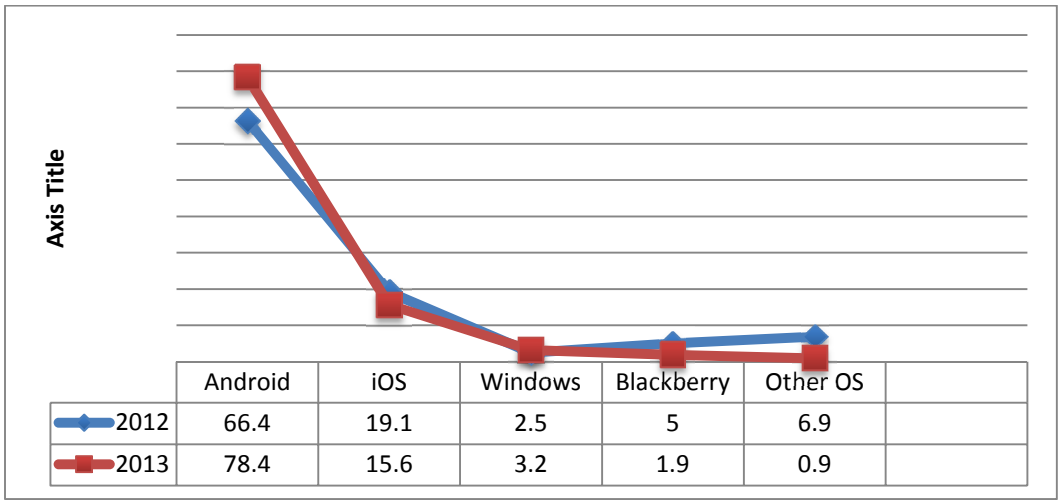

Figure 7. Worldwide comparative market share of smartphones, 2012–1013. Data are based on five operating platforms. Android smartphone is the leading platform with a 12% increase above the 2012 figure for market share. iOS operating system experienced a drop of 3.5%, whereas Windows and Blackberry recorded a marginal increase in market share. Adapted from Website "Worldwide Smartphone Sales to End Users by Operating System in 2013 (thousands of units)" by Gartner Inc., 2014.

Nikou and Bouwman (2012) argued that mobile service platforms play a critical role in the innovation-decision process of adopters of smartphones. This argument is evidenced by the changes in market share of various platform operators, as market share is a function of adopters' decisions to accept, adopt, and use a particular mobile phone, service, and applications.

Smartphone Diffusion in Africa's Rural and Urban Areas

Mobile phone penetration in Africa presents interesting peculiarities; Rashid and Elder's (2009) findings revealed that about 83% of the mobile subscribers in Ghana live in major towns, while 16% are in other urban areas, and only 0.4% lives in rural areas.

GSMA Intelligence (2014) research on mobile penetration presented an interesting paradox with respect to mobile penetration rates among the rural dwellers in Nigeria when compared with the overall teledensity of 94.42% posted by the NCC (2014). Teledensity in the rural areas of northern Nigeria stood at 24%, while it was 50% in the rural areas of the southern part of Nigeria. Teledensity in the urban regions of northern Nigeria stood at 34%, while it was at 50% in the urban areas in the southern part of Nigeria. Analysis shows an even development of the telecommunication infrastructure in the southern states of Nigeria across the rural/urban divide.

Zibi (2009) observed that 99% of mobile phone subscribers in rural and urban areas are in prepaid billing, which she believed to be an indication of income level. She argued further that subscriber churning is high with 5%-10% of all subscriptions being disconnected each month. In addition, voice services remain the most used services, accounting for 90% of telecom operators' revenue (Zibi, 2009). However, in a survey conducted by Mason (2013), 87% of the respondents across Africa reported browsing the Internet with their mobile phones. This situation clearly highlights the critical importance of diffusion of 3G and 4G enabling smartphone use in Africa. Another interesting piece of information that could be linked to one of the control variables in the UTAUT model is gender sensitivity to intention to use and continue to use a smartphone. GSMA Intelligence (2013) observed that 43% of women in Africa are less likely than men to have access to the Internet through mobile devices. According to GSMA Intelligence (2013), smartphone penetration is still relatively low in Africa when compared to the rest of the world. For instance, at the end of 2012, the penetration rate was only 4% in sub-

Saharan Africa (SSA) compared to the global average rate of 17%. Figures 8 and 9 show smartphone penetration in four countries in sub-Saharan Africa and mobile-enabled services in sub-Saharan Africa, respectively.

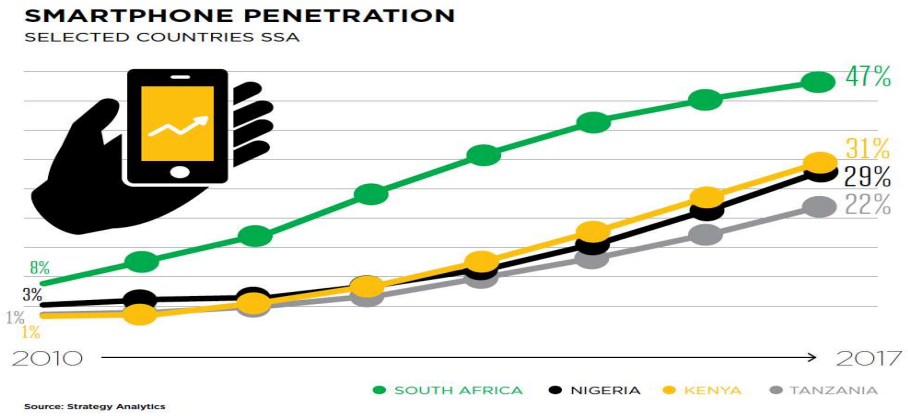

Figure 8. Smartphone penetration in four African countries.

South Africa recorded the highest penetration growth, followed by Kenya, while Nigeria had the third highest penetration rate. Adapted from *sub-Saharan Africa Mobile Economy 2013,* by GSMA Intelligence, 2013, p. 25. Reprinted with permission.

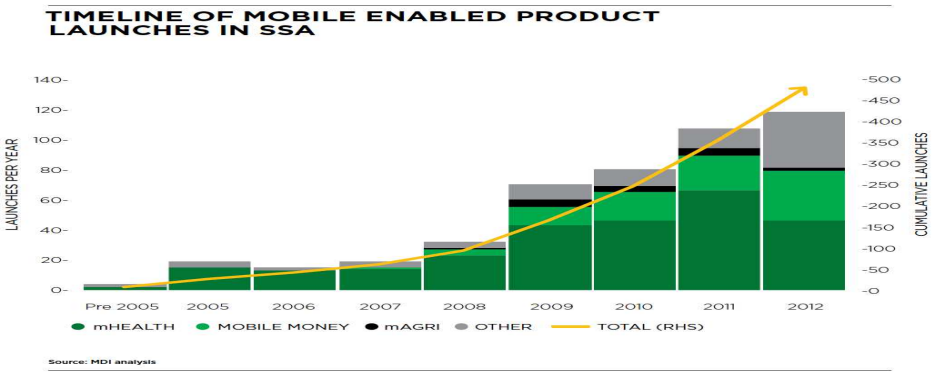

Figure 9. Mobile-Enabled services in sub-Saharan Africa to facilitate increased interest in the rate of diffusion of smartphones.

The services include mHealth, mMoney, mEducation, and mAgriculture. Adapted from *sub-Saharan Africa Mobile Economy 2013*, by GSMA Intelligence, 2013, p. 54. Reprinted with permission.

According to GSMA Intelligence (2014), the parties responsible for the launch of the services include mobile operators, entrepreneurs, governmental institutions, investors, and NGOs. A study by Margaux (2013) on the diffusion of smartphones among people at the bottom of the pyramid (BOP) in Africa shows that 14% of these people live in rural areas and browse the Internet with their mobile phones. Most of these users have benefited from services such as Mobile Money, notably because the majority of rural areas lack banking in addition to health facilities. Mostashari, Arnold, Mansouri, and Finger (2011) concluded from their findings that smartphones have definitely enhanced the quality of life in the urban areas of Africa through access to real-time information from other citizens, service providers, and the government.

Evolution of Mobile Telephony in Nigeria

Telecommunication operations began in Nigeria in 1886 during the British colonial era (Nigeria, Ministry of Communication, 2000). The initial effort to connect Nigeria to the outside world was done through the linkage of a submarine cable along some of the West African countries, namely, Ghana, Sierra-Leone, and Gambia to connect Lagos to the United Kingdom. At Independence, the country's population was 40million, with only 18,724 fixed telephone lines. The phone network consisted of 121 exchanges of which 116 were of the manual (magneto) type, and only five were automatic (Osuagwu, Okide, Edebatu, & Eze, 2013). The two government departments in charge of internal and external communication were the Department of Post and Telecommunications (P & T), which was in charge of internal networks, and Nigerian External Telecommunications (NET), which was saddled with the management of the external network. The P &T was divided into two bodies: the postal services division and the internal telecommunication division. The latter was merged with Nigeria External Telecommunication (NET) and became Nigeria Telecommunication Limited (NITEL); this company became the sole provider of telecom services (Nigeria, Ministry of Communications, 2000)—until August 2001, when the telecom sector was deregulated.

The deregulation of the telecommunication section was due to the government's inability and unwillingness to continue to carry the burden of subsidizing public utilities such as the public telecom company NITEL. Another major reason for the liberalization of the telecom sector were customer advocacy groups who fought for improved and efficient telecommunication services in place of the continuously poor service delivery

through NITEL. The deregulation of the telecom sector led to the entry of GSM into the Nigerian communication market, in August 2001. Before the advent of GSM technology in Nigeria, the country's teledensity stood at 0.4%. Fixed wired telephones were seen as a status symbol of the wealthy and the educated elite because the pricing of a telephone line was completely out of the reach of the poor. Telephone infrastructure was, therefore, only available in major cities and urban centers. The deregulation of the telecom sector, coupled with the introduction GSM, led to a radical diffusion of the technology. The number of telephone lines increased dramatically from less than 100,000 in August 2001 to nearly 132 million at the end of August 2014 (Apulu, Latham, & Moreton, 2011). Jentzsch (2012) argued that sub-Saharan Africa ranks among the top regions in terms of growth in the number of mobile phone users due to opening up of markets for private players and lenient regulatory policies.

The major challenge to confront the three network operators MTN, ECONET, and GLO was network expansion throughout Nigeria. Osuagwu, Okide, Edebatu, and Udoka (2013) corroborated the network expansion challenge and voiced their concerns regarding the need to develop a comprehensive ICT infrastructure, serving both rural and urban areas. Apulu, Latham, & Moreton (2011) argued that diffusion of mobile technology was happening rapidly in the cities, and it was extended to rural areas only because of the need to expand the customer base. Had the operators had better options, they would have shunned the rural areas because of the high overhead costs this expansion entails.

Mobile Phone Service Competition in Nigeria

Nigeria's mobile market is the largest on the continent of Africa. MTN, Airtel, and Glo are the dominant players, while MTEL, the government-owned telecom operator, became moribund. According to GSMA (2014), the three operators accounted for 85% of market share. However, the entrance of Etisalat, in 2008, has altered the competitive landscape. The major attraction for the telecom operators was a huge virgin market, where the operators' major priorities were concentrated on network expansion and increasing their customer base. A major obstacle to the adoption of mobile technology however is the issue of cost of expansion and adoption (Gruber & Koutroumpis, 2011; Chong, Chan, & Ooi, 2012; Chong, Ooi, Lin & Bao, 2012; Jambulingam, 2013; Kapoor, Dwivedi & Williams, 2014). The major cost issues that confront the developing countries in mobile technology adoption are the high cost of transactions, billing errors and lack of visibility of transaction costs (Ramburn & Van Belle, 2011; Sey, 2011). In a comparative study between Malaysian and Chinese mobile consumers conducted by Chong, Chan, and Ooi (2012), Chong, Ooi, Lin, and Bao (2012) found that cost is a major factor that significantly and negatively affects consumers' adoption of mobile commerce in both countries (Al-Debei & Al-Lozi, 2014).

The various observations made by the above scholars align with the Nigeria experience in respect to adoption of mobile technology. The first 3 years after take-off of the two pioneer PTOs (ECONET of Zimbabwe and MTN of South Africa), SIM cards were sold between N7000:00 ($46.00) and N34000.00 ($267.00); however, with the entrance of GLO, an indigenous PTO, the cost of acquiring a SIM card continued on a

downward trend to the extent that SIM cards were given out for free until recently, when the cost of a SIM card stood at N100 (or 0.6 cents). Figure 10 shows the downward trend of MTN rates per minute.

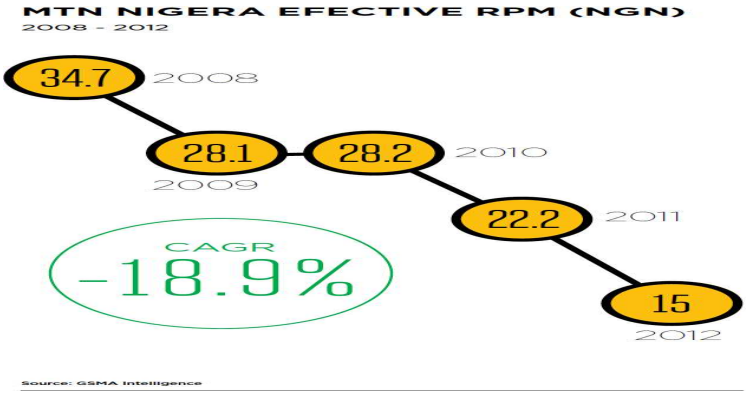

Figure 10. MTN 2008-2012 call rates per minute.

The figure shows a significant drop in call charges. Adapted from "*Analysis Country Overview: Nigeria*," by GSMA Intelligence, 2014. Reprinted with permission.

According to Apulu, Latham, & Moreton (2011), the entrance of PTOs made access to smartphones relatively cheap and easy. The waiting period for telephone lines decreased from 2 years for a fixed telephone line to 10 minutes. Costs for acquiring a telephone line also saw a downward spiral from the equivalent of USD $1,000 acquisition costs, prior to August 2001, to USD $50. Adeleke and Aminu (2012) referred to the current cost of acquiring a prepaid mobile line in Nigeria as amounting to 0.6 cents. In 2007, calling costs on prepaid services stood at 28 cents per minute (or 26 cents off peak calling times) for local calls. Apulu, Latham, and Moreton (2011) argued that the cost is still very high relative to the average income of a wage earner in Nigeria, where the national per-capita income stood at $1,000 in 2005.

The decline in cost of acquiring a SIM card is not without its attendant consequences. Adeleke and Aminu (2012) posited that the crash in the cost of obtaining a mobile line had a negative impact on the PTOs ability to retain customers. Another problem that confronted the PTOs was the decline in the subscriber growth rate. According to the NCC (2014), teledensity in Nigeria stands currently at 94.42%. One of the strategies of retaining customers is to make the cost of switching prohibitive. Thus, while the cost of acquiring a mobile phone may have become cheaper, the cost of migrating from one PTO to another leads to an expensive changing of the SIM card. The latest development in telecom services in Nigeria pertains to the introduction of mobile-number portability (MNP) in May 2013, which according to the GSMA (2014), occasioned a shift in market share.

Figure 11 shows market share across PTOs with an indication of a cut in MTN share since the introduction of MNP. Adeleke and Aminu (2012) believed that the unfriendly tariff regime was moderated by MNP, thus forcing PTOs to focus on service quality as one of their most effective strategies for attracting and retaining customers. Figure 12 shows mobile phone diffusion in the Nigerian states. Figure 13 depicts how mobile operators reported their launch-time indicators.

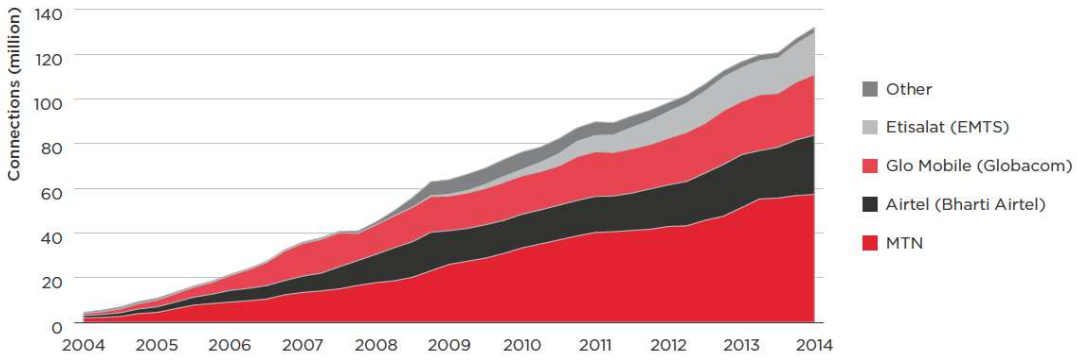

Figure 11. Market share by Nigeria's telecom operators 2004-2014.

The chart shows 10 years of market share by PTOs in Nigeria. MTN consistently remains the market leader, although there was a drop in its market share in 2013/2014. Adapted from "*Analysis Country Overview: Nigeria*," by GSMA Intelligence, 2014. Reprinted with permission.

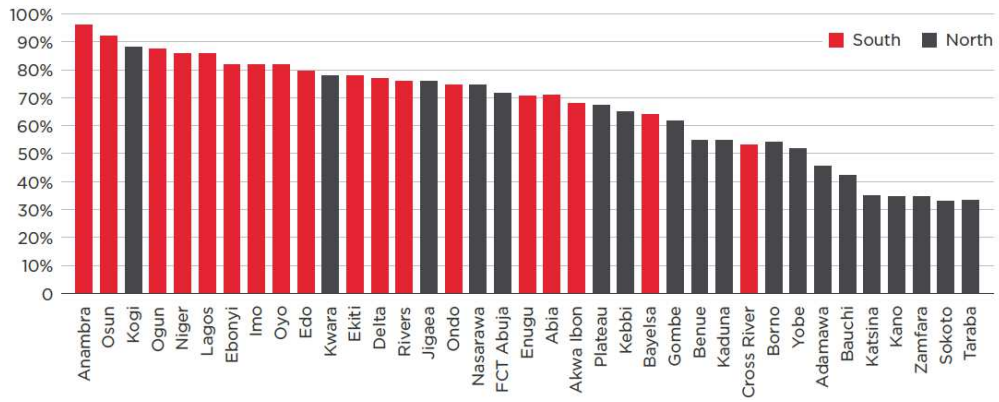

Figure 12. Mobile phone diffusion in the Nigerian states.

The entire country has 36 states, which can be divided into North and South. The northern states are represented in black, the southern states in red color. A cursory look at the mobile phone penetration across the 36 states shows that the southern states have higher penetration rates than the northern states. Adapted from "*Analysis Country Overview: Nigeria*," by GSMA Intelligence, 2014. Reprinted with permission.

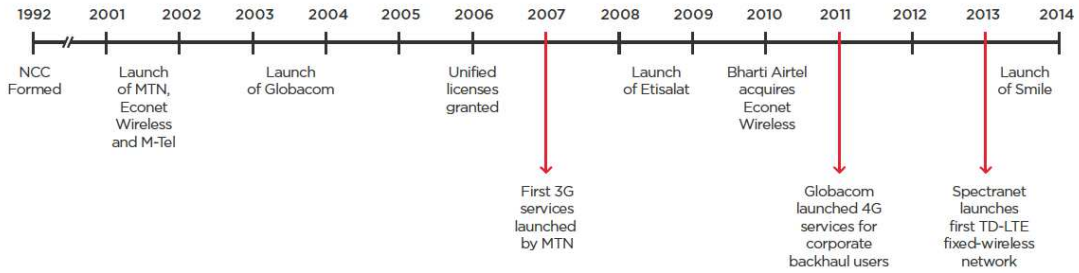

*Figure 13.*The mobile operators' launch-time indicator shows the entry time for mobile operators in Nigeria and the launching of various generations of mobile technologies. Adapted from "*Analysis Country Overview: Nigeria*," by GSMA Intelligence, 2014. Reprinted with permission.

Influence of Mobile Phone Adoption in Rural and Urban Areas

Current studies with respect to diffusion of smartphone technologies in developing countries generally focus on urban areas. Comparative studies between urban and rural areas are practically nonexistent. Wijetunga (2014) examined the low-income young users in Sri Lanka, and Barrantes and Fernández-Ardèvol (2012) studied three cities of Peru and concluded that prepaid subscription is the most common form of payment for using mobile networks among the rural dwellers of Peru. Aker and Mbiti (2010) focused on the correlation between mobile phones and economic development in Sub-Saharan Africa, Mozambique, and Tanzania, and Sife et al. (2010) examined the contribution of mobile phones to reducing poverty among the rural households in the Morogoro region of Tanzania. They later found that the fast and easy mode of communication increased the people's ability to access their livelihood assets, undertake diverse livelihood-enhancing strategies, and overcome their vulnerabilities. Jentzsch (2012) summarized the effect of the adoption of mobile technology in Africa; he opined that mobile phone usage could be regarded as one of the economic success stories in Africa. While different authors believed that mobile phone is a useful tool for sociodevelopment, Carmody (2010) believed that the technology could also serve as a tool for domination, exploitation, cooperation, or popular empowerment. He argued the technology is embedded in existing social relations of support, resource extraction, and conflict and it could also be a tool to reconfigure and reconstitute the identified socio-political issues.

Sife et al. (2010) further pointed out that, although mobile phones seems to have the potential for improving livelihood and reducing poverty, the precise mode and the extent to which mobile technologies contribute to sustainable livelihood and poverty reduction remain largely unexplored. Carmody (2012) believed that the claim about the transformational developmental impacts of mobile phones is contradictory. He posited that rather than reducing poverty, mobile phone adoption could actually increase poverty. The reason for the contradiction is explained in the work of Smith, Spence, and Rashid (2011), who believed that the benefits from mobile technology adoption might be proportionately greater in resource-constrained settings, (e.g., the poor and rural populations) and this is mostly true in a situation of extreme poverty that emanated from isolation. Carmody (2012) examined the effect of mobile phone adoption from an inclusion point of view and submitted that though mobile phones may be socially articulating; however, they recreate another forms of economic disarticulation, thereby replicating patterns of Africa's adverse inclusion in the global economy.

Trends in Pre- and Postadoption Behavior

Smartphone technology evolves fast, thus garnering increased attention from scholars (Aldhaban, 2012). Most studies on technology adoption focused on the question of potential users' initial decision to adopt or not to adopt (Kim & Crowston, 2011). Prior studies on technology adoption enunciated the differences in user perceptions between the initial adoption and the continued usage (Hong, Thong, & Tam, 2006). Understanding prior work of scholars with respect to users' pre- and postadoption behavior was critical

to the objective of this study. Adoption behavior has two distinct aspects: pre- and postadoption.

Preadoption behavior of smartphone users. In the study of users' Preadoption behavior, Kargin, Basoglu, and Daim (2008) employed conjoint analysis to analyze users' intention to adopt mobile value and add other services (VAS). The researchers discovered that the intention to adopt revolved around such considerations as personalization, content, cost, screen size, and service speed. Kang, Cho, and Lee (2011) used the TAM model to analyze the factors affecting smartphone adoption; their model was based on five functional attributes: wireless Internet, design, multimedia, application, and after-service. They concluded that users adopted a smartphone because they perceived it as a tool for a particular purpose. Huang et al. (2010) used a systematic methodology in order to understand the factors that affect users' perceived performance of some smartphone applications. Ozbek et al. (2014) found that individuals with a high level of amicability (those who are assumed to be kind, considerate, likable, helpful, and cooperative) view smartphone technology as valuable, while those who have a higher level of neuroticism (those who are assumed to be anxious, unconfident and preservationist) perceive smartphone technology as less useful. They established further that people with a higher level of openness (who are assumed to be willing to try new and different things, actively seek out new and varied experiences, and value change) perceive smartphone technology as more easy to use.

Laxmi, Akila, Ravichandran, and Santhi (2012) explained that the smartphone's degree of reliability was a critical factor regarding adoption in the mobile users' behavior

pattern. They stated that "mobile users behavior pattern consists of detailed information about service requirements, and mobility models that is essential to Quality of Service (QoS) and roaming support" (p. 5021). They posited further that, given the fact that users of smartphones do not travel arbitrarily, they exhibited some level of confidence in network mobility support. Chtourou and Souiden (2010) also applied the TAM and concluded that one factor that affected the adoption of a smartphone for mobile Internet was the fun such usage provided. Furthermore, they emphasized the need for inclusion of emotional motivation in the study of users' adoption of innovation. Chong (2013) used the DIT to explore the relevance of enjoyment for users' intention to adopt mobile technologies, websites and Internet based applications. Chiyangwa and Alexander (2015) summarized Chong (2013) findings and concluded that potential users are likely to adopt mobile technologies if they find the content, entertainment and location-based services enjoyable. Kim and Ammeter (2014) equally established a correlation between age and perceived enjoyment; they concluded that younger users of mobile technologies are more highly motivated to adopt the technology if they see enjoyable. They also linked perceived enjoyment with DIT; they believed that perceived enjoyment usually reduce perceived complexity, which may be associated with mobile technology.

Yoo, Yoon, and Choi (2010) examined the smartphone based on its characteristics and concluded that users' experience plays a critical role in the adoption. Shin, Shin, Choo, and Beom (2011) argued that smartphone technology is ubiquitous in the educational industry; they based their study on a modified UTAUT by using constructs from the ECT to examine the smartphone as a learning tool. Putzer and Park (2010)

focused on factors that affected individuals' decisions regarding health care, while Boulos, Wheeler, Tavares, and Jones (2011) discussed the barriers to the adoption of smartphone applications in health care. The latter concluded that cost, network bandwidth, battery efficiency, privacy, and usability were factors that affected the intention to use a smartphone. Aldhaban (2012) identified networking and connectivity as critical issues affecting adoption. Other aspects that tended to affect users' intention to adopt a smartphone include medical tasks (Khan, Lee, Lee, & Kim, 2010; Oresko, Duschi, & Cheng, 2010; Wolfenden, Brennan, & Britton, 2010).

Postadoption behavior of smartphone users. The postadoption stage marks the time when users have had direct experience with smartphone technology. Hong, Thong, and Tam (2006) explained that it was at this point in time that users decided whether to continue or discontinue to use the smartphone technology. The authors further elucidated that infrequent or ineffective use after the initial adoption could lead to increased operational costs, wastefulness, and redundancies. The ECT is the main theory for studying postadoption behavior; researchers use it to address the problem of changes in perception of technologies after the initial adoption. Prior studies mainly focused on behavioral variables of continued usage as opposed to other variables such as recommendations by others or complaints (Kim & Son, 2009; Zhou, 2011). Bhattacherjee (2001) argued that users' continued usage, rather than the initial adoption, is most critical to any innovation. Some of the scholarly work regarding postadoption includes the IS continuance model (Venkatesh et al., 2011) and continued use of cyber infrastructure (Kim & Crowston, 2011).

Hong et al. (2006) and Kim (2012) identified perceived usefulness and perceived enjoyment as postadoption expectations. The postadoption behavior of users could be regulated either through dedication or constraint-based mechanisms (Kim & Son, 2009). Dedication is inspired by perceived benefits, whereas constraint deals with service-specific investments. Commitment induces loyal customers to patronize the network operator and recruit friends, family members, and associates through word-of-mouth advertisement (Kim & Son, 2009). This position was corroborated by Al-Debei and Al-Lozi (2014), they believed that social influences posses a great manipulating power which, can change the opinion one hold about a certain product or service. Mobile operators usually are not oblivious to the implications of a loss of patronage, which mean a drop in revenue and profit. Zhou (2011) posited that paying attention to users' postadoption behavior is critical for mobile service providers.

Economic Influence of Diffusion of Mobile Technology

A series of studies have investigated the effect of adoption of mobile technology on economic development. Gruber & Koutroumpis, (2011) noted that, over the last 30 years, a high correlation could be shown to exist between the adoptions of mobile technology and their affect on the global economy. Reviews of studies from sub-Saharan Africa (Chavula, 2013; Hellstrom, 2010; Margaux, 2013; Mason, 2013) revealed that mobile phones were a key innovative technology in support of livelihoods, with evidence of a growing integration into agricultural extension, information provision, and marketing systems (Duncombe, 2012). In the same manner, Hellstrom (2010) observed a strong relationship between diffusion of mobile technology and increase in the number of

microfinance banks; small- and medium-scale enterprises; social development such as improvement in the areas of health, education, the environment; humanitarian relief to disaster areas and emergencies; and advocacy purposes (Duncombe, 2012). Rao (2011) believed that the technology could be used to disseminate critical information about farming and health care to isolated rural areas. Aker and Mbiti (2010) did extensive work on the adoption of mobile phones in Africa. In their study, they used IDT to establish five potential ways in which mobile phones could stimulate economic development: "First, mobile phones can improve access to and use of information, thereby reducing search costs, improving coordination among agents and increasing market efficiency" (Aker & Mbiti, 2010, p. 15). Second, this increased communication should improve firms' productive efficiency by allowing them better to manage their supply chains. Third, mobile phones create new jobs to address demand for mobile-related services, thereby providing income-generating opportunities in rural and urban areas. Fourth, mobile phones can facilitate communication among social networks in response to shocks, thereby reducing households' exposure to risk. Finally, "mobile phone-based applications and development projects sometimes referred to as m-development have the potential to facilitate the delivery of financial, agricultural, health and educational services" (Aker & Mbiti, 2010, p. 20).

Adoption of mobile phones is beneficial toward the reduction of cost and time invested in traveling because better communication via mobile networks leads to a decrease in the frequency of trips and the associated expenditure of resources (Duncombe, 2012). Other studies have pointed out a trade-off between the acquisitions of

other assets in preference to the possession of a mobile phone. Diga's (2007) study in the Wakiso District of Uganda reported that the women were willing to forgo store-bought items in order to purchase mobile phones and recharge credits, and in many cases, this was undertaken to strengthen longer-term asset-accumulation strategies focused on microenterprises (Duncombe, 2012).

Social Change Implication

Although the poor rural populations are not a homogenous group—they include artisans, farmers, fishermen, herders, migrant workers, and indigenous people, to name but a few—one common element is their lack of affordable access to relevant information and knowledge services. This lack of access can entrain other contributors to poverty (e.g., ignorance of income-earning or market opportunities and the inability to make their voices heard).

Summary and Conclusions

This chapter began with an introduction to the essence of the literature review. One of its main purposes was to help develop a framework for this study. I described the literature search strategy and the key words used in the search. Main areas of the literature reviewed were innovation diffusion and the decision process regarding adoption of new technology. Some of the models used in prior studies were also reviewed, namely, TAM; TRA; TPB; SCT; UTAUT; and a postadoption theory, ECT. This review also revealed a large gap in the professional literature, namely, the lack of comparative studies shedding light on the differences between perceived benefits derived from the technology among rural versus urban adopters. Most of the literature focused on the affect of mobile

technology on rural residents, while research about the affect on urban dwellers was very limited. With this study, I narrow the gap by providing empirical evidence on the sociodevelopmental effect of the technology and the pre- and postadoption behavior of rural and urban dwellers. In Chapter 3, I discuss the research methods and the rationale for the choice of the research design. I also describe the target population, sampling method, data collection, and issues related to reliability, validity, and the protection of the participants' rights and anonymity.

Chapter 3: Research Method

This chapter includes the research design for exploring the sparsely researched area of pre- and postadoption behaviors of smartphone adopters in rural and urban areas and the sociodevelopmental effect of smartphone adoption and usage. The purpose of this quantitative cross-sectional survey study was to examine the adoption behavior and the sociodevelopmental effect of smartphone acceptance among rural and urban residents of Nigeria.

This was an exploratory study of innovation diffusion of smartphone technologies among urban and rural dwellers. According to Ahlstrom (2010), innovation is the driving force for technological and economic growth; it facilitates greater productivity and better competitiveness. In this chapter, I discuss the research methods, research design, and the justification for selecting these methods. Issues covered in this chapter include target population, sampling procedures and sample size, instrumentation and data collection procedures, hypotheses testing, and data analysis techniques. Other pertinent issues addressed are confidentiality and protection of the participants' rights and privacy, research reliability and validity, and ethical considerations that govern the research.

The research problem examined in this study concerned the objective reality and objective knowledge of the participants; therefore, an analytical framework was considered most appropriate for the task. Application of a cross-sectional quantitative research method facilitated an in-depth understanding of the current situation with respect to the research problem.

Research Design and Rationale

There were three possible research methods for this study: qualitative, quantitative, and mixed methods. A quantitative method was used for this study because it is useful in studying large population such as the one for this study, which is approximately 45 million. The method provided precise numerical data and it was less time consuming when compared with qualitative research, which uses explanatory and descriptive method for its data. Other benefits of this method were that the research findings were easily generalizable based on random samples of sufficient population size and it eliminated researcher biases and enables researchers to remain emotionally detached and uninvolved with the objects of study. Qualitative research was not considered for this study because this was not an in-depth study of limited cases. It is also difficult to test unlike hypotheses in a quantitative method. Another research method, which could be applied to this study, is the mixed methods approach; however, this method was not chosen because of some of its drawbacks: it is time consuming, involves extensive data collection, rigorous analysis of both quantitative and qualitative analysis, and it also has a limited application in information system research (Venkatesh, Brown, & Bala, 2013).

Quantitative research could be divided into three designs: experimental, quasi-experimental, and nonexperimental. This study was not about cause and effect relationship or application of specific treatment that influences an outcome. Therefore, a true experiment was irrelevant to this study. The study also did not qualify as a quasi-experimental design, which involves nonrandomized assignment of subjects to

experimental conditions. A nonexperimental cross sectional survey design was appropriate for this study because of its ability to facilitate comparisons between groups such as the urban and rural residents.

The research problem and the research design were based on and were informed by an extensive review of the literature in regard to users' intention to use and continue to use smartphones and the sociodevelopmental influence of these technologies on the adopters in rural and urban areas. The work of Aker and Mbiti (2010), Davis (1989), Oliver (1980), Rogers (1998), and Venkatesh et al. (2003, 2012) provided a general framework for this study. The framework was designed to establish a plan of action or specification for collecting and analyzing the necessary data, suitable for hypothesis testing and providing answers to the research questions posed for the study. Frankfort-Nachmias and Nachmias (2009) noted that a research design is the program that guides the investigator in collecting, analyzing, and interpreting observations. It is a logical model that allows the researcher to draw inferences concerning causal relations among the variables under investigation. The research design also defines the domain of generalizability, that is, whether the obtained interpretation can be applied to a larger population or to different situations. The research design should, therefore, be based on the research questions as opposed to the researcher's familiarity (or bias) with respect to a phenomenon under study. The research questions for this study were as follows:

Research Question 1 (RQ1): What is the relationship between performance expectancy and rural and urban residents' intention use smartphones technologies?

IV = performance expectancy

DV = intention to use (IU)

Moderators = location and economic status

Research Question 2 (RQ2): What is the relationship between social influence and rural and urban adopters' intention to use smartphone technologies?

IV = social influence

DV = intention to use (IU)

Moderators = location and economic status

Research Question 3 (RQ3): What is the relationship between price value and rural and urban adopters' intention to use smartphone technologies?

IV = price value (PV)

DV = intention to use (IU)

Moderators = location and economic status

Research Question 4 (RQ4): What is the relationship between habit and users' intention to use smartphone technologies?

IV = habit

DV = intention to use (IU)

Moderators = location and economic status

Research Question 5 (RQ5): What is the relationship between adopters' initial intention to use smartphone and the subsequent continued intention to use smartphones?

IV = intention

DV = continued usage (CU)

Research Question 6 (RQ6): What is the relationship between adopters' continued usage of smartphones and their satisfaction with their smartphones?

IV = continued usage (CU)

DV = satisfaction

Research Question 7 (RQ7): What is the relationship between rural and urban dwellers' continued use of smartphones and their sociodevelopment status?

IV = continues usage (CU)

DV = socioeconomic growth

The central concept of this study concerned pre- and postadoption behaviors of rural and urban dwellers in regards to the diffusion of smartphone. Six independent variables were identified and considered relevant to this study: PE, SI, PV, habit, BI and CU. There were four moderating variables: age (18–25 years, 26–30 years, 31–35 years, 36–40 years, 41–45 years, 45 years and older), gender (male, female), location (urban or rural), and economic status (monthly income). In the original work of Venkatesh et al. (2003), the authors concluded that BI and CU of innovative technologies is influenced by PE, EE, SI, and FC. The theory was later modified in their seminal work of 2012; they discovered that, when the model was applied on the individual level, the following constructs played a significant role: hedonic motivation, price value, and habit. I added the work of Oliver (1980) on ECT to the framework for gaining insight into the adopters' postadoption attitude. This study introduced two independent variables: perceived performance and expectations, and two dependent variables: satisfaction and confirmation. These three constructs were introduced to enable me to measure the

relationship between service characteristics of smartphone and pre- and postadoption attitudes.

A quantitative, cross-sectional survey design was adopted for the study with a view toward achieving an outcome that best answers the research questions. This method was considered appropriate for the study because it enabled an empirical investigation into the research problem based on a pattern obtained from participants' answers to the survey. This type of research design transcends individual differences with respect to demographics and social structures in the society. A quantitative, cross-sectional design enables the researcher to gather and analyze data in order to solve the research problem and achieve the research objectives.

Methodology

This section addresses the methodology used for testing research hypotheses and answering the research questions. Methodology explains the process behind the choice and use of particular methods that achieve the desired outcome (Crotty, 1998). It is of the essence, therefore, clearly to identify the method that was used to collect and analyze data, which were generated from the research questions and hypotheses. Although a number of different methodologies were considered for this study, the cross-sectional survey technique was considered most suitable for this research. It is often referred to as an observational study because the investigator simply observes, but does not carry out any interventions (Mann, 2003). This approach is useful for data collection from either a small or a large population, and it is very economical and requires no follow up (Mann, 2003). Cross-sectional studies are the best way to determine prevalence and are useful for

identifying associations that can then be more rigorously studied using a cohort study or a randomized controlled study. A self-administered survey design was the data collection technique that enabled the processing of various responses related to the research questions and hypotheses.

Population

The target population for this study was smartphone users in Nigeria. According to NCC (2014), there are 180 million mobile phones in Nigeria; smartphone penetration stands at 25% of 180 million therefore the estimated population for this study was 45million. A stratified sampling method was used in this study and to arrive at the sample size. I used the sample size calculator by the creative research systems; the sample size is 385 based on 95% confidence level and 5% confidence interval. The accuracy of the sample size was tested using the equation developed by Cochran (1963)

$$n_o = \frac{z^2 pq}{e^2}$$

The population was subdivided into two categories: rural and urban residents. The potential participants were required to own and use a smartphone and be able to express themselves in English. The minimum required age for participation in the study was 18years; this was to eliminate situations where informed consent would be required from a parent or guardian to participate in the study. In addition, participants aged 18 years and older were expected to be able to process and answer the survey questions correctly.

I chose Nigeria for this study because it is the most populous country with the biggest economy in Africa; it is also among the countries with the fastest smartphone penetration rate in the world. Nigeria is located in West Africa and shares borders with

the republic of Benin in the west, Chad and Cameroon in the east, and Niger Republic in the north; its coast in the south lies on the Gulf of Guinea on the Atlantic Ocean. The country comprises 36 states and the Federal Capital Territory, with a total population of 174 million inhabitants.

The participants in the study came from Lagos State of Nigeria. The population of the state is 21 million, comprising 250 ethnic tribes (Campell, 2012). The state boasts a strong presence of all types of mobile technologies, from 2G to 4G wireless technologies; it also hosts the head offices of all the telecom companies in Nigeria. Lagos state was chosen as the representative state for three reasons: (a) it is the most populated state in Nigeria, (b) it is a cosmopolitan state, and (c) it is the commercial capital of Nigeria. The research sample was based on one major criterion, namely the availability of a 4G-smartphone network, and Lagos State was the only state that complied with this criterion. This cosmopolitan state is made up of 250 ethnic groups, as previously stated, which includes all major ethnic groups such as the Hausa, Igbo, and Fulani. Small minorities of American, British, East Indian, Chinese, white Zimbabwean, Greek, Syrian, Lebanese, and Japanese are also present in the city.

Sampling and Sampling Procedures

The sampling frame for this study consisted of smartphone users in Nigeria. Multistage sampling was used because it allowed potential participants to be selected through multiple steps or stages. According to the NCC (2014), subscriber statistics for mobile phone use in Nigeria are approximately180million. This figure includes 25% (or *n* = 45 million) smartphone users (Adebayo, 2014). Thus, the sampling frame for this study

was *n* = 45 million. The first step of purposive sampling was to determine Lagos as the most representative state. The second step consisted of stratified random sampling for the selection of local government authorities (LGAs). Potential participants were selected from 12 local governments out of a total of 20 local governments in Lagos State. Fifteen of the 20 LGAs were in the Lagos metropolis. To ensure proportionate selection, nine of the 15 LGAs in the metropolis were randomly selected, while three of the five local government councils in the rural areas were chosen. Lagos State was chosen because it is the commercial capital of Nigeria and has the highest concentration of a migrant population in Nigeria, which equates with the largest group of mobile phone users in Nigeria. The appropriate sample size for this study with a confidence level of 95% and a margin of error 5% was 385 participants. The software used for power analysis to determine the appropriate sample size was obtained from Survey Systems Software. The accuracy of the sample size was further tested using the equation developed by Cochran (1963). Cochran's equation that yields representative sample for proportion is calculated using the following formula:

Formula: $n_o = \frac{z^2 pq}{e^2}$

Description:

n_0 = required sample size

Z^2 = the abscissa of the normal curve that cuts off an area α at the tails (1 - α equals the desired confidence level, (e.g., 95%),

e = the desired level of precision

p = estimated proportion of an attribute that is present in the population.

q = 1-p.

The value for Z is found in statistical tables, which contain the area under the normal curve.

Z^2 =1.96 since confidence level is 95%

When p is unknown, most scholars estimate it at 50% (0.5)

q=1-p=1-0.5=0.5

e=margin error at 5%(standard value of 0.05)

Therefore, sample size=$(1.96^2 x(0.5x0.5)/0.05^2$

=(3.8416x0.25)/0.0025

=0.9604/0.0025

=384.16

=385

Allocation of sample to strata (selected local governments) proportionally was derived from the following formula:

Formula: $N_h=(N_h/N)n_o$

Description:

n_h=the sample size in stratum (local government) h, h=1,2,…,L

N_h=the population size in stratum (local government) h, h=1,2,…,L

N=the total population size

n=the total sample size

Table 4

Allocation of Sample Size to Strata (Selected Local Government Areas)

S/N	Local Government Areas	2006 Population (N/h)	Sample Size (nh)
	Urban Areas		
1	Agege	1,329,122	36
2	Ajeromi/Ifelodun	1,846,625	51
3	Ifako/Ijaye	957,633	26
4	Kosofe	1,202,458	33
5	Lagos Mainland	809,864	22
6	Mushin	1,700,240	47
7	Oshodi/Isolo	1,459,689	40
8	Shomolu	1,318,905	36
9	Surulere	1,639,572	45
	Rural Areas		
10	Ikorodu	886,513	24
11	Badagry	489,442	13
12	Epe	416,382	11
	Total Population of the selected Local Government Areas	14,056,445	385

Note. Calculation of sample size was based on the population figures extracted from the 2012 publication "*Abstract of Local Government Statistics*," Lagos Bureau of Statistics, Ministry of Economic Planning and Budgeting in 2012.

Figure 14 depicts the stages involved in the multistage sampling procedure.

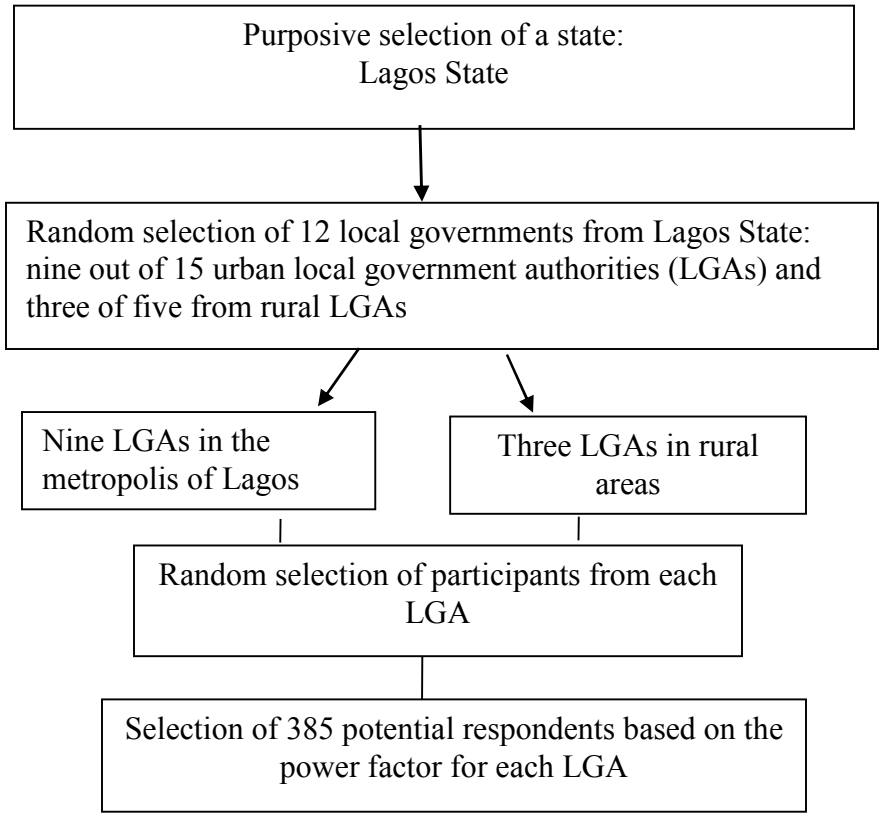

Figure 14. Stages involved in the multistage sampling procedure.

Procedures for Recruitment, Participation, and Data Collection

The initial identification, contact, and screening of participants for this study was based on the concept of equitable representation. Participation was based on fulfilling the principle of informed consent. Primary data were the type of data desired for this study, and they were collected through face-to-face and Web-based methods. The Web-based survey was accessible via a link to SurveyMonkey. An introductory letter stating the purpose of the survey in Lagos State, Nigeria, was attached to each copy of the survey. The links remained active for 7 days. Additionally, face-to-face distribution of survey

occurred simultaneously. The survey was distributed in major offices, event centers, public places such as government offices, schools, hospitals, local government offices, eateries in the selected local government headquarters, and various trade associations and gatherings. The demographic information collected included age, gender, education, income level, profession, and location. Potential participants were handed a survey as they arrived in the described places; they were asked to fill out the survey and submit it as they left the event center. Participants were carefully divided to represent at least all of the following groups: gender, age, location, and various professions.

Data Collection

Survey research usually involves numerical analysis of the data. A survey was the data collection instrument for this research. The choice of this technique was predicated by its nonexperimental approach, suitable for collection of primary data from participants. The survey included questions regarding smartphone usage that measured the impact of the technology and the adopters' attitudes during the pre- and postadoption phases. Seven constructs pertained to this study: PE, SI, PV, habit, SAT, BI, and CU. However, the expectation construct under ECT was infused with the PE construct under the UTAUT. The survey had a four-part design: (a) the first part collected the participants demographic information: gender, age, location, education, occupation, income level, and profession; (b) the second part contained questions on constructs related to the intention to use a smartphone; (c) the third part included the construct of postadoption attitude and its effect on the continued usage of a smartphone by the participant; and (d) the fourth

part examined the sociodevelopmental impact of continued use of the technology on the participants.

Survey Approach

A survey was chosen as the data collection technique because it was a cost-effective way of obtaining data from a large number of respondents, and it was less time-consuming than personal interviews, for example. The large numbers of surveys distributed demanded the engagement of research assistants: Three research assistants were employed to help with the distribution of surveys. A combination of two methods of administering the survey was considered: the face-to-face approach and a Web-based method through SurveyMonkey.

The strategy for collecting the face-to-face surveys was subdivided into two sections, according to the participants' location. Rural dwellers were recruited during their community town hall meetings. I used the occasion to explain the objective and the importance of the study and ask for their consent to administer the survey on volunteers' attendees. Those who intended to participate in the survey were given the survey with the instruction to complete and return it directly to me, at their own time but within the time frame of 2 weeks.

For urban dwellers, I randomly distributed the surveys to individuals within the identified local government areas. In addition, survey was administered on employees of organizations that were located within the identified local government areas. An approval was sought from the management of such organization before such surveys were administered. This approval was necessary for awareness and access. By participating in

the survey, participants were well informed that the completion of the survey indicated their consent.

The online survey complemented the face-to-face method, which was available only to smartphone users in Lagos metropolis. SurveyMonkey.com enabled me to send online surveys to an array of potential participants, who then submitted responses to the Web-based survey. Accompanied by an introductory letter explaining the purpose of the research, the link to SurveyMonkey stayed open for 7 days, after which the link was removed and the data retrieved for analysis.

Instrument Development

I made small modifications to the instruments developed by Bhattacherjee (2001) and Venkatesh et al. (2012) (see Appendix A). I also included survey questions on the sociodevelopmental effect of smartphone use that were not part of the work of the original authors. The research instrument used by Bhattacherjee (2001) and Venkatesh et al. (2012) in their seminal work was the instrument for this study, albeit with small modifications to the individual differences variable. The individual-differences variables in the authors' seminal work pertained to age, gender, voluntariness, and experience; however, in this study, I used location and economic status as moderator variables. The major constructs for the study (PE, SI, habit, PV, SAT, BI, and CU) emanated from existing scholarly works. The variables have been frequently validated in previous studies. In this study measures of PE, SI, PV and habit and BI were adapted from previous study of Venkatesh et al. (2012), measure of expectation confirmation (EC), continued usage (CI) and satisfaction were derived from Bhattacherjee (2001), and Zhou

(2014). Though their original work contains 11 constructs; however, only seven of these constructs were applied in this study.

The survey was simplified to enable participants to easily follow and understand the questions provided in the English language. Participants expressed their views by clicking on the answer that best represented their attitude and experience. The independent variables, RQs and Item numbers in the survey were as follows: RQ1 - performance expectancy, PE (items 17–20), RQ2 - social influence, SI (items 21–23), RQ3 - price value, PV (items 24–26), RQ 4 - habit (items 27–29), RQ 5 – BI and CU (item 30 –35), RQ 6 – satisfaction, SAT (items 36–43), RQ 7- Sociodevelopment, (item 44–49).

Because the items were predominantly adapted from previous research studies, and owing to limited time and financial resources, I did not conduct a full pilot study using the research instrument. However, I piloted the distribution method and understandability of the survey by administering the survey to a pilot sample of 80 participants in the target population. The responses demonstrated good engagement (i.e., sufficiently high standard deviations in response sets) and the variables were sufficiently normally distributed. Therefore, I considered the survey to be acceptable to gather data on the variables of interests for this study. The sections of the survey, as well as the measurement scales, are outlined in the next sections:

Section A. Demographic characteristics: age, education, income, gender, location (urban or rural), and profession. The answers to the demographics questions were measured as follows: Age was measured in years (Item 1), experience was measured in

years, gender was coded as F or M (Item 2), and location was either R or U (rural or urban) (Item 3).

Section B. The measurement factors for this study revolved around the independent variables of PE, SI, habit, and expectations. These variables were measured with a 5-point Likert scale, and the SPSS software package was used for data analysis. The major determinants in the choice of data gathering and measurement tools were cost, availability, required training, ease of administration, scoring, analysis, and time and effort required for participants to complete the measure. To avoid bias or leading questions, the survey design was simple and unambiguous.

Section C. This section pertained to user perceptions of intention, satisfaction and continued intention to use smartphones. The dependent variables were BI (items 30–32), CU (items 33–35), EC (items 36–38), SAT (items 39–43) and socioeconomic growth (items 44–49). The measuring scale for this section was the same as described in Section B. A Likert scale was chosen for this study because of its demonstrated high level of reliability; it is a widely accepted scale that has stood the test of time in both validity and reliability. One of the major advantages of a Likert scale is its ability to dilute the effect of random error, which may characterize an individual item (John, 2010); this strength increases the level of accuracy for the research outcome Factor analysis is considered appropriate in determining the reliability of the study; hence, it was conducted before the regression analysis. The essence of factor analysis was to ensure appropriate identification of the relevant items for the analysis. Factor analysis is a data reduction technique that uses correlations between data variables; its general underlying assumption

is that a number of factors exist to explain the correlations or interrelationships among observed variables (Chatfield & Collins, 1992). I carried out the factor analysis using a principal component analysis (PCA) alongside Varimax rotation with Kaiser normalization rotation method until the Eigen value of each factor was equal to 1 or more. Cronbach's alpha was used to test the internal consistency of each scale in the study. A correlation analysis was carried out to determine the level of significance between the BI, CU, and SAT (the dependent variables) and the independent variables of PE, SI, PV, and habit. A simple linear regression model was used for testing the hypotheses.

Instrumentation and Operationalization of Constructs

The objective of this study was to understand the innovation diffusion of smartphones among dwellers of rural and urban communities and the sociodevelopmental impact the adoption had on them. The survey instrument adopted for this study emanated from the research conducted by Bhattacherjee (2001) on online banking division (OBD) of one of the largest national bank in U.S. While the Venkatesh et al. (2012) instrument was administered to mobile phones users in Hong Kong; their instrument was published in English to ensure content validity. Venkatesh et al. (2012) used Smart-PLS software to examine the measurement model in order to assess reliability and validity. The internal consistency reliabilities (ICRs) of multi-item scales modeled with reflective indicators was .75, this, they concluded to be an indication the scales were reliable. The average variance extracted (AVE) was greater than .70 in all cases and greater than the square of

the correlations, indicating discriminant validity. The pattern of loadings and cross-loadings supported internal consistency and discriminant validity.

Bhattacherjee (2001) ensured reliability of his instrument, by examining the goodness-of-fit of the overall CFA model. He applied the findings of Bentler (1989), who suggested that models with good fit, should have chisquare normalized by degrees of freedom (x2/df) that did not exceed 5, while Bentler-Bonett Non-Normed Fit Index (NNFI) and Comparative Fit Index (CFI) should both exceed 0.9.4. The CFA model in their study was as follows: X2/dfw as 1.63 (X2 = 116.21; df = 71), NFI was 0.94, and CFI was 0.95, therefore, there is an adequate model fit. They evaluated convergent validity for the four measurement scales based on the three criteria suggested by Fornell and Larcker (1981): (a) all indicator factor loadings (X) should be significant and exceed 0.7, (b) construct reliabilities should exceed 0.80, and (c) average variance extracted (AVE) by each construct should exceed the variance due to measurement error for that construct (i.e., AVE should exceed 0.50), in their study all k values in the CFA model exceeded 0.7 and were significant at $p = .001$. Composite reliabilities (Pc) of constructs ranged between 0.82 and 0.88. AVE ranged from 0.60 to 0.65). Therefore, all three conditions for convergent validity were met.

The survey design adopted for this research had three major methods of administering the survey: self-administration, mail survey, and Web-based survey. A combination of Web-based and on-site distribution for self-administration was used for this study to ensure a good response rate. Response rate is critical in evaluating the reliability of survey results. Mail survey was not suitable for the Nigerian environment

due to lack of reliable postal directory and postal services. In addition to this particular problem, Sekaran and Bougie (2013) pointed out that, if participants had any doubts or questions, mailed surveys would be hard-pressed to provide clarification, which was a major drawback of this method. The Web-based survey was also a challenge in Nigeria because it required access to a computer system, which may not have been available to most people in rural areas, where the most prominent alternative for Internet access was through their smartphones.

Data Analysis Plan

My goal for this dissertation was to facilitate better understanding of the differences in behavioral attitudes of rural and urban dwellers with respect to smartphone adoption. In addition, the study aimed to measure the social and economic impact of the technology on the adopters. The outcome of the study may generate a technological acceptance framework that best suits the rural and urban communities from the perspectives of the developing economy. This study involved multivariate data: Five independent and three dependent variables were used to reveal the dominant pattern in the pre- and postadoption behavior of adopters. A structural equation modeling (SEM) statistical technique was used to examine measurement model, data analysis, and validation of the model. One of the benefits of the SEM for this study was that it is a multivariate technique that combines aspects of multiple regression and factor analysis. The model allowed me to examine a series of interrelated dependency relationship at the same time. I used the procedure developed by Fornell and Larcker (1981) to examine discriminant validity of the constructs. The procedure recommends the comparison of the

average variance extracted (AVE) to the variance shared between the constructs. AVE is used to measure the amount of variance that an LV component captures from its indicators relative to the amount due to measurement error

SPSS and Amos software were chosen for descriptive and inferential statistics. Raw data from the on-site survey was keyed into the software while the Web-based survey was imported into the software. Descriptive statistics were used to generate frequency distribution, mean, standard deviation, and range for all dependent and independent variables. The collected data was analyzed using the SEM software and associated statistics to test the framework of this study and its validity and reliability.

CFA was used to test if the research data fit the hypothesized measurement model based on the UTAUT and ECT. This process facilitated the assessment of the research questions and hypotheses by determining whether the observed variables were, indeed, good indicators of the latent variables. The process suggested by Byrne (2010), Carvalho and Chima (2014), and Schumacker and Lomax (2010) were followed. A separate confirmatory factor model was run for each set of hypothesized and observed variables to indicate their respective latent variable. Subsequently, the observed variables were diagrammed in Amos software and linked to an SPSS data file to test if the indicator variables were acceptable in defining the latent variable. The research questions and hypotheses from which the survey questions were derived for compiling the data for analysis were as follows:

The null hypotheses were designed to answer the research questions, which were based on the framework provided by the UTAUT- 2 and ECT. These theories

underscored the core determinants that predict intention to use, actual usage, continued usage, and postadoption behavior of users with respect to innovative technology. In addition, the theories enabled me to investigate agents that may expand or contract the effects of the core determinants. The null hypotheses were as follows:

H_{01}: Adopters locale will not influence performance expectancy on intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

H_{a1}: Adopters locale will influence performance expectancy on intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

H_{02}: Adopters locale will not affect social influence on intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

H_{a2}: Adopters locale will affect social influence on intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

H_{o3}: Adopters locale will not influence price value with respect to intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

H_{a3}: Adopters locale will influence price value with respect to intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

H_{o4}: Adopters locale will not influence their habit with respect to intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

H_{a4}: Adopters locale will influence their habit with respect to intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

H_{05}: There is no difference between adopters' initial intention to use smartphones and the subsequent continued intention to use a smartphone?

H_{a5}: There is a difference between adopters' initial intention to use a smartphones and the subsequent continued intention to use a smartphone.

H_{06}: Rural and urban dwellers' user satisfaction with smartphones will not be positively related to continued intention to use the technology, and the level of satisfaction will be the same among the adopters.

H_{a6}: Rural and urban dwellers' user satisfaction with smartphones will be positively related to continued intention to use the technology, and the level of satisfaction will not the same among the adopters.

H_{o7}: Intention to use smartphones will not be positively related to rural and urban adopters' sociodevelopment status, and the intent to use will be the same between the two groups of adopters.

H_{a7}: Intention to use smartphones will be positively related to rural and urban adopters' sociodevelopment status, and the intent to use is not the same between the two groups of adopters.

Threats to Validity

Validity and reliability are two important elements to take into consideration in the evaluation of a measurement instrument (Tavakol & Dennick, 2011). A validity measure determines the extent to which the instrument is able to measure what it purports to measure; it can be divided into two areas: internal and external validity. Leedy and Ormrod (2010) stated that reliability is the consistency with which a measuring instrument yields certain results when the entity being measured remains unchanged. According to Miller (2012), reliability is the stability or consistency of scores over time or across raters. The major internal threat to the validity of the research resided in the issues of subject selection and response rate. To ensure validity, selected participants were individuals who own and use a smartphone and were at least 18 years of age. The selection process used a stratified random-sampling method. The qualifying age bracket was intended to reduce reliability threats from too voluminous or the wrong kind of data. If large amounts of mostly useless data had been collected, the handling and weeding out would have become quite cumbersome and expensive. In addition, large amounts of data would also have increased the chances of errors in coding, transcribing, and computerization of the data.

External Validity

External validity in quantitative research is concerned with the generalizability of a study's result across different individuals, contexts and attributes (Bryman & Bell, 2011). High external validity is desirable because other researchers could make inference from a particular study beyond the immediate context of that study. (Brigham, Lumpkin,

Payne, & Zachary, 2014). To ensure a good response rate for this study, a combination of Web-based and self-administered surveys were used for data collection. The justification for the combination of the two methods was that ICT infrastructure was still very weak in the rural areas of Nigeria; a Web-based survey would have excluded the majority of rural dwellers because they would have needed a computer system to access the survey and a reliable Internet connection to respond to the questions. Thus, Web-based surveys were not a feasible option for this category of participants and neither were mail-in surveys because of the absence of postal services and a reliable Internet connection. The majority of the people with access to the Internet in the rural areas gain this access through their smartphones. However, the Web based survey was suitable for urban dwellers, as most of the people have access to a reliable Internet connection on the computer system. SurveyMonkey of the online research platform was used in distributing the survey to the target audience.

Affecting the response rate was also the fact that the population targeted by this study was limited to individuals who owned and used a smartphone. To reduce validity threats to the barest minimum, I used of the original question scales used by Bhattacherjee (2001), Oliver (1980), Venkatesh et al. (2003, 2012) and in their work. My survey is listed in Appendix B. To suit the context of this research, the instrument was combined to form the questions in the survey; the only modification to the original instrument was the addition of location and economic status to the moderating variables. The instrument used by Bhattacherjee (2001), Oliver and Venkatesh et al. has been widely applied in peer-reviewed research, and benefitted this study. Another issue that

could have affected validity was a poor sampling method; I used stratified random sampling to ensure that participants were properly represented according to age, gender, location, and cultures.

Internal Validity

Cronbach's alpha coefficient is the most proficient in testing internal validity; it determines the internal consistency of each scale in research. When Cronbach's alpha coefficient is close to 1, it implies that questions are measuring a similar dimension of factors; any factor of Cronbach's alpha that is less than 0.6 is to be eliminated (Frankfort-Nachmias & Nachmias, 2008). The scale used in this study emanated from the existing, validated instruments and theoretical model of Bhattacherjee (2001), Oliver (1980) and Venkatesh et al. (2012) and their work has been widely peer-reviewed in notable journals, and the instruments have been fully validated. Therefore, it was not necessary to conduct a pretest exercise before data collection for the study began.

Content validity is difficult to assess because it deals with an unknowable sampling issue and the issue about the evaluation of the instrument itself (Cronbach, 1971). To ensure content validity of the scales, participants were selected based on individual ownership and usage of a smartphone. The selection represented, therefore, the concept about which generalizations can be made. The selected constructs came mainly from prior studies by Bhattacherjee (2001), Venkatesh et al. (2012), and Oliver (1980).

Construct Validity

Construct validity focuses on the instrument and establishes that the correlation between and among variables is correctly measured. Churchill and Lacobucci (2002)

were of the opinion that correlation among different variable is the most difficult construct to demonstrate. To overcome this hurdle, Bryman and Cramer (2005) posited that researchers should deduce hypotheses from a theory most relevant to the concept. Hypotheses for this study were drawn from the UTAUT (Venkatesh et al., 2012) and the ECT (Oliver, 1980). The major constructs from these theories, which have been consistently tested and validated, are as follows: PE, EE, FC, PV, and habit in relation to BI and CU of the technology, and user satisfaction.

Ethical Considerations

Ethical standards in research measures the moral fabric of the researcher and could affect validity and reliability of the research. Burton (2000) posited that ethical concerns are present in all research designs and go beyond data collection to include analysis and publication. The Internal Review Board of Walden University (IRB) provides the safety net for all research work conducted under the auspices of the university; it ensures that risks to participants are minimized and the integrity of the research not be compromised. It is in this spirit that all research work must be approved by the IRB, including this very study. As primary data were obtained through the survey, the survey for this study was made available to the school's ethics committee for approval before application. This research was presented for approval to the IRB in order to ensure that the study upheld all ethical standards: respect for persons, beneficence, and justice. Approval by the IRB was sought before any contact with participants was initiated. The consent form captured what participants were being asked, by whom, and for what purpose; risks and vulnerability were explained, as was the participants' right to

participate in the study or to decline participation, the right of review and withdrawal from the process, and dissemination (Seidman, 2013).

The first step in gathering information through a survey is to assure participants of the confidentiality of their personal details and the information supplied. This survey maintained strict secrecy about the identity of the participants; therefore, the data did not have any unique identifiers. This process was fulfilled through the cover letter of the survey. All information gathered with the survey was, is, and will be treated as confidential matter to prevent violation of the participants' privacy; in addition, the survey was designed not to probe into personal details such as names, addresses, or social security numbers. Access to the survey was limited to me and the statistician who helped with the data analysis.

Some of the critical issues considered in this study were privacy and confidentiality. The survey did not ask participants to disclose their identity and data from the survey was digitalized in order to ensure anonymity and confidentiality. As data are susceptible to theft, all digital files have been properly encrypted and strengthened with password protection. A secondary and tertiary back up of the digitalized data have been maintained. The secondary back up was the transfer of the data into an external hard drive; the tertiary back up saved the data in Google drive. The data shall remain protected and stored for a minimum of 5 years after completion of the study; then, the data will be safely disposed of. No monetary reward of any kind was offered to participants.

Summary

A quantitative cross-sectional method is discussed in this chapter. The chapter started with the research methodology and research design. The rationale for the choice of research design was discussed. The data collection instrument for the study, a survey, was shown to be constructed in three sections: Section A collected the participants demographic information; Sections B, C, and D tried to find answers to the research questions based on a 5-point Likert scale. The intention to use and continue to use a smartphone was measured through six constructs, and the users' perception on satisfaction and continued intention to use a smartphone was explored. The issue of reliability and validity of the research was also addressed in this chapter. I explained that internal and external validity of the study was enhanced through the use of Cronbach's alpha and the application of the widely reviewed and validated instrument by Oliver (1980) and Venkatesh et al. (2012). The target population, stratified random sampling, and recruitment strategies were described, as well as the use of Smart-PLS software for data analysis. This chapter also included various ethical issues in research and the importance of protecting the participants' rights and privacy. The following chapters present the results of the study. Conclusions are drawn based on the findings, and recommendations are offered for practical application and further research on the topic.

Chapter 4: Results

The purpose of this quantitative cross-sectional survey study was to examine the adoption behavior and the sociodevelopmental effect of smartphone acceptance among rural and urban residents of Nigeria. There were three components to the purpose: examining the difference, if any, between the orientation of rural and urban dwellers toward technology acceptance; exploring the pre- and postadoption behaviors of smartphone users with respect to intent to use and continued use of smartphones; and determining the potential sociodevelopmental influence of smartphone adoption in both groups. The theoretical framework consisted of the UTAUT-2 and the (ECT).

The research questions and alternative hypotheses for this study were as follows:

Research Question 1 (RQ1) - What is the relationship between performance expectancy and rural and urban adopters' intention to use smartphone technologies?

H_{a1}: Adopters locale will influence performance expectancy on intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

Research Question 2 (RQ2) - What is the relationship between social influence and rural and urban adopters' intention to use smartphone technologies?

H_{a2}: Adopters locale will affect social influence on intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

Research Question 3 (RQ3) - What is the relationship between price value and rural and urban adopters' intention to use smartphone technologies?

H_{a3}: Adopters locale will influence price value with respect to intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

Research Question 4 (RQ4) - What is the relationship between habit and rural and urban adopters' intention to use smartphone technologies?

H_{a4}: Adopters locale will influence their habit with respect to intention to use smartphones to the extent that the effect will be stronger among urban adopters than rural adopters.

Research Question 5 (RQ5) - What is the relationship between adopters' initial intention to use smartphone and the subsequent continued intention to use smartphones?

H_{a5}: There is a difference between adopters' initial intention to use a smartphones and the subsequent continued intention to use a smartphone.

Research Question 6 (RQ6) - What is the relationship between adopters' continued usage of smartphone and their satisfaction with their smartphones?

H_{a6}: Performance expectation with respect to smartphones will be positively related to rural and urban adopters' satisfaction with smartphones, and the level of expectation is not the same between the two groups of adopters.

Research Question 7 (RQ7) - What is the relationship between rural and urban dwellers' continued use of smartphones and their sociodevelopment status?

H_{a7}: Rural and urban dwellers' user satisfaction with smartphones will be positively related to continued intention to use the technology, and their sociodevelopment status will not the same among the adopters.

This chapter presents the results of the study. The first section describes the results of data collection, including the sample demographics and a description of the data. In the second section, I present the study results, including normality and reliability tests, the development of the measurement model, model fit, and hypothesis testing. A summary, including the answers to the research questions, concludes the chapter.

Data Collection

Data were collected over a period of 19 days in 2015. The survey instrument was distributed to 657 people, of whom 442 returned the survey, for a response rate of 67.28%. The appropriate sample size for this study with a confidence level of 95% and a margin of error 5% was 385 participants, according to the formula developed by Cochran (1963). Therefore, the final sample size is adequate to answer the research questions.

Sample Demographics

The majority of participants were men (53%). The largest age group was the 26-40 years group (47%), and the largest proportions of participants were educated at the HND/BSC level (49%; equivalent to an undergraduate degree in the United States). A large majority (85%) of participants were either salaried, self-employed, or students. Only 1% was unemployed. The sample was well distributed with regard to income, with 37% reporting monthly earnings between N11,000 and N50,000 (approximately USD $55–$250). However, there were many missing values for the survey question asking about income; this is perhaps attributable to the survey design, which did not provide a response for the range between N201,000 and N500,000. Table 5 summarizes the personal demographic characteristics for this sample.

Table 5

Sample Personal Demographics

Variable	*n*[a]	%[a]
Gender *n* = 418[a]		
Male	221	52.9
Female	197	47.1
Age *n* = 421		
18–25 years	162	38.5
26–30 years	71	16.9
31–35 years	81	19.2
36–40 years	48	11.4
41–45 years	30	7.1
46 or more years	29	6.9
Education level *n* = 403		
SCE	70	17.4
ND	89	22.1
HND/BSC	196	48.6
Master's	43	10.7
Doctoral	5	1.2
Location *n* = 442		
Rural	186	42.1
Urban	256	57.9
Occupation *n* = 415		
Professional salaried	157	37.9
Professional self employed	37	8.9
Student	158	38.1
Workman	25	6.0
Business	28	6.7
Unemployed	6	1.4
Farming	4	1.0
Income *n* = 368		
Less than N10,000	76	20.7
N11,000–N50,000	135	36.7
N51,000–N100,000	87	23.6
N101,000–N200,000	53	14.4
More than N500,000	17	4.6

[a] Total *n* varies because some respondents did not answer all the demographic questions.
[b] Percentages represent proportions of the respondents who answered the question.

Based on the results of the sample size calculations, presented in Chapter 3, it is clear that the actual sample is more evenly distributed between urban (57.9%) and rural (42.1%) dwellers. In the actual population of the regions from which the sample was drawn, only 12.7% of residents reside in rural areas (see Table 4). This indicates that the

sample for this study is not perfectly representative of the population of interest. However, owing to the even distribution of rural and urban residents, the sample allows the researcher to draw strong conclusions about the differences between urban and rural residents. This issue is discussed further in Chapter 5.

Data Descriptive Statistics

Ninety percent of participants reported owning a smartphone. Many participants reported using more than one service provider; this is usual in Nigeria, where poor reliability and network coverage induce many users to subscribe to multiple services. Indeed, the majority (65%) of participants reported owning more than one smartphone. The most commonly used service provider was MTN (49%), followed by GLO (28%), Etisalat (26%), and Airtel (23%). Most participants reported monthly spending of less than N2, 000 each on Internet and phone services. A plurality (37.6%) had owned smartphones for more than 3 years, and most (69%) reported using the Internet daily. The most commonly reported daily smartphone tasks were making and receiving calls, socializing on social networks, and sending and receiving SMS; 84%, 76%, and 74% of participants, respectively, reported using their smartphones daily for these purposes. The least frequently reported smartphone tasks were shopping online, checking the weather forecast, and navigation; 31%, 31%, and 33% of participants, respectively, reported never using their smartphones for these purposes. Tables 6 and 7 include a summary of the descriptive statistics related to smartphone and Internet use.

Table 6

Sample Smartphone and Internet Descriptive Statistics

Variable	n^a	%[b]		n^a	%[b]
Have a smartphone (*n* = 422)					
1.0 yes	378	89.6			
2.0 no	44	10.4			
Service Providers (*n* = 418)[c]					
GLO	118	28.2	Etisalat	107	25.5
MTN	206	49.3	Airtel	96	23.0
More than one phone (*n* = 413)					
Yes	270	65.4			
No	143	34.6			
Monthly spending on Internet usage (*n* = 411)					
Less than N1,000	112	27.3	N1,000 - N2,000	142	34.5
N2,000 - N3,000	74	18.0	N3,000 - N4,000	34	8.3
More than N4,000	49	11.9			
Monthly spending on voice services (*n* = 394)					
Less than N1,000	132	33.5	N1,000 - N2,000	128	32.5
N2,000 - N3,000	64	16.3	N3,000 - N4,000	34	8.6
More than N4,000	36	9.1			
Daily average time spent online (*n* = 416)					
Less than 30 minutes	80	19.2	30 - 60 minutes	103	24.8
1 – 2 hours	81	19.5	2 – 3 hours	54	13.0
More than 3 hours	98	23.5			
Years have had smartphones (*n* = 396)					
Less than 1 year	71	17.9	1 - 2 years	91	23.0
2 - 3 years	85	21.5	More than 3 years	149	37.6
How often do you use the Internet (*n* = 408)					
Daily	282	69.1	Twice/week	49	12.0
Weekly	33	8.1	Twice/month	23	5.7
Monthly	21	5.1			
Self-assessment about using the smartphone (*n* = 412)					
Excellent	121	29.4	Very good	136	33.0
Good	107	26.0	Fair	41	10.0
Poor	7	1.6			

[a] Total n varies because some participants did not answer all the demographic questions.
[b] Percentages represent proportions of the participants who answered the question.
[c] Participants could choose more than one provider.

Table 7

Frequency for Types of Smartphone Usage

Type of use	Many times/day	A few times/day	Once per day	Occasional	Never
Make and receive phone calls	204 (50.0)	142 (34.8)	24 (5.9)	37 (9.1)	1 (0.2)
Socialize on social networks	203 (49.8)	109 (26.7)	40 (9.8)	43 (10.5)	13 (3.2)
Browse the Internet	184 (45.4)	92 (22.8)	30 (7.4)	75 (18.5)	24 (5.9)
Download and listen to radio/music	138 (34.5)	88 (21.9)	40 (10.0)	98 (24.4)	37 (9.2)
Blogging or reading online forum	135 (33.8)	117 (29.3)	59 (14.8)	71 (17.8)	17 (4.3)
Taking photographs and download images	130 (32.1)	102 (25.2)	35 (8.6)	109 (26.9)	29 (7.2)
Send and receive SMS	123 (31.0)	169 (42.5)	30 (7.6)	69 (17.4)	6 (1.5)
Read news, books, magazines, or newspapers	118 (29.1)	129 (31.8)	58 (14.3)	74 (18.2)	27 (6.7)
Send and receive e-mail	94 (24.0)	91 (23.3)	40 (10.2)	125 (32.0)	41 (10.5)
Download and play games	78 (19.4)	96 (23.8)	42 (10.4)	134 (33.2)	53 (13.2)
Research/job search	69 (17.3)	74 (18.5)	56 (14.0)	130 (32.5)	71 (17.7)
Transfer and receive money	53 (13.3)	58 (14.6)	42 (10.6)	147 (36.9)	98 (24.6)
Pay bills with mobile banking	51 (13.1)	49 (12.7)	30 (7.8)	99 (25.6)	158 (40.8)
Advertising	46 (11.5)	65 (16.2)	65 (16.2)	93 (23.2)	132 (32.9)
Shop online	45 (11.5)	58 (14.8)	36 (9.2)	133 (33.9)	120 (30.6)
Weather forecast	35 (9.0)	54 (13.9)	52 (13.4)	126 (32.5)	121 (31.2)
Navigation	34 (9.0)	61 (16.1)	45 (11.9)	114 (30.2)	124 (32.8)

Note. Total *n* varies because some respondents did not answer all the questions. Numbers in cells are n(%)

Study Results

The independent and dependent variables (PE, SI, PV, habit, BI, CU, SAT, and socioeconomic growth) were measured by the questions in Sections B and C of the survey instrument (see Appendix C). The total score for each variable was calculated by

summing the responses to the items for each variable. All items were scores on a 5-point Likert scale ranging from strongly agree (1) to strongly disagree (5). The average response was calculated by dividing the variables total score by the number of items for that variable. Therefore, a low average response indicates that the participant has a high degree of agreement with positive statements about smartphones. For all responses, the means were around 2, indicating that the sample, on average, agreed with positive statements about smartphones. The lowest mean response was for performance expectancy ($M = 1.86$, $SD = .78$), and the highest mean response was for continued usage ($M = 2.57$, $SD = .64$).

Normality and Reliability

I calculated the skewness statistic to test for normality, which is one of the assumptions of multivariate analysis. If the skewness statistic has absolute values less than one, the distribution can be considered to be approximately normal and the data therefore suitable to multivariate analysis. All variables for this study had skewness values within the desired range, with the exception of performance expectancy, for which skewness was 1.18. Because this outlying skewness value approaches the desired range, and because all other variables were normally distributed, I proceeded with analysis.

I calculated the Cronbach's alpha statistic to test for reliability in each variable. All variables had reliabilities within the acceptable range ($\alpha > .6$), with the exception of continued usage, which had a low reliability score ($\alpha = .339$). Through further analysis, I determined that the reliability for continued usage increased to .621 if item 33 ("I intend to continue to patronize my current service provider(s)") was omitted from the

calculation. This can perhaps be explained by the fact that the wording of this item refers to continued use of particular providers, rather than of devices and technologies in general. Therefore, I considered Item 33 as a candidate for removal in the following analyses. Table 8 includes the variable descriptive statistics, along with normality and reliability results.

Table 8

Scale Descriptive Statistics, Normality, and Reliability

Scale	*n*	Min	Max	Mean	SD	Skew[a]	α[b]
Performance expect	377	1	5	1.86	0.78	1.183	.821
Intent to use	392	1	5	2.04	0.91	.855	.869
Satisfaction	384	1	5	2.05	0.72	.860	.812
SES growth	357	1	5	2.17	0.79	.880	.813[c]
Social influence	375	1	5	2.29	0.87	.641	.775
Price value	383	1	5	2.42	0.95	.592	.806
Habit	389	1	5	2.42	1.02	.519	.770
Expectation confirm	392	1	5	2.52	0.88	.402	.713
Continue usage	400	1	5	2.57	0.64	.141	.339[d]

Note. Total n varies because some participants did not answer all the questions
[a] Skew = skewness statistic used to determine if distribution is approximately normal.
[b] α = coefficient alpha for reliability.
[c] α decreases to .803 when Items #48 and #49 are eliminated.
[d] α increases to .621 when Item #33 is eliminated.

Measurement Model

Before testing the hypotheses, I developed the measurement model using exploratory factor analysis (EFA) with principal component calculations and the Varimax rotation. Using Kaiser's criterion (eigenvalue > 1), the EFA solution yielded an 8-factor solution, with the ninth factor (eigenvalue = .950) adding nearly 3% to the cumulative variance explained, such that the 9-factor solution explained 67.613% of the variance in the data. These nine factors were clearly interpretable using the variables of interest, with some exceptions (described later in this section). Additionally, constraining the result to seven or eight factors yielded solutions with problematic crossloadings and difficulty of interpretation. Therefore, the 9-factor solution was retained. Table 9 includes the eigenvalues and percentages explained by the nine factors. The pattern matrix is represented in Appendix A (see Table A1).

Table 9

Eigenvalues

Factor	Items	Initial Eigenvalues Total	% of Variance	Cumulative %
1	38–43	9.870	29.908	29.908
2	17–20	2.272	6.884	36.793
3	44–47	2.143	6.493	43.286
4	30–32	1.915	5.804	49.090
5	24–26, 37	1.547	4.689	53.779
6	21–23	1.347	4.081	57.860
7	27–29	1.206	3.655	61.515
8	34–36	1.063	3.221	64.735
9	33, 48–49	.950	2.878	67.613

Examining the factor loadings and interpretability of the EFA solution led to the removal of some problematic items. The items on factor 1 corresponded to the satisfaction scale, with the exception of item 38 (“Overall, most of my expectations of smartphone are confirmed”), which also demonstrated the lowest factor loading (.570). Therefore, item 38 was removed from the model. Factor 2 matched the performance expectancy scale, with no exceptions. Factor 3 contained items from the socioeconomic growth scale, but lacked items 48 and 49 from that scale. These two items loaded with problematic crossloadings on factors 1 and 9. Removing items 48 and 49 reduced the alpha reliability of the socioeconomic status variable to .801, which was still acceptable

(see Table 8); therefore, I removed Items 48 and 49 from the model. Factor 4 matched the behavioral intention to use scale. Items 24–26, on Factor 5, matched the price value scale. Item 37 also loaded on this factor, but with an unacceptably low loading (.419) and a problematic crossloading on Factor 1 (.411). Therefore, Item 37 was eliminated for further analysis. Factors 6 and 7 perfectly matched the social influence and habit scales, respectively. Two of the items loading on Factor 8 (34 and 35) corresponded to the continued usage variable. Item 36, on expectation confirmation, exhibited problematic crossloadings and was therefore removed from the analysis. Item 33, which did load positively on any factor, was removed from the expectation confirmation scale, increasing the alpha reliability of this variable to .621 and bringing it within the acceptable range. Finally, Factor 9 contained one negative crossloading (Item 33) and one item each from the continued usage (Item 48) and socioeconomic growth (Item 49) scales, all of which were removed as stated above.

In summary, five items were removed from analysis at the EFA stage: 33, 36-38, 48, and 49. This resulted in the complete elimination of the expectation confirmation variable. The resulting EFA solution was adequate and easily interpretable, indicating a measurement model fitting the data. I proceeded with the analysis using this model.

Model Fit

All hypotheses were tested using path analysis in Amos version 23. Using the measurement model developed using EFA, I built the model in Amos (see Figure 15).

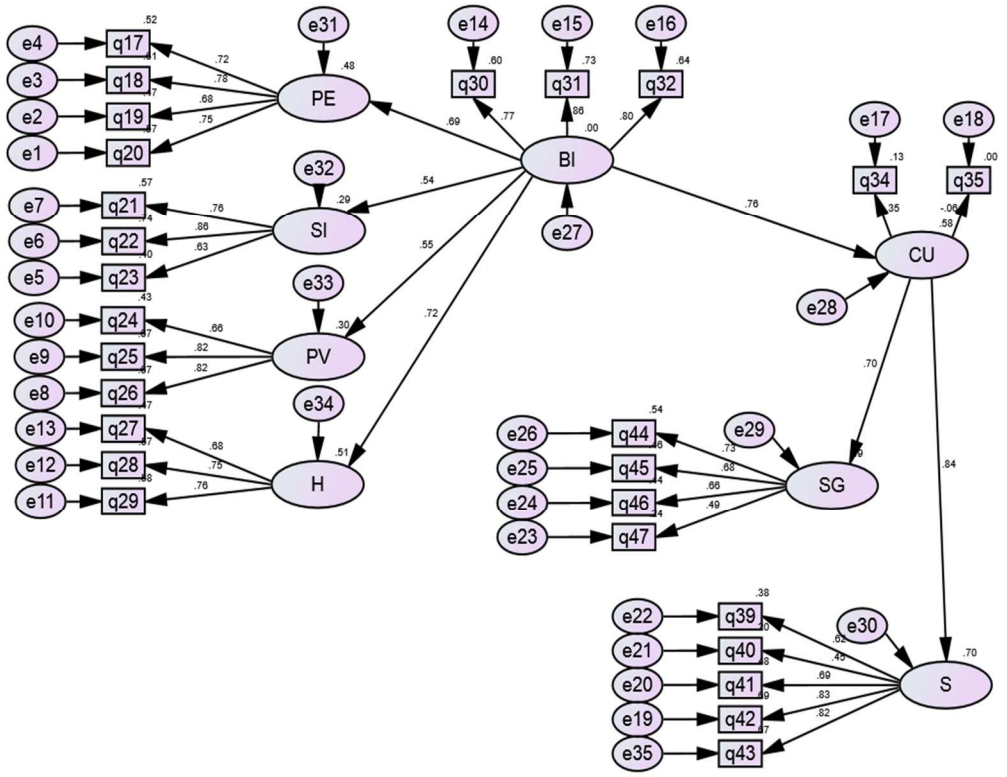

Figure 15. Final model.

Variables labeled q with a number (q1, q2, etc.) are the questions on the survey. Latent variables are SI: PV: H = Habit, BI: CU of Smartphone, SG = Socio-economic Growth, S = Satisfaction.

Model fit statistics were in the range of acceptability after employing covariances on intrafactor error terms, as suggested by modification indices. The model fit statistics were as follows: $\chi^2 = 742.042$; $df = 308$; IFI = .904; CFI = .903; RMSEA = .057. These are within or close to acceptability thresholds cited by Hair, Black, Babin, Anderson, and Tatham (2006). Additionally, all standardized regression weights therefore, I considered the model to be a good fit for the data and proceeded with hypothesis testing.

All standardized regression weights for the paths of interest to the study

hypotheses were large and significant, indicating significant positive relationships between the variables before considering moderators. See Table 10 for the regression weights.

Table 10

Standardized Regression Weights

Hy[a]	Dependent Variable	Independent Variable	Estimate	*p*
1	Perf expectancy	Behavioral intention	.690	***
2	Social influence	Behavioral intention	.539	***
3	Price value	Behavioral intention	.552	***
4	Habit	Behavioral intention	.716	***
5	Continued use	Behavioral intention	.761	***
6	Satisfaction	Continued use	.838	***
7	SES growth	Continued use	.697	***

[a] Hypothesis numbers
*** $p < .001$

Hypothesis Testing

For Research Questions 1–4, 6, and 7, I used Fisher's *z* test for differences between correlations to determine whether the relationships of interest were different between rural and urban dwellers. For Research Question 5, I used regression analysis to determine the regression weight and significance level of the hypothesized path. The following paragraphs present the results of each test in detail.

RQ1. This research question asked, "What is the relationship between

performance expectancy and rural and urban adopters' intention to use smartphone technologies?" The independent variable was performance expectancy. The dependent variable was intention to use. The grouping variable was location (rural, urban). Among both groups, there was a significant, positive relationship between performance expectancy and intention to use. This indicates that, as performance expectancy increases, intention to use also increases. Results of the *z* test ($z = 2.89$, $p = .002$) indicated that the relationship between performance expectancy and intention to use was significantly different for rural adopters ($r = .37$) and urban adopters ($r = .60$). Therefore, the null hypothesis was rejected (see Table 11).

RQ2. This research question asked, "What is the relationship between social influence and rural and urban adopters' intention to use smartphone technologies?" The independent variable was social influence. The dependent variable was intention to use. The grouping variable was location (rural, urban). Between both groups, there was a significant, positive, and small relationship between social influence and intention to use. This indicates that, as social influence increases, intention to use also increases. Results of the *z* test ($z = 1.02$, $p = .154$) indicated that the relationship between social influence and intention to use was not significantly different for rural adopters ($r = .36$) and urban adopters ($r = .45$). Therefore, the null hypothesis was not rejected (see Table 11).

RQ3. This research question asked, "What is the relationship between price value and rural and urban adopters' intention to use smartphone technologies?" The independent variable was price value. The dependent variable was intention to use. The grouping variable was location (rural, urban). Between both groups, there was a

significant, positive, and small relationship between price value and intention to use. This indicates that, as price value increases, intention to use also increases. Results of the *z* test ($z = .77$, $p = .221$) showed that the relationship between price value and intention to use was not significantly different for rural adopters ($r = .33$) and urban adopters ($r = .40$). Therefore, the null hypothesis was not rejected (see Table 11).

RQ4. This research question asked, "What is the relationship between habit and rural and urban adopters' intention to use smartphone technologies?" The independent variable was habit. The dependent variable was intention to use. The grouping variable was location (rural, urban). Between both groups, there was a significant, positive, and moderately large relationship between habit and intention to use. This indicates that, as habit increases, intention to use also increases. Results of the *z* test ($z = .53$, $p = .298$) showed that the relationship between habit and intention to use not significantly different for rural adopters ($r = .52$) and urban adopters ($r = .56$). Therefore, the null hypothesis was not rejected. Table 11 summarizes the results for research questions 1-4.

Table 11

Correlations of Intent to Use with Predictors Variables by Location

Predictor	RQ	Null rejected?	Rural	Urban	*z*	*p*
Performance Expectancy	1	Yes	.37	.60	2.89	.002
Social Influence	2	No	.36	.45	1.02	.154
Price Value	3	No	.33	.40	0.77	.221
Habit	4	No	.52	.56	0.53	.298

RQ5. This research question asked, "What is the relationship between adopters'

initial intention to use smartphone and the subsequent continued intention to use smartphones?" The independent variable is the intention to use. The dependent variable was continued usage. The result indicated that there was a significant, positive relationship between intention to use and continued usage ($\beta = .761$, $p < .001$; see Table 8). This indicates that, as intention to use increases, continued usage also increases. Therefore, the null hypothesis is rejected.

RQ6. This research question asked, "What is the relationship between adopters' continued usage of smartphone and their satisfaction with their smartphones?" The independent variable was continued usage. The dependent variable was satisfaction. The grouping variable was location (rural, urban). Between both groups, there was a significant, positive, and small relationship between satisfaction and continued usage. This indicates that, as satisfaction increases, continued usage also increases. Results of the z test ($z = .64$, $p = .261$) showed that the relationship between satisfaction and continued usage was not significantly different for rural adopters ($r = .31$) and urban adopters ($r = .31$). Therefore, the null hypothesis is not rejected. See Table 12.

RQ7. This research question asked, "What is the relationship between rural and urban dwellers' continued use of smartphones and their socioeconomic growth?" The independent variable was continued usage. The dependent variable was socioeconomic growth. The grouping variable was location (rural, urban). Among both groups, there was a significant, positive, and small relationship between socioeconomic growth and continued usage. This indicates that, as socioeconomic growth, continued usage also increases. Results of the z test ($z = 1.25$, $p = .106$) showed that the relationship between

socioeconomic growth and continued usage was not significantly different for rural adopters (r = .05) and urban adopters (r = .18). For this reason, the null hypothesis is not rejected. The results for research questions 5-7 are summarized in Table 12

Table 12

Correlations of Continued Usages with Socioeconomic Growth and Satisfaction by Location

Predictor	RQ	Null rejected?	Rural	Urban	*z*	*p*
Satisfaction	6	No	.31	.37	.64	.261
Socioeconomic Growth	7	No	.05	.18	1.25	.106

Summary

The data for all variables of interest were found to be normal and reliable. The result of EFA yielded a nine-factor solution, which was reduced to eight factors corresponding to the variables of interest (except expectation confirmation, which was eliminated). After removing five nonperforming items, the model fit the data well. Results of the hypothesis tests resulted in the rejection of null hypotheses associated with RQ 1 and 5. The remaining null hypotheses could not be rejected on the basis of the results. Therefore, the answers to the research questions are as follows:

RQ1: What is the relationship between performance expectancy and rural and urban adopters' intention to use smartphone technologies? Adopters' locale influences the effect of performance expectancy on intention to use smartphones to the extent that the effect is stronger among urban adopters than rural adopters.

RQ2: What is the relationship between social influence and rural and urban adopters' intention to use smartphone technologies? Adopters' locale does not significantly influence the effect of social influence on intention to use smartphones.

RQ3: What is the relationship between price value and rural and urban adopters' intention to use smartphone technologies? Adopters' locale does not significantly influence the effect of price value on intention to use smartphones.

RQ4: What is the relationship between habit and rural and urban adopters' intention to use smartphone technologies? Adopters' locale does not significantly influence the effect of habit on intention to use smartphones.

RQ5: What is the relationship between adopters' initial intention to use smartphone and the subsequent continued intention to use smartphones? There is a positive relationship between adopters' initial intention to use a smartphones and the subsequent continued intention to use a smartphone.

RQ6: What is the relationship between adopters' continued usage of smartphone and their satisfaction with their smartphones? Adopters' locale does not significantly influence the effect of satisfaction on intention to use smartphones.

RQ7: What is the relationship between rural and urban dwellers' continued use of smartphones and their sociodevelopment status? Adopters' locale does not significantly influence the effect of socioeconomic growth on intention to use smartphones.

This chapter presented the results of the study, including the normality and reliability tests, measurement model development, model fit, and statistical tests. In the next chapter, I discuss the results of the study. Chapter 5 includes an interpretation of the

findings, a description of the limitations of the study, recommendations, implications, and the conclusions of the study.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this quantitative cross-sectional survey study was to examine the adoption behavior and the sociodevelopmental effect of smartphone acceptance among rural and urban residents of Nigeria. There were three components to the purpose: examining the difference, if any, between the orientation of rural and urban dwellers toward technology acceptance; exploring the pre- and postadoption behaviors of smartphone users with respect to intent to use and continued use of smartphones; and determining the potential sociodevelopmental impact of smartphone adoption in both groups. The theoretical framework consisted of the UTAUT-2 and the ECT.

Results indicated that the positive relationship between performance expectancy on intention to use smartphones was stronger among urban dwellers than among rural dwellers. Additionally, I found that there was a significant positive relationship between adopters' initial intention to use a smartphones and the subsequent continued intention to use a smartphone. No further significant relationships were uncovered. In this chapter, I interpret and discuss the findings, describe the limitations of the study, provide recommendations and implications, and conclude the study.

Interpretation of Findings

In this study, results revealed that urban and rural smartphone users differed significantly with respect to only one of the relationships tested: that between, PE and BI to use smartphones. PE refers to the degree to which users believe that using technologies (in this case, Internet-enabled devices like smartphones) will improve their performance. Therefore, this result indicates that urban dwellers believe smartphones will improve their

lives subsequently intend to use their smartphones more often than rural dwellers with the same level of PE . Venkatesh et al. (2012) argued that users will consider PE in making decisions about whether to use technologies, and the finding of this study, regardless of user locale, supports this argument.

Regarding the moderating effect of locale, there are several possible explanations for this finding. Apulu, Latham, and Moreton (2011) argued that diffusion of mobile technology was happening rapidly in African cities, but it was extended to rural areas only because of the need to expand the customer base. This could suggest that there is less demand for smartphones overall among rural Nigerians than among their urban-dwelling counterparts. However, if this were the case, one would expect there to be a significant moderating effect from locale with respect to other relationships, which the results of this study did not reveal. Therefore, another explanation is needed.

Several research teams focusing on African nations have stressed the importance of existing social structures in determining usage patterns for communication technologies (Carmody, 2010; Jentzsch, 2012; Sife et al., 2010). In particular, Carmody (2010) argued that technology is embedded in existing social relations of support, resource extraction, and conflict. This suggests that, even if rural dwellers perceive that mobile technologies could be useful in enhancing their performance, their intent to use such technologies could fail to increase accordingly if the social structures in place for smartphone use are not as developed as in urban areas. Conversely, the relationship could be stronger among urban dwellers because social and cultural norms are more favorable toward smartphone use. Because there is so little existing research on the use of

smartphones and mobile technologies in rural Nigeria, further research is required to confirm this supposition.

The finding related to socioeconomic growth to some extent contradicts the claims of Smith et al. (2011), who believed that the benefits from mobile technology adoption might be proportionately greater in resource-constrained settings such as rural areas when compared with urban areas. According to the results related to RQ7, intention to use smartphones is only slightly positively associated with socioeconomic growth, and the effect was not stronger among rural respondents. The Smith et al. argument would lead one to expect that socioeconomic growth among smartphone users should be greater in rural settings, but this study disconfirms that notion. Therefore, the Smith et al. argument is in question.

Furthermore, the body of literature related to the economics of mobile phone use in sub-Saharan Africa has suggested that mobile technology leads to improved business performance, information access, and marketing access (Duncombe, 2012), and that therefore mobile phones supported livelihoods in this region (Chavula, 2013; Hellstrom, 2010; Margaux, 2013; Mason, 2013). This study; however, suggests that, even if mobile technologies support individuals' livelihoods in the form of socioeconomic growth, this support is not greater for rural than for urban dwellers. Indeed, the positive effect of smartphone use on socioeconomic growth may be, in general, rather small. This is an important finding from the perspective of rural development and international aid, because it indicates that smartphone availability may not lead to great gains in socioeconomic development in rural areas, and therefore investment in mobile

technologies as a development strategy is brought into question. Although mobile technologies appear to be useful for socioeconomic growth, it remains to be determined whether investment in such technologies delivers adequate returns to adopters. As mobile technologies become more and more common, the comparative economic advantage they generate on the individual level may exhibit diminishing returns.

Another possible explanation of the finding related to RQ7 was articulated by Diga's (2007) study in the Wakiso District of Uganda, which revealed that the women were willing to forgo store-bought items in order to purchase mobile phones and recharge credits. This suggests that rural and low-income individuals may give up other resources in order to afford mobile technologies. If so, rural dwellers may not experience the full economic gain theoretically possible from smartphone use, since this gain could be counteracted by losses in terms of foregone resources. This study did not examine the effect of income on the relationship between smartphone use and socioeconomic growth, so further research would be required to confirm or disconfirm this supposition.

The study also revealed that intention to use and continued usage are strongly positively correlated. This sheds light on the usefulness of studying intent to use as a measure of the success of smartphones and other technologies. Bhattacherjee (2001) argued that continued usage was more important for studying innovations than intent to use. However, this study demonstrates that the two variables are closely related, indicating that it remains appropriate to study intent to use as a measure of the success of technology products. This is also consistent with the technology acceptance model, which served as part of the theoretical framework for this study.

Limitations of the Study

This study suffers from certain limitations, and any interpretation of the findings should take the limitations into account. First, the cross-sectional approach made it impossible to assess participants' behaviors over time. This limitation is to some extent ameliorated by the inclusion of both initial and continued intent to use measures. However, actual use and continued use over time cannot be assessed using the data collected for this study. Longitudinal studies would be required to empirically confirm any conclusions regarding long-term smartphone use and other behaviors.

Second, owing to cultural and economic differences, the results of this study are not generalizable beyond the region of sub-Saharan Africa, and the results may not be relevant to smartphone users outside that region. Third, the distribution of rural and urban dwellers, though it exceeded the desired sample size for the study and was equally distributed, did not reflect the actual distribution of rural and urban residents in the areas of Lagos under study. This indicates that the results may not be perfectly representative of this area; however, owing to the strong sample size, I expect that the results are sufficiently representative to draw strong conclusions.

Recommendations

Several directions for future research emerge clearly from the results of the present study. First, the general lack of significant differences between urban and rural Nigerians with respect to mobile phone use contradicts arguments and hypotheses forwarded by scholars in the past, for example, Smith et al. (2011). However, it is not yet possible to explain this finding, owing to the lack of research on smartphone use among

rural Nigerians. Therefore, smartphone use in this population needs to be explored further. In particular, the present study raises the following questions, which are recommended for future research:

1. When considered longitudinally, what is the effect of smartphone adoption on the economic situation among rural Nigerians?
2. To what extent do urban and rural Nigerians forego other purchases in order to support smartphone purchases and services? Do these foregone resources significantly affect Nigerians' socioeconomic growth? If so, could smartphone use be economically detrimental among low-income populations?
3. Do different smartphone uses (e.g., surfing the internet, using mobile banking) result in different socioeconomic growth results among rural and urban Nigerians?
4. Does investment in diffusing mobile technologies to rural areas yield adequate returns in terms of socioeconomic development? If so, what are the factors that support these returns and factors that hinder them?

In addition, this study indicated that, among this research sample, there was a strong relationship between original intent to use smartphones and continued usage. However, because this was a cross-sectional study, it is not clear whether this correlation translates into actual use. In order to further address the adequacy of cross-sectional intent to use as a measure of innovation success in Nigeria, future researchers should design studies addressing the following question: To what extent is cross-sectional continued usage correlated with actual continued usage in a longitudinal study?

Next, future research should examine the extent to which individual socioeconomic development resulting from smartphone use translates to broad improvements in socioeconomic development at the regional and national levels. Such research would contribute an understanding of the degree of importance of smartphone diffusion to the broader progress of Nigeria. Finally, the body of research literature would benefit from future studies replicating this study, both longitudinally and in other parts of sub-Saharan Africa. Such studies would serve to enhance our understanding of the effect of smartphone technology diffusion in Africa, and its role in the continued economic development of these regions.

Implications

The study has some important implications for positive social change. First, the information on the frequency of different types of cell phone use among Nigerians (see Table 7) may be useful to organizations hoping to provide useful services or empower the public to make use of technology. In particular, these statistics demonstrate that online shopping and advertising are underused functions of smartphone technology in Nigeria. Both businesses and nonprofit groups could therefore use this information to educate business owners and individuals regarding these potentially socioeconomic-status-enhancing smartphone uses. Additionally, this study could provide information to service providers and regulations that could help improve mobile communication services in urban and rural areas of Nigeria. Service providers, seeing the overall low degree of difference between urban and rural users with respect to smartphone use, could increase investment in mobile infrastructure, improving smartphone access in rural Nigeria. This,

in turn, could enable more rural-dwelling Nigerians to make use of smartphones to improve their lives.

The completion of this study facilitates further discourse in the field of diffusion of innovation, particularly the growing field of smartphone mobile technologies in Africa. Proper use of mobile technologies for social development is of national concern, and findings from this study could benefit government at various levels. The study outcomes may deepen regulators' understanding of the relationship between mobile phone diffusion and sociodevelopmental growth. The results may deepen service providers' understanding of the relationship between intent to use smartphones and a variety of factors. Furthermore, the research outcome may be a useful tool in the reevaluation of national policies on communication technology development and assist governmental agencies in policy formulations that enhance millennium development goals and strategies.

Conclusions

The number of mobile phones in use in Africa increased from less than 25 million in 2001 to 650 million in 2013 (Parr, 2013), indicating a social and economic change the effects of which are still not understood. Alarmingly few research studies exist regarding the use of mobile phones in Africa generally, and in rural Nigeria in particular. Therefore, it is unknown how this society-altering technology is contributing to or detracting from the country's social goals. This study has taken an important step forward in addressing this gap by investigating the degree to which smartphone use differs between rural and urban Nigerians. Results revealed few differences related to locale; in particular, intent to

use smartphones did not result in greater socioeconomic gains among rural dwellers, as the work of previous scholars would have suggested.

Given the outstanding problems with basic infrastructure in Africa—only 29% of roads are paved and barely a quarter of the population has access to electricity (ITU, 2012; World Bank, 2008)—the findings of this study sharply call into question continued investment in mobile technology diffusion and infrastructure. Access to mobile telephony in sub-Saharan Africa continues to increase dramatically, while infrastructure problems continue. If, as the results of this study suggest, access to mobile phones leads to only marginal gains in socioeconomic status among rural Africans, perhaps it is time for businesses, nonprofit organizations, and governments to consider whether investment in mobile technology is having the desired effect.

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Appendix A: Approval Letter for Instrument use

Permission to Adapt Survey Instrument

Original E-Mail:Viswanath Venkatesh <vvenkatesh@vvenkatesh.us> 12/11/14

to me

Thanks for your interest. You have my permission.

You will find other related papers at:
http://vvenkatesh.com/Downloads/Papers/fulltext/downloadpapers.htm

You may also find my book (that can be purchased for a significant student discount and faculty member discount) to be of use: http://vvenkatesh.com/book

Hope this helps.

Sincerely,
Viswanath Venkatesh
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From: Olukunle Iyanda [mailto:olukunle.iyanda@waldenu.edu]
Sent: Thursday, December 11, 2014 9:11 AM
To:vvenkatesh@vvenkatesh.us; jthong@ust.ht; xin.xu@polyu.edu.hk
Subject: REQUEST AND PERMISSION FOR ADOPTION OF RESEARCH TOOL AND MODEL

Sir,
I write to request for the research tool UTAUT2 adopted in your work on Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. Venkatesh, V., J. Y. Thong, and X. Xu (2012). I am interested in this tool because it has been widely reviewed,

testedand accepted.

My name is Olukunle Ariyo Iyanda. I am a PhD student at Walden University, and my work bothers on Information Management System. My research topic is: *Technology leapfrogging, Innovation Diffusion of Smartphone in Nigeria*.

The research is a comparative study that examines the major purpose of the study in three folds: examination of the correlation in the orientation of urban and rural dwellers toward technology acceptance; explore the pre and postadoption behavior of Smartphone users in respect to the intention to use and the continued usage of Smartphone technologies; and determine the socio-economic impact of Smartphone adoption on the two adopters.

I intend to combine this research instrument with Oliver's work on Expectation Confirmation Theory (ECT). I would also appreciate the permission to use the model UTAUT2 in my literature review.

I look forward to a positive response, as it would help me greatly in the progress of my work.

Regards.

Olukunle Iyanda.

xu, xin [MM] <xin.xu@polyu.edu.hk> 12/12/14

to me

Dear Olukunle,

Yes, please cite and integrate our work properly.

Best,
Xu Xin

Olukunle Iyanda <olukunle.iyanda@waldenu.edu> 12/12/14

toxin

Dr Xu,
Thanks for the approval,

Olukunle Iyanda

Appendix B: Survey

Please mark the answer that is most appropriate for you.

Section A

1. What is your age?

__ 18-25 years__ 26-30 years __ 31-35 years

__ 36-40 years __ 41-45 years __ 46 and above

2. What is your gender?

__ Male __ Female

3. State your location: _____

4. (a) Do you have a smartphone? __ Yes __ No

(b) Who is your service provider? __Glo __MTN__Etisalat __Airtel

5. (a) Do you have more than one phone? __ Yes __ No

(b) Who is your service provider? __Glo __MTN __Etisalat __Airtel

(c) Why do you have more than one phone? _____

6. What is your level of education? __SSCE __ND __HND/BSC

__Master's Degree __Doctoral Degree

7. What is you occupation? __Professional salaried __ Professional self employed

__ Student __Workman __ Business __ Unemployed __ Farming

8. What is your monthly income?

__Less than N10,000 __ N11,000-N50,000__ N51,000-N 100,000

__ N101,000-N200,000 __ above N500,000

9. How much do you spend per month on Internet usage?

__ Less than N1,000 n __ N1,000-N2,000 __ N2,000-N3,000

__ N3,000-N4,000 __ above N4,000

10. What is your monthly spending on Voice services?

__ Less than N1,000 __ N1,000-N2,000 __ N2,000-N3,000

__ N3,000-N4000 __ Above N4,000

11. What is the daily average time you spend online?

__Less than 30minutes __30-60minutes __1-2 hours

__2-3 hours __more than 3hours

12. How long have you had smartphones (in years)?
Please √ only one answer

__ Less than 1 year __1-2 years __2-3 years __more than 3 years

13. At present, overall how often do you use the Internet?

__Daily __ Twice per Week __ Weekly __ Twice per month

__ Monthly

14. What is your self-assessment about using the smartphone?

__ Excellent __ Very Good __ Good __ Fair __ Poor

15. Please choose your usage frequency for each of the following:
Fill in the appropriate circle

	Many times per day	A few times per day	Once per day	Occasionally	Never
Make and receive phone calls	O	O	O	O	O
Send and receive SMS	O	O	O	O	O
Blogging or reading online forum	O	O	O	O	O
Socialize on social network, e.g., BBM, Whatsapp, Facebook, or other	O	O	O	O	O
Read news, books, magazine or newspaper	O	O	O	O	O
Advertising	O	O	O	O	O
Transfer and receive money	O	O	O	O	O
Research/job search	O	O	O	O	O
Send and receive e-mail	O	O	O	O	O
Pay bills with mobile banking	O	O	O	O	O
Navigation	O	O	O	O	O
Download and playing games	O	O	O	O	O
Internet browsing	O	O	O	O	O
Weather forecast	O	O	O	O	O
Shop online	O	O	O	O	O
Taking photographs and download images	O	O	O	O	O
Download and listen to radio/music	O	O	O	O	O

16. (a) Do you use the smartphone for other things? __Yes __No

(b) If yes, please describe _____

Section B

Answer key: SA = *strongly agree;* A =*agree;*NS = *not sure;* D = *disagree;* SD = *strongly disagree*

Question	Performance Expectancy and Expectation	SA	A	NS	D	SD
17	I find smartphone useful in my daily life.	O	O	O	O	O
18	Using 4G smartphone increases my chances of achieving things that are important to me.	O	O	O	O	O
19	Using mobile Internet helps me to accomplish things more quickly.	O	O	O	O	O
20	Using smartphone increases my productivity.	O	O	O	O	O
	Social Influence					
21	People who are important to me think I should use smartphone.	O	O	O	O	O
22	People who influence my behavior think I should use smartphone.	O	O	O	O	O
23	People whose opinion I value prefer that I use smartphone.	O	O	O	O	O
	Price Value					
24	Smartphone is reasonably priced.	O	O	O	O	O
25	Smartphone mobile service is a good value for the money.	O	O	O	O	O
26	At the current price, smartphone provides a good value.	O	O	O	O	O
	Habit					
27	The use of a mobile phone has become a habit with me.	O	O	O	O	O
28	I am addicted to using mobile Internet.	O	O	O	O	O
29	I must use smartphone.	O	O	O	O	O

Section C: BEHAVIORAL INTENTION, CONTINUED USAGE, AND SATISFACTION

Question	**BEHAVIORAL INTENTION TO USE**	**SA**	**A**	**NS**	**D**	**SD**
30	I intend to continue using of smartphone in the future.	O	O	O	O	O
31	I will always try to use smartphone in my daily life.	O	O	O	O	O
32	I plan to continue to use smartphone.	O	O	O	O	O

Question	CONTINUED USAGE OF SMARTPHONE	SA	A	NS	D	SD
33	I intend to continue to patronize my current service provider(s).	O	O	O	O	O
34	I intend to continue to use smartphone rather than another alternative (laptop, desktop, or tablets) for Internet browsing.	O	O	O	O	O
35	If I could, I would like to discontinue my use of these mobile services.	O	O	O	O	O
	EXPECTATION CONFIRMATION					
36	My experience with using smartphone is better than what I expected.	O	O	O	O	O
37	The service level of my network provider is better than I expected.	O	O	O	O	O
38	Overall, most of my expectations of smartphone are confirmed.	O	O	O	O	O
	SATISFACTION					
39	I am very satisfied with using my smartphone.	O	O	O	O	O
40	I feel content about using my mobile services.	O	O	O	O	O
41	It was a wise choice to have a smartphone.	O	O	O	O	O
42	Compared to my initial expectation, using smartphone increased my productivity.	O	O	O	O	O
43	Compared to my initial expectation, using smartphone enhanced my effectiveness.	O	O	O	O	O

Section D: SOCIODEVELOPMENT, GROWTH, AND SATISFACTION

Question	SOCIOECONOMIC GROWTH	SA	A	NS	D	SD
44	Usage of smartphone has helped my business to grow.	O	O	O	O	O
45	I use smartphone to search and get a job.	O	O	O	O	O
46	Smartphone has advanced my career progress.	O	O	O	O	O
47	Smartphone helps me to get more client/customers.	O	O	O	O	O
48	It helps my work or studies.	O	O	O	O	O
49	Smartphone brings me into contact with more people.	O	O	O	O	O

Note. Answer key: SA = *strongly agree*; A = *agree*; NS = *not sure*; D = *disagree*; SD = *strongly disagree*.

THANK YOU

Appendix C: Exploratory Factor Analysis Solution

Table A1

Factor Analysis: Varimax Rotated Factor Matrix

Item	1[a]	2	3	4	5	6	7	8	9
q41	.759								
q40	.752								
q39	.624								
q42	.593								
q43	.587								
q38	.570								
q18		.784							
q20		.717							
q17		.694							
q19		.678							
q47			.828						
q45			.741						
q46			.718						
q44			.718						
q32				.808					
q31				.799					
q30				.701					
q25					.765				
q26					.713				
q24					.692				
q37	.411				.419				
q22						.841			
q21						.746			
q23						.717			
q28							.818		
q29							.712		
q27							.647		
q35								-.713	
q34								.685	
q36					.409			.473	
q33									-.662
q48	.404								.592
q49	.400								.443

Note. Kaiser-Meyer-Olkin Measure of Sampling Adequacy = .880, Bartlett's Test of Sphericity χ^2 (df =528), p = .000. Gray rows represent items removed from the analysis.
[a]1 = Satisfaction, 2 = Performance Expectancy, 3 = Socioeconomic Growth, 4 = Behavioral Intentions, 5 = Price Value, 6 = Social Influence, 7 = Habit, 8 = Continued Usage, 9 = Mixed (all items removed)