An investigation on the adoption and diffusion of mobile applications in Africa

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Declaration

I hereby declare that the study entitled ***An investigation into the adoption and diffusion of mobile applications in Africa***, which I am submitting to North-West University, Potchefstroom Campus, is in compliance / partial compliance with the requirements laid down for the degree: is my own work, has been worded in accordance with the requirements.

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Chinedu Wilfred Okonkwo

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Finally, I would like to thank all those who have participated in making this study a great success in one way or another.

Dedication

I dedicate this thesis to Almighty God, for He is the one who gives the wisdom, knowledge and understanding through which this work has been accomplished (Proverbs 2:6), my wife Ngozi Peace Okonkwo and my children Somtochukwu and Chidubem for their backing, endurance and prayers which make this study possible.

Abstract

In recent years, the emergence of various kinds of mobile application (mobile app) has become noticeable across Africa. Many people are using mobile apps in their everyday activities. The penetration of mobile apps services in Africa is unprecedented and mobile services have changed the way business and personal interactions are conducted. The introduction of mobile devices, such as mobile phones, personal digital assistants, computers, etc., has triggered the development of various kinds of mobile app. It is a common belief that an owner of a mobile device is also an adopter and user of mobile apps. As African societies are embracing mobile services, a large number of mobile apps are being developed with high local content to facilitate various activities in education, the health care system, commerce, government, and agriculture. The global economic development, and in particular on the African continent, is propelled mainly by the mobile technologies. Many mobile technology start-ups have been established to boost the adoption and diffusion of mobile apps innovation in Africa. As a result, large populations of Africa are connected to digital communications. The constant growth of mobile services in Africa is influenced by some underlying factors which determine the adopters' perceptions of mobile apps and affect their attitudes in decision making either to adopt or reject the mobile apps. Despite the increasing penetration of mobile devices and the rapid growth of mobile apps adoption and diffusion, there are also the rejection and discontinuance of the use of some mobile apps. In addition, a reasonable number of African populations are non-adopters of mobile apps. Therefore, the underlying factors and how mobile apps are adopted and diffused in Africa are not clearly defined or known.

The primary purpose of this study is to investigate the adoption and diffusion of mobile apps in Africa to determine how mobile apps are adopted and used in the African social system. Five countries were selected from the five geographical locations in Africa, including South Africa (South), Nigeria (West), Morocco (North), Kenya (East), and the Democratic Republic of Congo (Central). The Diffusion of Innovation Theory was used as the theoretical basis for the research. To achieve the study purpose, a detailed literature review regarding mobile apps adoption and diffusion, especially in Africa was conducted. The adoption and diffusion of mobile apps in the selected countries were empirically examined and compared. This research required quantitative data, thus the positivist research paradigm was applied. Through a survey and using a questionnaire as the instrument for data collection, the opinions of the participants from the five selected countries were gathered. A total of 1 285 out of 2 300 questionnaires distributed were returned, giving a response rate of 55.87%. The obtained data were analysed with different statistical data analysis methods to achieve the required results. Some of these findings include the significant features, the reasons for the discontinuance and rejection, sources of information, ways of dissemination of information, adopters' categories, and the adopters' attitudes regarding the adoption and diffusion of mobile apps. In addition, the effect of mobile apps and the predicting factors of mobile apps adoption and diffusion in Africa were among the findings. Finally, a framework for the successful adoption and diffusion of mobile apps in Africa was proposed. The findings of this study will be of interest to the body of knowledge, innovators and industries or organisations.

Keywords: Mobile apps, Adoption and Diffusion, Adopter's attitudes, Perceptions, Features of mobile apps, Predicting factors, Social system, Framework

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Acronyms

AMO	-	Africa Mobile Operator
ASP	-	Average selling price
DIT	-	Diffusion of Innovation Theory
ECT	-	Expectation Confirmation Theory
GDP	-	Gross domestic product
GPRS	-	General packet radio services
GUI	-	Graphic user interface
HCI	-	Human communication interface
ICT	-	Information and communication technology
iDEA	-	Information technology developers entrepreneurship accelerator
NGO	-	Non-profit organisations
MMS	-	Multimedia messaging services
MNO	-	Mobile network operator
OLT	-	Ovi life tools
PIN	-	Personal identification number
SAP	-	Systems application and products
SCT	-	Social Cognitive Theory
SMS	-	Short message services
TRA	-	The theory of reasoned action
TAM	-	Technology acceptance model
TPB	-	Theory of planned behaviour
USSD	-	Unstructured supplementary service data
UTAUT	-	Unified theory of acceptance and use of technology
WAP	-	Wireless applications protocol

Chapter 1

Introduction to the study

1.1 Introduction

This research involves investigating the adoption and diffusion of mobile apps in Africa using the diffusion of the theory of innovation. Consequently, the research question investigated by the researcher is: "How are mobile apps adopted and used in Africa?" The research includes different geographical locations in Africa, including south (South Africa), north (Egypt), west (Nigeria), east (Kenya) and central (Democratic Republic of Congo). The study entails a literature study on the following topics: description of mobile apps, evolution and development of mobile technology in Africa, the African mobile ecosystem, classification of mobile apps, mobile apps enabling innovation, mobile apps enabling digital inclusion, contribution of mobile apps to the development of Africa, factors that determine the acceptance of mobile applications, and adoption and diffusion of mobile apps in the selected countries. The study includes an empirical study and data from the sample population in the selected African countries were collected.

In Africa, mobile apps development is growing fast and many mobile apps are being developed in the mobile technologies market (Lule *et al.*, 2012). The rate of adoption and diffusion of mobile devices, such as smartphones is increasing significantly in Africa, and this motivates mobile apps innovation (GSMA, 2015a). The innovation has gained widespread acceptance which results in technological changes both in developed and developing countries of the world, including having an impact on educational technology (El-Hussein & Cronje, 2010), health care, farming, banking, and information gathering (Murugesan, 2013).

It is important to information and communication technology practitioners and researchers to understand the diffusion of information technologies (Nickerson *et al.*, 2014). This can be accomplished through a study of adoption and diffusion, which means acceptance into use

(Rogers, 2003, Lule *et al.*, 2012, GSMA, 2015a) and continuance of use of a new innovation (Taylor *et al.*, 2011, Rogers *et al.*, 2014).

The framework used in this study is the Diffusion of Innovation Theory or framework proposed by Rogers (Rogers, 2003). This framework has been applied to different studies across several disciplines, including information technology, marketing, education, sociology and economics. The concept of innovation is linked to new products, practice, methods, ideas, services, and inventions. Hence, the diffusion of innovation theory seems to be suitable in explaining the adoption and diffusion of mobile applications in the social system (Chang, 2010). African software developers are creating numerous mobile apps (Murugesan, 2013) and the mobile apps market is expanding, but there is little knowledge about the adoption of mobile apps (Lule *et al.*, 2012). As stated by Nickerson *et al.* (2014), "Mobile technologies and apps are innovative and worthy of study within the framework of diffusion of innovations theory."

In this study, the researcher took a closer look at the adoption and diffusion of mobile apps innovation in Africa. The use of mobile applications spread rapidly across the African continent. Many individuals, organisations and governments have developed their respective mobile apps to aid their activities towards the enhancement of their services. This fast and widespreading innovation ("mobile applications innovation") will be measured to obtain the participants' behaviour in the adopter's category of the diffusion of innovation theory.

In this chapter, the problem statement is introduced in section 1.1, followed by the problem statement in section 1.2, background information in section 1.3, definition of terms in section 1.4, research aims and objectives in section 1.5, research approach in section 1.6, research paradigm in section 1.7, data collection in section 1.8, data analysis in section 1.9, expected contribution of the study in section 1.10, structure of the thesis in section 1.11, ethical considerations in section 1.12, and chapter summary in section 1.13.

1.2 Problem statement

There is significant growth in the adoption and diffusion of mobile apps in Africa. The introduction of mobile devices, such as mobile phones, personal digital assistants, computers, etc., has triggered the development of different types of mobile app that are being used in various activities (Hellström & Troften, 2010; Murugesan, 2013; GSMA, 2015) Many mobile technology start-ups have been established across Africa to encourage/boost mobile apps innovations (Nickerson *et al*., 2014; GSMA, 2015). The advancement in digital technology has improved communication systems in Africa; as a result, there is an increasing number of African populations being connected to digital communications. (Van Zyl, 2013, Lee *et al.*, 2011b). The adoption and diffusion of mobile apps are transforming the African world, socially, economically and politically. (Shaikh & Karjaluoto, 2015, Qiang *et al.*, 2011, Murugesan, 2013, Kearney, 2011, Hellström & Tröften, 2010, Beger *et al.*, 2012). Despite the increasing penetration of mobile devices and the rapid growth of mobile apps adoption and diffusion, there are rejection and discontinuance of the use of some mobile apps. Some of the African populations are also non-adopters of mobile apps. Therefore, how mobile apps are adopted and diffused in Africa is not clearly defined or known.

There are a number of studies on mobile apps in Africa mostly concerning the usage of mobile apps (Bankole, 2011; Mtega, 2012; Forrest, 2015), the contribution of mobile apps to African development (Aker, 2010; Asongu, 2016) and factors that affect the adoption of mobile apps (Cudjoe, 2015; Brown, 2015; Achieng, 2015). However, these studies are fragmented and focus on individual aspects of the adoption and diffusion process of mobile apps. There is a scarcity of research on the complete process of how mobile apps are being adopted and diffused in Africa. Hence, there is a need for an investigation on adoption and diffusion of mobile apps in Africa. This study investigates the adoption and diffusion of mobile apps in selected countries of Africa using Rogers' diffusion of innovation theory. The Diffusion of Innovation theory aids in describing the adoption procedure of an innovation by modelling the whole process according to the aspects of communications and human information relations. The diffusion theory offers valued perceptions into the access, acceptance, circulation, and usage of mobile apps (Chang, 2010).

Studying the adoption and diffusion of mobile apps innovation in Africa has been chosen for several reasons:

1. From the review of research reports, there is a lack of research on the complete adoption and diffusion process of mobile apps in Africa (Chang, 2010).

2. Africa as developing region is experiencing rapid growth in the development and usage of mobile apps (Hellström & Troften, 2010; Murugesan, 2013; GSMA, 2015).

3. Mobile apps have influenced and improved the economic, social and political development in Africa (Shaikh & Karjaluoto, 2015, Qiang *et al.*, 2011, Murugesan, 2013, Kearney, 2011, Hellström & Tröften, 2010, Beger *et al.*, 2012).

1.3 Background Information

According to the GSMA 2018 report, there were over five billion mobile subscribers worldwide at the end of 2017 and mobile technology has a wider spread than any other technology. In Africa, the penetration of mobile services is increasing at an unprecedented rate, and mobile apps form the basis of all mobile services. Mobile apps are the computer coded instructions created to make use of mobile technology (Rajput, 2015), run on mobile devices with full awareness of its environmental context (Perera *et al.*, 2014), and are used to manage the mobile services, internet and the cloud computing (Oriwoh *et al.*, 2013, Dinh *et al.*, 2013). The adoption and diffusion of mobile apps in Africa has grown to such an extent that the mobile app is the engine propelling some of the new changes in African development (Qiang *et al.*, 2011, Murugesan, 2013). Currently, the African continent is among the top adopters of mobile technology services in the world, thereby bringing new mobile services to the population (Hosman & Fife, 2012, GSMA, 2017).

The early development of mobile apps can be associated with the requisite program for the functionality of evolved mobile devices (Bates, 2014). In Africa, telecommunications over the years were mainly through a fixed-line system and the services were monopolised or controlled by the central governments of the respective countries (ITU, 2006, Chavula, 2013). The introduction of mobile telecommunications in the late 1990s brought a considerable improvement to the African continent, so much so that countries, such as Nigeria, Uganda and Cote d'Ivoire had more mobile telephones than fixed lines (ITU, 2006). The mobile telecommunications system has a faster and wider adoption and diffusion in Africa than the fixed lines and as of 2010, some countries, such as the Comoros, Kenya, Malawi, Mauritius, the Seychelles, South Africa, and Uganda had almost 90% mobile network coverage in their rural locations (Batuo, 2008). The advancement of mobile technology engineered the manufacturing of various kinds of mobile device, such as smartphones and the increase in smartphone usage resulted to the development, adoption and diffusion of mobile apps to facilitate the mobile services.

The evolution, distribution and usage of mobile technology services involved a community of interrelated network entities called the mobile ecosystem (Zhang & Liang, 2011, Qiang *et al.*, 2011, Lindgren *et al.*, 2015). Several aspects of the mobile ecosystem participate in different ways towards the process for the development, delivery, adoption and diffusion of mobile apps and their services.

Mobile apps are developed for various services with respect to the stakeholder's objectives, expectations and operational services. There are several kinds of mobile app and each type of mobile app offers a unique service to its users. These include mobile learning, mobile commerce, mobile health, mobile agriculture, mobile banking, and mobile governance used for online education (e-learning), business transactions, healthcare services, agricultural services, banking services, and government information dissemination respectively (Wu *et al.*, 2012, Okazaki & Mendez, 2013, Van der Boor *et al.*, 2014, Free *et al.*, 2013, Gichamba & Lukandu, 2012, Hellström, 2012). All these different types of mobile app are what this study referred to as the classification of mobile apps.

The African mobile ecosystem has promoted the development of different types of mobile app in Africa (GSMA, 2015b). The adoption and diffusion of mobile apps in Africa are unprecedentedly high, resulting to a high growth rate in mobile services on the continent (Murugesan, 2013). There is significant growth of mobile technology services in Africa which has rejuvenated the mental abilities of the African innovators into creating and doing new things or doing the old things in a different way (Hellström & Tröften, 2010). Thus, mobile apps enable innovations and propel economic development in Africa.

Before the introduction of mobile technology, the African telecommunications were based on the fixed-line infrastructure. The acquisition and maintenance of the fixed-line telephone system are extremely costly. As a result, it was unaffordable and unavailable to the majority of the African population, especially the rural dwellers and low-income earners (Van Zyl, 2013, Chavula, 2013). Mobile technology provides a wide range of network coverage which facilitates easy access to telecommunications services among the African population (Etzo & Collender, 2010, Lee *et al.*, 2012a). Currently, there are available and affordable telecommunications systems and over 70% of the African population is connected to the digital communications network (GSMA, 2018). In this way, mobile technological services are enabling digital inclusion.

The adoption and diffusion of mobile apps in Africa have contributed immensely to the development of Africa. Mobile services have changed habits of the African population by changing the ways of doing some things. In other words, the growth in the usage of mobile apps to perform different activities has improved the living standard of the people of Africa which in turn promotes economic, social, political, and educational development of the entire African nations (Baelden & Van Audenhove, 2015, Murugesan, 2013, Hellström & Tröften, 2010, GSMA, 2017, Aker & Mbiti, 2010).

According to the GSMA 2017 report on the mobile economy in sub-Saharan Africa, a number of issues are affecting mobile adoption and diffusion in the African region. Although there is a faster growth of mobile technologies and mobile apps adoption and diffusion in the region, the penetration to remote and rural areas is slow. About 60% of the population lives in remote locations where many potential users are constrained by the challenging network coverage, volatile economic conditions, low income and purchasing power, and political and social instability. Moreover, some scholars have identified various significant factors that must be considered for greater adoption and diffusion of mobile apps in Africa (Joubert & Van Belle, 2013, Mtebe & Raisamo, 2014, Lekhanya, 2013, Iddris, 2013, Dagada, 2012, Bankole *et al.*, 2011). These factors will be discussed in Chapter 2. However, it is necessary to understand the complete process of the adoption and diffusion of mobile apps in the African context and to develop a framework for this process. It is the intention to address these issues in this study through the investigation of the adoption and diffusion of mobile apps in five selected countries from the five geographical locations of Africa.

1.4 Preliminaries and Definition of Terms

In this section, brief definitions of the following key terms in this domain are presented:

- ✓ Mobile applications (mobile apps)
- ✓ Innovation
- ✓ Adoption
- ✓ Rejection
- ✓ Diffusion
- ✓ Technology
- ✓ Communication
- ✓ Digital inclusion
- ✓ Theory
- ✓ Ecosystem
- ✓ Social system

1.4.1 Mobile applications (Mobile apps)

Mobile apps are the software created to make use of mobile technology, supporting data gathering and transmission for economic and social events either for commercial, governmental and entertainment purposes (McNamara, 2009). Mobile apps can further be described as software that runs on various devices (Rajput, 2015, Qiang *et al.*, 2012), based on the mobility of technology, users and devices (El-Hussein & Cronje, 2010), and are actionable programs based on user and context awareness to produce context-based output (Muccini *et al.*, 2012). Therefore, mobile apps are computer programs created to run in mobile devices to facilitate various mobile technological services.

1.4.2 Innovation

Innovation is an output of knowledge perspective which can be a new practice, idea, or product (Martín-de Castro *et al.*, 2011). Rogers (2003) defined innovation as an idea, practice, or project that is perceived as new by individual or other units of adoption. Crossan & Apaydin (2010), stated that innovation is both process and outcomes. They defined innovation in a broader manner as "production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and the establishment of new management systems". Mergel & Bretschneider (2013) stated that innovation is something new to an organisation or individual. According to Ellström (2010), there are two kinds of innovation: potential and actual innovation. A potential innovation involves an untested anticipated change that seems to be a new idea while an actual innovation is a demonstrated idea that has a significant contribution to the social system. This study concentrates on the actual innovation, which can be defined as a new idea or product adopted and in use by the social system of Africa. An originally created new mobile app can be referred to as an innovation.

1.4.3 Adoption

Rogers (2003) defines adoption as a choice of complete acceptance and usage of a mobile technological innovation, such as mobile apps. The GSMA (2015a) stated that adoption is acceptance and making use of a new invention. It is users' acceptance (Lule *et al.*, 2012) and usage (Taylor *et al.*, 2011) of an innovative product, such as mobile apps. Therefore, we defined adoption as the acceptance and usage of an idea or product that is perceived to be new by the adopters.

1.4.4 Rejection

Rejection is total refusal to accept and make use of an innovation (Rogers, 2003). When a newly invented product does not gain the acceptance of the general consumers, thereby not being used, it is said to be rejected – not accepted to be used by the people. For the purposes of this study, the definition which states that rejection is users' refusal to put an innovation into use will be applied.

1.4.5 Diffusion

Diffusion is the procedure of transferring an innovation through definite networks over time among the members of a social system (Rogers, 2003; Nickerson *et al*., 2014). The diffusion process typically includes both mass media and interpersonal communication channels. In the world today, the Internet and cell phones are formidable tools of diffusion and they combine aspects of mass media and interpersonal channels. Rogers *et al.* (2014) define diffusion as a way of communicating new a product or idea to the general consumers. If a company launched a new product, it is diffusing the product. For example, when Apple launched the I-POD, it was diffusing a new product. It is a process of spreading a product from one consumer to another (Taylor *et al.*, 2011). Drawing from the above definitions, distribution of a finished product means putting the product into practice (implementation) and customers' acceptance means that the customer believes that he/she will get the necessary support for his/her decision (confirmation) otherwise discontinuance will occur. For the purpose of this study, diffusion is the combination of the implementation and confirmation stages of the innovation-decision process in the diffusion of innovation theory. Hence, diffusion is defined as the process of distribution, use and discontinued use of a product.

1.4.6 Technology

Technology refers to methods, systems, and devices which are the result of scientific knowledge being used for practical purposes. It involves two parts: hardware and software. While the hardware is "the tool that embodies the technology in the form of a material or physical object," software is "the information base for the tool" (Rogers, 2003). For this research, technology is a scientific product created to improve various activities of the social system.

1.4.7 Communication

Communication is a process in which participants create and share information with one another in order to reach a mutual understanding. Communication occurs through a channel or medium between sources, including mass media and interpersonal communication channels (Rogers, 2003).

1.4.8 Digital inclusion

This involves the provision of mobile broadband to unconnected geographical zones by extending network coverage to those areas, which in turn overcomes the affordability barriers by aiding many consumers to connect to mobile technology services at low cost (GSMA, 2015a). Formerly, it was difficult and expensive for the poor population in Africa to gain access to telephones and the Internet, but the emergence of a mobile network has created the provision for the larger population, including the poor to get connected and have access to digital communications (Van Zyl, 2013, Lee *et al.*, 2011a). In regard to this research, digital inclusion means getting involved or connected to use mobile technological services, such as mobile apps.

1.4.9 Theory

The Merriam-Webster Dictionary defines theory as "the general principles or ideas that relate to a particular subject". Scientifically, a theory is a well-validated description of some aspect of the natural world that can integrate facts, laws, suggestions, and tested hypotheses. The theory is an assembly of laws relating to a specific behaviour or phenomenon. It involves carefully gathering of the verified interrelated hypothesis (Waltz, 2010:2). Therefore, a theory can be defined as a collation of principles or laws that are applicable to particular and related domains.

1.4.10 Ecosystem

The mobile ecosystem is a community of key players involved in mobile applications development, services delivery and sustainability. These players comprise software developers, mobile network operators, marketers, local businesses, start-ups, and related participants, such as government departments, financiers, and regulators (Qiang *et al.*, 2012, Murugesan, 2013). Basole *et al.* (2012) reported that an ecosystem involves a set of various and constantly evolving companies connected through a network of corporate interest. The formation and circulation of mobile applications are produced by the ecology of business organisations (Dougherty & Dunne, 2011). Regarding this research, a mobile ecosystem is the community of all the stakeholders involved in the adoption and diffusion of mobile apps.

1.4.11 Social system

The social system is a set of interconnected entities involved in mutual problem solving to achieve a common objective (Rogers, 2003). It is a formal organization comprising individuals, groups and institutions having common interrelationships (Merriam-Webster, 2016). In regard to this research, an African social system involves the population and the environment in which the population lives and operates.

1.5 Research aims and objectives

In Africa, mobile apps play a vital role in delivering digital services to the people. Mobile technology has become the preferred platform for developing, distributing and consuming digital content and services, together with those that aid to resolve several social challenges in Africa (GSMA, 2017). The adoption and use of mobile apps facilitate easy access to the internet, financial and business transactions, dissemination of information, learning and other activities (Murugesan, 2013, Hellström & Tröften, 2010). The mobile ecosystem is providing more advanced mobile apps to offer complex services and creating new opportunities for productivity and efficiency gains to individuals, businesses and even the government (Qiang *et al.*, 2011). Adequate adoption and diffusion of mobile apps will play a central role towards achieving the UN Sustainable Development Goals (SDGs) – a 17-point plan to end poverty, combat climate change and fight injustice and inequality by 2030. Mobile connectivity is enabling digital inclusion and powering various services that directly affect the SDGs. Mobile apps services such as SMS messaging, mobile money and machine to machine (IM2M) are used to convey scalable and commercially viable services that address a wide range of social challenges in the African region (GSMA, 2017). The improvement and sustainability of the development brought to Africa by the adoption and diffusion of mobile apps is unprecedented. According to Juma (2011), mobile apps is the new engine for African development. The adoption and diffusion of mobile apps have been promoted with some effect on the development of Africa, but it is not clear how mobile apps are adopted and used. Therefore, the research question for this study is: "*How are mobile apps adopted and used in Africa?*" To address this question, the following aims and objectives were derived from the problem statement.

The aim of this research is:

- ➢ To investigate the adoption and diffusion of mobile applications in a selected number of African countries.

To achieve the aim of this study, the following objectives will be met.

- ✓ Conduct a literature review of the use of mobile apps, especially in Africa.
- ✓ Investigate the effect of mobile apps on African development.
- ✓ Investigate the adoption of mobile apps in the selected countries.

- ✓ Compare the adoption and diffusion of mobile apps in the selected countries.
- ✓ Outline the guidelines and propose a framework for successful adoption and diffusion of mobile apps in Africa.

1.6 Overall research approach

For this study, a structured methodological framework was applied. The study entails a holistic investigation into the African contextual environment comprising different countries, each from a different geographical location. Five countries were selected as representatives of each geographical location in Africa because of time and funding constraints, as well as the belief that the lifestyle in each location is similar. The required quantitative data is collected from each location for empirical evaluation to determine how mobile apps are being adopted and used in Africa. The diffusion of innovation theory (DIT) was applied to the obtained results to verify how mobile apps are being adopted and diffused in Africa. The analyses of all the research results, together with the DIT verification, provided a framework for successful adoption of mobile apps in Africa.

1.7 Research paradigm

A research paradigm is a pattern containing the underlying principles for conducting a research study. There are four major research paradigms, namely positivism, post-positivism, interpretivism and the critical paradigm. Each of these paradigms has a different understanding and belief concerning the realities of the world. Selecting a paradigm for a specific study depends mostly on the topic under study, the researcher's viewpoint and the target audience/population.

This study entails the measurement of mobile apps adoption and diffusion which is a quantifiable variable; hence positivist and post-positivist paradigms will be used. Positivism and post-positivism are philosophical positions that emphasise empiricism and objectivity. These paradigms focus on empirical observation of real events that can be rationally analysed for clarification and experimentation which reduces the complications of the outside world. Positivism and post-positivism paradigms include determinism, validity and generalisation (Denscombe, 2010, Cohen *et al.*, 2007, Lincoln *et al.*, 2011). These concepts allow researchers to conclude with certainty the way the world works and the truths within it. Although these paradigms are grounded on objectivity, there is a clear difference in their stance or belief in respect of objectivity. Positivists believe in pure objectivity whereas post-positivists believe that pure objectivity can never be achieved, especially due to cultural beliefs. The quantitative data are collected from the participants without the influence of the researchers; therefore, empiricism and objectivity are upheld. In this study, consideration is given to the fact that the participant may not be purely objective due to certain factors, such as cultural beliefs, the mental state of the participants and the environment in which he/she was completing the questionnaire. More details in this respect will be discussed in Chapter 4.

1.8 Data collection

In a positivist and post-positivist research paradigm, survey and experiment are the commonly used research methods in data collection (Williams, 2011, Richey & Klein, 2014, Mathiyazhagan & Nandan, 2010, Johnson *et al.*, 2007, Creswell, 2014). With proper consideration of the research topic, the most suitable method will be selected for a particular study.

In this study, data are obtained from a large group of people in a standardised and systematic way to obtain their views on the topic under study. The survey research method has thus been applied to data collection. Moreover, it is a research method commonly connected to positivism (Oates, 2006:93). The survey research method can apply several data collection techniques, and these are a questionnaire, observations and documents. One or more of the techniques can be used for research, depending on the research topic and target population. For the purpose of this study, a questionnaire was used to gather the required quantitative data needed for the study. The questionnaire was comprehensively designed, piloted and vetted by a statistician with respect to the research goals. It contains seven sections and is produced in two different languages (English and French). The two versions of the questionnaire help bridge the language gap and increase the reliability of the data collected. The data used for this study were gathered from South Africa (English), Nigeria (English), Kenya (English), Egypt (English) and the Democratic Republic of Congo (French).

The designed questionnaire will be sent to these countries using reliable and verifiable university institutions as the contact body. The researcher will also be physically present in some countries.

1.9 Data analysis

The collected data were carefully extracted, and various statistical analyses were performed, including descriptive analysis, correlational analysis, Cronbach alpha coefficient analysis, the measure of sample adequacy, t-test analysis, analysis of variance, Pearson Chi-Square, Cramer's V, factor analysis, Kaiser Meyer Olkin (KMO), Bartlett's and Robust tests, ANOVA, and Regression analyses.

The step by step process of the overall research approach is shown in Figure 1.1.

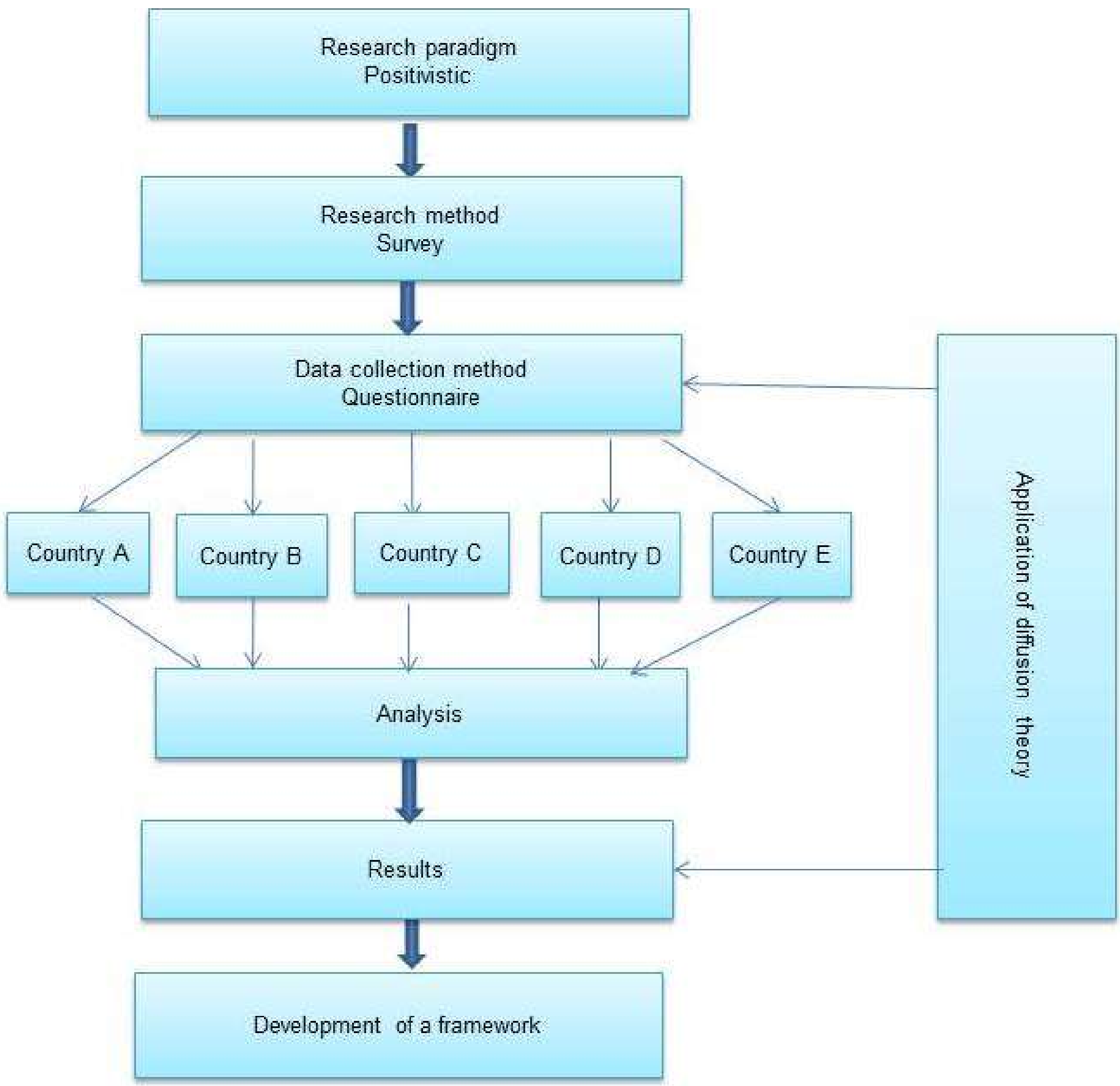

Figure 1.1: Overall research approach algorithm

1.10 Expected contribution of this study

The findings of this study will add to the body of knowledge about adoption and diffusion of the innovation (mobile apps) in Africa by assisting in finding the perceived innovation features, impacts, hitches and benefits of mobile apps in Africa. It will improve the creativity of the innovators/developers which will enable the creation of more successful mobile apps that can be widely adopted and used across the Africa nations and even beyond. It will help the industries in evaluating the advantages and disadvantages of future decisions and approaches for implementing mobile apps. This will enhance the adoption of mobile apps and improve operations and productivity.

1.11 Structure of the thesis

This thesis contains nine (9) chapters, which present the research work and outcomes in the sequence of the completed study phases.

In Chapter 1, as presented above, a general overview of the study together with the needs, the research problem, the aim and objectives, the methodological approach of the study and the relevance of the study are outlined.

In Chapter 2, the theoretical knowledge extracted from previous research work in relation to the topic under study will be presented. It will cover the important preceding findings surrounding this study which form the basic concept of the study.

In Chapter 3, some scientific theories used to conduct research in information systems will be described, and a detailed review of the diffusion of innovation theory which is a major instrument to be used for the research will be given.

In Chapter 4, the research method and design used to conduct this study are outlined. In this section, a detailed discussion of the paradigms, the selected paradigm applied to the study, the reason why it was chosen and its relevance to the study are given. Furthermore, the applied research methods, data collection method and the statistical analyses used in accomplishing the purpose of this study are also expounded.

In Chapter 5 the data analysis is presented. In this section, a detailed description of the sample population used for the study, the obtained data, data analysis and the supporting tables, figures, diagrams, graphs, etc. are given.

In Chapter 6, the obtained results in respect of the study aim and objectives are discussed.

In Chapter 7, the adoption and diffusion of mobile apps in the five selected countries are compared.

In Chapter 8, a proposed framework for the adoption and diffusion of mobile apps in Africa is presented.

Finally, in Chapter 9, the overall conclusions of the research and the results, contributions, implications and further work are presented.

1.12 Ethical considerations

This study entails no ethical prejudice or harm. The Scientific Committee of the Unit of Business Mathematics and Informatics of the North-West University reviewed the research proposal and recommended that the study does not involve any vulnerable group and has no negative impact on the environment. For this reason, ethical clearance was granted.

1.13 Chapter summary

In this chapter, a brief overview of the study entitled *An investigation into the adoption and diffusion of mobile applications in Africa* was given. It consisted of the general introduction to the complete research work, concise background information covering the literature review, problem statement that justifies the need for this study and the aim and objectives of the study. The method of the investigation covering the research paradigm, research method and statistical analyses used for this study were briefly discussed. The significant contributions of the study and the structure of the whole thesis concluded the chapter.

In Chapter 2, the focus is on a detailed review of previous work related to the topic under study.

Chapter 2

Theoretical overview of mobile applications

2.1 Introduction

In this chapter, the theoretical background of mobile applications (mobile apps) is presented with the emphasis on the adoption and diffusion thereof in Africa. Mobile apps are innovations that are currently mushrooming across the globe, having their services integrated in virtually all aspects of life, including the economic, social, educational, and political spheres. The innovation has gained widespread acceptance which results in positive technological changes both in developed and developing countries of the world, including an having an impact on educational technology (El-Hussein & Cronje, 2010), health care, farming, banking, and information gathering (Murugesan, 2013). Mobile apps can be considered as innovations and require investigation in respect of their adoption and diffusion processes (Nickerson *et al.*, 2014).

The GSMA (2015) indicated that there is a rising rate of smartphone adoption and mobile broadband usage in Africa which stimulates the adoption of mobile apps, and there is growth in the development of local or home-made mobile apps that are now catching the interest of local users. Several mobile apps have been developed in Africa with a wide range of adoption and diffusion across the region, including social networking and messaging mobile apps, such as 2go and How Far, entertainment mobile apps, such as Simfy Africa, Spinlet, iRokoTV, SOLO and iROKING, and commerce mobile apps, such as M-Pesa and M-farm (Murugesan, 2013, GSMA, 2015a). The introduction of cellular phones and mobile apps has meaningfully changed the algorithm of African activities involving culture, politics and business (Hersman, 2013).

This chapter is structured as follows: in Section 2.2 the definition of mobile apps is given, in Section 2.3 a discussion on the evolution and development of mobile technology in Africa is presented and in Section 2.4 a mobile ecosystem is discussed. In Section 2.5 the classification of mobile apps is highlighted, in Section 2.6 mobile enabling innovation is investigated, and in

Section 2.7 mobile enabling digital inclusion is discussed. In Section 2.8 there is reflection on the contribution of mobile applications in African transformation, in Section 2.9 the factors that determine the adoption and diffusion of mobile apps innovation are highlighted, and in section 2.10 the chapter is concluded. This structure is depicted in Figure 2.1.

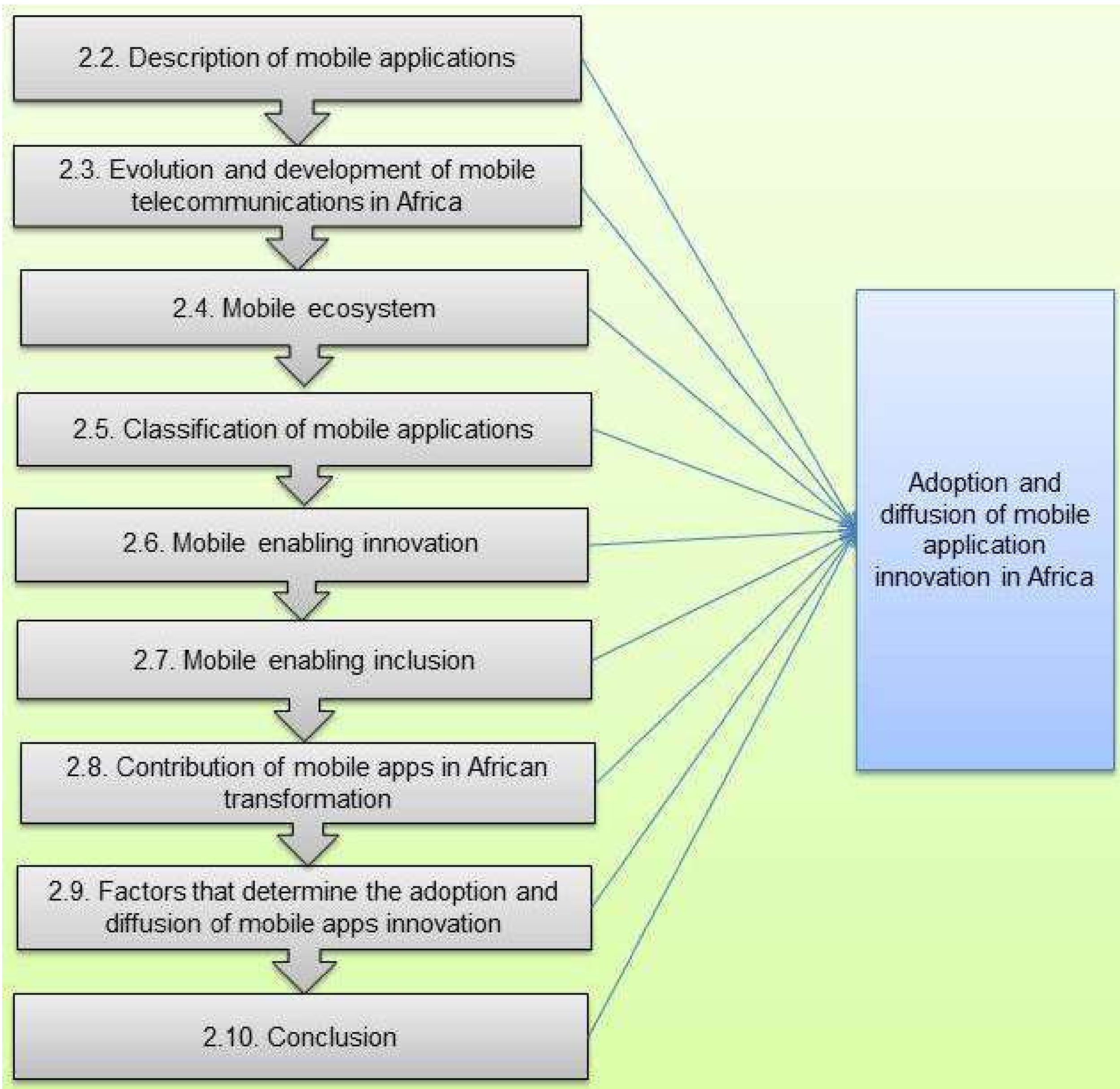

Figure 2.1: Structural diagram of the theoretical overview of the chapter

2.2 Definition of mobile apps

In recent times, mobile apps innovation has attracted researchers from various academic fields to conduct research in their respective areas. As a result, many authors, write-ups and web pages have defined mobile apps in several and related manners according to their knowledge and understanding. Some of these definitions include:

Mobile apps are the software created to make use of mobile technology, supporting data gathering and transmission for economic and social events either for commercial, governmental and entertainment purposes (Mc Namara, 2009). Qiang *et al.* (2012) refer to mobile apps as software that associates with various mobile devices in providing information and enabling activities. According to Rajput (2015), mobile apps are computer programs designed and developed to run on different kinds of mobile device.

From the educational perspective, mobile apps are used for e-learning whereby users can connect to and browse the Internet with the help of their mobile devices to download and study the necessary articles related to their areas of study. Mobile apps are computer programs based on mobility of technology, mobility of learners and mobility of learning which enhances the educational background (El-Hussein & Cronje, 2010).

As far as software testing is concerned, Muccini *et al.* (2012) documented in their research report on software testing for mobile apps that mobile apps are computer applications designed and created in such a way that users are able, from their actions, to input data from potential environments surrounding mobile devices producing context-based outputs.

In context-aware computing, software applications are conscious of the computing setting in which it operates, and responds in-line with its computing, user, physical, or time context. From this aspect, mobile apps can be referred to as computer programs that run with the full awareness of the environmental context and adapt appropriately to the contextual components, such as user, physical device and time (Perera *et al.*, 2014).

In a report by Oriwoh *et al.* (2013), drawing from their description of the internet of things, mobile apps were referred to as software applications that run in things to facilitate several purposes, including identification, communication, sensing, and data collection.

Giessmann *et al.* (2012), in their report on mobile enterprise applications, defined mobile apps as computer software created to operate on mobile devices and wireless networks which facilitates and supports business processes within a unique domain. Examples would be mobile commerce and mobile business.

In cloud computing, data are stored and processed through web browsers in mobile devices. As a result, mobile cloud computing is being described as a new paradigm for mobile apps whereby the data processing and storage are carried out from the mobile device to a better-centralised computing platform located in the clouds. From this viewpoint, mobile apps are defined as computer programs that enable the mobile users to store and process data in the cloud (Dinh *et al.*, 2013).

Nowadays, mobile phone users sit in the comfort of their homes, offices and at any leisure point and perform self-service operations with their mobile devices. Services, such as banking transactions, socialising, networking and even office activities become easy and more efficient with the use of mobile telephones facilitated by mobile apps. In this regard, Donner & Tellez (2008) defined mobile apps as a set of applications that enables mobile device users to deploy their services from different locations.

All these definitions are correct descriptions of the mobile app; however, they were influenced by the topic under study and the context in which the research was performed. Generally, the authors agreed that a mobile app is a computer program that operates on mobile devices through a wireless network. They differ in their perceptions and area of application to the extent that mobile application is associated with various aspects, including mobile technology-enabled (Rajput, 2015, Qiang *et al.*, 2012, Mc Namara, 2009), mobility (El-Hussein & Cronje, 2010), user action subjected to context-based (Muccini *et al.*, 2012), context awareness (Perera *et al.*, 2014), internet of things (Oriwoh *et al.*, 2013), unique domain (Giessmann *et al.*, 2012), cloud application (Dinh *et al.*, 2013),and location-based (Donner & Tellez, 2008). The definitions are particular in relation to the authors' knowledge and environment of the research. As a mobile technological innovation, the mobile app has a significant impact on many aspects of life. It is a unique invention that influences human operations, resulting in its adoption and diffusion even in most remote areas of Africa.

Considering the above descriptions of mobile apps and the context of this study, a mobile app can therefore be defined as a mobile technological innovation of a computer program that runs on mobile devices, enabling users to perform their economic, political, educational and social activities irrespective of the location and context of the user.

The evolution of mobile apps and the development of mobile technology in Africa are discussed in the following section.

2.3 Evolution and development of mobile technology in Africa

Mobile app evolution is linked to mobile phone evolution, whose microchips needed a basic communication computer program. In the early 1990s, the first recognised mobile app was developed for the Psion range of hand-held computers, mostly personal digital devices under the EPOC operating system. In 1996, Palm emerged having touchscreen graphic user interface (GUI) with a basic mobile app, including a wireless application protocol (WAP) browser under the Palm operating system. Palm was upgraded to the ACCESS Linux platform and later abandoned in favour of the Web operating system which is now used in LG's smart televisions. The Symbian operating system grew from EPOC (Bates, 2014).

According to Chavula (2013), the governments of African countries were initially in charge of providing telecommunication services to their people, hence the general assumption was that telecommunication services were a natural monopoly and supposed to be deployed at relatively low cost by one central company. Furthermore, by the late 1980s, most African countries started to improve their telecommunication sectors due to technological advancements. The new development allowed private ownership and privatisation of state-owned institutions, which resulted in making the natural monopolies less tenable. In addition, the poor delivery of state-owned telecommunication services engineered the start-up of independent telecommunication services, including mobile technology services, which resulted in competitive markets (Chavula, 2013). In Africa, the telecommunication sector has been experiencing steady improvement due to mobile technology innovations and the wide centralisation of the telecommunication markets (Aker & Mbiti, 2010). These evolutions have led to an extraordinary growth in access to telecommunication services, making Africa the fastest developing region in the global telecommunications market. The sector has developed from less than two million mobile subscribers in 1998 to over 620 million in 2011 in Africa, exceeding Latin America, and becoming the second biggest mobile market in the world after that of the Asia Pacific (GSMA, 2011).

The process used to design and develop computer programs that run on wireless hand-held mobile devices is referred to as mobile apps development (Charland & Le Roux, 2011). Designing and creating mobile apps requires a suitable development platform which can support the current and future needs of the software project. Some common examples of mobile apps development platforms are Android Mobile, Apple iOS, Symbian, Blackberry, and Windows phone (Wasserman, 2010, Stott, 2012, Gavalas & Economou, 2011, Apple, 2014).

There is a regular increase in the development and usage rate of mobile apps across the world, but the adoption rate among countries is irregular. For instance, the adoption rate of mobile banking varies among African countries; it is higher in South Africa than in Nigeria. The variation in adoption rate is associated with several characteristics, including socio-economic circumstances, differences in technological and market structures, political ideology, and even age (Lule *et al.*, 2012, Lee *et al.*, 2011a).

The development of mobile apps involves different significant entities interrelating with each other to form a network known as a mobile ecosystem. Hence a detailed description of a mobile ecosystem is discussed in the subsequent section.

2.4 Mobile ecosystem

The mobile ecosystem is a community of key players involved in mobile apps development, services delivery and sustainability. As reported by Basole *et al.* (2012), this community involves a set of heterogeneous and continuously evolving companies interconnected through a network of common interest. The creation and distribution of a mobile app is produced by the ecology of business organisations (Dougherty & Dunne, 2011), including software developers, mobile network operators, marketers, local businesses, start-ups, and related participants such as government departments, financiers, and regulators (Murugesan, 2013, Qiang *et al.*, 2012). Mobile technology is a converging business ecosystem and its potential application requires proper intelligence of understanding, identification, strategic collaboration, and market prediction of an innovation (Basole *et al.*, 2012). In the mobile ecosystem, mobile application development is an important component and mobile applications services have captured the global economy. Furthermore, mobile technology is trying to conquer the next frontier of the internet of things (IoT) technology which includes wearables, smart home, smart car, and various sensors that gather, process and communicate data (Dogtiev, 2016).

An African mobile application ecosystem emerged as the social system moved towards mobile phones for more services and content delivery. The ecosystem pays great attention to fulfilling its customers' present and future needs. For instance, in the DRC, VMK has created its own mobile app store to take care of the people's needs because some popular foreign app stores refused to grant credit facilities to people of the DRC (Murugesan, 2013). The technological start-up VMK was launched in 2009 in the Democratic Republic of Congo with the aim of producing local mobile phones. Instead of importing complete mobile phones, the company imports the raw materials and assembles them in the DRC, thereby producing locally made mobile phones. VMK brands include the tablet Way-C, a smartphone Elikia and a low-end mobile phone, Moke (Reuters, 2015). Globally, mobile ecosystems comprise the same/similar components, but there are some differences in a comparison between ecosystems of developed and developing countries, as shown in Table 2.1.

Table 2.1: Mobile app ecosystem in developing and developed countries

Participants / features	Developing countries	Developed countries
Key players	▪ Mobile network operators are gatekeepers	▪ Platform providers' dominant (such as Apple's App store) ▪ Independent providers are key players
Platform	▪ Platform being developed (such as Ovi Store) ▪ Often no mobile payment system ▪ Mobile money available in some countries (such as Kenya's M-PESA) ▪ Operator billing negotiated at the platform level	▪ Easy to put m-apps on the platform ▪ Platform provides developer support, customer service, payment system (credit card, PayPal), and guarantees the functionality of apps
Content and services	▪ Hyper-local information ▪ Highly local training ▪ Content often not available in digitised form, so greater need for collaboration with local content providers	▪ Multiple ways of getting information and services in both rural and urban areas ▪ Substantial information available in digitised form

The participants/features of a mobile app ecosystem as shown in Table 2.1 are described in the sub-sections 2.4.1, 2.4.2 and 2.4.3.

2.4.1 Key players

The key players are mobile network operators, mobile apps providers, users and content providers. More information on each will be provided next.

2.4.1.1 Mobile network operators (MNO)

MNOs are the wireless services providers or mobile network carriers that provide the wireless communication services. Their services control all the essential elements involved in the diffusion of mobile applications. MNOs provide the tools needed to host and distribute mobile apps, while the market decides on the ones to use according to demand. In developing countries, such as in Africa, the mobile ecosystem tends to be a loose association and MNOs dominate the mobile ecosystem (Qiang *et al.*, 2011). The opposite is true in developed countries where the introduction of the iPhone and the app store stabilise the ecosystem to the extent that mobile application providers have more influence and revenue than the MNOs. Some examples of African MNOs include MTN (South Africa, Nigeria, and Uganda), Vodafone (Egypt, South Africa and Ghana) and Safaricom (Kenya) (Qiang *et al.*, 2012, Hellström & Tröften, 2010). However, in Africa, the MNOs play a domineering role and determine which mobile application they will host on their network thereby being the gatekeepers in the mobile ecosystem. In contrast to developed countries, the MNOs are only data carriers which are secondary and less important in mobile app hosting platforms. For example, in Kenya, Safaricom is the gatekeeper that connects mobile applications to the communication network and charges up to 85% of the revenue from any mobile app transaction. In developing countries, MNOs are the gatekeepers which facilitate the hosting and diffusion of mobile applications with greater influence than mobile application providers (Murugesan, 2013, Qiang *et al.*, 2012).

However, as new players enter the mobile ecosystem, MNOs are now facing the challenges of trying to maintain their role of "gatekeepers" and enabling user satisfaction. Mobile app stores are now the bandwagon onto which most of the key players have jumped and the new mobile-portal distribution platform provides easy access to mobile app contents and services. Currently, mobile apps developers can decide on which distribution platform to create and distribute their mobile apps (Cortimiglia *et al.*, 2011).

2.4.1.2 Mobile application providers

Mobile application providers are the software developers, including independent and corporate developers. They are the innovators that create and drive the mobile app development. In developed countries, mobile app providers are more influential than the MNOs in the mobile technology ecosystem. The Apple iOS and Google Android development platforms rely on third-party providers for mobile apps and take about 30 percent of transaction revenue (Qiang *et al.*, 2011)

2.4.1.3 Users

These are the people who use mobile services for their various activities, including social, economic, political, and educational activities. There are several kinds of mobile app with specific goals targeting different users. The desires and needs of people determine the particular mobile app to adopt and use. In the developing world, users of mobile apps demand relevant, hyper-local content. Considering prices for agricultural goods, for instance, the relevant content will be sourced from local and regional markets to enable farmers to compare and decide where to sell their produce. In Africa, some of the mobile apps that provide this kind of information are Manobi in Ghana and Senegal, and Ovi Life Tools (OLT) in Nigeria. Some types of users include (Qiang *et al.*, 2011):

- Economic users – this group makes use of mobile apps for business purposes, such as banking and commerce. Examples of African mobile apps are M-Pesa and M-Shwari (Murugesan, 2013)
- Educational users – this set uss mobile apps for educational purposes, including e-learning. Worldreader provided access to digital books for the children of Africa, for example in Ghana, Uganda, Kenya and Tanzania (Murugesan, 2013).
- Social users – this group comprises all the users of mobile apps purposely for social communication. Different mobile apps exist for social communication, including How far, 2go, Facebook, Twitter, WhatsApp, Instagram, IMO, Skype and many others.
- Governmental users – this group uses mobile apps to access government information and services. Among the e-governance, mobile apps include TV and radio mobile apps. Examples are IrokoTV (GSMA, 2015a) and Ushahidi (Hellström & Tröften, 2010).
- Agricultural users – this group uses mobile apps for agricultural purposes. Some of the mobile apps used in Africa for agricultural services include KACE in Kenya and Manobi in Ghana.

2.4.1.4 Content providers

Mobile applications are developed for the general public to serve a unique purpose (Nickerson *et al.*, 2014), and their specific function depends on their content (Cortimiglia *et al.*, 2011). Content providers are therefore the part of the mobile ecosystem that provides the required data for the development of a mobile app. In a mobile ecosystem, many players offer useful and relevant information needed for mobile apps development, including (Qiang *et al.*, 2011):

- Government – Several government departments provide data for local mobile apps. For instance, in Kenya, the government launched an open data source which helps in providing data for government spending, parliamentary spending, national census, and public service locations as part of a test to see what innovative mobile apps that developers can create using the data.
- Civil society – societal activities and needs contribute to providing real-time data for providers in the design of their mobile apps. The growing unemployment in Nigeria also provides the locally relevant content of creating job-search websites in the region (GSMA, 2015a).
- Commercial centres – there are market research centres that monitor, gather and report market information to media on bid/ask prices. Some offer relevant market information to farmers regarding prices, delivery and other services. In Kenya, KACE has organised market research centres that observe and gather local market data daily, report information to radio stations and offer farmers market links, and pick-up and delivery transportation.
- Media – The media also provide relevant data for mobile apps content to developers. In Kenya, KACE broadcasts local agricultural prices and trades, using community radio. In South Africa, ShowMax is providing about 1 000 hours of content (GSMA, 2015a).

2.4.2 Platform

In mobile technology, the most significant mobile apps innovation is the formation of a platform which enables independent mobile apps developers to create mobile apps. A platform is a foundational software architecture that provides services to other applications (Qiang *et al.*, 2012, Chappell, 2011, Bhardwaj *et al.*, 2010). In this study, a platform is defined as a software suite used as a tool for creation and management of mobile apps. Examples of mobile app platforms include Apple iOS, Google Android, Windows phone, Symbian and Blackberry (Wasserman, 2010, Gavalas & Economou, 2011, Butler, 2011, Allen *et al.*, 2010). A mobile app platform comprises five components and each of the components provides a specific service, including an operating system, execution services, data services, cloud services and development tools as shown in Figure 2.2 (Chappell, 2011).

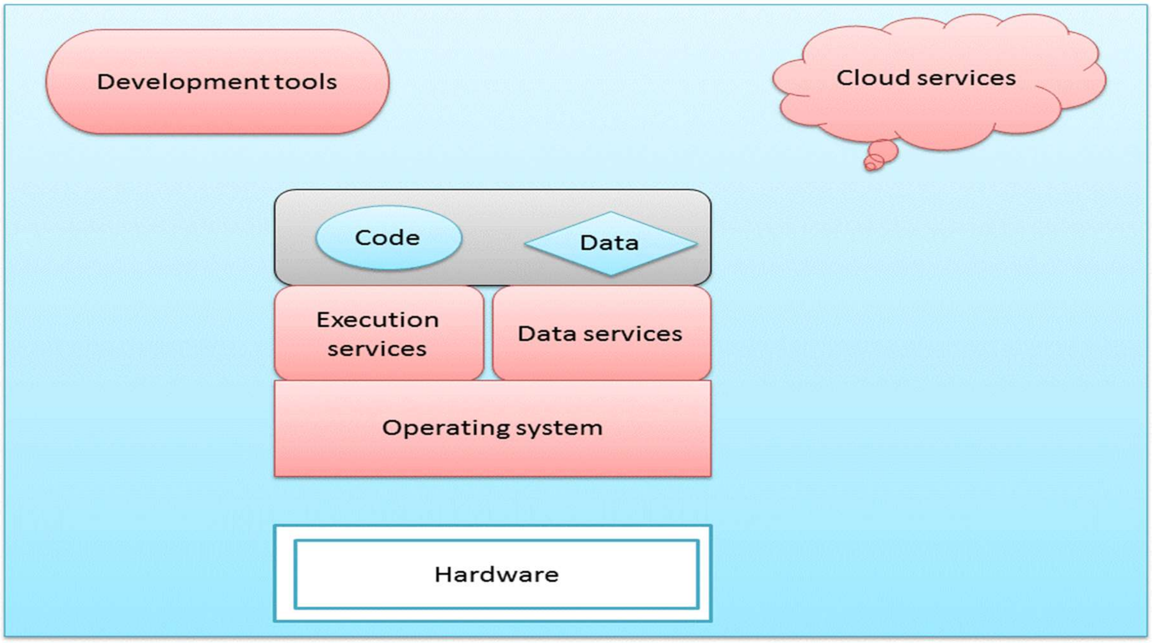

Figure 2.2: Components of an application platform (Chappell, 2011)

A discussion of the components of an application platform seen in Figure 2.2 follows:

- Operating system: this component executes and provides foundational services on which all applications depend, including file system storage, and the basics required to run a code, such as scheduling.
- Execution services: this component provides the libraries for running software. It involves support for forming user interfaces on clients, connecting with other software, organising how code executes (e.g., with workflows), and many other things.
- Data services: this section handles the data processing aspect of the platform using a database management system as the main technology. As technology advances with innovative changes, managing large data requires technologies that go beyond traditional relational database systems.
- Cloud services: this unit offers remote functionality that applications can use. For instance, cloud platform services allow organisations and individuals to run their applications without relying on maintenance and management infrastructures, such as hard drives and servers.

- Development tools: this component provides helping services to mobile apps development teams enabling them to create and maintain applications. These tools range from common code editors to full-featured tool supporting writing code, testing, deployment, and other aspects of the development process.

In developed countries, the introduction of mobile apps stores created an operator-neutral platform which enables mobile apps providers to be more innovative and getting their applications into the mobile app market is made relatively easy (Qiang *et al.*, 2011). Initially, the development arena for mobile application services has been dominated by key role players, such as MNOs, phone manufacturers and some influential application and content providers, especially in developing countries, such as in Africa (Holzer & Ondrus, 2011). The platform offers the application developer the choice of various development technologies, and in turn, enabling the developer to develop functional mobile apps. However, creating a good platform for mobile apps development will resolve some obstacles faced by application and content providers, including low mobile broadband penetration, lack of an m-payment system, low smartphone penetration, and low advertising revenue (Qiang *et al.*, 2011). In Africa, the growth of mobile application innovation depends on the mobile app ecosystem platform. It facilitates the communications, as well as transactions between the mobile apps developers and the consumers thereby contributing to the adoption and diffusion of mobile application innovation (Qiang *et al.*, 2012, Gavalas & Economou, 2011).

2.4.3 Content and Services

Mobile content is any form of media (pictures, music, text, videos) that can be used in creating mobile apps for the mobile device (cell phone or tablet) (Ring, 2012). It is another fundamental factor that influences the mobile apps ecosystem, providing the ability for mobile apps adoption and diffusion. The scaling up of any mobile apps is determined by its contents and services with regard to the target users and environment. In developing countries, the content of mobile apps must be hyper-local and tailored to user requirements even to remote village level. To offer value to customers in developing countries, information provided by mobile apps must be hyper-local and services must include outside demonstrations and training. For example, in Kenya, Kilimo Salama (an insurance marketing application) offers farmers integrated financial training and educational extension services about insurance and high yield seeds (GSMA, 2015). In South Africa, ShowMax, a video-streaming service is offering 1 000 hours of content, including local favourites in Afrikaans (GSMA, 2015a). The high level of unemployment in Nigeria initiates the local content for various job websites. Unlike in developed countries, the information and services or mobile apps can easily be found on the Internet, irrespective of the content (Biztech Africa, 2015).

In African mobile ecosystems, the content and services play a significant role in acceptance and distribution of mobile apps. The products of the mobile ecosystem comprise several kinds of mobile application, hence the classification of mobile apps (GSMA, 2015a). Mobile apps are classified into different types in relation to their functionality contents, as presented in the next section.

2.5 Classification of mobile applications

Different types of mobile application are used for various purposes, including mobile commerce, mobile agriculture, mobile health, mobile learning, mobile governance, and mobile socialising (Qiang *et al.*, 2012, Mutula & Mostert, 2010, Murugesan, 2013, Hellström & Tröften, 2010, GSMA, 2015a). These will be discussed as follows:

2.5.1 Mobile Commerce (M-commerce)

Mobile commerce involves any commercial transaction performed through different kinds of mobile device over a wireless network connection or telecommunication (Joubert & Van Belle, 2013, Chong *et al.*, 2012, Bhatti, 2015, Abdelkarim & Nasereddin, 2010). According to Bhatti (2015), there are two categories of mobile commerce namely content delivery mobile commerce and transactions mobile commerce. The former involves reporting, notification and consultation while the latter covers data entry, purchasing and promotions. The GSMA (2015a) reported that mobile commerce is on the rise in the African region due to rising growth of internet penetration and that 20% of South African internet users have made purchases online and another 48% are expected to do so in the future. Mobile commerce is important for economic growth in Africa because of ubiquitous and unison access to information and services, and the likelihood of a unique and personalised exchange of information (San Martín *et al.*, 2012, Bhatti, 2015). The significance of mobile commerce has resulted in the establishment of digital commerce sites across the African region. In 2012, Jumia was launched in Nigeria with funding from Rocket Internet. The company has expanded beyond its original base, with local sites across many other African countries, including Cameroon, Senegal, Kenya, Tanzania, Ghana and Uganda. It is also in partnership with MTN and Millicom to drive future growth and facilitates the efficiency of mobile commerce among increasing mobile users (GSMA, 2015a). Hellström & Tröften (2010) point out some key drivers of mobile commerce, especially mobile banking, including:

- Increased diffusion and penetration of mobile phones.
- Falling prices of mobile phones and services.
- Cost-effectiveness of mobile solutions.
- Strong branding of easy to use mobile apps.
- User demand and needs.
- Need for banks to reach out and get more customers.
- Need for operators to keep customers (loyalty).
- Scalable agent distribution for cash-in cash-out.
- Fast and simple customer registration process.

Mobile commerce applications include mobile banking and business transactional applications such as:

M-Pesa

This is one of the greatest success stories of mobile application innovation adoption and diffusion in East Africa. M-Pesa means mobile money in Swahili and was launched in 2007 in Kenya and powered by Safaricom. It is a popular money transfer application and uses common cell phones. All the mobile phone subscribers of Safaricom in Kenya use the application. It has revolutionised daily banking activities for many rural dwellers that do not have access to traditional banks. In East Africa, it is the dominant method of money transfer and its major advantage is that its users can send money to people irrespective of whether the person has a bank account or not. M-Pesa is now being used in other transactions, such as paying utility bills and school fees (Qiang *et al.*, 2012, Murugesan, 2013, Hellström & Tröften, 2010, GSMA, 2015a). The rapid growth of this application is moving beyond Kenya to other African countries. Moreover, Vodafone has sprung M-Pesa in Tanzania, and Afghanistan and is working towards expanding the services to other countries in Africa. The underlying technology used for the deployment of M-Pesa differs between Safaricom and Vodafone in that Safaricom uses SIM toolkits, while Vodafone uses unstructured supplementary service data (USSD) (Hellström & Tröften, 2010). M-Pesa is a financial solution mobile application designed to offer services to unbanked people, and although it is gaining widespread adoption and diffusion, it cannot function without the formal financial sector.

There are many other M-commerce applications developed and functioning actively in Africa. These include all banking mobile apps. Examples of these are FNB and Standard Bank's online banking applications in South Africa, and FBN and GTB banks' online banking applications in Nigeria. Others are commercial M-commerce apps, such as DSTV, Ackerman, Spree online shopping applications and many others.

2.5.2 Mobile Agriculture (M-agriculture)

These are mobile apps that deal with agricultural business. The rural dwellers in developing countries are mostly poor farmers and their families living in poverty. Their physical location is somehow isolated and compounded by poor infrastructural development, making it difficult for them to have access to services and markets. The farmland is of a low quality and dependent on unreliable rain. Access to government support services, quality seeds and fertiliser is very limited. In addition, they have insufficient information and communication resources on how to improve productivity, including cultivation techniques, varieties of newly improved crops, farming threats and methods of combating crop diseases (Murugesan, 2013, Hellström & Tröften, 2010).

In recent times, the increasing rate of urbanisation and economic growth require higher value-added agricultural products, mostly in developing countries, such as in Africa. Deployment of intelligent and affordable information communication technology can assist in creating a 'virtuous circle' of innovation, which will be beneficial to local farmers and integrate them into regional and global commodity markets. This virtuous circle in the mobile domain involves the interaction of four elements: access, affordability, appliance innovation, and applications. The technological development has improved farmers' information, communication, transaction, networking and resource services (Patel, 2013, Hellström & Tröften, 2010). In his report, Murugesan (2013) stated that agricultural experts agree that having access and sharing agricultural data with humans and machines will help to alleviate the problems of the poor farmers. Farming data, such as weather conditions, plant genomics, rainfall levels, suitable crops for particular soil type, pest and disease information, and market prices enhances productivity. Examples of helpful agricultural mobile applications are (Murugesan, 2013):

- M-Farm – created in Kenya in 2010. This application provides up-to-date market information to link the farmers and buyers and offers information on agricultural trends.
- iCow – developed in Kenya to provide information about dairy farming. It helps dairy farmers to manage their cows sustainably.
- Farm Radio – this is a media mobile app used mainly by broadcasters to provide information about small-scale farmers and their families. It is a widespread mobile app being used in about 38 African countries and by over 400 broadcasters.

Mobile agricultural services have contributed positively in supporting agricultural development and improving the livelihood of poor farmers in Africa. According to Hellström & Tröften (2010), some of these benefits include:

- Empowerment of low-scale farmers to help in lifting them out of poverty.
- On-time access to agricultural information about good cultivation practices, market prices of the product, preference market, improved crop varieties, and management of pests and diseases.
- Improved dissemination of information to make the market more efficient and transparent.
- Facilitates important complimentary services, such as financial support services and linking small-scale farmers to high-end agricultural value chains.
- Improved communication among farmers which enables the formation of corporative organisations.

2.5.3 Mobile Health (M-health)

Mobile health is the application of mobile communication technologies to deliver health services (Murugesan, 2013, Martínez-Pérez *et al.*, 2013, Liu *et al.*, 2011, Kumar *et al.*, 2013, Hellström & Tröften, 2010, Fox & Duggan, 2012). Mobile technology has been directed and applied in a variety of health-related areas and sophisticated mobile apps have been designed for mobile devices as unique and active sources of health information and patient self-management tools (Handel, 2011, Hellström & Tröften, 2010). As reported by the National Institutes of Health (NIH), mobile technologies “allow providers to help patients improve their health in real time, enabling them to personalise healthcare options and monitor progress” (NIH, 2011). The advancement in technology has resulted in the development of mobile apps that can track and manage the information about the health and wellness of people.

In Africa, the health care system faces a big challenge in offering adequate health services to its people, especially those in rural areas. There is a severe lack of medical personnel and quality drugs in remote places of Africa; as a result, many people die due to untreated illness. The introduction of mobile phones and mobile apps provide solutions to these problems so that people in rural areas can have access to healthy living and self-management information to improve their living standards (Murugesan, 2013, Hellström & Tröften, 2010). Mobile health can be used in several ways, including (Murugesan, 2013, Milošević *et al.*, 2011):

- General provision of health information.
- Increase access to the health care system, especially for those in rural areas.
- Connect patients to qualified doctors and other medical practitioners.
- Remind patients to take their medication.
- Help patients to locate the nearest clinic at the point of emergency.
- Transmit test and lab results from the local clinic to experts for further analysis.
- Provision of health counselling.
- Lifestyle and general well-being monitoring (e.g., to deal with obesity).
- Computer-assisted rehabilitation and therapy.

An example of M-Health application includes:

- Open hospital – an M-Health application developed by Italian volunteers at Informatici Senza Frontiere for St. Luke Hospital, a rural hospital in Uganda. It is a small open source application that aids in the operational management of the hospital. It covers operations, such as patient's registration, facilitates admissions, monitoring outpatient's department visits, managing pharmacy and bills, vaccine database maintenance, supporting internal communications, and reports generation and statistics. Recently, the application has been deployed beyond Uganda rural hospital to other remote hospitals in developing countries (Murugesan, 2013).
- In Ghana, Bright Simons runs m-Pedigree, a breakout business that confirms medicine and help in avoiding fakes via SMS (Hersman, 2013).
- In collaboration with Vodacom South Africa, an Internet and mobile-enabled platform (WAP) permits providers to convey HIV- and STI-prevention information by engaging young individuals on the topics of sex, love, and relationships. The platform has an estimated 1.3 million subscribers and has now extended to Kenya and Tanzania (Forrest *et al.*, 2015).
- MedAfrica is an M-health app developed by Shimba technologies in Kenya aimed at providing comprehensive health care assistance to the general masses. The platform will gather information from several sources to offer health care services including first-aid recommendations, health alert and updates, and a list of doctors from the local hospitals (Talbot, 2011).

2.5.4 Mobile Learning (M-learning)

Mobile learning is the acquisition of knowledge by means of portable hand-held wireless technological devices that can be used wherever mobile communication network coverage is available (El-Hussein & Cronje, 2010, Park, 2011, Murugesan, 2013, Hwang & Chang, 2011, Hellström & Tröften, 2010). Mobile technological innovation has had a significant effect on educational development; as a result, the potential of e-learning has increased. Mobile apps facilitate learning in various and often unstructured methods across the globe. The use of educational mobile apps grows from the mobile phone's easy inbuilt applications, such as the calculator and the notebook utility to more advanced uses, such as broadcasting TV and radio, slide shows and streaming other media. The concept of mobile learning emphasised mobility and learning, and it is meaningful when the user's technology is fully mobile. Mobile learning has opened various possibilities in education, namely lectures and seminars are recorded, pictures and videos are taken, and interviews and examinations are conducted through the aid of mobile educational technological services (Hellström & Tröften, 2010, El-Hussein & Cronje, 2010).

Murugesan (2013) reported that the key factor boosting Africa's socio-economic status is education and skills development which facilitates the living standards of people and improves competitiveness with other nations. The advent of digital technology has changed education in Africa, enabling children to have access to books and other educational services online. For instance, in 2013, Worldreader distributed over 609 000 e-books in sub-Saharan Africa and there is an on-going project in Kenya, Uganda, Ghana and Tanzania (www.worldreader.org). SAP Africa launched an education and entrepreneurship program called "Skills for Africa" for the development of information and technology skills in Africa. The program is created to meet the complex requirements of African skills development and to ensure easy learning in challenging environments. SAP also sprung its Social Sabbatical program to support, create skilled jobs and help employee learning and innovation. In this program, successful SAP employees from across the world contribute their time and talent to mentor entrepreneurs and small businesses in evolving markets and support underserved communities in South Africa, Brazil, and India (Murugesan, 2013).

There are several mobile apps used for mobile learning, including mobile wikis, eFundi, SMS, mobile blog, and research report database websites. Social networking applications are efficient tools used for mobile learning, such as Facebook, Whatsapp and Twitter (Hellström & Tröften, 2010). Some of these applications have been used in exceptional ways to support educational projects, including:

- In South Africa, the Meraka Institute of the Council for Scientific and Industrial Research (CSIR) launched an educational promotional project called Doctor Maths in 2007. In this project, an instant messaging mobile app, Mixit, was utilised for educational purposes so that learners from primary and secondary schools post mathematics questions for discussion with a tutor ready to answer the questions (Hellström & Tröften, 2010).
- The Ministry of Education of Tanzania, in collaboration with the International Youth Foundation, Nokia, Vodacom and Pearson, launched an education promotional project called BridgeIT to enhance distance-learning education. This project involves the use of mobile phone and TV to deliver digital, multimedia materials to teachers and students. The users can gain access to the library of science and download Maths and English videos via GPRS to a mobile phone connected to a TV. This enables distance learning through a mobile learning application (Hellström & Tröften, 2010).
- In Kenya, Nivi Mukherjee has developed an Android tablet called eLimu that supports primary school students in their preparation for important exams (Hersman, 2013).

2.5.5 Mobile Governance (M-governance)

Mobile Governance can be defined as the conveyance of governance-associated services through mobile communication devices promoting citizen to citizen, citizen to government and government to citizen relations that can be improved to strengthen democracy and good governance (Poblet, 2011, Hellström & Tröften, 2010, Hellström, 2011). Mobile app innovation has brought in new technological channels of communication that promote good governance other than the old means of press, radio and TV (Hellström & Tröften, 2010). Mobile technology offers a new platform through which citizens can access government information and services via text, data and audio browsing methods, which in turn facilitates transparency of governance. Mobile governance has been proven to be significant to people in the world today to the extent that it strengthens human rights. Citizens can now easily pass information or suggestions or complaints directly to governing authorities and to fellow citizens (Hellström, 2011). There is great potential in using mobile phones for governance service delivery, improved involvement, holding governments accountable and encouraging openness (Poblet, 2011, Hellström, 2011). We have observed mobile phones help build an informative, connected, innovative, and uniting society all over the globe. It is now much more difficult to commit open crime because anyone with a mobile phone can record, take a photo, SMS or MMS news of the event even as it is happening. Various governance services in East Africa that can be delivered with the aid of mobile governance applications include government news/information updates, law enforcement/safety, elections, disaster and crises management, education and awareness, data collection, monitoring, mobilisation, employment, agriculture, health and education (Hellström & Tröften, 2010).

The above section 2.5 illustrates various kinds of mobile app innovation used in different sectors of life, including commerce, health, learning, agriculture, and government. The adoption and effective use of these mobile apps transform our social interactions, our lifestyles, and our workplaces, which in turn improve the living standards of the people (Milošević *et al.*, 2011). As mobile technology improves, African mobile app providers are creating and embracing the changes in mobile technology in order to address people's needs in many areas (Murugesan, 2013), hence mobile enabling innovation, which is presented in the next section.

2.6 Mobile enabling Innovation

In recent years, mobile app innovation has seen extensive adoption in Africa so that both private organisations and government play increasing roles in supporting the innovation (Nickerson *et al.*, 2014, GSMA, 2015a). Several incubators and accelerators have been launched across the African region, particularly in Nigeria, South Africa, Botswana, Kenya and Ghana, and a huge number of innovative start-ups sprang up outside incubators. An incubator aids new start-ups to develop their idea, figure out their market, build the team and get initial clients and feedback, while an accelerator is a short and intense programme used to facilitate the proper growth of new start-ups (Cohen, 2013).The outlook for start-ups in the region continues to develop positively, resulting in an increase in the availability of higher speed mobile broadband connectivity and additional growth in smartphone adoption. Analysts foresee that venture capital funding in tech start-ups across the African continent will exceed half a billion dollars by 2018 (Rao, 2012, Hersman, 2013, GSMA, 2015a).

Furthermore, the GSMA (2015a) research report indicated a rapid growth and backing in mobile application innovation start-ups in Africa, including:

- Airtel, a mobile network operator in Nigeria that launched an initiative known as "Catapult-a-Startup" in 2014 to motivate and assist start-up mobile application developers.

- Millicom, that launched Millicom foundation in 2014 to support mobile application innovators in Africa and Latin America through a USD 10 million budget and mentoring programme.
- Tigo, an affiliate of Millicom, that started up an accelerator programme in Rwanda. Safaricom in Kenya launched a USD 1 million Spark Venture fund in 2015 to support technology start-up innovation.

A report by Biztech Africa (2016b) indicated that Huawei Technologies, a Chinese multinational networking and telecommunications equipment and services company is creating significant waves in supporting African innovators. In Nigeria, Huawei launched Huawei Innovation and Experience Centre, established under the concept of "Cloud", which enables visitors to share Huawei global. The latest cutting-edge ICT technologies, such as 4.5G, Internet of Things and digital service innovation will be deployed on this platform.

In present-day Africa, governments are very eager to start technology hubs and offer an enabling policy environment to support technology innovation. Botswana, in collaboration with the World Bank, initiated the government-supported Innovation Hub which is now changing to a more sustainable model aimed at supporting economic diversity and competitiveness in Botswana's economy. The government of Kenya has initiated a five-year strategic plan by launching a technology innovation hub in its 47 counties. In addition, the government of Nigeria provided a support fund to the Information Technology Developers Entrepreneurship Accelerator (iDEA) incubator for over 100 start-ups.

As reported by Hersman (2013), mobile technology is an enabler of the technological innovation transitioning African culture, business and politics. The cellular telephone brought significant improvement to African innovators' creativity (Aker & Mbiti, 2010). In South Africa, Fundamo pioneered mobile money solutions for millions of people before being acquired by Visa. The report from the United Nations Conference on Trade and Development stated that "ICT infrastructure is an increasingly vital determinant of the overall investment climate of a country" (UN, 2011). Moreover, wireless technology is vigorously promoting entrepreneurship and small business development so that new practices are emerging rapidly. Mobile subscribers in developing countries are exponentially growing and creating immense and various prospects for social and economic development (West, 2012). From the Gallup poll conducted in 2011, there is noteworthy diffusion of mobile phone usage in Africa – 71% of adults have cell phones in Nigeria, 62% in Botswana, and over 50% in Kenya and Ghana. Universally, Africa has the second largest number of mobile subscribers after Asia with an estimated 616 million mobile users as a whole (Juma, 2011). In 2010, Rwanda's Kigali Institute of Science and Technology launched a start-up called "HeHe", a mobile application innovative firm aimed at promoting entrepreneurship and software-related business development. HeHe takes advantage of mobile technology to accelerate information technology innovations (Juma, 2011).

Africans have developed a considerable number of interesting popular mobile applications that have gained widespread adoption in most African countries. These mobile applications mainly originated from South Africa, Nigeria and Kenya, including 2go, How Far, Simfy Africa, Spinlet, iRokoTV, SOLO, iROKING, M-Farm and M-Pesa (Murugesan, 2013, Hellström & Tröften, 2010, GSMA, 2015a).

Mobile technology is playing a significant role in driving the African continent forward. The noticeable increasing growth in social, political and economic activities within the African continent is being promoted by mobile-enabled innovation. In recent times, studies have shown that one of the greatest changes across Africa is that many people hae cell phones and access to the internet. With mobile technology, there is tremendous growth in digital inclusion across Africa (Juma, 2011, GSMA, 2011). The next section deliberates on digital inclusion in Africa.

2.7 Mobile-enabling digital inclusion

Digital inclusion is the provision of mobile broadband to unconnected geographical zones by extending network coverage to those areas, which in turn overcomes the affordability barriers by aiding many consumers to connect to mobile technology services at low cost (GSMA, 2015a). Mobile communication remains the major platform through which the majority of populations across Africa gain access to the internet. In Africa, fixed-line infrastructure is limited and where it is available, it is mainly too expensive for local populations. Mobile technology plays a critical role in resolving the affordability barrier with regard to the level of income in the region. In Kenya, for instance, large populations have turned to mobile networks for their internet and telephone needs (Van Zyl, 2013, Lee *et al.*, 2011a, GSMA, 2015a).

It was reported that at the end of 2014, the estimated number of internet users in sub-Saharan Africa was about one-fifth of the population comprising about 13% that could access high-speed services via mobile phones. In contrast, less than 0.5% of the population could connect to the internet through fixed broadband services. There is an expectation that access to the mobile internet will be increasing over the period to 2020, with over 200 million of the population gaining mobile internet access. Despite the significant growth, about 40% is expected to be connected and 60% unconnected by 2020, with the region still lagging behind the global average. This is an indication of the presence of significant barriers to mobile internet adoption in sub-Saharan Africa (GSMA, 2015a).

In 2014, the GSMA collaborated with governments, MNOs, NGOs and other interest groups and launched a promotional programme known as “Digital inclusion.” The programme aims to address three major barriers to mobile internet access in order to extend global connectivity and increase mobile internet adoption in sub-Saharan Africa. These barriers include coverage gap, affordability, and digital literacy and local content (GSMA, 2015a):

2.7.1 Coverage gap

Network coverage is a major barrier to expanding mobile internet access, especially in the remote rural areas where a majority of the unconnected population in sub-Saharan Africa lives. The roll-out cost and network infrastructural maintenance are the key issues hindering the extension of mobile broadband coverage to the unconnected living in sparsely populated areas where the majority of consumers are typically on low incomes (GSMA, 2015a).

A report on closing the coverage gap of mobile network by the GSMA (2015b) evaluated three wide approaches to handle the coverage gap issue, including network sharing, government support and alternative technologies. Network sharing involves an agreement between MNOs to share some part of their network. Government support includes financial and fiscal incentives to promote network coverage. Alternative technologies involve having substitute mobile technologies that will provide network coverage.

Several solutions are being applied by MNOs to handle the challenge of off-grid connectivity, including making use of green options, such as solar power, wind, water, biomass and fuel cells. For instance, in 2014, in the Benin Republic, Africa Mobile Operator (AMO), in collaboration with local operator, Bell Benin Communications, built and operates solar-powered mobile base stations in remote rural communities of over 4 000 people. AMO plans to expand the network coverage solution to other African countries, including Nigeria, Zambia, Angola, Côte d’Ivoire, Ghana and Zimbabwe (GSMA, 2015a).

2.7.2 Improving affordability

Affordability remains a key hindering factor for many consumers in Africa, especially poorer rural residents who still fight to afford data-enabled devices and tariffs. Among the biggest barriers of digital inclusion is excessive taxes levied on the mobile sector, including airtime and SIM taxes. Some of these taxes run counter to the principle of taxation outlined by the international monetary fund and other associated expert organisations. In many countries, taxes take a greater percentage of the total cost of acquiring a mobile device and mobile services. In effect, excessive taxes reduce incentives for investment in mobile network infrastructure and quality of service improvement, resulting in a high cost of service delivery. This, in turn, lowers usage of mobile services. In the 2013/14 financial year, MNOs in Tanzania paid more than $540 million in taxes, accounting for almost 50% of their revenue. Although the turnover of the mobile sector directly contributes 3.8% of Tanzanian GDP, it offers over 11% of Tanzanian tax revenue (GSMA, 2015a).

Biztech Africa (2016) noted that affordability will help improve access to mobile technology. Furthermore, in Zambia, the price of smartphones prevents many people from gaining access to mobile technology, but Huawei, smartphone manufacturer, has entered the Zambian market and is helping to ease the situation.

The average selling price (ASP) of smartphones has dropped considerably in most markets across the African region, with more devices now available on the market. However, many global mobile device vendors are increasingly investing in the region with reduced mobile phone prices to enable the poor in rural communities to gain access to the Internet. In 2015, Google launched Hot 2 smartphone in sub-Saharan Africa with a marked price of $50 from the original $90 for the next three years. Reducing the cost of smartphones has played a major role in improving the affordability of mobile services (GSMA, 2015a).

2.7.3 Digital literacy and local content

Digital literacy is simply emerging technology literacy (Koltay, 2011) while local content is the major portion of internet knowledge for which consumers are looking (GSMA, 2015a). In sub-Saharan Africa, there is a high level of illiteracy, especially among the rural population. About 40% of adults in the region have low or no basic knowledge of the mobile internet. This has a big negative impact thereby hindering the adoption and diffusion of mobile services. Local content packages involve mostly hyper-local information, such as commodity prices relevant to local requirements.

MNOs are working to address the issues of awareness, as well as supporting programmes to boost digital literacy. In Nigeria, Airtel launched a literacy and content promotional programme known as “Boost ICT Usage in Rural Areas” to offer basic knowledge of mobile internet services to underserved and rural consumers. This programme teaches the consumers about smartphones, their usage and internet services. It helps to overcome the barrier and promotes adoption and diffusion of mobile services in rural communities (Biztech Africa, 2015).

The innovation of the mobile network enables the expansion of network connectivity even to the rural areas of Africa and this, in turn, provides access to and use of mobile services. In effect, most of the activities are being performed through one or more mobile apps associated with them. The adoption and usage of mobile app services have significantly contributed to African transformation. In the next section, the contributions of mobile app services will be discussed in detail.

2.8 Contribution of mobile applications to African transformation

Significantly, mobile app innovation is contributing to the transformation of African society. The diffusion of mobile services is rapidly growing across African nations more than every other core infrastructure (Kearney, 2011). As a result, many mobile applications are being developed by African software developers to address the needs of Africans in different aspects including economic, social, agricultural, banking, education, healthcare, and political (Shaikh & Karjaluoto, 2015, Qiang *et al.*, 2012, Murugesan, 2013, Kearney, 2011, Hellström & Tröften, 2010, Beger *et al.*, 2012, Salehan & Negahban, 2013, Taylor *et al.*, 2011). Each of these will now be discussed in more detail.

2.8.1 Economic contribution

Mobile technology innovation has made an immense contribution to economic development in Africa. The uptake of mobile app services across African countries has resulted in an increase in the gross domestic product (GDP) of about 3% and at country level, it ranges from 0.7% in Sudan to 6.0% in Senegal. The GDP is one of the primary measurements of the strength of a country's economy (Kearney, 2011). Studies have shown that there is a direct correlation between mobile diffusion and GDP (Kearney, 2011, Gruber & Koutroumpis, 2011, Bohlin *et al.*, 2010). Furthermore, Kearney (2011) reported that for every 10% increase in mobile services diffusion there is a 0.81% increase in the GDP of developing countries whereas in developed countries GDP increases by 0.6%.

There is a noticeable contribution by mobile communication delivery to regional economic growth. The mobile ecosystem has greatly improved the productivity of individuals who apply mobile technologies in their daily activities. It facilitates several work activities, especially with regard to aspects of communication and service delivery (Kearney, 2011). For instance, a chief executive can pass instructions to workers while he is away, doctors can attend to patients and technicians can render support services through mobile application services. Studies have shown that a mobile ecosystem contributes about 3.5% in the GDP growth of African countries (Smith & Elder, 2010, Kearney, 2011).

However, the mobile ecosystem is also a major provider of employment in Africa. Holistically, the ecosystem for mobile services comprises five main groups: infrastructure vendors and support services, the MNOs, mobile device producers, marketing agents, and content and service providers. These aspects of the mobile ecosystem are potential employers of labour and as of 2010, 5.4 million people are directly and indirectly employed in the mobile ecosystem (Kearney, 2011). The GSMA reported that the mobile sector facilitates the creation of more jobs, particularly by the organisation in the supply chain. Companies that offer some services as production inputs to the mobile sector will engage more people due to the rise in the demand by the mobile sector. In 2014, about 2.4 million jobs were indirectly created in this form (GSMA, 2015a).

The mobile ecosystem also contributes greatly to public finances at several levels, such as VAT/indirect tax, corporate tax, social security taxes of direct and indirect employees, income tax and regulatory fees (universal service fees). In addition, MNOs contributed to public finances through the buying of spectrum license fees. A specific beneficiary was Egypt's public finances which received USD 1758 million as a result of its 3G auction in 2007 (Kearney, 2011).

The mobile industry is the main contributor to the economic growth of nations across Africa (Hellström & Tröften, 2010, GSMA, 2018). More than its direct contribution, the mobile industry has an important impact on other industries inside and outside the mobile ecosystem. It significantly improves the economy, generates substantial direct and indirect employment, and contributes to public finance to empower governments to accomplish their national development aims. As governments consider policies to improve their economies and societies, they must consider the mobile industry as an enabler of development outside its instant revenues. Investing in, and creating the conditions for increased participation in the mobile industry will move economic development far beyond its direct domain (Kearney, 2011).

2.8.2 Social contribution

The invention of mobile apps has meaningfully transformed the way we live and it has become an inseparable portion of our lives. Several people (particularly the youth) use mobile applications on a daily basis. With the introduction of smartphones, people use their phones on-the-go for a variety of tasks, including calling, texting, internet browsing, navigation, gaming and social networking. In recent years, the popularity of social networking services has grown so fast that they provide their subscribers with various ways of communicating, including via the web, by e-mail and chatting. Some of these social networking mobile applications that have contributed immensely in improving communication among people are Facebook, Twitter, Instagram, 2go, Simfy Africa, WhatsApp and other instant messaging applications (Salehan & Negahban, 2013, Kayastha *et al.*, 2011, GSMA, 2015a).

2.8.3 Agricultural contribution

In sub-Saharan Africa, most of the rural population depend on subsistence farming and they lack access to vital agricultural information, training and proven farming practices. Mobile app services provide a new prospect to bridge this gap and to link the farmer with up-to-date agricultural information. In Kenya, for instance, about 70% of the population are farmers. M-Kilimo was created by the GSMA Development Fund to help in providing necessary agricultural information and advice to farmers. This helpline expert offers improvement service to farmers on four main topics of inquiry, including agricultural tips and efficient farming practices, questions on plant and animal diseases and treatment, agriculture-specific weather forecasts and market price information. With dialogue between the farmers and helpline experts, most of their problems are resolved on call (Murugesan, 2013, Kearney, 2011, Hellström & Tröften, 2010).

2.8.4 Banking contribution

From a banking perspective, mobile banking applications have revolutionised financial services to the extent that customers can sit in the comfort of their homes and perform all their transactions freely, thereby saving time and money. Money transfer services have been launched in several African countries, such as Nigeria, Ghana, Kenya, Tanzania, Uganda, and South Africa. M-Pesa is a mobile money transfer application used mostly in East Africa to transfer money to people even in rural areas where there is no bank branch. In Ghana, Tigo Ghana’s “Life Care” is a mobile application service that provides insurance transactions (Kearney, 2011, Murugesan, 2013). Similarly, in South Africa, FNB created the eWallet mobile application that enables their clients to transfer money by SMS to people, including those without a bank account. With a personal identification number (PIN) and the phone number the recipient can collect the money from his/her nearest FNB automatic teller machine (ATM). Besides offering larger stability to low-income groups, research has proved that mobile banking services always serve as an entrance to more formal banking services. According to Mbiti and Weil (2011), the introduction of M-Pesa has led to a 58% increase in the number of Kenyans who have bank accounts. These innovative mobile services therefore not only offer an instant service to the poor, but they also facilitate the on-going growth in the broader economy (Mbiti & Weil, 2011, Kearney, 2011).

2.8.5 Educational contribution

Education is widely considered to be the greatest long-term scheme to develop the standards of living for the poor. M-learning initiatives enable education and learning in rural locations, by providing assistance to schools in areas where schools are scarce and access to education is limited. This limitation may be because of factors, such as the cost of education and the anticipation that children may take on child employment, as well as language and social barriers. Mobile learning application services aid in resolving these issues by making education accessible and tailored to individual learning conditions. It helps in resolving gender inequality in education, mostly in developing countries by providing a safe learning environment for women so that they can learn within their homes and communities. In addition, m-learning services provide valued assistance to professionals in on-the-job training. For example, in the UN's Millennium Villages, such as those in Uganda, Rwanda and Kenya, Community Health Workers (CHW) have access to m-learning modules on their mobile phone (Kearney, 2011, Hellström & Tröften, 2010).

2.8.6 Health care contribution

From a health perspective, mobile app services are evolving as a significant tool to enhance the provision of health care across Africa and is presently being used in many areas, such as capturing and analysing data for disease surveillance, providing remote diagnoses via telemedicine, supporting community health workers in gathering and managing health information, improving access to health education, information and resources through health hotlines, and coordinating drug and medical supply distribution. In many African nations, mobile apps have been developed and used to manage the health care system. In Nigeria and Ghana, applications have been developed and deployed to allow users to check the genuineness of drugs. GlaxoSmithKline is one of the current pharmaceutical companies to join the initiative, which assists consumers in sending a code printed on the drug packet by SMS and getting a response, either validating the genuineness of the drug or cautioning that the product may be fake and providing a helpline number to call for advice (Murugesan, 2013, Kearney, 2011).

2.8.7 Political contribution

Mobile communication has emerged as a means of disseminating political discourse among network ties (Campbell & Kwak, 2011). As the fastest diffusing medium ever, its contribution to politics is significant in making citizen journalism, reporting and crowd-sourcing increasingly popular in developing countries. Ushahidi (meaning witness) is a mobile app created to enable users to collect and spread information using mobile phones. It is a free and open-source platform that enables users to download and crowd-source information through multiple channels, such as SMS, Twitter, the Web and e-mail. It was purposefully built in 2008 during the Kenyan election. With the aid of Google Maps and SMS, the mobile app can show the hotspot map of any violence. Globally, it has been used in other real-time circumstances such as Haiti earthquake and has advanced into three associated products for democratising information, increasing transparency, and lowering barriers to sharing stories (Murugesan, 2013). Other than the traditional communication channels of TV, radio and the press, mobile apps have enhanced means of communication between government and the people, as well as between individuals. The application of mobile technology as a means of communication in the political environment has significantly improved human rights, democracy and good governance in Africa (Poblet, 2011, Hellström, 2011).

Murugesan (2013) points out several trends that support mobile applications in transforming lives in Africa, including:

- Improvements in mobile technologies.
- The development of novel mobile applications of value and relevance to people.
- The integration of mobile apps with back-end information systems.
- The constant growth in coverage of mobile cellular networks.
- The preparedness of enterprises (both domestic and global) to deploy the essential information technology infrastructure and mobile apps at an affordable cost.
- Increased user acceptance of mobile applications.

The above-described contributions of mobile apps to African development are summarised in Figure 2.3.

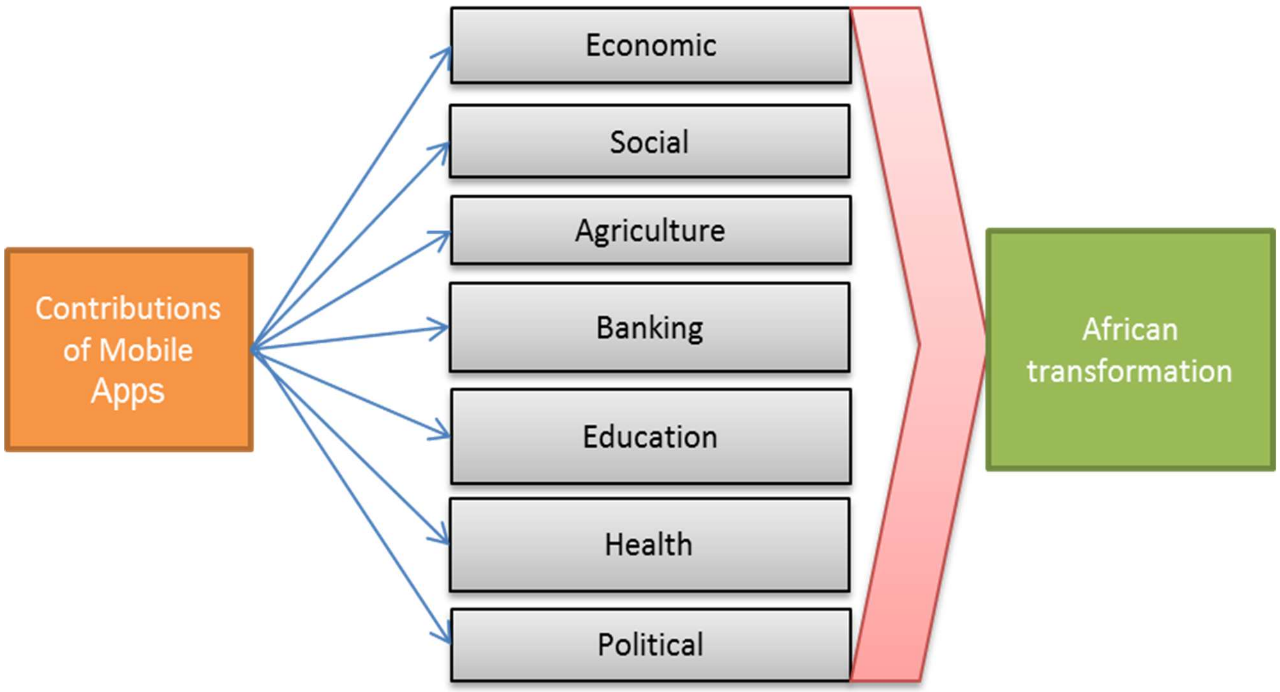

Figure 2.3: Contributions of mobile apps to African development

These contributions of mobile apps are significant to socio-economic development in Africa. The adoption and diffusion of mobile app innovation facilitate the widespread benefits from the mobile app services among the individuals of the social system. Despite these contributions, there are a few negative issues connected to mobile apps adoption and diffusion, including security and privacy of information, and criminal activities associated with the use of mobile apps. For instance, in using M-commerce, users are expected to input some of their banking details. Internet hacking attempts, such as spoofing, spam and pharming are the negative sides of the adoption and diffusion of mobile apps (Whitman & Mattord, 2011). The question is, however, what are the factors that determine the adoption and diffusion of the mobile app in Africa? This will be discussed in section 2.9.

2.9 Factors that determine the adoption of mobile applications

Mobile technology and mobile apps have gained wide-spread acceptance both for personal and business use and are used extensively for different tasks, namely in commerce, for social purposes, for communication, etc. The adoption and diffusion, as well as the growth of mobile devices in Africa are resulting in rapid and simultaneous widespread use of mobile applications across African regions (Hellström & Tröften, 2010, GSMA, 2015a).

Research reports on information systems suggested some factors that determine the adoption and diffusion of mobile applications in Africa, including relative advantage, compatibility, complexity, trialability, observability, social influence, user perception, perceived technology reliability, facilitating conditions, demography, mobile technology efficacy, mobile technology self-efficacy, ICT anxiety and perceived financial cost (Nasri & Charfeddine, 2012, Karjaluoto *et al.*, 2010a, Joshua & Koshy, 2011, Iddris, 2013, Dagada, 2012, Bankole *et al.*, 2011, Achieng & Ingari, 2015, Lekhanya, 2013). These will be discussed in sub-sections 2.9.1-2.9.13.

2.9.1 Relative advantage

Rogers (2003) defined relative advantage as "the degree to which an innovation is perceived as being better than the idea it supersedes". Relative advantage is similar to usefulness (Moore & Benbasat, 1991). Dagada (2012) stated that usefulness and ease of use are essential in the acceptance of mobile banking services in South Africa. Riquelme & Rios (2010) identified perceived usefulness as a vital factor that influences consumers' adoption of a new invention. A study conducted in Tunisia by Nasri & Charfeddine (2012) shows that perceived usefulness plays a significant role in predicting user's intention to use internet banking. (Karjaluoto *et al.*, 2010b) wrote that the higher the perceived relative advantage of mobile technology, the more likely it will be adopted and used by the consumers. Al-Jabri & Sohail (2012) agreed that relative advantage has a positive influence on mobile application services, especially on mobile banking. Elogie (2015) reported that there is a significant relationship between relative advantage and adoption of smartphones among university students in Nigeria. Similarly, Kiura & Solomon (2012) established in their study in Kenya that there is a strong and positive relationship between relative advantage and mobile banking adoption in Kenya, that relative advantage highly influences adoption of mobile banking services. In a report on determinants of internet and cell phone banking adoption in South Africa, Brown & Molla (2015) stated that relative advantage seems to be a key factor that affects the adoption of mobile services, such as internet banking.

2.9.2 Compatibility

Compatibility is the extent to which an innovation is perceived as stable with the current values, past experiences, and desires of possible adopters (Rogers, 2003). Thus, if an innovation is compatible with the consumer's needs, then uncertainty will decrease, and the adoption rate of the innovation will rise. In a study on the adoption of e-commerce in the South African hotel industry, compatibility was found to be positively correlated to electronic commerce, that organisations would be more keen to accept technology if innovations were compatible with the environment and work practices (Mndzebele, 2013). Therefore in Africa, compatibility is considered to be a key factor that influences the adoption and usage of mobile apps services (Brown & Molla, 2015, Achieng & Ingari, 2015).

2.9.3 Complexity

Complexity is the level to which an innovation seems to be easy or difficult to learn and use (Rogers, 2003). It is negatively correlated with the rate of adoption. Thus, if an innovation (mobile app) is too difficult to understand, it will hinder users from adopting it. Complexity is similar to ease of use (Moore & Benbasat, 1991). Liu *et al.* (2010) reported that learners would be more eager to practice m-learning if the technology was easy to use. The perceived ease-to-use plays a dominant role in convincing users to accept a new mobile technology innovation with more emphasis on mobile banking (Sripalawat *et al.*, 2011, Dasgupta *et al.*, 2011). Elogie (2015) concluded that complexity influenced adoption of new technology, such as smartphones, by undergraduate students in Nigeria, while Mndzebele (2013) noted a positive correlation between complexity and the extent of adoption of electronic commerce by hotels in South Africa. Pennings (2012) also found complexity to be a significant predictor in respect of the adoption of mobile technology and stated that the adoption and diffusion of a complex innovation occur slowly.

2.9.4 Trialability

Drawing from Rogers (2003), trialability is the extent to which an innovation may be tested before adoption. It has a positive relationship with the rate of adoption such that the more an innovation is tested, the faster it can be adopted. Al-Jabri & Sohail (2012) reported that the testing of mobile banking services will reduce fear and motivate the possible customers to adopt the mobile app. Furthermore, Rogers (2003) stated that an innovation can be changed or modified by potential adopters during the trial of the innovation which in turn increases the adoption rate. Brown & Molla (2015) noted that trialability seems to influence cell phone banking in South Africa. Hence, trial of a new innovation brings conviction to the intending users and it is better to test a new technology before acquisition and adoption (Tunmibi *et al.*, 2015).

2.9.5 Observability

Rogers (2003) defined observability as "the degree to which the results of an innovation are visible to others". From the banking perspective, Al-Jabri & Sohail (2012) stated that observability is the capacity to perceive the beneficial results in using mobile banking apps, such as instant access to transactions anytime and anywhere. Furthermore, they noted that observability has a significant effect on mobile banking adoption. Observing the operations and benefits of smartphones, increases the acquisition interests of university students in Nigeria and the Republic of Benin, hence observability appears to be an important factor that influences adoption of mobile technology (Tunmibi *et al.*, 2015).

2.9.6 Social influence

According to the Unified Theory of Acceptance and Use of Technology (UTAUT), social influence is "the extent to which consumers perceive that important others (e.g., family and friends) believe they should use a particular technology" (Venkatesh *et al.*, 2012). It is based on subjective norms (Sripalawat *et al.*, 2011, Karjaluoto *et al.*, 2010b), social factors and image (Dasgupta *et al.*, 2011). Zhou *et al.* (2010) supported this factor as an important catalyst of behavioural intention to use mobile banking. In addition, Bhuasiri *et al.* (2012) stated that social influence is a relevant factor for a positive e-learning environment. The possibility of consumers accepting an innovation is also influenced by the people surrounding them (Singh *et al.*, 2010). Similarly, a study conducted in Ghana by Cudjoe *et al.* (2015) on determinants of mobile banking adoption in the Ghanaian banking industry agreed that social influence is an important determinant of mobile banking adoption, that users are influenced by their peers who first know and use an application.

2.9.7 Perceived technology reliability

This factor covers the trust, risk and credibility involved in using a new technological innovation. Perceived technology reliability is considered to be a significant factor that determines the adoption and diffusion of mobile application innovation because it involves the security of the user's privacy and property. In developing countries, such as those in Africa, consumers are still unwilling to use mobile commerce applications due to fear of the risk either exposing their bank detail for mobile banking or lack of trust in online shopping. The impact of perceived risk and credibility influence the adoption and usage of mobile banking services in Kenya (Achieng & Ingari, 2015). With the use of a social network mobile application, such as Facebook, users also doubt the protection policy of their personal information and photos. Since there is considerable negative news concerning new technology usage, several individuals are still frightened that their personal data may be stolen. In effect, there is a relation between perceived risk and adoption of mobile technology services to the extent that perceived risk deters most individuals from accepting mobile technology services (Oluoch *et al.*, 2012). Consumers are far more inclined to adopt a highly valued and reliable innovation. As a result, there is trust in the reliability of the innovation which in turn overcome the perceived risk to the safety of the user's information (Luo *et al.*, 2010). Therefore, it can be concluded that perceived technology reliability plays a significant role in adoption and usage of mobile technology services in Africa (Achieng & Ingari, 2015).

2.9.8 Facilitating conditions

According to Venkatesh *et al.* (2012), facilitating conditions are the extent to which the consumers rely on the existing organisation and technical infrastructure to support the use of the new technology. Furthermore, they indicated that facilitating conditions and behavioural intention were two direct elements of adoption behaviour. In accepting mobile technology innovation, Joshua & Koshy (2011) demonstrated that easy access to computers and the Internet improves the usage capabilities of the users. This results in a greater adoption rate of mobile technology innovation. In a study conducted in Kenya, Mtebe & Raisamo (2014) stated that facilitating conditions have a substantial positive effect on students' behavioural intention to use mobile learning.

2.9.9 Demographics

This is another factor that significantly influences the adoption and diffusion of mobile application innovation, especially in Africa. Demography includes gender, age, occupation, education level, income, and experience. Dagada (2012) reported that demographics, particularly income and age, impact on the adoption of mobile banking in South Africa. Considering gender, Koenig-Lewis *et al.* (2010) reported that a larger proportion of men use mobile banking services than women. The reason is that men seem to be more task-oriented than women and mobile application services are typically inspired by goal realisation. For instance, women perceived more risk in respect of online transactions (online banking and purchasing), while men prefer using online services, but are more concerned with service cost and cost of internet access (Cruz *et al.*, 2010). In a report on gender differences in web-based shopping, Van Slyke *et al.* (2002) stated that gender is an important factor that influences individuals intention to make purchases over the Web. (Mtega *et al.*, 2012) stated that income hinders university students in Tanzania from accessing useful m-learning applications as they are not free. Moreover, in developing countries, a higher proportion of men go to high schools than women, hence having advantage greater likelihood of using mobile services than women. Most of the users of mobile services are predominantly young and educated people with males having a higher user percentage (Karjaluoto *et al.*, 2010b, Joshua & Koshy, 2011). Drawing from the innovation of diffusion studies (Rogers, 2003), it was discovered that early adopters of technological innovations are usually younger in age, have higher incomes, are better educated, and have higher social status and occupation. In Kenya, early adopters of the mobile phone were primarily males living in urban areas (Aker & Mbiti, 2010).

2.9.10 Mobile technology self-efficacy

Acceptance and usage of an innovation is based on the user's knowledge about the product and its services. The mobile app is a mobile technological innovation which requires basic knowledge of information and communication technology (ICT) for proficiency in the use of its services. Research indicated that the higher the user's knowledge of a technology, the more proficient his/her use of that particular technology, which results in a greater adoption rate of users using the technology (Joshua & Koshy, 2011). Chen & Tseng (2012) reported that technology has transformed lives and also significantly improved the pace of life, especially in learning. People are far more eager to acquire the necessary knowledge to increase their ability to adopt and use new technologies. Mtega *et al.* (2012) confirm the impact of self-efficacy on their finding that lack of Web 2.0 skills excluded the majority of university staff and students from using social media, which are believed to improve relations and collaborations thus being appropriate for teaching and learning. Computers, smartphones and their associated mobile applications require basic knowledge of ICT skills as it enables the users to easily and effectively adapt, learn and use any new mobile app. Iddris (2013) agreed on this factor and reported that mobile apps require knowledge and learning with the emphasis on mobile banking.

2.9.11 ICT Anxiety

Rahimi & Yadollahi (2011) defined ICT anxiety as "the feeling of discomfort, apprehension and fear of coping with ICT tools or uneasiness in the expectation of negative outcomes from computer-related operations". These negative feelings have been demonstrated to have an undesirable impact on lecturers' acceptance of a technological innovation, such as e-learning mobile apps and perception of how easy it will be to use the new technology. Anxiety has also been proven to have a negative effect on lecturers' digital literacy, making it more likely for them to reject learning new ICT skills (Parayitam *et al.*, 2010, Mac Callum *et al.*, 2014).

2.9.12 Financial cost

The adoption and the use of mobile apps are associated with a degree of financial cost. According to Brown & Molla (2015), one of the major factors to consider in comparing technologies for adoption is cost. The user has to obtain a smartphone, subscribe to the wireless network for surfing the internet and pay some fees, such as bank commissions in mobile banking. All these expenses increase the user's cost (Huili & Zhong, 2011). In a study conducted in Kenya on mobile banking adoption, Achieng & Ingari (2015) concluded that the perceived impact of the financial cost is a major factor preventing people from adopting mobile banking. Iddris (2013) identified a difference between the rate of adoption of mobile banking among high-income earners and low-income earners in his study in Ghana, namely that the high-income earners do not perceive any obstacle and easily adopt the mobile apps while the low-income earners perceived obstacles and hardly adopt the mobile apps.

2.9.13 Culture

Culture is the social behaviour and norms of people in a particular society. From the perspective of human communication interface (HCI), Ford (2005) defined culture as "the patterns of thinking, feelings, and acting that influence the way in which people communicate among themselves and with the computer". Lekhanya (2013) noted that cultural factors have a significant impact on the adoption and diffusion of new social network technologies in South Africa. Cultural values play an important role in individuals' behaviour and adoption of mobile banking in Nigeria (Bankole *et al.*, 2011). In the description of the decision stage of the innovation-decision process, Rogers (2003) mentioned that culture can change the order of the innovation-decision process from knowledge-persuasion-decision to knowledge-decision-persuasion. Cultural effect is one of the influencing factors of mobile phone services (Swar *et al.*, 2009).

In Table 2.2, the research on the predicting factors of mobile apps adoption and diffusion are summarised.

Table 2.2: Summary of empirical research on the factors affecting the adoption of mobile services in Africa based on several theories referred to in this study

Author	Theory	Sample and countries	Main findings
Kiura & Solomon (2012)	DIT	171 members of staff of Equity Bank constituted the target population in Kenya.	Adoption of mobile banking has been initiated and escalated by innovation in telecommunication. Technological features play a role in the adoption of mobile banking services. Relative advantage influences adoption and use of mobile banking.
Elogie (2015)	DIT and TAM	226 undergraduate students from Ambrose Alli University, Ekpoma, Nigeria.	The findings of this study reveal that relative advantage and complexity were the only technological characteristics that explained adoption of smartphones among undergraduate students. Contrary to Rogers' theory, trialability, observability and compatibility with lifestyle could not adequately predict adoption.
Mndzebele (2013)	DIT	332 hotels in South Africa	Compatibility and complexity are predictors of the extent of adoption of electronic commerce within the hotel industry while the relative advantage is not.
Bankole *et al.* (2011)	UTAUT	231 sampled population of mobile banking customers in Nigeria	The main finding is that cultural values are playing a pertinent role towards mobile banking adoption in Nigeria. User satisfaction, utility and effort expectancy have a significant relationship with behavioural intention to use mobile banking. There is no significant relationship with trust.
Achieng & Ingari (2015)	DIT and TAM	169 account holders in Kenya commercial bank	The study concludes that cost was a key factor stopping people from adopting mobile banking. Perceived ease of use of mobile banking did not affect mobile banking adoption.
Brown & Molla (2015)	DIT	304 sampled population in South Africa	The findings indicate that both the adoption intent and the perception of Internet banking users differ markedly from cell phone banking Users.

Table 2.2 (contd.): Summary of empirical research on the factors affecting the adoption of mobile services in Africa based on several theories referred to in this study

Author	Theory	Sample and countries	Main findings
Oluoch *et al.* (2012)	TAM	300 bank customers in Kenya	This study found that perceived usefulness had a positive impact on M-banking adoption while perceived risk was found to have a negative impact.
Lekhanya (2013)	Not specified	175 business owners/managers in South Africa	Results indicate that they do consider their cultural values as most important when diffusing and adopting new social media technologies, such as Facebook, Twitter, and Mixit
Cudjoe *et al.* (2015)	DIT, TAM and TRA	150 sampled customers of Access Bank in Ghana	The study unveiled that perceived credibility and perceived financial cost were the major setbacks with regard to customers' adoption of mobile banking services. Perceived credibility and perceived financial cost have a stronger effect on consumer intention to adopt and use mobile banking service than perceived usefulness and perceived ease of use.
Tunmibi *et al.* (2015)	DIT	200 undergraduate students were sampled in Nigeria and the Republic of Benin	The findings indicate that complexity, trialability, observability and compatibility influence the adoption of smartphones by university students.
Dagada (2012)	Not specified	Sample unspecified but study is in South Africa	The study found that demographics, usefulness and ease of use affect adoption of mobile banking. Experience is not a predictor.
Nasri & Charfeddine (2012)	TAM and TPB	284 sample population in Tunisia	Perceived usefulness plays a significant role in predicting users' intention to use internet banking.

Table 2.2 (contd.): Summary of empirical researches on the factors affecting the adoption of mobile services in Africa based on several theories referred in this study

Author	Theory	Sample and countries	Main findings
Mtebe & Raisamo (2014)	UTAUT	823 students selected from five higher learning institutions in Tanzania	The results showed that four factors, namely performance expectancy, effort expectancy, social influence, and facilitating conditions had significant positive effects on students' mobile learning acceptance with performance expectancy being the strongest predictor.
Mtega *et al.* (2012)	TAM	70 sampled population, including teachers and students	The study indicated that the majority of the respondents use their cell phones for teaching and learning, including mobile apps.

The above discussion dealt with the theoretical background information of this study. A detailed description of the mobile app was provided in section 2.2. It can be observed that mobile app innovation has been developed, adopted and in use across African nations (section 2.3). African software innovators have developed different kinds of mobile app, covering various aspects of human activities, including economic, social, political, educational and health care activities as described in the classification of mobile apps (section 2.5). The influence of mobile apps in the above-mentioned areas is enabling innovation and initiating supportive start-ups to boost mobile app innovation (Section 2.6). In addition, larger populations of Africans are being connected to digital communication (section 2.7). The fast growth of mobile technology has positively contributed to the development of African nations (section 2.8). Studies have described an African mobile ecosystem (section 2.4) and identified factors affecting the adoption of mobile app innovation in Africa (section 2.9).

Obviously, there are numerous mobile app innovators in Africa, many mobile apps have been developed and are in use in Africa, mobile apps have penetrated all activities with a high adoption rate, and the adoption and diffusion in Africa are exceptional. Generally, there are many studies on mobile app innovation in Africa, primarily regarding the usage of mobile apps, the contribution of mobile apps to African development and factors that affect the adoption of mobile apps. These studies are fragmented and focus on individual types of mobile app, such as M-learning, M-banking, etc. Some of the researches focus on the adoption of mobile devices and not on mobile apps. However, there is little or no in-depth research on how mobile app innovation is being adopted and diffused in Africa and factors that influence it. There is a need for an in-depth investigation of adoption and diffusion of mobile apps in Africa. This study will conduct a holistic investigation, covering mobile apps as a whole and not just one, including all the stages of the adoption and diffusion of mobile apps.

The research findings will contribute to theory, considering that there is a scarcity of literature about the adoption and diffusion of mobile apps in Africa. It will bring greater insight to how mobile apps are being accepted and used in the African region. For the innovators, it will improve their innovation, thereby enabling them to create more successful mobile apps which can be widely adopted and used across the Africa nations and even beyond the African context. The industries will have a better understanding of the factors that will enhance the adoption of their mobile apps and work towards improving their operations and productivity.

2.10 Chapter summary

In this chapter, a detailed discussion of mobile application adoption and diffusion, especially in Africa, was presented, covering the definition of mobile apps, evolution and development of mobile telecommunications in Africa, description of mobile apps, mobile ecosystem, classification of mobile applications, mobile enabling innovation and inclusion, effect of mobile applications on African transformation with the emphasis on economic, social and governmental environments, and factors that influence the adoption and diffusion of mobile apps.

This study entails the investigation of the adoption and diffusion of mobile application innovation in Africa, using a scientific theory, namely the Diffusion of Innovation theory proposed by Rogers in 2003. There are other theories or models that have been effectively and successfully used in information technology research and reflecting on these theories or models will create more awareness of various scientific theories.

In Chapter 3, the focus will be on the description of the theories/models used in conducting information systems research and a detailed review of the diffusion of innovation theory will be discussed, including some technological studies performed with regard to the application of the theory.

Chapter 3

Theories used in information technology

3.1 Introduction

Several theoretical perspectives have been proposed for research purposes in the information system domain. These theories have been used to conduct research on various aspects of information systems (Lule *et al.*, 2012). Some of the theories used in related studies that can be applied to the study will be discussed and compared for the purpose of this study. For example: the Expectation-Confirmation Model (ECT) (Bhattacherjee, 2001), the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1977), the Theory of Planned Behaviour (TPB) (Ajzen, 1991), the Technology Acceptance Model (TAM) (Davis, 1989), the Unified Theory of Acceptance and Usage of Technology (UTAUT) (Venkatesh *et al.*, 2003), the Social Cognitive Theory (SCT) (Bandura, 1986), and the Diffusion of Innovation Theory (DIT) (Rogers, 2003). Brief details of these theories are described in the following sections:

- Section 3.2 – The Theory of Reasoned Action (TRA)
- Section 3.3 – The Technology Acceptance Model (TAM)
- Section 3.4 – The Theory of Planned Behaviour (TPB)
- Section 3.5 – The Expectation Confirmation Theory (ECT)
- Section 3.6 – The Unified Theory of Acceptance and Use of Technology (UTAUT)
- Section 3.7 – The Social Cognitive Theory (SCT)
- Section 3.8 – Overview of the Diffusion of Innovation Theory (DIT)
- Section 3.9 – Diffusion theory and mobile applications
- Section 3.10 – Research conceptual model
- Section 3.11 – Chapter summary

3.2 Theory of Reasoned Action (TRA)

The TRA was developed by Martin Fishbein and Icek Ajzen in 1967 from the results of earlier research that began as the theory of attitude. It is among the three main classic persuasion models of psychology, which is also applied in communication discourse as a theory of understanding persuasive messages. The main goal of the theory is to describe the correlation between attitudes and behaviours within the human action, which in turn is used to predict how people behave based on their pre-existing attitudes and behavioural intentions (Fishbein & Ajzen, 1977). Ajzen and Fishbein propose two factors that control intention: attitudes and subjective norms. An attitude is a person's view of whether a behaviour is positive or negative, while a subjective norm is a seeming social pressure arising from one's view (Colman, 2015). In 1992, the TRA theorists identified three conditions that can affect the correlation between behavioural intention and behaviour including the measure of intention that must correspond with respect to their levels of specificity, stability of intentions between time of measurement and performance of behaviour and the degree to which carrying out the intention is under the volitional control of the individual (Madden *et al.*, 1992). The TRA has been used to conduct an investigation of mobile technology adoption and diffusion (Mishra *et al.*, 2014, Bhuasiri *et al.*, 2012, Alwahaishi & Snásel, 2013).

Though the model has done very well in predictions of aims and actions, relating a clear opinion among alternatives, studies have challenged and found some major problems with the TRA, including unawareness of the relations between people, both the interpersonal and social relations in which they act, and the limit of social structures which rule social practice (Yousafzai *et al.*, 2010, Terry *et al.*, 1993),

3.3 Technology Acceptance Model (TAM)

The technology acceptance model (TAM) is an information systems theory developed by Davis Fred in 1989. It models how users come to adopt and use a technology. The TAM was adopted from the theory of reasoned action (TRA). The TAM changes many of the TRA's attitude measures with the two technology acceptance measures, namely ease of use, and usefulness. The model proposes that when consumers are offered a new technology, several factors influence their choice about how and when they will use it, particularly perceived usefulness – the extent to which an individual believes that using a particular technology would improve his/her work performance and perceived ease-of-use – the extent to which an individual believes that using a particular technology would be easy to use (Davis, 1989). Several researchers have applied the TAM to offer empirical proof of the relations that exist between usefulness, ease of use and system use (Venkatesh *et al.*, 2012, Lule *et al.*, 2012, Lin, 2011, Edmunds *et al.*, 2012).

Although the TAM has been widely used, it has also been widely criticised in various ways, including its doubtful empirical value, inadequate descriptive and analytical power, triviality, and lack of any practical value (Venkatesh *et al.*, 2012, Lee *et al.*, 2012b, Chuttur, 2009, Chung *et al.*, 2010).

3.4 Theory of Planned Behaviour (TPB)

In 1985, Icek Ajzen proposed the theory of planned behaviour which was adopted from the theory of reasoned action. Ajzen introduced the theory of planned behaviour by adding a new factor, "perceived behavioural control". In this way, the TRA is extended to include non-volitional behaviours for predicting behavioural purpose and real behaviour (Ajzen, 1991). The TPB has been used in various studies to investigate relations among beliefs, behavioural intentions, attitudes, and behaviours in several fields, including technology, public relations, education and health care (Yousafzai *et al.*, 2010, Lee *et al.*, 2010, Heirman & Walrave, 2012, Cheon *et al.*, 2012).

The TPB has been criticised on the grounds that it is based on cognitive processing. The TPB does not clearly specify that attitudes are formed intentionally or that evaluation of beliefs is not subjective to emotions. There is also no mention of where beliefs and their assessments come from, hence there is no base for excluding emotion from its claims (Venkatesh *et al.*, 2012, Sniehotta *et al.*, 2014).

3.5 Expectation confirmation theory (ECT)

The ECT was developed from two articles by Richard L. Oliver in 1977 and 1980 (Oliver, 1980, Oliver, 1977). It seeks to describe post-purchase or post-adoption satisfaction as a function of expectations, perceived performance, and disconfirmation of beliefs. Originally the ECT was used only in psychology and marketing literature, but now it has been applied to scientific fields, including information systems (IS) (Venkatesh *et al.*, 2012, Lin *et al.*, 2012). The ECT comprises four constructs, namely expectations, perceived performance, disconfirmation of beliefs and satisfaction. Expectation is the user's anticipation of a product, service or technology artifact. Perceived performance refers to a user's views of the real performance of a product, service, or technology artifact. Disconfirmation of beliefs refers to user's decisions over a product, service, or technology artifact. Satisfaction refers to the degree of a user's contentment with a product, service, or technology artifact after personal usage (Bhattacherjee, 2001).

The ECT is mostly used in IS research to investigate cognitive beliefs and affect influencing consumer's intention to continue using IS (Bhattacherjee, 2001). Hossain & Quaddus (2012) noted that using the ECT in IS study, the dependent variable (continue usage intention) is consistent, while the independent variables are logically varied as they are measured from contextual viewpoints. As a result, there is no general agreement relating to the definition, associations and measurement methods of the ECT constructs.

3.6 Social Cognitive Theory (SCT)

The Social Cognitive Theory is an educational theory built on the idea that people study by observing others. These learned behaviours can be fundamental to one's personality. The social psychologists believe that the place or environment where an individual grows up, affects the person's behaviour. In SCT, the individual person and the environment where he/she lives are important. People learn by witnessing others, with the environment, behaviour, and cognition all as the principal elements in influencing development in a mutual triadic association. For instance, every observed behaviour can change an individual's manner of reasoning (cognition). Likewise, the environment in which one grows up may impact on future behaviours, just as a father's mind-set (also cognition) decides the environment in which his children are raised (Bandura, 2002, Bandura, 1986).

The primary ideas of this theory can be described by Bandura's schematisation of the triadic reciprocal relationship. The schema indicates how the duplicate of an observed behaviour is subjective to the relations of three factors, including personal, behavioural and environmental factors. The social cognitive theory is used today in several areas, such as mass media, public health, education, marketing, and communication (Bandura, 2002, Bandura, 1986).

The SCT is so broad and therefore has been criticised for lacking a unifying principle or structure and it is difficult to apply all the aspects of the theory at one time. The SCT claimed that behaviour is mainly learned, and it has been argued that some behaviour is as a result of emotional responses. For instance, jealousy makes one act in an abnormal way. Additionally, the SCT does not recognise genetic differences that could lead to inconsistencies between people's cognitive abilities and behaviour (Flamand, 2009).

3.7 Unified Theory of Acceptance and Use of Technology (UTAUT)

(Venkatesh *et al.*, 2003) developed the unified theory of acceptance and use of technology (UTAUT). They conducted reviews and comparisons of eight models, including the theory of reasoned action, the technology acceptance model, the motivational model, the theory of planned behaviour, a model combining the technology acceptance model and the theory of planned behaviour, the model of PC utilisation, the innovation diffusion theory, and the social cognitive theory. Using elements of these models, they empirically formulate the unified model. The UTAUT is proposed to describe user intentions to use an information system and consequent practice performance. The theory comprises four main constructs: 1) performance expectancy, 2) effort expectancy, 3) social influence, and 4) facilitating conditions. The first three are direct factors of usage intention and behaviour, and the fourth is a direct factor of user behaviour. Gender, age, experience, and voluntariness are used as the moderator to the constructs on usage intention and behaviour. The theory was developed through a review and consolidation of the constructs of eight models that earlier research had employed to explain information systems usage behaviour. To validate this model, Venkatesh *et al.* (2003) performed a longitudinal study and the finding indicated that the model accounted for 70% of variation in behavioural intention to use and 50% in real use.

The UTAUT presented a thoughtful and well-meaning prototype, but it presents a model with many independent variables for predicting intentions and behaviour. This resulted in making the study of technology adoption becoming confused. The theory created an opening for every splinter of knowledge to describe decision making (Bagozzi, 2007). Scholars also condemn the grouping and labelling of many items and constructs and considered it to be problematic (Van Raaij & Schepers, 2008).

3.8 Overview of Diffusion of Innovation Theory (DIT)

The process of accepting a new idea, product, service or technology has been studied for many decades across the globe using these theories or models (Lule *et al.*, 2012). The DIT is one of the most popular adoption models used in studying the adoption and diffusion of products from a broad variety of disciplines, including education, politics, health, economics, communication and technology. The DIT aids in describing the adoption procedure of an innovation by modelling the whole process according to the aspects of communication and human information relations. Hence, diffusion theory offers valued perceptions into the access, acceptance, circulation, and usage of mobile applications (Chang, 2010).

Rogers' diffusion of innovation theory is the most suitable for studying the acceptance of technological innovations (Chang, 2010). For Rogers, diffusion research involves technological innovations, so he uses the words "technology and innovation" synonymously. According to (Rogers, 2003), "*a technology is a design for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving the desired outcome*". It involves two parts: hardware and software. While the hardware is "*the tool that embodies the technology in the form of a material or physical object,"* software is *"the information base for the tool*" (Rogers, 2003).

Furthermore, adoption is a choice of complete use of an innovation as the greatest available means of action and rejection is a choice not to accept an innovation. The diffusion of innovation theory describes the process by which an idea or practice is communicated through certain channels over time among the members of a social system (Rogers, 2003). From this definition, the theory comprises four main elements, including innovation, communication channels, time and social system. The overview of the DIT covers elements of the DIT, innovation-decision process, attributes of innovation and rate of adoption, adopter categories and studies conducted based on Rogers' theory. These are described in sub-sections 3.8.1-3.8.5.

3.8.1 Four Main Elements in the Diffusion of Innovations

These are the four key components of the DIT, namely

Innovation

Rogers presented the following explanation of an innovation: "*An innovation is an idea, practice, or project that is perceived as new by an individual or other units of adoption*" (Rogers, 2003). An innovation may have been developed for a long time, but if people perceive it as new, then it becomes an invention for them. The newness feature of an adoption is more associated with the three stages of knowledge, persuasion, and decision of the innovation-decision process. Additionally, Rogers claimed there is a lack of diffusion research on technology clusters. A technology cluster contains more than one different component of technology that seems to be closely interconnected (Rogers, 2003).

The major significant difficulty in accepting a new idea is uncertainty. The consequences of an innovation may result in uncertainty: "*Consequences are the changes that occur in an individual or a social system as a result of the adoption or rejection of an innovation"* (Rogers, 2003*)*. To decrease the uncertainty of accepting an innovation, people should be educated about its benefits and drawbacks to make them conscious of all its consequences. Moreover, Rogers stated that consequences can be categorised as direct versus indirect (immediate result or result of the immediate result), desirable versus undesirable (functional or dysfunctional), and anticipated versus unanticipated (recognised and intended or not) (Rogers, 2003).

Communication Channels

A communication channel is the second component of the diffusion of innovation process. As defined by Rogers (2003), communication is "*a process in which participants create and share information with one another in order to reach a mutual understanding*." This communication happens via channels between sources. Source is defined as a person or an institution that creates a message. A channel is the way through which a message gets from the source to the receiver. Rogers states that diffusion is a unique type of communication with the following components: an innovation, two individuals or other units of adoption, and a communication channel. There are two kinds of communication channel: mass media and interpersonal communication channels. Mass media channels include TV, radio, or newspaper, and interpersonal channels consist of a two-way communication between two or more individuals. In other words, diffusion is a social process that comprises relational communication associations. Hence, interpersonal channels are more influential to develop/transform individuals' strong characters. Interpersonal channels consist of homophilic characteristics, which means the extent to which two or more individuals who interrelate are alike in certain attributes, such as beliefs, education, and socioeconomic status, but the diffusion of innovations entails at least some extent of heterophilia, which is the extent to which two or more individuals who interrelate are different in certain attributes. In fact, one of the major challenges in spreading innovations is that the individuals are relatively heterophilous (Rogers, 2003).

Communication channels are classified into two types: localite channels and cosmopolite channels. While localite channels involve interactions between the members of the local social system, cosmopolite involves interactions with outside sources. Most mass media channels are cosmopolite and interpersonal channels comprise both. As a result of the characteristics of these communication channels, mass media channels are more important at the knowledge stage and interpersonal channels are more important at the persuasion stage of the innovation-decision process (Rogers, 2003).

Time

(Rogers, 2003) stated that researchers tend to ignore the time aspect in most of the studies on human behaviour. He contended that involving the time dimension in diffusion study demonstrates one of its powers. The innovation-diffusion process, adopter categorisation, and rate of acceptances all involve a time dimension.

Social System

The last component in the diffusion process is the social system which is defined as a set of interconnected entities involved in mutual problem solving to achieve a common objective. Since diffusion of innovations occurs in the social system, it is subjective to the social structure of the social system. According to Rogers (2003), structure is the systematic plan of the components in a system. He further claimed that the nature of the social system affects peoples' innovativeness, which is the key condition for classifying adopters.

3.8.2 The innovation-decision process

According to Rogers (2003), the innovation process is an information-seeking and information-processing activity whereby a person is inspired to lessen uncertainty about the benefits and drawbacks of an innovation. The process involves five stages, namely 1) knowledge, 2) persuasion, 3) decision, 4) implementation, and 5) confirmation. These stages move consecutively in a sequential time-order style as shown in Figure 3.1.

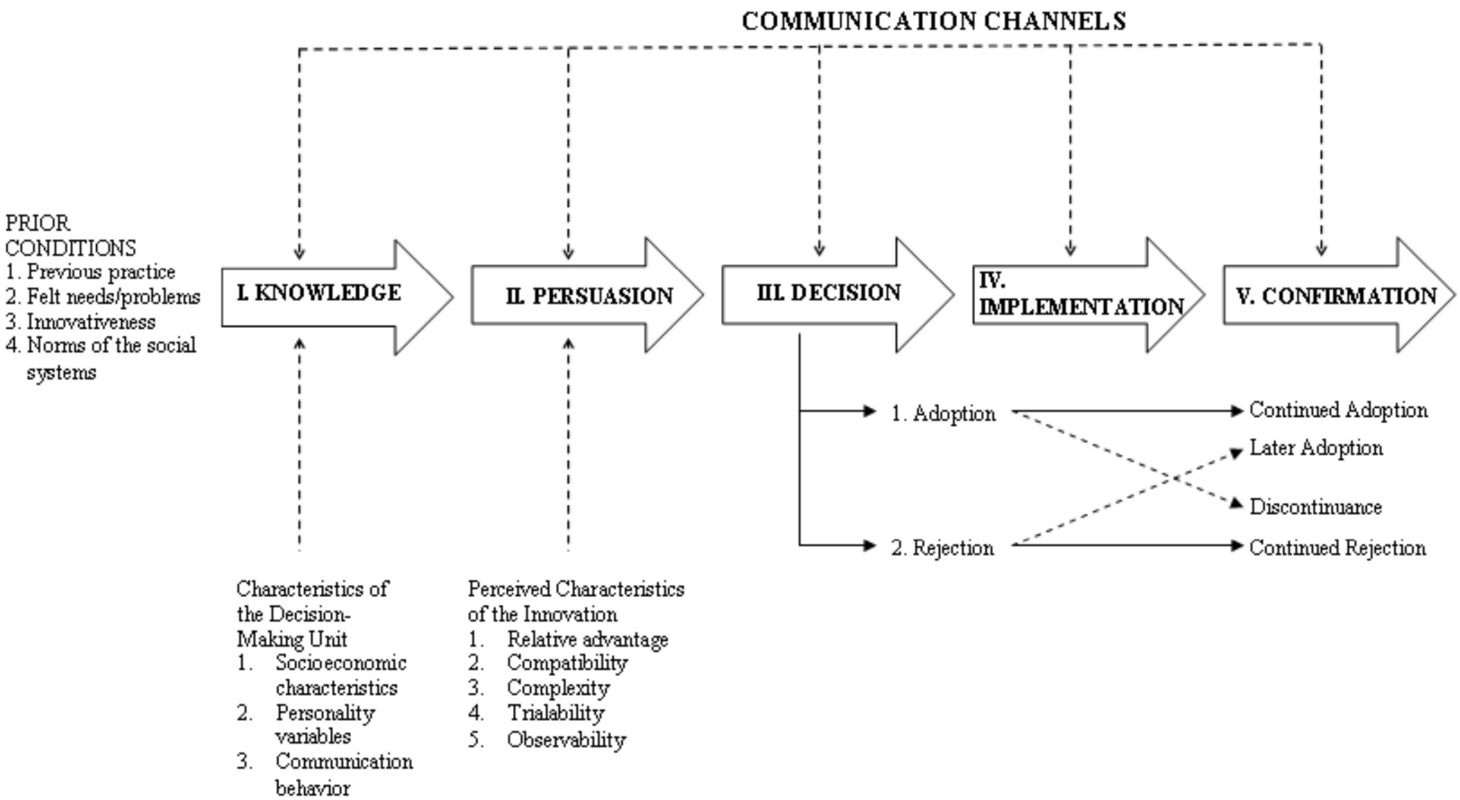

Figure 3.1: Five stages in the innovation-decision (Rogers, 2003).

The five stages of the innovation-decision process will now be discussed in more detail.

The knowledge stage

The innovation-decision process begins with the knowledge stage. At this point, a person acquires the information about the existence of innovation and searches for knowledge about the innovation. “What?”, “how?”, and “why?” are the serious queries in the knowledge phase. In this stage, the individual tries to decide “what the innovation is and how and why it works”. These questions form three kinds of knowledge; awareness-knowledge, how-to-knowledge, and principles-knowledge (Rogers, 2003).

- Awareness-knowledge: Awareness-knowledge signifies the knowledge of the presence of an innovation. This kind of knowledge can inspire the individual to study more about the innovation and, finally, to accept it. It may encourage an individual to investigate the other two types of knowledge.
- How-to-knowledge: this contains information about how to use an innovation correctly. In the adoption and diffusion of an innovation, it is very crucial for an individual to gain

proper knowledge of how to effectively use the innovation. For example, a faculty with the technical background may not effectively use a technology in teaching, unless it obtains the knowledge of how to use it correctly. Thus, technology can only be used at the expected level if and only if the individual acquires the how-to-knowledge of the technology. Hence this knowledge is a vital variable in the innovation-decision process, and to increase the acceptance chance of an innovation, an individual should have a sufficient level of how-to-knowledge prior to the trial of the innovation.

- Principles-knowledge: This knowledge involves the operational principles explaining how and why an innovation works. An innovation can be adopted without this knowledge, but the misapplication of the innovation may result in its discontinuance. To build new knowledge, technology education and usage should offer both how-to experience and know-why experience. In fact, an individual may have all the necessary knowledge, but this does not mean that the individual will accept the innovation because the individual's attitudes contribute in the acceptance or refusal of the innovation.

The Persuasion Stage

The persuasion stage happens when the individual has a negative or positive attitude toward the innovation, but the creation of an advantageous or disadvantageous character toward an innovation does not continuously lead directly or indirectly to acceptance or refusal. In the innovation decision-making process, the persuasion stage follows knowledge stage because immediately after an individual acquires the information about an innovation, he/she will prepare him/herself for the innovation. In addition, the knowledge stage is more cognitive- (or knowing-) centred, and the persuasion stage is more affective- (or feeling-) centred. Thus, at the persuasion stage, the individual is committed to reasoning about the innovation. The extent of doubt about the innovation's working and the social support from others (colleagues, peers, etc.) affect the individual's feelings and beliefs about the innovation. Generally, the experts release information about a new innovation to the social system, hence opinions of trusted close peers towards an innovation are most convincing to an individual's decision making (Rogers, 2003).

The Decision Stage

The decision stage in the innovation-decision process is simply an individual verdict stage. At this point, the individual makes his/her choice, either to adopt or to reject the innovation. Adoption implies accepting an innovation as the best alternative and putting it into complete active usage, while rejection implies the total refusal of an innovation. Often times, an innovation may have a partial trial base, whereby it can quickly be adopted because most people have the opportunity to try it on their own conditions and then decide to adopt the innovation. The trial of an innovation quickens the innovation-decision process, though rejection is still possible in this situation. There are two types of rejection: active rejection and passive rejection. Active rejection refers to the discontinuance decision, which is rejection after adoption. An individual may try an innovation and decide to adopt it, but later he/she may change his/her decision and reject it. Passive rejection is referred to as the non-adoption position; the individual does not consider accepting the innovation at all. It is a direct total rejection situation. Furthermore, previous studies on diffusion could not clearly differentiate these types of rejection. In some situations, people's culture can change the innovation-decision order from knowledge-persuasion-decision to knowledge-decision-persuasion, especially when a decision is done collectively instead of personally. Whatsoever the case may be, the implementation phase comes after the decision phase (Rogers, 2003).

The Implementation Stage

The Implementation Stage is the practice phase of the innovation-decision process. At this stage, the innovation is put into use. However, an innovation comes with newness in which some extent of doubt is included in diffusion. Though this is a practice stage, there can still be some elements of uncertainty about the results of the innovation which may be problematic. Therefore, there may be a need for technical assistance from change agents and others during implementation in order to decrease the extent of uncertainty about the implications. If the innovation loses its unique characteristic quality as the distinct identity of the innovation vanishes, the innovation-decision process will stop, and reinvention occurs. Most often, reinvention normally occurs at the implementation stage. The extent to which a new idea is modified by a consumer in the course of its acceptance and application is referred to as reinvention. Thus, the more reinvention occurs, the sooner an innovation is accepted and comes to be established. As innovations, computers are the tools that contain several likely chances and uses, so computer technologies are more exposed to reinvention (Rogers, 2003).

The Confirmation Stage

At this stage, the individual has made the innovation-decision, but looks for support for his/her decision. However, the decision can be reversed if the individual notices any contradictory information about the innovation. The individual will be more likely to avoid this information and try to get helpful messages that endorse his or her decision. Thus, attitudes become more important at the confirmation stage. Subject to the backing for acceptance of the innovation and the approach of the individual, later adoption or discontinuance occurs within the period of this stage. Rejection or discontinuance may possibly happen at this stage in two ways including replacement discontinuance and disenchantment discontinuance. Replacement discontinuance occurs when the individual discards the innovation to accept more enhanced innovation replacing it, and disenchantment discontinuance occurs when the individual discards the innovation because of unsatisfactory performance and not meeting the user's needs and expectations. It does not deliver a perceived relative advantage, which is the first attribute of innovations and impacts on the rate of adoption (Rogers, 2003).

3.8.3 Attributes of Innovations and Rate of Adoption

According to Rogers (2003), the innovation-diffusion process is "an uncertainty reduction process," and he suggests five attributes of innovations that help to reduce uncertainty about the innovation, including: 1) relative advantage, 2) compatibility, 3) complexity, 4) trialability, and 5) observability. He stated that people's perceptions of these characteristics determine the adoption rate of the innovation. Although there are many studies on the attributes of the adopter categories, there are few studies on the impact of the perceived attributes of innovations on the rate of adoption.

As defined by Rogers (2003), the rate of adoption is "the relative speed with which an innovation is adopted by members of a social system." For example, the number of people who accept the innovation within a given time can be considered as the rate of adoption of the innovation. The important predictors of the rate of adoption are the five characteristics of the innovation which described 49-89% of the difference in the rate of adoption of innovations. Additionally, the predictability of innovations adoption rate may include, the innovation-decision type (optional, collective, or authority), communication channels (mass media or interpersonal channels), social system (norms or network interconnectedness), and change agents. For example, the adoption of a personal and optional innovation-decision normally occurs faster than that of a collective or organisational innovation-decision. Relative advantage is the highest predictor of the rate of adoption of an innovation. Each of the five attributes will be discussed briefly.

Relative Advantage

Relative advantage is the extent to which an innovation seems to be better than another, especially the one it supersedes. The cost and social status incentive features of innovations are components of relative advantage. For example, while innovators, early adopters, and the early majority are more status-motivated for accepting innovations, the late majority and laggards perceive status to be less important. Rogers classified innovations into two categories: preventive and incremental (non-preventive) innovations. A preventive innovation is a new product that a user adopts to reduce the possibility of some undesirable future event. The relative advantage of a preventive innovation is highly uncertain which results to the low rate of adoption. An incremental innovation is a new product that offers favourable outputs within a short period. Its relative advantage is highly certain, and the adoption rate is faster. To increase the rate of accepting innovations and to make relative advantage more active, direct or indirect, financial payment motivations may be applied to help the people of a social system in accepting an innovation. Incentives and compatibility attributes are aspects of help and motivation factors in the diffusion process.

Compatibility

In some diffusion investigation, relative advantage and compatibility were observed as similar, although they are abstractly dissimilar. Compatibility is the extent to which an innovation is perceived to be reliable with the current values, past experiences, and requirements of possible adopters. A dearth of compatibility in IT with individual requirements may adversely influence the individual's IT use. Innovation was explained to have some degree of influence on teachers' opinions, beliefs, values, and perceptions about teaching. If an innovation is compatible with an individual's requirements, then uncertainty will reduce and there will be an increase in the rate of adoption of the innovation. Thus, even identifying the innovation is a significant aspect of compatibility. An innovation should be given a meaningful name and what the innovation does, should be clearly explained to the possible adopter. This is part of the complexity characteristics.

Trialability

Rogers (2003) defines trialability as "the degree to which an innovation may be experimented with on a limited basis". It is positively associated with the rate of adoption. The more an innovation is tried, the quicker its adoption is. As discussed in the implementation stage of the innovation-decision process, reinvention may happen during the experimental period of the innovation. The innovation may then be changed or modified by the potential adopter. Increased reinvention may result in faster adoption of the innovation. For later adopters, indirect testing is always helpful for the adoption of an innovation. However, early adopters perceive the trialability feature of innovations as more significant than later adopters.

Observability

The last attribute of innovations is observability. Observability is the extent to which the outcomes of an innovation are observable to others. Peer observation is the crucial motivational factor in the adoption and diffusion of technology. Similar to relative advantage, compatibility, and trialability, observability is also positively interrelated with the rate of adoption of an innovation.

Regarding the adoption attributes, Rogers (2003), claimed that innovations providing more relative advantage, compatibility, simplicity, trialability, and observability will have a higher rate of adoption than other innovations. Moreover, he stated that it is difficult to adopt a new innovation even when it has clear advantages, so the availability of all of these variables of innovations hastens the innovation-diffusion process.

3.8.4 Adopter Categories

Rogers (2003) defines the adopter categories as “the classifications of members of a social system on the basis of innovativeness”. This categorisation consists of innovators, early adopters, early majority, late majority, and laggards. Individuals are alike in each of the adopter groups in relation to their innovativeness. Innovativeness is described as “a relatively-stable, socially-constructed, innovation-dependent characteristic that indicates an individual’s willingness to change his or her familiar practices”. In addition, innovativeness assisted in understanding the preferred and main behaviour in the innovation-decision process. He therefore categorises the adopters based on innovativeness as Figure 3.2 shows (Rogers, 2003).

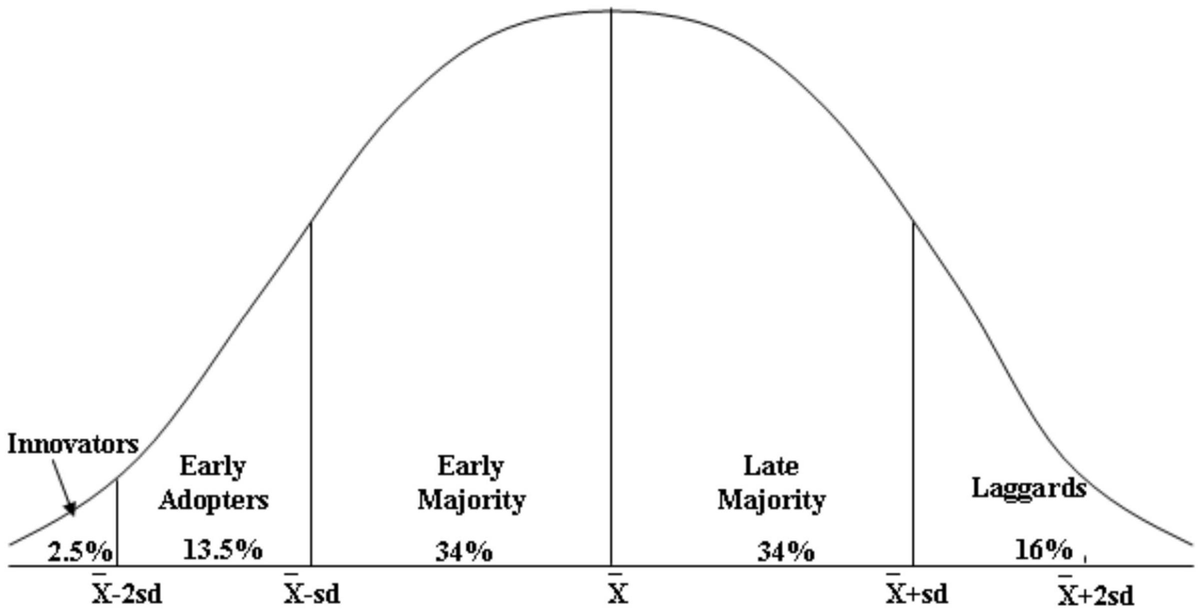

Figure 3.2: Adopter categorisation on the basis of innovativeness (Rogers, 2003).

It was also documented by Rogers (2003) that only complete or successful adoption of an innovation can generate this curve of adopter categories over time, whereas incomplete or unsuccessful adoption of an innovation cannot create adopter classification. In this normal distribution, every category is described by a standardised percentage of participants. For example, the area lying under the left side of the curve and two standard deviations below the mean comprises innovators who accept an innovation as the first 2.5% of the people in a system.

Innovators

Innovators are the gatekeepers that bring innovation in from outside the system. They are keen to practise new ideas. They should be willing to cope with favourable and unfavourable innovations and a certain level of uncertainty about the innovation. Other members of the social system may not appreciate them because of their high desire for innovation and close interactions outside of the social system. Their innovativeness requires innovators to have compound technical knowledge (Rogers, 2003).

Early Adopters

Early adopters are likely the leaders of the social system and are used to render advice or information to the members of the social system about the innovations. Unlike the innovators, early adopters operate mainly within the boundaries of the social system. In the innovation process, they play significant roles, mostly in deploying the resources that move innovation forward.

As role models, early adopters' approaches toward innovations are essential. Their subjective assessments of the innovation get to other members of the social system via interpersonal networks. Early adopters' leadership in accepting the innovation reduces doubt about the innovation in the diffusion process. Finally, "early adopters put their stamp of approval on a new idea by adopting it" (Rogers, 2003).

Late Majority

Like the early majority, the late majority involves one third of all the members of the social system who delayed, waiting for their friends or colleagues to adopt the innovation first before joining them. Although they are doubtful about the innovation and its outputs, economic need and peer pressure might convince them to accept the innovation. To decrease the uncertainty of the innovation, interpersonal networks of close peers should encourage the late majority to feel safe and accept the innovation (Rogers, 2003).

Laggards

Laggards are the set in the social system that has local perceptions, with a high level of uncertainty about innovations and change agents more than the late majority. As the traditional group of the social system, their interpersonal networks mostly comprise other members of the social system from the same class. Lacking awareness-knowledge of innovations and limited resources, they are non-leaders in the society. They always want to confirm the functioning capabilities of an innovation before they can adopt it. It takes a relatively long period for the laggards to decide on adopting an innovation after seeing the successful working of the innovation and that other members of the social system have adopted it (Rogers, 2003).

Additionally, (Rogers, 2003) classified these five categories of adopters into two groups, namely earlier adopters and late adopters. Earlier adopters are made up of innovators, early adopters, and the early majority, while late adopters consist of the late majority and laggards. He stated that the difference between the two groups is positively associated to innovativeness in relation to socioeconomic status, personality variables, and communication behaviours. Generally, the people who will gain most from a new idea (the less educated, less wealthy, and the like) are usually the last set to adopt the innovation (Rogers, 2003).

3.8.5 Technology-related Studies based on Rogers' Theory

Rogers' diffusion of innovation framework has been applied in many research studies involving different disciplines, including education, marketing, economics, sociology, and technology management (Sahin, 2006, Chang, 2010). Some of these investigations are:

- Isleem (2003) used Rogers' diffusion theory and qualitative research method to measure the level of computer use by technology educators for instructional purposes. Isleem investigated the correlation between the degree of computer usage and a number of selected factors, such as support, attitude, access and teacher characteristics. The findings showed that technology teachers used more conventional computer applications than customised computer applications. Isleem found that perceived access to computers, teachers' perceived expertise, and perceived attitude toward computers are the major factors that influenced the level of computer use.
- In 2001, Medlin used Rogers' theory to measure the factors that might influence faculty members' motivation and decision to adopt new technology for teaching in the classroom. Medlin found that social, organisational, and personal motivational are major predictors. According to Medlin, there is no significant difference among the self-identified adopter behaviour groups based on Rogers' theory in terms of social, organisational, and personal motivational factors.
- Less (2003) applied Rogers' diffusion theory to measure the adoption of computer technology for teaching in a North Carolina community college. The findings showed that there is a significant relationship between adopters' categories and their years of teaching experience and highest qualification. She classified the faculty into users and non-users in adopters' categories and there is no significant difference among users and non-users in demographic features, teaching experience and highest qualification.
- Similarly, Surendra (2001) used the diffusion of innovation framework proposed by Rogers to examine the acceptance of Web technology by professors and administrators at a college. Generally, the study found that access and training are the main predictors in the diffusion process of web technology-based educational innovation. Rogers' attributes of innovations are important factors in innovation adoption, and there was a relationship between computer awareness and acceptance of innovation.
- Van Slyke *et al.* (2002) used the diffusion of innovation framework to examine the factors that may influence the intentions of using a particular groupware application. The findings indicated that gender is a significant factor that influences individual's intention

to adopt m-commerce and the general levels of the perceived innovation features differ by gender.

- In 2010, Chang applied Rogers' diffusion of innovation theory to investigate the trend of hashtag adoption using the Twitter hashtag perspective as a case study. The results indicate that the diffusion theory provides valuable insights into interface design that helps Twitter hashtag use and access. It also supports in assessing hashtag life cycles, thus providing the requisite information for decision making in regard to hashtag management.
- López-Nicolás *et al.* (2008) integrated the Technology Acceptance Model and the Diffusion of Innovation Theory to examine the adoption of advanced mobile services. In the published report, they defined advance mobile services as "data services that have the look and feel of Internet pages and are accessible via mobile or hand-held devices and operating at 2.5 and 3G+ mobile telecommunication networks". They found that user perception, including ease of use and perceived usefulness can be associated with diffusion-related variables.
- Hsu *et al.* (2007) used the diffusion of innovation framework to investigate the adoption of mobile internet, using multimedia message services as a case study. They found that user perceptions were the difference over the diffusion of innovation categories and there was a significant difference among prospective adopters and users.
- In 2012, Al-Jabri and Sohail studied mobile banking in Saudi Arabia using the diffusion of innovation framework as baseline theory. The findings indicated that relative advantage, compatibility, and observability have a significant impact on mobile banking adoption.
- Nickerson *et al.* (2014) applied the diffusion of innovation theory to examine the diffusion of mobile technologies in unique domains. They concluded that the attributes of innovation are positively and partially correlated with adopters' categories in a unique domain and attributes of innovations are positively correlated with the adoption of the innovations.
- In an exploratory study in South Africa on cell phone banking, Brown & Molla (2015) applied the diffusion theory to investigate the predictors of adoption of cell phone banking. They identified that relative advantage, trialability, and consumer needs are the main factors that influenced the adoption of cell phone banking. Perceived risk also had a significant negative influence on cell phone banking adoption.

- Tunmibi *et al.* (2015) used the diffusion of innovation framework to investigate the factors influencing the adoption of smartphones by university students in a cross-border approach. They found that all the attributes of innovation including relative advantage, complexity, compatibility, trialability, and observability influenced the adoption of smartphones among university students.

  From the above research, it can be observed that the diffusion of innovation theory is a valid and robust framework that can be used in explaining the adoption and diffusion of technology innovations. It is therefore the intention of the researcher to apply the theory in an investigation on the adoption and diffusion of mobile application innovation in some selected countries in Africa.

  The DIT seems to be very suitable for describing the adoption and diffusion of technological innovation, but it is criticised for omitting some significant aspects of the diffusion technologies. Various basic principles of the DIT, therefore, need a careful review in the context of the networked and complex technologies. Specifically, the DIT does not provide suitable constructs to deal with collective adoption behaviours including the critical role of standards, critical mass, network externalities, sunk costs, path dependencies, etc. Researchers should be careful in evaluating the effect of the nature and meaning of technology, the role of institutional policies and regime, and the effect of the industrial policies and strategies (Lyytinen & Damsgaard, 2001).

3.9 The reason for using Diffusion of innovation Theory for the study

This study will examine the adoption and diffusion of mobile app innovation in Africa. Innovation concept is associated with new products, practices, methods, ideas, services, and inventions. Diffusion of innovation theory is a valid and robust framework that can be used to explain technology innovation adoption and diffusion (Chang, 2010). From the discussion on the theories, it can be seen that the most suitable for this study is the diffusion of innovation theory. We will therefore apply the theory in an investigation into the adoption and diffusion of mobile app innovation in some selected African countries.

3.10 Research conceptual model

The conceptual model of the study is drawn from the combination of the theoretical literature study described in Chapter 2 and the diffusion of innovation theory. The literature covers the description of mobile apps, evolution and development of mobile technology in Africa, the African mobile ecosystem, classification of mobile apps, mobile app enabling innovation, mobile app enabling digital inclusion, contribution of mobile apps to the development in Africa, factors that determine the acceptance of mobile applications, and adoption and diffusion of mobile apps in the selected countries. This conceptual model will be empirically tested to arrive at a validated framework. African mobile apps innovators are creating mobile apps to address the needs of the social system. These mobile apps are being adopted and used according to consumers' desires and activities. The research is to investigate the adoption and diffusion of mobile app innovation across the African social system using Rogers' diffusion of innovation framework.

The research conceptual model is developed based on the diffusion of innovation framework. It depicts the methodological approach to achieve the study aim. Knowledge regarding the background information of the topic under study will be obtained from the existing literature. The adoption of mobile apps involves three stages, including the knowledge, persuasion and decision-making stages. The knowledge stage provides the information about the mobile apps, the persuasion stage influences the attitudes of the adopter towards decision making and the decision-making stage provides the adopter's choice either to adopt or to reject the mobile app. The innovation decision process involves the adopting unit and its characteristics. The last component of this model is the diffusion. It comprises the implementation and confirmation stages of the diffusion of innovation framework. In the diffusion stage, the practical use of mobile apps, types of use and discontinuance are determined. Achieving the primary purposed of this research study will validate this model. The research conceptual model is shown in Figure 3.3.

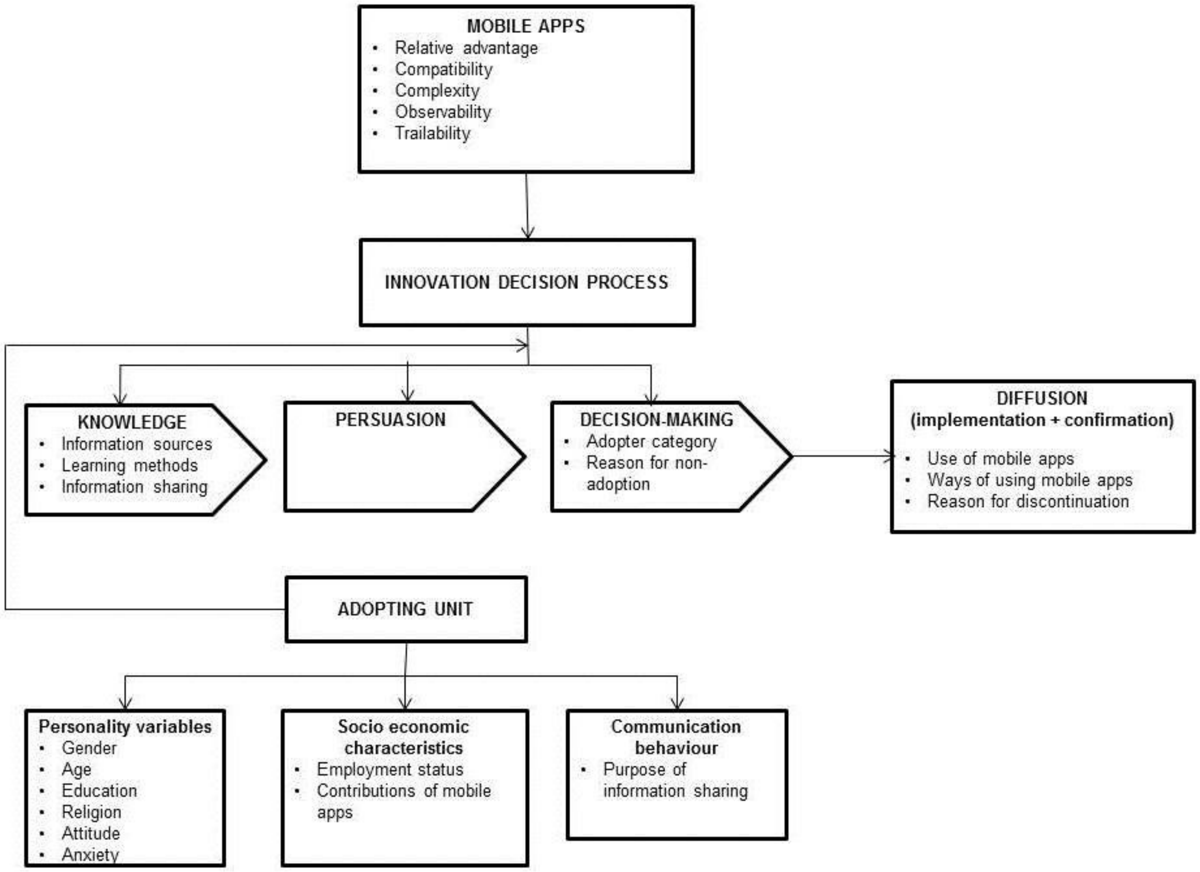

Figure 3.3 - Research conceptual model

3.11 Summary

In this chapter, the study presented an overview of some of the theories used in conducting scientific research in information systems as shown in Table 3.1. The conceptual model for this research was also presented.

In Chapter 4, the focus will be on the detailed description of the research methodology applied to conduct the study.

Table 3.1: A summary of the models as described in Chapter 3

S/N	Title	Author(s)	Main idea	Criticisms
1.	Theory of Reasoned Action (TRA)	Fishbein & Ajzen, 1977	The TRA main goal is to describe the correlation between attitudes and behaviours within the human action, in turn, used to predict how people behave based on their pre-existing attitudes and behavioural intentions (Fishbein & Ajzen, 1977)	The TRA is unaware of the relations between people, both the interpersonal and social relations in which they act and the limit of social structures which rule social practice (Terry *et al.*, 1993, Yousafzai *et al.*, 2010)
2.	Technology Acceptance Model (TAM)	Davis, 1989	The TAM proposes that when consumers are offered with a new technology, several factors influence their choice about how and when they will use it, particularly: perceived usefulness and perceived ease of use (Davis, 1989).	The TAM has been widely criticised in various ways, including its doubtful empirical value, inadequate descriptive and analytical power, triviality, and lack of any practical value (Venkatesh *et al.*, 2012, Lee *et al.*, 2012b, Chuttur, 2009, Chung *et al.*, 2010).
3.	Theory of Planned Behaviour (TPB)	Ajzen, 1985; Ajzen, 1991	The TRA is used for predicting behavioural purpose and real behaviour of consumers towards a new innovation (Ajzen, 1985; Ajzen, 1991).	The TPB is based on cognitive processing. It does not clearly specify that attitudes are formed. There is also no mention of where beliefs and their assessments come from intentionally (Venkatesh *et al.*, 2012, Sniehotta *et al.*, 2014).
4.	Expectation Confirmation Theory (ECT)	Oliver, 1977: Oliver, 1980	The ECT seeks to describe post-purchase or post-adoption satisfaction as a function of expectations, perceived performance, and disconfirmation of beliefs (Oliver, 1977: Oliver, 1980).	There is no general agreement relating to the definition, associations and measurement methods of ECT constructs (Hossain & Quaddus, 2012)
5.	Unified Theory of Acceptance and Use of Technology (UTAUT)	Venkatesh *et al*., 2003	The UTAUT is proposed to describe user intentions to use an information system and consequent practice performance (Venkatesh *et al*., 2003).	The theory created an opening for every splinter of knowledge to describe decision making (Bagozzi, 2007). Scholars also condemn the grouping and labelling of many items and constructs and considered it to be problematic (Van Raaij & Schepers, 2008).
6.	Social Cognitive Theory (SCT)	Bandura, 1986; Bandura, 2002	The SCT describes the idea that people learn by observation and cognition (Bandura, 1986; Bandura, 2002).	The SCT is criticised for lacking a unifying principle or structure, claimed that behaviour is mainly learned and does not recognise genetic differences (Flamand, 2009).
7.	Diffusion of Innovation Theory (DIT)	Rogers, 2003	The DIT describes the process of adopting and diffusing new innovation (Rogers, 2003).	DIT is criticised for omitting some significant aspects of the diffusion technologies and therefore need a careful review in the context of the networked and complex technologies (Lyytinen & Damsgaard, 2001)

Chapter 4

Research design and methodology

4.1 Introduction

Every research study should follow defined principles and procedures in line with the philosophical assumptions that constitute the validity of the research and the appropriate method(s) to be used in the development of the expected knowledge of the study. To conduct and evaluate a research study, it is necessary to follow a distinct philosophical approach. The goal of this study is to investigate the adoption and diffusion of mobile apps in Africa and to obtain the required knowledge surrounding this study, a well-defined approach will be followed.

According to Thomas *et al.* (2011), it is necessary to put the research findings to test beyond the academic world. In that regard, the researcher needs to follow a well-designed research approach that would be understandable to the outside world. The study on the adoption and diffusion of mobile apps will lead to the development of a framework for the adoption and diffusion of mobile apps in Africa, thus a proper research design and methodology is required. It is therefore imperative for the researcher to be certain as to which research approach/approaches to employ in order to achieve the required results (Druckman, 2005, Clough & Nutbrown, 2010). The research design and methodology should be scientifically based and reliable (Cooper *et al.*, 2011, Churchill & Iacobucci, 2006, Bassey, 2003).

This chapter presents the discussion of the research methodology used for the study and how it will be applied, including the research paradigm, research method, data collection method and data analysis methods.

4.2 Research design

A research design is a blueprint for investigating a topic under study (Burns & Grove, 2003). It is referred to as a research plan or framework (Wiid & Diggines, 2009, Malhotra, 2010). According to (Parahoo, 1997), it is a plan that explains how, when and where data are to be gathered and evaluated. In unified minds, (Polit-O'Hara *et al.*, 2001) defined it as the researcher's general method for answering the research question(s) or testing the research hypothesis. Bless *et al.* (2006) describe research design as "… *operations to be performed, in order to test a specific hypothesis under a given condition*". Therefore, research design is a strategy or functional plan that logically integrates different aspects of the research study in order to answer the research question. It consists of the entire steps in the investigation process, including plan, measurement, and analysis. The research design is completely dependent on the research problem. Finding the most suitable research design is a function of the research problem (Zikmund *et al.*, 2010) or research objectives and required data (Hair *et al.*, 2010). This means that the researcher must think through the research problem, goals and the type of data needed for the study in order to decide on the proper approach to be applied. The purpose of the research design is to enable the researcher to understand the research decisions and to increase the possibility of obtaining valid results (Vosloo, 2014).

For the purpose of this study, an empirical study will be applied. The required quantitative data will be collected from mobile app users in order to make to reliable decisions. The nature and complexity of this study, including the research problem, research questions, and the research goals call for a quantitative enquiry; hence, a quantitative research approach will be followed.

4.3 Research methodology

Research methodology is referred to as the general approach used in executing a research project (Kumar & Phrommathed, 2005, Leedy & Ormrod, 2010), which includes the research paradigm, approach, process, methods, tools and techniques applied in achieving the desired results (Mouton, 2001, Huisman & Iivari, 2006).

This study started with the definition of the research problem, literature review, and empirical research. It was shown that a large portion of the African population has embraced the use of mobile apps in their various activities, but the way in which they adopt and diffuse the mobile apps is not known. The empirical research follows a quantitative approach through conducting a survey and using a questionnaire as the instrument for data collection.

4.4 Research map

A research map is a diagrammatic representation of the research design and methodology. It is a map that indicates the beginning, the connecting links and the end processes of the research approach. According to Novak & Cañas (2008), a map is a structured diagram that represents the relationships among objects. The authors explained that the purpose of a map is to showcase the concepts connecting the represented objects. From a knowledge perspective, Brinkmann (2005) referred to a map as a “knowledge map” that uses structures to explain how theories and ideas are interconnected in the topic. In this study, a map is a systematic diagram that depicts the connections between one stage of the research process to another towards the achievement of the research goals. The research map for this study is shown in Figure 4.1.

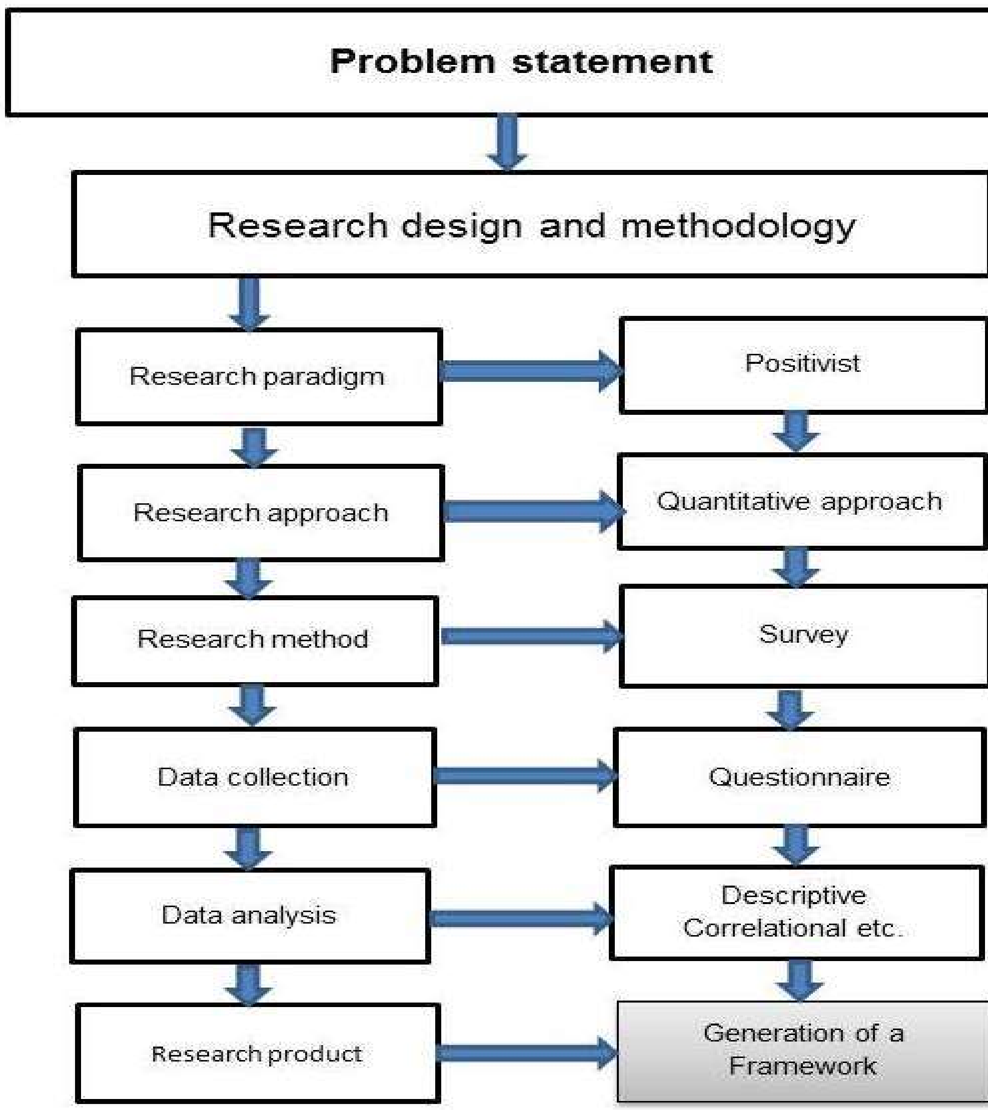

Figure 4.1: Research map

4.5 Paradigm

Each research topic has a particular pattern of investigation. The research approach of any topic under study depends on the way the researcher views, thinks and understands the problem and the way it can be studied in order to achieve credible findings. Conducting a study, the researcher needs to follow a structured or an organised research pattern and this pattern is what is referred to as a paradigm. Kuhn (1962) defined paradigm as a conceptual framework that provides scientific researchers with a convenient model for investigating and finding solutions to problems. Schwandt (2001) referred to a paradigm as a philosophy that reflects beliefs and values in an area of study that also provides a pathway for problem solving. It also embodies the philosophical and theoretical framework that informs the assumptions, plans and perception for investigating and solving problems (Rubin & Babbie, 2010, Mackenzie & Knipe, 2006, Creswell & Clark, 2007, Collis & Hussey, 2009). In this study, the paradigm can be referred to as a philosophical framework based on some underlying assumptions and guidelines for the investigation and evaluation of a research study.

A paradigm is associated with some basic assumptions, including (Patton, 2002, Mack, 2010, Haworth, 1984, Grix, 2004, Crotty, 1998).

- Cosmology: entails the way the world is structured and the human position within the world.
- Ontology: nature of existence, how do we believe in the nature of the world and its reality?
- Epistemology: nature of knowledge; it deals with the way of inquiry to gain knowledge about the nature of the world.
- Axiology: entails the philosophical field of study based on social norms and values.

Without these contextual assumptions, human minds cannot be involved in the construction of theories about less inclusive portions of natural processes (Haworth, 1984). Every research work follows a specific type of paradigm which influences the study and the final outcome(s) of the research. There are three major types of paradigm including positivism/post-positivism, interpretivism and critical paradigms. These paradigms are discussed below.

4.5.1 Positivism

The term positivism was coined and popularised by Auguste Comte, a French philosopher (Pring, 2000, Crotty, 1998, Bogdan & Biklen, 2003). Positivism holds the opinion that science is the base of real knowledge (Schwandt & Schwandt, 2001). It maintains the view that the research methodological approach used in natural sciences provides the most appropriate framework for studying the social world (Denscombe, 2010). Positivism believes in objectivity which suggests that objects around the world actually exist with meaning and independent of our consciousness of them (Crotty, 1998, Cohen *et al.*, 2007). Positivism is linked to scientific model; as a result, it attempts to formulate laws which can be used to explicate the reasons of noticeable and quantifiable behaviour (Welman *et al.*, 2009). A positivism paradigm deals with a scientific approach in investigating a topic under study. Accordingly, Hughes (2010) stated that this paradigm is founded on static universal laws, and with knowledge of these laws, we can understand and explain everything that happens around us. Positivism adopts theories of reality and knowledge about nature, in such a way that we can use sense and reasoning to create knowledge about the reality of the world (Hume, 2000, Descartes, 1998). Positivism involves a belief built on the assumptions that pattern, method, procedures, generalisation and cause-and-effect problems can also be applied to social sciences (Lincoln *et al.*, 2011, Glicken, 2003, Denscombe, 2010). This suggests that the objects of the social sciences, such as people are appropriate for the application of scientific methods.

Critical emphasis on the positivism paradigm was expressed on its approach to empirical observation of real events that can be scientifically analysed in order to clarify the complications of the outside world (Henning *et al.*, 2004); that is, the truth of scientific studies can be uncovered and presented through empirical means.

Therefore, the positivism tradition represents the realist and objectivist perspectives which see the natural world and social world to be similar and the same methodological approach can be applied to study both.

It comprises two forms of approach; exploratory and confirmatory. The exploratory approach involves observations and patterns to develop a theory, while the confirmatory approach involves using the hypothesis to test a theory. Some features of the positivist paradigm are as follows (Stahl, 2008, Oates, 2006, Coolican, 2014):

- Observation and data collection.
- Searching for patterns and creating a theory.
- Making use of hypothesis to test and confirm any theory through research.
- Provides room for adjustment of theory.
- Believes that research is independent and purely objective.

- The world is based on universal laws and everything that happens around the world can better be explained with knowledge of these laws.

In the middle of the 20th century, there was a shift from the dogmatic perspective of positivism to post-positivism. According to Crotty (1998), some physicists placed much emphasis on turning from absolute certainty to probability; that a scientist deals with the creation of knowledge instead of observing the laws of nature. They argued that "no matter how faithfully the scientist adheres to scientific method research, research outcomes are neither totally objective, nor unquestionably certain" (Crotty (1998). The argument represents the view of post-positivism. Post-positivism is reductionist; it follows the process of reducing ideas into a small, distinct set to test, such as the variables that contain hypotheses and research questions (Creswell, 2014). In comparison, positivism focuses on theory verification, whereas post-positivism focused on theory falsification (Ponterotto, 2005). Trochim (2002) stated that post-positivism is influenced by philosophical critical realism. Both positivism and post-positivism shared the same view on reality, independent of human thinking, which can be investigated by means of scientific methods. Post-positivism believes that observation may contain mistakes and theories can be reformed (Trochim, 2002). Phillips (1990) claims that in as much as objects of our inquiry can be separated independently from our minds, observations cannot be viewed with absolute accuracy. It is impossible to achieve absolute objectivity in our studies.

However, the positivist tradition does not gain the full support of some scientists, resulting in some doubts and questions, especially on the underlying assumptions. Henning *et al.* (2004), Babbie (2010), Rubin & Babbie (2010) and Denzin & Lincoln (2011) argued that positivists presume that individuals behaviour is rational, therefore social reality can be explicated in rational terms, but by contrast, individuals do not always behave rationally. Instead, some of the non-rational behaviour could be observed, understood and predicted as being rational. Babbie (2010) particularly noted that everyone reasons, behaves and explains things subjectively to a certain degree and the subjectivity is distinctive to every person. The critical theorists criticised the positivists' belief in their claim of generalisation and their view on the world as a "closed system" without considering its complexity (Cohen *et al.*, 2007, Blaikie, 2004). This was reinforced by Scott & Usher (2010) who stated that "positivism can, therefore, be critiqued on the grounds that it fails to understand the multiplicity and complexity of the lifeworld of individuals." Hereafter, the interpretivism research paradigm emerged.

4.5.2 Interpretivism

Interpretivism or the constructivism paradigm involves a subjective approach to research, starting from what happens internally through direct interactions and experiences of the people. In essence, the major argument that informs the constructivism paradigm is that research should be approached subjectively and not objectively. Many scholars view the interpretivism or constructivism paradigm as anti-positivism because it was created as a result of not agreeing with the positivism approach to research. It studies events in their natural settings trying to make meaning from people's viewpoints (Joubish *et al.*, 2011). Cohen *et al.* (2007) stated that with the interpretivism paradigm the researcher needs to "understand, explain, and demystify social reality through the eyes of different participants". Interpretivism believes that social reality can be perceived by many people and through communication with multiple participants; as such, one can identify different perceptions about an event. There is also a need to consider the subjective interpretations and perceptions of people in order to gain more understanding of the social life phenomenon (Ernest, 1994). The nature of research with this paradigm is associated with qualitative research and it also makes use of textual analysis to deduce knowledge from the social world.

According to Boland (1986), the philosophical base of the interpretive research paradigm is hermeneutics and phenomenology. While hermeneutics offers the philosophical basis for interpretivism (Prasad, 2002, Clarke, 1999, Bleicher, 2017), phenomenology deals with the study of the phenomena, understanding things as they seem in our knowledge (Lester, 1999, Cresswell, 1998, Aspers, 2004). Rubin & Babbie (2010) agreed with Collis & Hussey (2009) that the main purpose of research is to understand and interpret daily events, knowledge, social structures and values involved in these phenomena. Interpretivists alleged that social reality is subject to the participants' perception, attached values and the goals of the investigator.

The failure to produce consensus guidelines that suits all the qualitative research methodologies results in the criticism of the interpretivism paradigm as stated by Sandelowski (1986) that: "In short, the debate surrounding the methodological rigor of qualitative research is confounded by its diversity and by lack of consensus about the rules to which it ought to conform and whether it is comparable to quantitative research." Interpretivists believed in interpretation (subjectivity) but they never provided a completely accurate interpretation of an event (Scott & Usher, 2010), this questioned and criticised the claimed subjectivity in their research approach (Ceci *et al.*, 2002).

This paradigm is characterised by the following (Yanow & Schwartz-Shea, 2009, Williams, 2000, Schwandt, 1994):

- Understanding people's perception is its key purpose.
- Its reality is dynamic in nature because of changes in people's perceptions.
- Its viewpoint is based on the knowledge of the people.
- Subjective data based on people's perception.
- The primary source of data is the people.

4.5.3 Critical research

The critical research paradigm originated from the critical theory which was developed by some political philosophical thinkers. The critical approach placed greater emphasis on historical and social contexts in order to establish a meaning from social phenomena (Lincoln *et al.*, 2011). It involves a research approach that aims at dissuading conventional knowledge bases. As such, it could either be quantitative or qualitative in nature, portraying scientific objectivity. It endeavours to reveal the socio-historical specificity of knowledge and also to identify how particular knowledge reproduces structural relations of inequality and oppression (Muncie, 2006). The critical approach supports most of the criticisms against positivism on realism and objectivity, but agrees to a greater degree with interpretive social science, though this approach also finds interpretivism to be over-subjective and relativistic (Neuman, 2013, Cohen *et al.*, 2007). The critical theory is not only used to investigate and obtain knowledge about the society, but is also used to criticise and reform the society, thus it is considered to be one of the top influential frameworks (Patton, 2002). Critical theory offers a philosophical and methodical structure that regards research as being fundamental, political and change-oriented (Cohen *et al.*, 2007).

This paradigm is characterised by the following;

- Emancipation – the critical research approach purposes to encourage emancipation (Stahl, 2008).
- It projects a belief that inspires researchers not to agree with social conventions, but to ask questions that yield productive answers which lead to better arguments (Muncie, 2006).

- Non-performativity Intent – Critical research seeks to improve results that are objective and not necessarily always positive. It also aims to avoid streamlining research findings to suit the interests of benefactors, such as financiers (O'Brien, 2001).
- Critique of technological determinism - It promotes that technology should depend on the idea of people and not the other way round (Thomas, 2006).
- Reflexivity - By accepting a reflexivity approach, the entire research process can be evaluated from an objective perspective to ascertain the confidence level in the results obtained (Somekh & Lewin, 2005).

The goal of the critical approach is to improve the studied context, but due to the political underlying principle, this approach has been criticised for having a political plan. Ernest (1994) stated that “The disadvantage is that there are often hidden institutional sources of resistance to change, such as teacher and pupil ideologies, institutional structures, and so on, which may prevent the desired progress.” Additionally, (Cohen *et al.*, 2007) noted that the critics continually question the critical research approach to the ideology, neutrality and power of action.

4.6 Research paradigm applied in this study

In this study, the positivism research paradigm was applied. The study on the adoption and diffusion of mobile applications in Africa involves the collection of quantitative data from participants residing in different geographical locations in Africa. As a result, the participants are totally separated from the researcher and their responses to the research questions are independent from the researcher’s mind, knowledge and beliefs. Therefore, this study is required to follow the principles of positivism and post-positivism by using the scientific approach to collect self-determining quantitative data beyond the researcher's influence which may not be accurate. The scientific research method, its techniques, principles and other related aspects used in this study are discussed in the subsequent sections.

4.7 The positivistic paradigm

The positivistic paradigm, also known as the scientific method, can be defined as an organised, methodical approach that is embedded in objective reality with purpose/goal of developing common knowledge about natural phenomena (Kaboub, 2008, Cohen *et al.*, 2007). It comprises techniques for investigating phenomena and is generally based on the quantifiable or empirical evidence subject to unique principles of reasoning (Goldhaber & Nieto, 2010). The positivist/post-positivist paradigm is referred to as a scientific method (Creswell, 2014). It has been reviewed for improvement by many scholars and is considered to be the research approach that gives the most accurate result (Schwandt *et al.*, 2007). In the early 20th century, the Vienna circle confirmed the scientific method as the leading research approach (Neurath, 1973). The features of a scientific method include systematic processes, a controllable investigation, empirical facts, generalisation, assumptions, and test hypotheses. Oates (2006) stated that the scientific method comprises two basic assumptions:

- The world we live in has a form of order which is simply not random; that is, irrespective of the position or place in this world, a particular situation will always give the same results. For example, a stone thrown to an open-air surface must certainly fall due to gravitational force.
- The world can be investigated objectively – this implies that studies should be objectively and logically performed regardless of the researcher's knowledge.

This study is focused on the objective investigation in which the participants will freely complete the questionnaire based on their experience of the adoption and diffusion of mobile applications without any interference from the researcher.

4.7.1 Strengths and Weaknesses of positivism/post-positivism

The research approach and research structure of positivism/post-positivism make it more suitable for this study. Scholars have identified the following strengths and weaknesses of this research approach (Houghton, 2011, Cohen *et al.*, 2007).

Strengths

- It uses scientific approaches in its inquiry.
- It is built on quantitative data with a larger degree of reliability.
- It delivers objective information which enables the researcher to make scientific assumptions.
- It is possible to make future predictions from quantitative data obtained.
- The accuracy of the Parsimony aids in making it valuable for studying large numbers of people, therefore, it saves time.
- It uses a definite structure in conducting research and discussions. That is, it follows a set of rules/guidelines in its studies.
- The structure creates room for variable changes during the study and this makes the study special through experiments which are more accurate.
- The research findings can be generalised.

Weaknesses

- Empiricism and objectivity are not suitable for research in social natural settings, especially when testing human behaviours.
- There is no flexibility in positivism; positivists believe that everything can be measured and calculated. They perceive things as they are and do not accept unsolved phenomenon.
- Inability to give an account of a particular capability of one's practices and represents it to others.
- Generalised knowledge may not be applicable to a particular case.

4.7.2 Techniques of positivism

According to Hjørland (2005) and Creswell (2014), three basic techniques are applicable to the scientific method including reductionism, repeatability, and refutation.

- Reductionism – this involves breaking down a complex system into smaller parts for easy investigation.
- Repeatability – this involves repeating the research experiment to confirm if it can give the same results.
- Refutation – this involves disproving a research experiment which when repeated, does not give the same results.

To collect the required quantitative data for this investigation, the adoption and diffusion of mobile apps in Africa are divided into seven sections:

- Background information of the participants: – to obtain detailed information of the participants.
- Mobile applications: – to test the participants' knowledge of mobile apps.
- Adoption and diffusion of mobile apps: - to investigate the adoption and use of mobile apps.
- Mobile apps innovation characteristics: – to investigate the innovation (mobile apps) characteristics.
- Predicting factors of mobile apps adoption and diffusion: to investigate the factors influencing the adoption and diffusion of mobile apps in Africa.

- Contributions of mobile apps innovation to the development of Africa: - to investigate the effect of mobile apps on African development.
- Adopters' category: - to investigate the mobile apps users' category in Africa.

The complexity of this study is broken into simpler portions for easy investigation; therefore, the reductionism technique is the most suitable and will be applied to this study.

4.7.3 Principles of positivism

The scientific research method follows well-defined unique procedures to achieve the anticipated goals. These are the fundamental philosophies associated with each research method that create a clear methodological approach to research, covering questioning, investigating, reasoning and thinking. According to Feuer *et al.* (2002), there are six basic principles of scientific method:

- Definition of a valid empirically verifiable question(s): *In this study, the research question that the researcher intends to investigate is "**How are mobile apps adopted and diffused in Africa?**" There is a need for quantitative data that will be verified through empirical means.*
- In scientific inquiry, research is connected to theory: *This study involves the investigation of the adoption and diffusion of mobile apps using the diffusion of innovation theory, thus the study is linked to a theory.*
- The research methods allow straight examination of questions: *The instrument for data collection of this study is a questionnaire and the questionnaire was designed with appropriate questions that will answer the research question (Table 4.3).*
- There is provision for logical reasoning: *The questionnaire used for this study was logically designed in such a way that the participants would have a clear understanding of it and respond appropriately.*
- There is provision for generalisation and reproduction of ideas: *This principle is applicable to random sampling, but in this study, purposive and convenience sampling are used.*
- The research process is transparent and permits scholarly debate: *The results and conclusions of this study will be well elucidated to the scientific community.*

4.7.4 Research strategies associated with positivism

Some of the research methods associated with positivist paradigm include:

- Survey research method.
- Experimental research method.
- Design and Create research method.

Survey research method – is a research method that involves the data collection from the responses of a targeted population either through verbal or written communication (Mathiyazhagan & Nandan, 2010).

Experimental research method – Experiments are operations or procedures carried out under controlled circumstances in an attempt to discover an unknown effect or law, to test, confirm, or establish a hypothesis, or to illustrate a known law (Libby *et al.*, 2002, Johnson *et al.*, 2007).

Correlational method – is a research method used to test for relationships between two variables in a situation where an experiment seems to be difficult or impossible (Thompson *et al.*, 2005, Williams, 2011).

Design and create - This method focuses on developing new ICT products and the strategy of design and creation is by means of awareness, suggestion, development, evaluation, and conclusion (Richey & Klein, 2014).

The research approach for this study is a quantitative approach and the survey research method is the most suitable research method, thus the survey research method will be applied.

4.8 The Survey

According to Oates (2006), the survey research method is commonly associated with positivism/post-positivism research. It involves the collection of data from a group of people known as the "Sample" to enable the researcher to access their mind and perceptions of the particular topic under study. The purpose of a survey is to collect similar kinds of data from a selected population in a standardised and systematic way. One then looks for patterns in that data to generalise to a larger population than the group that has been surveyed. This study involves the collection of quantitative data from a selected group of individuals (mobile apps users) living in the five selected countries from five geographical locations in Africa and will attempt to generalise the findings to an entire African population.

4.8.1 Strengths and weaknesses of using survey research method

According to some scholars, there are some strengths and weaknesses associated with survey-based research (Oates, 2006, Marshall, 2005, Blackstone, 2012, Mathiyazhagan & Nandan, 2010).

Strengths

- Cost-effective: - Survey produces quick and large results at low cost compared to other methods.
- Replication: - It makes provision for replication of the results from time to time.
- Generalisation: - It provides a broad coverage of people or events so that the results are more likely to be representative of the wider population.
- Versatile: - It is a suitable method for people with low communication and interpersonal skills.
- Reliable: - It is a systematic and standardised tool, using the same questions, phrased in the same way for all the participants.
- Ethics: - the survey is more ethical than the experiment.

Weaknesses

- A survey tends to focus on measurable cases that depend on statistical analysis
- It lacks depth.
- It does not establish cause and effect.
- It covers a particular point in time, rather than noticing on-going practices and change.
- In regard to an internet or postal survey, the correctness of the response cannot be established through observation because there is no physical contact with the participants.
- Data may lack validity due to poor sampling and non-response bias.
- Data may be insincere.

These weaknesses were properly considered during the planning and designing of the survey to reduce their effect on the final results of this study. In this regard, a detailed survey was designed in a clear layout and uncluttered form such that all the questions will mean the same thing to all the participants. Moreover, the questions were constructed to cover and linked to the aim and objectives of this research study. The survey design was checked and approved by the Statistical Consultation Services of the North-west University. In addition, the sample used for this study was selected from various sectors of life, including economics, politics, education, finance and the social sector. Consequently, a meaningful survey that covered the research goals was designed and a good representative of the population was involved in the research study.

4.8.2 Survey design

According to Oppenheim (2000), Oates (2006) and Brace (2008), there are six important criteria or activities involved in the planning and designing of a survey questionnaire. These authors emphasised that these criteria or activities must be properly considered because the nature of the questionnaire used in a study contributes to the final results of the study. These criteria or activities are listed and briefly discussed below.

- Data requirements.
- Data-generation method.
- Sampling frame.
- Sampling technique.
- Response rate and non-responses.
- Sample size.

4.8.2.1 Data requirement

This involves the particular data needed to conduct the study at hand. The data can be directly associated with the study, such as being linked to the research questions or indirectly associated with the study, such as demographic data. Oates (2006), in particular, advised researchers to always think carefully and ahead when designing a survey question, as the participants have only one opportunity to respond. The researcher must think, and know the expected results and other research outputs before designing the questions for the questionnaire. In this study, the conceptual model determines the data requirement.

4.8.2.2 Data-collection method

The generation of data for research requires a proper method with due consideration to the topic under study. There are many data-collection techniques associated with survey research method, including the questionnaire, interviews, documents and observations (Oates, 2006, Bohlin *et al.*, 2010). With regard to the study, the researcher will decide which of the techniques is the most suitable for the study (Oates, 2006). These techniques are briefly explained below.

Structured Interviews – Also known as standardised interviews involve fixed-format interviews with already prepared questions in a unique order. The same questions will be administered to all the interviewees in a similar manner.

Observation – This is another means of obtaining data through merely watching the activities or actions of the participants and listening to their discussions.

Documents – This involves reviewing the existing documents containing data that are related to the study including the review of electronic bulletin boards, recorded videos, diagrams, etc.

Questionnaire – This comprises a set of pre-planned questions designed in a unique form with respect to the study. The questionnaire can contain open-ended, closed or both open-ended and closed questions. An open-ended question is an unstructured form of question whereby the participants respond in their own words whereas closed questions are a structured type of question whereby the participants are expected to choose an option among the given choices.

Each of the above data-generation techniques is appropriate for the survey. Selecting a technique depends on the topic under study, population, environment and the required data in relation to the researcher's preference. In this study, quantitative data is required from the large population (mobile app users), hence questionnaire data collection is the most appropriate.

4.8.3 Data-collection method use in this study (Questionnaire)

Data collection is the process through which data is collected for research studies. In regard to survey-based research, the applicable data collection techniques were discussed above (see section 4.10.4). The most appropriate data collection method to be used for this study is the questionnaire. This is because the study requires quantitative data from independent participants. Monette *et al.* (2011) described the questionnaire as a means of data collection in survey-based studies containing questions to be answered by the participants without the assistance of the researcher. It is a means of obtaining quantitative data for scientific studies.

4.8.3.1 Strengths and Weaknesses of the questionnaire

There are some strengths and weaknesses in using the questionnaire for data collection, including (Oates, 2006, Marshall, 2005, Muijs, 2010, Wilkinson & Birmingham, 2003).

Strengths

- It is more convenient for participants to respond to because of the pre-defined answers.

- It is more economical in comparison with other data collection types.
- There are many ways of questionnaire distribution; as a result, little or no geographical limitations exist during questionnaire distribution.
- Self-administration questionnaires do not need extra skills more than those of the researcher.
- It can be distributed by any individual other than the researcher.
- It makes the collection of larger quantity data easier.

Weaknesses

- There is no room for correction or explanation of misunderstandings in the questions.
- Incomplete answering of questions could result in poor or weak results in some cases.
- It is not suitable for people with poor literacy skills and visual handicaps to respond to a self-administered questionnaire.
- The validity of answers cannot be controlled by the researcher
- The response in the respondents' own time affects the return rate.

To minimise the effect of the weaknesses, the questionnaire was designed in a careful, simple and personalised form. The participants can easily comprehend the questions and respond to them as personal interactions. A pilot test was conducted, and necessary changes were made. To ensure that the questionnaire covered the goals of the research, a statistician was consulted, and the questionnaire was professionally evaluated.

The questionnaire was logically constructed in alignment with the literature overview and the theory to be used to address the aims and objectives of the study. The target population is mobile app users across the selected African nations. The questionnaire was designed in accordance with some underlying principles as stated by some scholars including (Thietart, 2001, Partington, 2003, Morris, 2006, Delport & Roestenburg, 2011):

- The principle of economy, which would enable respondents to provide as much information as possible in the shortest possible time and space available.
- The format of the questionnaire was developed to have a professional appearance with a clear, neat and easy to follow layout.
- Clear and precise instructions were provided for the completion of the questionnaire.
- The theoretical foundation and the framework served as a parameter for the development of the questionnaire, in accordance with the research aims and purpose of this study.

- Particular and thorough attention was given to question formulation.

4.8.3.2 Components of the questionnaire

The questionnaire comprises seven sections: Background information, Mobile applications, Adoption and Diffusion of Mobile Apps Innovation, Mobile apps Innovation Characteristics, Predicting Factors of Mobile apps adoption and diffusion in Africa, Contributions of mobile apps innovation to the development of Africa and Adopters' category.

Section A: Background information (Questions 1- 6)

This section aimed to obtain personal and general information from the participants, such as the country of residence, gender, age group, educational level, employment status, and religion. The questions are multi-choice type questions in which many choices are provided from which the participants are to select one.

Section B: Mobile applications (Questions 7 – 8)

The questions in this section were included to gain information about mobile apps from the participants, how important are mobile apps to the African population and the aspects of life where they are using or have used mobile apps. It contains scale rating questions between 1 and 5 (1 - strongly disagree and 5 - strongly agree) testing the degree to which the respondent agreed to the statements.

Section C: Adoption and Diffusion of mobile apps innovation (Questions 9 – 18)

The purpose of this section is to know how the participants started to adopt and use mobile apps. It seeks to know the medium through which the participants got to know and learn about mobile apps, the purpose of adopting mobile apps and how they share the knowledge about new mobile apps. The reason for continued or discontinued use of mobile apps and the period it takes to adopt a new mobile app will be obtained. It contains scale rating questions between 1 and 5 (1 - strongly disagree and 5 - strongly agree) testing the degree to which the respondent agreed to the statements.

Section D: Mobile apps innovation characteristics (19a – 19n).

This section tests to find the information about the attributes of innovation on the adoption and diffusion of mobile apps in Africa. It seeks to know the relative advantages, compatibility, complexity, trialability, and observability of using mobile apps. The questions are in the scale rating form, between 1 and 5 (1 - strongly disagree and 5 - strongly agree) testing the degree to which the respondent agreed to the statements.

Section E: Predicting factors of mobile apps adoption and diffusion in Africa (20a – 20y).

The aim of this section is to find out the influencing factors that caused the adoption or rejection of mobile apps. It contains scale rating questions between 1 and 5 (1 - strongly disagree and 5 - strongly agree) testing the degree to which the respondent agreed to the statements.

Section F: Contributions of mobile apps innovation to development in Africa (21a – 21t).

This section investigates the effect of mobile app technologies on African development. It is to obtain the information on how mobile apps have improved the living standard and general activities in Africa, including education, economics, politics and social activities. The questions are in the scale rating form, between 1 and 5 (1 - strongly disagree and 5 - strongly agree) testing the degree to which the respondent agreed to the statements.

Section G: Adopter's category (22a – 22u).

This section was included to gain the knowledge about the type of adopter the participants are; innovators, early adopters, early majority, late adopters or laggards in relation to the adopter's category described in the diffusion of innovation theory. The questions are in the scale rating form, between 1 and 5 (1 - strongly disagree and 5 - strongly agree) testing the degree to which the respondent agreed to the statements.

In section A, personal information about the participants is needed, thus multi-choice type questions were used whereby the participant is expected to select one out of the given options.

In Sections B – G, a five-point Likert scale method is used as the measurement standard. This method requires an indication of the degree/extent to which the participant agreed to a particularly given question item. Unanimously, scholars agreed that Likert scale rating is suitable in evaluating survey data (Thomas *et al.*, 2011, Neuman, 2011, Morris, 2006, Faul, 1995, Delport & Roestenburg, 2011). The rationale for using a five-point scale rating was to accommodate indifferent or neutral responses on the question items. The types of scales used in the questionnaire are shown in Tables 4.1 and 4.2.

Table 4.1: Frequency scale.

Very low	Low	Neutral	High	Very High
1	2	3	4	5

Table 4.2: Agreement scale.

Totally disagree	Disagree	Neutral	Agree	Totally agree
1	2	3	4	5

In this study, the aim is to investigate how mobile apps are being adopted and diffused in Africa using the diffusion of innovation theory in order to obtain quantitative data. A detailed literature study about the topic under study was conducted in order to gain the fundamental knowledge concerning mobile apps usage in Africa. In considering the literature study, the research question and other expected research outputs, a detailed survey questionnaire was designed to address the goals of the study (Appendix A). The questionnaire was developed so that it would be able to collect the required data as shown in Table 4.3.

Table 4.3: Design of questionnaire for the study

Section	Question	Reason for question	Question contribution towards research objectives	Research variable	Question type	Reference (optional)
A: Background information	1. Indicate the country where you reside in Africa.	To link the answer to the country in which the respondent resides.	Obj. 3 & 4	Country	The country where the respondent is based will be determined through an optional list of selected countries of Africa.	
	2. Please select your gender.	To test whether adoption and diffusion can be linked to gender.	Obj. 3 & 4	Demographic - gender	The gender of the respondent is determined using a dichotomous question (male or female).	Koenig-Lewis *et al*. (2010); Riquelme and Rios (2010) in Chapter 2 (2.10.11).
	3. What is your age group?	To test whether adoption and diffusion can be linked to age.	Obj. 3 & 4	Demographic - age	The age of the respondent is determined using a given optional range of age brackets between 20-70 years.	Rogers (2003); Karjaluoto *et al*., (2010b); Dagada (2012) in Chapter 2 (2.10.11).
	4. What is your highest level of education?	To test whether adoption and diffusion can be linked to education level.	Obj. 3 & 4	Demographic - education	The respondent will choose from a list of different levels of education.	Rogers (2003); Joshua & Koshy (2011) in Chapter 2 (2.10.11).
	5. What is your current employment status?	To test whether adoption and diffusion can be linked to employment status.	Obj. 3 & 4	Demographic - employment	The respondent will choose from a given list of possible status of employment.	Rogers (2003); Karjaluoto *et al*. (2010b); Joshua & Koshy (2011) in Chapter 2 (2.10.11).
	6. What is your religion?	To test whether adoption and diffusion can be linked to the respondent's belief.	Obj. 2, 3, 4 & 5	Culture, Adoption and diffusion	The respondent will choose from given options or specify. status.	

Table 4.3 (contd.): Design of questionnaire for the study

Section	Question	Reason for question	Question contribution towards research objectives	Research variable	Question type	Reference (optional)
B: Mobile applications	7. To what extent do you agree with the following statements?	To determine the respondent's perception of mobile apps and the use of mobile apps.	Obj. 2, 3, 4 & 5	Mobile apps innovation, development and adoption	Scale rating question between 1 and 5 (1 – not at all and 5 – a great deal) testing the degree to which the respondent agreed with the statement.	Hellström & Tröften (2010); Kearney (2011) in Chapter 2 (2.9).
	8. I use mobile apps for?	To determine the purpose of using mobile apps.	Obj. 3 & 4	Adoption and diffusion	Scale rating question between 1 and 5 (1 – not at all and 5 – a great deal) testing the degree to which the respondent agreed with the statement.	Qiang *et al.* (2012; Murugesan (2013); GSMA (2015) in Chapter 2 (2.6)
C. Adoption and diffusion of mobile apps innovation	9. I acquire information about the existence of mobile apps innovation through:	To determine the channel(s) through which the respondent acquires information about mobile apps innovation.	Obj. 3, 4 & 5	Information	Scale rating question between 1 and 5 (1 - strongly disagree and 5 - strongly agree) testing the degree to which the respondent agreed with the statement.	Rogers (2003) in Chapter 3 (3.7.1-2).
	10. I learned how to use mobile apps correctly through:	To determine the channel(s) through which the respondent learned about the use of mobile apps.	Obj. 3, 4 & 5	Knowledge	Scale rating question between 1 and 5 (1 - strongly disagree and 5 - strongly agree) testing the degree to which the respondent agreed with the statement.	Rogers (2003) in Chapter 3 (3.7.1-2).
	11. How did you react whenever you hear about new mobile apps?	To determine how the social system welcomes a new mobile app.	Obj. 3, 4 & 5	Social system	A multiple-choice question, the respondent will choose from given options.	Rogers (2003) in Chapter 3 (3.7.1).

Table 4.3 (contd.): Design of questionnaire for the study

Section	Question	Reason for question	Question contribution towards research objectives	Research variable	Question type	Reference (optional)
	12. To what degree are you nervous about using new mobile apps?	To determine the extent of the feelings of the social system over new mobile apps.	Obj. 3, 4 & 5	Social system	Scale rating question between 1 and 5 (1 – not at all and 5 – very nervous) testing the degree to which the respondent is nervous	
	13. I use mobile apps, because?	To determine the main reason why individuals accept using mobile apps.	Obj. 3, 4 & 5	Social system	Scale rating question between 1 and 5 (1 - strongly disagree and 5 - strongly agree) testing the degree to which the respondent agreed with the statement.	Rogers (2003) in Chapter 3 (3.7.1).
	14. I tried mobile apps and considered adopting them, but later I decided not to adopt them.	To determine the rejection of mobile apps.	Obj. 3, 4 & 5	Rejection	Scale rating question between 1 and 5 (1 - strongly disagree and 5 - strongly agree) testing the degree to which the respondent agreed with the statement.	Rogers (2003) in Chapter 3 (3.7.2).
	15. I discontinued the use of a particular mobile app because:	To determine the reason for discontinuance of an innovation after being used.	Obj. 3, 4 & 5	Rejection	Scale rating question between 1 and 5 (1 - strongly disagree and 5 - strongly agree) testing the degree to which the respondent agreed with the statement.	Rogers (2003) in Chapter 3 (3.7.2).

Table 4.3 (contd.): Design of questionnaire for the study

Section	Question	Reason for question	Question contribution towards research objectives	Research variable	Question type	Reference (optional)
	16. I share information about mobile apps with others in order to:	To determine the diffusion of mobile apps.	Obj. 4 & 5	Diffusion	Scale rating question between 1 and 5 (1 - strongly disagree and 5 - strongly agree) testing the degree to which the respondent agreed with the statement.	
	17. Information about a new mobile app innovation can be transferred to people, through?	To determine the medium of diffusion of mobile apps.	Obj. 4 & 5	Diffusion	Scale rating question between 1 and 5 (1 – not all and 5 – a great deal) testing the degree to which the respondent agreed with the statement.	Rogers (2003) in Chapter 3 (3.7.1).
	18. Since the time I first became aware of a mobile app, I normally adopt and use it within a period of?	To determine how long it can take for an individual to adopt and use mobile apps.	Obj. 4 & 5	Time	A multi-choice question in which the respondent can choose more than one option.	Rogers (2003) in Chapter 3 (3.7.1).
D. Mobile apps innovation characteristics	19. To what extent do you agree with the following statements? (19a-19n).	To determine the influence of innovation attributes on the adoption and diffusion of mobile apps in Africa.	Obj. 3, 4 & 5	Relative advantage, Compatibility, Complexity, Trialability, and Observability.	Scale rating question between 1 and 5 (1 - strongly disagree and 5 - strongly agree) testing the degree to which the respondent agreed with the statement.	Rogers (2003); Al- in Chapter 2 (2.10.1 - 5) in Chapter 3 (3.7.3).

Table 4.3 (contd.): Design of questionnaire for the study

Section	Question	Reason for question	Question contribution towards research objectives	Research variable	Question type	Reference (optional)
E. Predicting factors of mobile apps adoption and diffusion.	20. To what extent do you agree with the following statements? (20a – 20y).	To determine the factors that influence the adoption and diffusion of mobile apps in Africa.	Obj. 3, 4 & 5	Social influence, Culture, Facilitating conditions, User perception, Demographics, Technology reliability, ICT anxiety, Self-efficacy and financial cost.	Scale rating question between 1 and 5 (1 - strongly disagree and 5 - strongly agree) testing the degree to which the respondent agreed with the statement.	(Karjaluoto *et al*., 2010a; Bankole *et al*., 2011; Joshua & Koshy, 2011; Dagada, 2012; Nasri & Charfeddine, 2012; Iddris, 2013; Lekhanya, 2013; Achieng & Ingari, 2015) in Chapter 2 (2.10.1 -13).
F. Contributions of mobile apps innovation to the development of Africa.	21. To what extent do you agree with the following statements? (21a – 21t).	To determine the contributions of mobile apps towards African development.	Obj. 2, 3, 4 & 5	Economic, Social, Education, Banking, Government, Agriculture, and Politics.	Scale rating question between 1 and 5 (1 - strongly disagree and 5 - strongly agree) testing the degree to which the respondent agreed with the statement.	(Hellström & Tröften, 2010; Kearney, 2011; Taylor *et al*., 2011; Beger et al., 2012; Qiang *et al*., 2012; Murugesan, 2013; Salehan & Negahban, 2013; Shaikh & Karjaluoto, 2015) in Chapter 2 (2.9.1-11).
G. Adopter's category	22. To what extent do you agree with the following statements? (22a – 22u).	To determine the category of the adopters.	Obj. 4 & 5	Category	Scale rating question between 1 and 5 (1 - strongly disagree and 5 - strongly agree) testing the degree to which the respondent agreed with the statement.	Rogers (2003) in Chapter 3 (3.7.4).

4.8.4 Sampling frame

Turner (2003) defined a sampling frame as "*the set of source materials from which the sample is selected*"; that is, a set of people among the general population from which a sample will be selected. It is a list or collection of the entire population of people that might be involved in the survey, from which a sample will be selected (Oates, 2006).

For the purpose of this study, the sampling frame involves all the mobile app users in the five selected countries in Africa. Five countries were selected from the five geographical locations in Africa because it is not possible to conduct a study in each country in Africa. This comprises various classes of individuals, educated and uneducated, rich and poor, young and old, students and workers, employed and unemployed from different sectors of life, including the economic, political, social and educational sectors.

The sample for this study was selected from the sampling frame which consists primarily of the various classes of individuals and tertiary institutions. In the tertiary institutions, it is possible to get access to different individuals with different living standards. It is a body that involves cleaners (uneducated and poor), students (young and unemployed), lecturers or office workers (young, old, educated and employed) and others.

4.8.5 Sampling techniques

A sampling technique is the process of choosing the participants who will represent the whole population (Polit-O'Hara *et al.*, 2001, Neuman, 2011). According to Burns & Grove (2003), it is a process of selecting a set of people for research purposes. There are two types of sampling technique; probability and non-probability.

Probability sampling technique – this technique provides equal opportunity or probability to any of the possible samples to be selected and can perfectly reflect the entire population, including:

- Random sampling.
- Stratified sampling.
- Cluster sampling.
- Systematic sampling

Non-probability sampling technique – this technique provides unequal opportunity or probability to the samples to be selected and the researcher is uncertain if the selected sample is a true representative of the whole population or not. This technique includes (Oates, 2006):

- Purposive sampling.
- Snowball sampling.
- Self-selection sampling.
- Convenience sampling.

For the purpose of this study, the non-probabilistic sampling technique was applied because it is difficult to get an accurate number of mobile app users in Africa. The purposive and convenience sampling method were considered in the selection of the study sample for data collection. Since it was not possible for the researcher to cover the entire likely sample, it was therefore imperative to choose a sample population which involved all the desired participants. Hence the purposive technique was required. In the selected sample, the researcher was not be able to access everyone except those who were conveniently accessible; at this point, the convenience technique became necessary and was also applied. With the purposive technique, educational institutions (universities) were chosen and with the convenience technique, data was collected from the participants.

4.8.6 Response rate and non-responses

Regardless of the technique(s) used, the goal of every survey is to gather sufficient data required for the research. The rate of response and non-response is imperative and could affect the final results of the survey. Thus, in any study, it is important to select a sampling process that will yield a maximum response or return rate. To increase the response rate, (Oates, 2006) suggested the following steps:

- Include more of the participants who are willing to respond.
- Give a good description of the study purpose and the contributions.
- In a polite manner, issue a follow-up notice as a reminder to the participants yet to respond.
- Try to find out the type and character of the participants, especially those that have not responded.

Non-response occurs when the participants refused to be part of the survey due to different reasons (Welman *et al.*, 2009). Vosloo (2014) suggested that the reasons for non-response could be as a result of some inter-related problems, such as:

- Refusal to respond.
- Ineligibility to respond.
- Inability to locate participant.
- Participant located, but unable to make contact.

To achieve a maximum response rate for this study, the questionnaire was designed in a simple, precise and easy to understand form. In addition, a letter of introduction was written and attached to the questionnaire to serve as authentication to the participants that it is a real study. At the point of contact, the participants were made to understand the importance of the research. This was done in order to obtain a good response rate.

4.8.7 Sampling size

Oates (2006) described sample size as the actual portion of the population that participated in the survey. It is the final selected individuals from the whole sample population to participate in a research survey (Shapiro, 2008).

In this study, the sample is the mobile app users in the five selected countries in Africa with the total estimated population of 477 million, comprising Nigeria (191 million), Egypt (98 million), the DRC (81 million), South Africa (57 million) and Kenya (50 million) (Worldometers, 2018). With a confidence level of 95% and confidence interval (margin of error) of 5%, the sample size can be calculated. According to Oates (2006), confidence interval tells us how near we are to the real population whereas a confidence level of 95% implies that the researcher is 95% sure that the sample size obtained is a good representative of the true population.

4.8.7.1 Sample size determination

This calculation shows how the sample size for this study was obtained. Following Krejcie & Morgan (1970), this study used the sampling formula:

$$Ss = \frac{(x^2N)P(1-P)}{\left(d^2(N-1)\right) + x^2P(1-P))} \qquad (1)$$

where:

Ss = sample size

x^2 = value for confidence level (1.96 for 95%) = 3.841

N = Population size

P = Population proportion = 0.5 (for maximization)

d^2 = Degree of accuracy (Margin of Error) = 5%

Substituting:

$$Ss = \frac{(3.841)(477000000)0.5(1-0.5)}{\big(0.0025(477000000-1)\big) + (3.841)0.5(1-0.5))}$$

$$Ss = \frac{458039250}{1192500.96} \qquad = 384.1$$

The calculated sample size corresponds with the values obtained from the on-line calculator (www.surveysystem.com) and the research advisor's table (see Appendix B). Hence, the expected minimum sample size for this study is approximately ≥ 384 participants. A total of 1 285 responses were obtained, giving a response rate of 55.87%.

4.9 Reliability

Reliability is simply the dependability of the obtained results from a survey (Gratton & Jones, 2010). It is the extent to which a measuring tool yields the same results from the participants on different occasions. In other words, reliability means dependable, trustworthy, consistent, stable, and truthful. It is measured through the computation of a correlational coefficient (Salkind, 2017). The reliability of a tool can be obtained through various procedures, such as test-retest, internal consistency, parallel form and split-half methods or techniques (Delport & Roestenburg, 2011, Dalton & Kreahling, 2010, Salkind, 2017). To obtain a 100% reliability in a measuring tool might not be possible but scholars suggested some ways to maximise the reliability of measures, including (Salkind, 2006, Neuman & Kreuger, 2003):

- Make use of multiple indicators of variables.
- Remove unclear items.
- Increase the level of measurement.
- Standardise the conditions under which the test is taken.
- Moderate the degree of difficulty of the instrument.
- Minimise the effects of external events.
- Standardise instructions.
- Maintain consistent scoring procedures.
- Use pre-tests, pilot studies and replications.

In this study, the measure of reliability was done through a pilot test and the computation of Cronbach alpha coefficients to ensure that the measurement instrument (questionnaire) is reliable.

4.9.1 Cronbach alpha coefficient

Cronbach alpha coefficient analysis was performed on the obtained data to determine the repeatability or the internal consistency of the measuring tool. The minimum threshold criterion for an exploratory research is 0.6 (Sethi and King, 1991, Numally, 1978). If the items are well formulated with strong correlations among them, the alpha coefficient will be high and close to one, otherwise the alpha coefficient will be low and close to zero.

4.9.2 Pilot test

A pilot test is a process of verifying the research approach/measurement instrument with a small group of people before conducting the main research to determine if the approach/instrument is suitable and correct (Bless *et al.*, 2006). It is a trying out of the study instrument (Baker, 1994), or the small-scale trial runs of the research (Polit-O'Hara *et al.*, 2001) in preparation for the main research. The purpose of the pilot study is to improve the research design prior to conducting the study. According to Wilkinson & Birmingham (2003), the researcher can improve the research measurement instrument (questionnaire) through pilot testing by identification and correction of errors. In addition, the pilot test helps to identify and clarify any ambiguous formulation of the questionnaire items or questions (Welman *et al.*, 2009, De Vos *et al.*, 2011).

In this study, 20 questionnaires were used to conduct a pilot test. 17 responses were received. In their comments, 10 respondents suggested that the design of the questionnaire was good enough for the research, two respondents suggested removal of some questions and five respondents suggested that some questions be rephrased. All the suggestions were considered and implemented. The questionnaire was discussed, analysed and approved by the Statistical Consultation Services at North-West University, Potchefstroom Campus.

4.10 Data-analysis techniques

Data-analysis techniques are applied which are suitable for the sample characteristics, i.e. non-probalistic, purposeful and convenient. Descriptive analysis was performed to describe the frequency and response percentage from the participants. Pearson Chi-Square and Cramer’s V tests were performed to evaluate the strength of association between the categorical variables (criteria $\alpha < 0.05$). Factor analysis was performed to reduce the complexity in a set of data. Kaiser Meyer Olkin (KMO) and Bartlett’s test were performed to measure the strength of relationships among the variables (criteria 0.5 = minimum, 0.7 very acceptable and > 9.0 = superb). Cronbach alpha reliability analysis was used to compute reliability coefficients for each of the examining variables (criteria 0.6). Analysis of variance was performed to determine the difference in the groups of the dependent variables. A t-test analysis was performed to determine the difference in the mean of two independent samples.

4.11 Chapter Summary

This chapter discussed the research design and methodology used for the study in detail. Three major research paradigms were highlighted, including positivism, interpretivism and the critical paradigm. The positivism research paradigm was found to be the most appropriate for the study and was further discussed in detail, covering the principles, techniques, strengths, and weaknesses, research strategy and data-collection methods.

The survey research method would be applied, and a questionnaire would be used as the instrument for data collection. The quantitative data to be collected will be appropriately analysed using several statistical methods, such as descriptive statistics, correlational Cronbach alpha coefficient, etc.

In Chapter 5, the details of the data analysis and the findings with respect to the adoption and diffusion of mobile apps in Africa are presented.

Chapter 5

Data analysis

5.1 Introduction

In this chapter, the analyses of the collected quantitative data is described, presented and interpreted. The purpose of this study is to investigate the adoption and diffusion of mobile apps in Africa. The objectives include:

1. Conduct a literature review of the use of mobile apps, especially in Africa.
2. Investigate the adoption and diffusion of mobile apps in Africa.
3. Investigate the effect of mobile apps on African development.
4. Compare the adoption and diffusion of mobile apps in the selected countries.
5. Outline the guidelines and propose a framework for successful adoption and diffusion of mobile apps in Africa.

Objective 1 was addressed in Chapter 2. In this chapter, the data collected from the five countries will be presented and in the next chapter, the data collected from each country will be presented and discussed individually. In this chapter, objectives 2 and 3 will be discussed.

The results of the data analysis are presented according to the order of the research conceptual model variables. This is to ensure that the remaining objectives of this study are accomplished. For more clarity and understanding of the analysis and discussion, see the conceptual model of the study below.

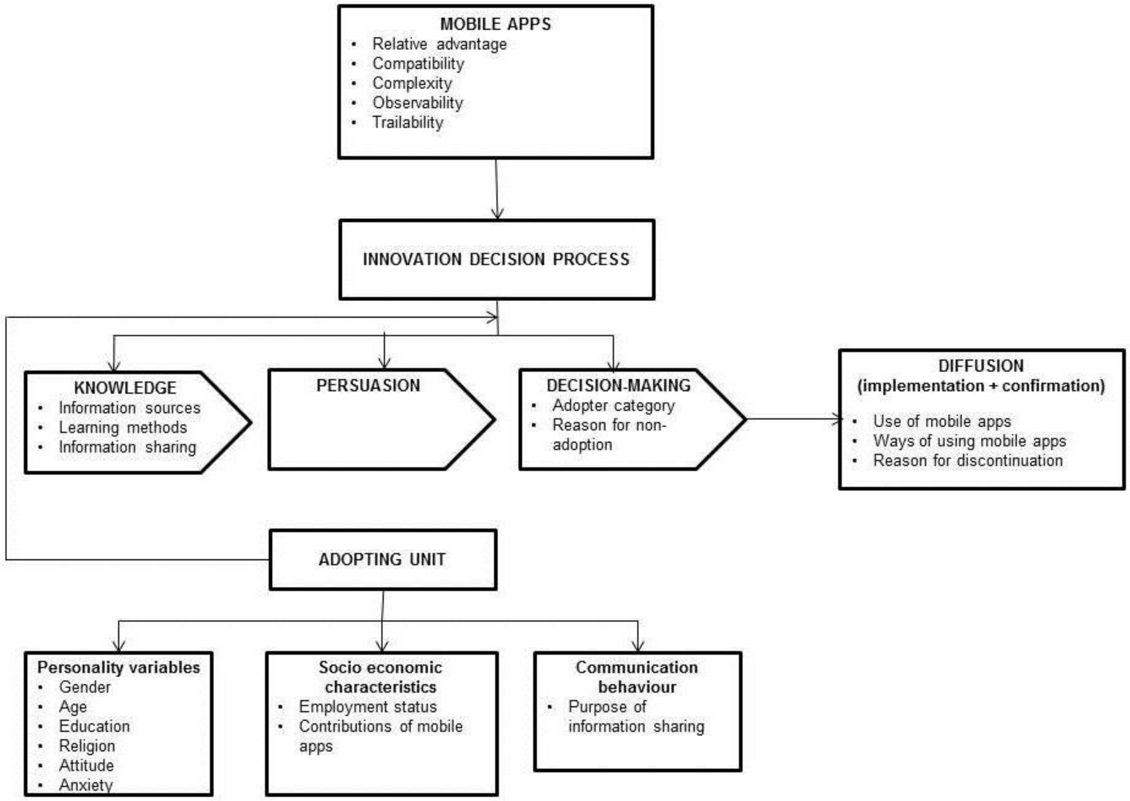

Figure 5.1: Research conceptual model

As survey-based research, a questionnaire was used as an instrument of data collection. The questionnaire contained the following seven sections:

1. Background information
2. Mobile applications
3. Adoption and diffusion of mobile apps innovation
4. Mobile apps innovation characteristics
5. Predicting factors of mobile apps adoption and diffusion in Africa
6. Contributions of mobile apps innovation to the development of Africa
7. Adopter's category

The required quantitative data for this research were collected from five selected countries in Africa, representing the five geographical locations in Africa. These countries are South Africa (south), Nigeria (west), Morocco (north), Kenya (east) and the Democratic Republic of Congo (central).

Drop-off and electronic methods were applied in the distribution of the research questionnaire. The participants were taken from different age groups and different employment levels to ensure that the captured data covers general opinions. A total of 1 285 out of 2 300 questionnaires distributed were returned, giving a response rate of 55.87%. The responses include 957 drop-off and 328 electronically completed questionnaires. Table 5.1 shows the number of participants from each country.

Table 5.1: Summary of the responses

Country	Total distributed	Total returned
South Africa	500	335
Nigeria	500	370
Morocco	400	116
Kenya	400	212
DRC	500	252
Total	2 300	1 285

In section 5.2, the methods used in the data analyses are explained; in section 5.3, the profiles of the participants are discussed and in section 5.4, the mobile apps innovation in Africa is described. The innovation-decision process is presented in section 5.5 and in section 5.6, the adopting unit is covered. Finally, in section 5.7, the chapter is summarised.

5.2 Methods used in the data analyses

In this section, all the data analysis methods used in this study are described. Descriptive analysis was performed on all the research variables to describe the frequency and response percentage from the participants. A Pearson Chi-Square test was performed to evaluate the strength of association between the categorical variables (criteria $\alpha < 0.05$). Factor analysis was performed on the research variables with multiple describing items to reduce the complexity in a set of data. The obtained factors were used for further analysis. Kaiser Meyer Olkin (KMO) and Bartlett's test were performed to measure the strength of relationship among the variables (criteria 0.5 = minimum, 0.7 very acceptable and >9.0 = superb). Cronbach alpha reliability analysis was used to compute reliability coefficients for each of the examining variables (criteria 0.6). Analysis of variance (ANOVA) was performed on the research variables, including the personal data to determine the difference in the groups of the dependent variables (selected countries). T-test analysis was performed on gender to determine the difference in the mean of two independent sample populations (male and female). Finally, regression analysis was performed on the factors (variables) to test the relationship between the dependent variables and the independent variables. The results of data analysis will be presented according to the components of the conceptual model. In regard to the study aims and objectives, the descriptive statistics will be presented first, followed by the factor analysis and reliability analysis. Thereafter, the ANOVA and regression analyses will be discussed in Chapters 7 and 8.

5.3 Background information

In this section, the description of the participants involved in this study is provided. It covers the country where the participant resides, gender, age group, education level, employment status and religion. This is done to obtain more knowledge about the participating population. The results are shown in Table 5.2-5.6.

Table 5.2: Gender description

Participants	Gender		Total
	Male	**Female**	
Total	703 (54.71%)	582 (45.29%)	1 285 (100%)

Table 5.2 shows that the population involved in the survey covered a fairly balanced gender proportion, though the number of male participants is larger with 703 (54.71%), whereas the female group is 582 (45.29%).

Table 5.3: Age group description

Africa	Age group							
	Below 20	**20-30**	**31-40**	**41-50**	**51-60**	**61-70**	**Above 70**	**Total**
Total	158 (12.3%)	409 (31.8%)	379 (29.5%)	187 (14.6%)	77 (6.0%)	47 (3.7%)	28 (2.2%)	1285 (100%)

Table 5.3 depicts that all the targeted age groups participated in the survey in a different proportion. Age groups 20-30 and 31-40 accounted for over 60% of the population with 409 (31.8%) and 379 (29.5%) respectively.

Table 5.4: Level of Education

Africa	Education						
	Matric	**Diploma**	**University**	**Masters**	**Doctorate**	**Others**	**Total**
Total	272 (21.2%)	332 (25.8%)	412 (32.1%)	142 (11.1%)	78 (6.1%)	49 (3.7%)	1285 (100%)

Table 5.4 indicates that a good representation of various education levels was obtained, ranging from matric/secondary to doctorate, including the option for Other, which may be less than matric/secondary. The results show the education level of the participants, namely

matric 21.2%, diploma 25.8%, university 32.1%, masters 11.1%, doctorate 6.1% and Other 3.7%. 96.3% of the participants reached the lowest education level of matric/secondary, whereas 3.7% does not.

Table 5.5: Employment description

Africa	Employment				
	Student	**Employed**	**Retired**	**Unemployed**	**Total**
Total	402 (31.3%)	615 (47.9%)	118 (9.2%)	150 (11.7%)	1285 (100%)

Table 5.5 depicts the employment status of the participants, including student (31.3%), employed (47.9%), retired (9.2%) and unemployed (11.7%). This indicates that 81.2% of the participants were students and working-class people, though the working class was the larger group.

Table 5.6: Religion description

Africa	Religion					Total
	Christian	**Muslim**	**Hindu**	**Atheist**	**Other**	
Total	947 (73.7%)	263 (20.5%)	26 (2.0%)	19 (1.5%)	30 (2.3%)	1285 (100%)

Table 5.6 shows the proportion of the different religious groups that were involved in the survey. This includes Christian 73.7%, Muslim 20.5%, Hindu 2.0%, Atheist 19 1.5% and Other 2.3%.

From the results in section 5.3, it can be seen that the participants are from all five selected countries and also, that their gender, age group, level of education, employment status and religious background are different. It indicates a good distribution of the participants' profile information which is encouraging to the study.

5.4 Mobile apps innovations in Africa

As discussed in the literature study in Chapter 2, the evolution of mobile apps is rapidly transforming African society. As an innovation, mobile apps have five key features/characteristics. The aim of this section is to analyse the data collected on the general perceptions of the participants on the features of mobile apps. Questions were answered using a five-point Likert scale (1 – strongly disagree and 5 – strongly agree).

5.4.1 Influencing features of mobile apps

It was mentioned in the literature that a mobile app is a technological innovation comprising some influencing features including relative advantage, complexity, compatibility, observability and trialability. These features help to reduce the degree of uncertainty about the mobile app. Individual perceptions of these features predict the adoption rate of any mobile app. This question intends to determine the perceptions of African mobile apps adopters about the features of mobile apps and the obtained results are depicted in Table 5.7.

Table 5.7: Features of mobile apps

Research variables	**Scale rating**					**Total**	**Mean**	**Std. dev.**
	Strongly disagree				**Strongly agree**			
	1	**2**	**3**	**4**	**5**			
Complexity (ease of use)	45 (3.5%)	95 (7.4%)	343 (26.7%)	417 (32.5%)	385 (30.0%)	1285 (100%)	3.8	1.1
Relative advantage	73 (5.7%)	123 (9.6%)	299 (23.3%)	363 (28.2%)	427 (33.2%)	1285 (100%)	3.7	1.2
Compatibility	57 (4.4%)	139 (10.8%)	319 (24.8%)	371 (28.9%)	399 (31.1%)	1285 (100%)	3.7	1.1
Trialability	78 (6.1%)	128 (10.0%)	283 (22.0%)	382 (29.7%)	414 (32.2%)	1285 (100%)	3.7	1.2
Observability	130 (10.1%)	170 (13.2%)	285 (22.2%)	316 (24.6%)	384 (29.9%)	1285 (100%)	3.5	1.3

It can be seen from Table 5.7 that most of the participating population agree that relative advantage influences their adoption and diffusion of a particular mobile app. 33.2% strongly agree, 28.2% agree, 23.3% stand neutral, 9.6% disagree and 5.7% strongly disagree on this aspect.

Regarding complexity, the participants believe that adoption and diffusion of mobile apps is a simple and easy process. 30% of the participants strongly agree, 32.5% agree, 26.7% stand neutral, 7.4% disagree and 3.5% strongly disagree.

Most participants believe that the compatibility aspect of any mobile app influences their adoption and diffusion of that particular mobile app. 31.1% strongly agree, 28.9% agree, 24.8% are neutral, 10.8% disagree and 4.4% strongly disagree to this purpose.

Concerning observability, the results show that 29.9% and 24.6% strongly agree and agree respectively that they use mobile apps because they see other people using them, whereas 10.1% and 13.2% strongly disagree and disagree respectively to this fact. 22.2% neither agree nor disagree.

Finally, 32.2% of the participants strongly agree and 29.7% agree on the trialability feature. 6.1% strongly disagree and 10.0% disagree. 22.7% are neutral.

The means of the research variables are ≥ 3.5 and ≤ 3.7, indicating that relative advantage, complexity, compatibility, observability and trialability are the influencing features of mobile apps and complexity has the biggest influence, whereas observability has the least influence on the adoption and diffusion of mobile apps.

These features of mobile apps, namely relative advantage, complexity, compatibility, observability and trialability, are described with explanatory items to simplify the meaning of each particular characteristic. More investigation was conducted on the explanatory items and the collected data were factorised. The results obtained from the participants' responses are shown in Table 5.8.

Table 5.8: Mobile apps characteristics

Items (Research variables)	**Scale rating**					**Mean**	**Std. dev.**
	Strongly disagree			**Strongly agree**			
	1	**2**	**3**	**4**	**5**		
Using mobile apps makes my work easier.	59 (4.6%)	129 (10.0%)	325 (25.3%)	382 (29.7%)	390 (30.4%)	3.7	1.1
Using mobile apps to do my work improves my efficiency.	78 (6.1%)	129 (10.0%)	316 (24.6%)	375 (29.2%)	387(30.1%)	3.8	1.2
Using mobile apps enables me to gain more knowledge on the way I perform my tasks.	69 (5.4%)	124 (9.6%)	334 (26.0%)	424 (33.0%)	334 (26.0%)	3.7	1.1
I was encouraged to use mobile apps because of the benefits I observed in them.	73 (5.7%)	124 (9.7%)	364 (28.3%)	404 (31.5%)	319 (24.8%)	3.6	1.1
I have no difficulty learning how to use mobile apps.	72 (5.6%)	157 (12.2%)	333 (26.0%)	390 (30.4%)	331 (25.8%)	3.6	1.2
Use of mobile apps fits well with the way I like to do my work.	79 (6.1%)	183 (14.2%)	294 (22.9%)	407 (31.7%)	322 (25.1%)	3.6	1.2
I like to use mobile apps on a trial basis to see what they can offer.	96 (7.5%)	186 (14.5%)	290 (22.6%)	405 (31.5%)	308 (24.0%)	3.5	1.2
It is/was easy for me to perform my daily activities using mobile apps.	77 (6.0%)	176 (13.7%)	358 (27.9%)	409 (31.9%)	263 (20.5%)	3.5	1.1
A trial of mobile apps quickens my decision to adopt them.	91 (7.1%)	207 (16.1%)	308 (24.0%)	391 (30.4%)	288 (22.4%)	3.5	1.2
Using mobile apps enables me to accomplish my tasks quicker.	128 (10.0%)	173 13.5%)	334 (26.0%)	311 24.2%)	339 (26.3%)	3.5	1.3
Using mobile apps is compatible with all aspects of my lifestyle.	108 (8.4%)	189 (14.7%)	331 (25.8%)	370 (28.8%)	287 (22.3%)	3.4	1.2
I like to see the trial demo of mobile apps before accepting to use them.	103 (8.0%)	191 (14.9%)	310 (24.1%)	427 (33.3%)	253 (19.7%)	3.4	1.2
Using mobile apps enables me to have more control over my activities.	95 (7.4)	197 (15.3%)	381 (29.6%)	357 (27.8%)	255 (19.8%)	3.4	1.2
I am using mobile apps because I can see other people using them.	133 (10.4%)	227 (17.7%)	260 (20.2%)	377 (29.3%)	288 (22.4%)	3.4	1.3

Table 5.8 shows that the mean results obtained from all the items are > 3.3, indicating that all the characteristics of innovation are significant.

Factor analysis was performed to identify the loadings of these items with respect to the features of mobile apps and the results obtained are shown in Table 5.9.

Table 5.9: Factor loading for the characteristics of mobile apps

Items	**Factor 1**	**Factor 2**	**Factor 3**
Using mobile apps enables me to accomplish my tasks more quickly.	0.668		
Using mobile apps enables me to gain more knowledge on the way I perform my tasks.	0.759		
Using mobile apps to do my work improves my efficiency.	0.755		
Using mobile apps make my work easier.	0.742		
Use of mobile apps fits well with the way I like to do my work.	0.593		
Using mobile apps is compatible with all aspects of my lifestyle.	0.527		
Using mobile apps enables me to have more control over my activities.		0.554	
I am using mobile apps because I can see other people using them.		0.822	
I was encouraged to use mobile apps because of the benefits I observed in them.		0.521	
I have no difficulty in learning how to use mobile apps.			0.300
I like to use mobile apps on a trial basis to see what they can offer.			0.736
A trial of mobile apps quickens my decision to adopt them.			0.788
I like to see the trial demo of mobile apps before accepting to use them.			0.714
It is/was easy for me to perform my daily activities using mobile apps.			0.319

Table 5.9 shows that 14 items related to mobile apps innovation characteristics were factor analysed using principal component analysis with direct Oblimin rotation. The analysis resulted in three factors covering 50.5%% of the variance for the total set of variances.

Factor 1 was labelled Relative advantage and compatibility due to the loadings of the following items: Using mobile apps enables me to accomplish my tasks quicker; Using mobile apps enables me to gain more knowledge on the way I perform my tasks; Using mobile apps to do my work improves my efficiency; Using mobile apps makes my work easier; Use of mobile apps fits well with the way I like to do my work; Using mobile apps is compatible with all aspects of my lifestyle. The variance explained by this factor was 33.73% with an eigenvalue of 4.72.

Factor 2 was labelled Observability due to the loading of the following: Using mobile apps enables me to have more control over my activities; I am using mobile apps because I can see other people using them; I was encouraged to use mobile apps because of the benefits I observed in them. The variance explained by this factor was 9.14% with an eigenvalue of 1.23.

Factor 3 was labelled Trialability due to the loading of the following: I have no difficulty in learning how to use mobile apps; I like to use mobile apps on a trial basis to see what they can offer; A trial of mobile apps quickens my decision to adopt them; I like to see the trial demo of mobile apps before accepting to use them; It is/was easy for me to perform my daily activities using mobile apps. The variance explained by this factor was 7.64% with an eigenvalue of 1.07.

The average of the communalities of the variables is 0.505, indicating good relationships among the variables. The KMO adequate value is 0.885 and the Bartlett's significance is 0.000, indicating that the set of variables used is adequately related for the factor analysis. From Table 5.9, the identified clear patterns from the responses obtained from the adopters of mobile apps in Africa regarding the transmission of the information about new mobile apps to people in Africa are:

1. Relative advantage and compatibility.
2. Observability.
3. Trialability.

The factors are internally consistent with alpha coefficient values of relative advantage and compatibility, 0.8, observability, 0.6 and trialability, 0.7.

In general, the features/characteristics of mobile apps were tested, and the results indicated that all the features are significant to mobile apps and complexity was perceived by the participants as the highest significant feature. Furthermore, the features of mobile apps were investigated using some simplified and easy to understand questions/items to describe each feature. It was observed that relative advantage, compatibility, observability and trialability are the significant features of mobile apps. Relative advantage and compatibility were perceived to be similar because the two features loaded on one factor. Noticeably, complexity that was the highest significant feature on a general direct test was no longer significant. Either the participants do not understand the detailed meaning of complexity in the first test or the explanations provided by the description items in the second test caused the perception of mobile apps being simple and user-friendly innovations with little or no complexity. This study suggests that some research variables should be investigated both in general and simplified descriptive forms to obtain a practically significant result.

In section 5.4, the mobile apps innovations in Africa were presented and discussed in general, covering the influencing features of mobile apps which include relative advantage, compatibility, complexity, observability and trialability. In the next section, the results obtained from the investigation on the innovation-decision process are presented.

5.5 Innovation-decision process

As discussed in the literature, the innovation-decision process is an information-seeking and information-processing activity, in which the adopters of mobile apps are motivated to decrease the uncertainty surrounding the benefits and difficulties of mobile apps adoption and diffusion in Africa. From the research model, it involves four stages, namely knowledge, persuasion, decision making and diffusion.

In this section, the adoption and diffusion of mobile apps in Africa (Objective 2) are investigated. Questions were posed to the participants to determine the following:

Knowledge about mobile apps

- ✓ Information sources.
- ✓ Learning methods.
- ✓ Information sharing.

Decision making

- ✓ Adopter's categories.
- ✓ Reasons for non-adoption.

Diffusion

- ✓ Ways of using mobile apps.
- ✓ Reason for discontinuance.

These are described in the subsequent sub-sections.

5.5.1 Knowledge about mobile apps

The adoption and diffusion of mobile apps begin with knowledge about mobile apps. It involves the acquisition of the information about mobile apps, what a mobile app is and how it works. Afterwards it is about how and what methods to use in learning how to use mobile apps and share the information about mobile apps with other people. In this regard, this section investigated the information sources, learning methods, and information sharing of mobile apps. The results obtained are presented below.

5.5.1.1 *Information sources*

Mobile apps are designed and created to be used by the general public for several purposes. There are various types of mobile apps that can be used to perform different tasks, but individuals can only use them if they know about mobile apps. Firstly, one needs to acquire information about a mobile app before adopting and using it. Information about mobile apps can be acquired through a source. The source of information can either be from individuals or institutions (Rogers, 2003). Participants were asked (through five-point Likert questions, 1 – strongly disagree and 5 – strongly agree) to identify how they acquired the information about the existence of mobile apps and the results obtained are conveyed in Table 5.10.

Table 5.10: Information sources

Acquisition means	**Scale rating**					**Mean**	**Std. dev.**
	Strongly disagree				**Strongly agree**		
	1	**2**	**3**	**4**	**5**		
Interpersonal communication	71 (5.5%)	116 (9.0%)	307 (23.9%)	447 (34.8%)	344 (26.8%)	3.7	1.1
The Internet	109 8.5%)	196 (15.3%)	262 (20.4%)	330 (25.7%)	385 (30.0%)	3.5	1.3
Mass media	93 (7.2%)	200 (15.6%)	339 (26.4%)	315 (24.5%)	338 (26.3%)	3.5	1.2
The organisation	175 (13.6%)	259 (20.2%)	305 (23.7%)	342 (26.6%)	204 (15.9%)	3.1	1.3
Special events	178 (13.9%)	278 (21.6%)	340 (26.5%)	278 (21.6%)	211 (16.4%)	3.1	1.3

From Table 5.10, the mean value ranges from 3.1 to 3.7 showing that the participants obtain information about mobile apps through all the means, including interpersonal communication, the Internet, mass media, the organisation and special events. Interpersonal communication is the most used source, followed by the Internet and mass media, whereas the organisation and special events sources are the least used ways to obtain information about the existence of mobile apps.

These sources of information are described with explanatory items to simplify the meaning of each particular source. More investigation was conducted on the explanatory items and the collected data were factorised. The results obtained from the participants’ responses are shown on Table 5.11.

Table 5.11: Factor loading of information sources

Items	**Factor 1**	**Factor 2**
Mass media, e.g. TV, radio and newspaper.	0.523	
Organisation where I am situated.	0.808	
Special events, e.g. conferences, trade shows and exhibitions.	0.919	
Internet (websites).		0.783
Interpersonal communication, e.g. friends and family.		0.829

Five sources of the acquisition of the information about the existence of mobile apps were analysed using principal component analysis with direct Oblimin rotation. The analysis resulted in two factors covering 63.42% of the variance for the total set of variances.

Factor 1 was labelled External initiated actions due to the loading of the following items: Mass media; Organisation where I am situated; Special events. The variance explained by this factor was 42.95% with an eigenvalue of 2.15.

Factor 2 was labelled Personal initiated actions due to the loading of the following: Internet (websites); Interpersonal communication. The variance explained by this factor was 20.47% with an eigenvalue of 1.02.

The average of the communalities of the variables is 0.634, indicating good relationships among the variables. The KMO adequate value is 0.664 and the Bartlett's significance is 0.000, indicating that the set of variables used is adequately related for the factor analysis. From Table 5.11, the identified clear patterns from the responses obtained from the adopters of mobile apps in Africa regarding the acquisition of information about the existence of mobile apps in Africa are:

1. External initiated actions.
2. Personal initiated actions.

The Cronbach alpha coefficient analysis was performed on the factors and they were found to be internally consistent. Their alpha values are eternal initiated actions, 0.7 and personal initiated actions, 0.5. The means of inter-item correlations are 0.4 and 0.3 for external and personal initiated actions respectively.

5.5.1.2 *Learning methods*

This section investigates the methods through which the participants learn how to use mobile apps. The results obtained are shown in Table 5.12.

Table 5.12: Learning method

Method	**Scale rating**					**Mean**	**Std. dev.**
	Strongly disagree				**Strongly agree**		
	1	**2**	**3**	**4**	**5**		
Interpersonal communication	85 (6.6%)	151 (11.8%)	335 (26.1%)	391 (30.4%)	323 (25.1%)	3.6	1.2
The Internet	95 (7.4%)	189 (14.7%)	336 (26.1%)	351 (27.3%)	314 (24.4%)	3.5	1.2
Operational manual	143 (11.1%)	190 (14.8%)	348 (27.1%)	303 (23.6%)	300 (23.4%)	3.3	1.3
Informal training	153 (11.9%)	182 (14.2%)	392 (30.5%)	309 (24.1%)	248 (19.3%)	3.3	1.2
Formal training	245 (19.1%)	265 (20.6%)	364 (28.3%)	237 (18.4%)	174 (13.6%)	2.8	1.3

From Table 5.12, it can be observed that four out of five learning methods, including interpersonal communication, the Internet, operational manual, informal training have mean values of ≥ 3.3 and ≤ 3.6, whereas formal training has a mean value of 2.8. This implies that individuals can learn how to use mobile apps through four methods, including interpersonal communication, the Internet, operational manual and informal training, whereas formal training is not frequently used to learn how to use mobile apps.

5.5.1.3 *Information sharing*

In Africa, the diffusion of mobile apps involves a process through which the population creates and shares information through a medium. This medium is referred to as a communication channel. According to Rogers (2003), there are two main communication channels for the diffusion of innovation, namely mass media and interpersonal communication. This study was interested in determining the communication channels by which the adopters of mobile apps in Africa share the information about mobile apps with one another.

Five items were used to measure this research variable in order to determine the medium used to transfer the information about newly created mobile apps among the African population. These items are:

- A mass media, such as TV, radio or newspaper.
- Two-way communication between two or more individuals.
- The Internet (websites).
- Conferences, trade shows or exhibitions.
- Organisations where people are situated.

The obtained results are shown in Table 5.13.

Table 5.13: Information sharing

Medium of information transfer	**Scale rating**					**Mean**	**Std. dev.**
	Strongly disagree				**Strongly agree**		
	1	**2**	**3**	**4**	**5**		
Two-way communication between two or more individuals	47 (3.7%)	120 (9.3%)	327 (25.4%)	427 (33.2%)	363 (28.2%)	3.7	1.1
The Internet (websites)	68 (5.3%)	140 (10.9%)	307 (23.9%)	388 (30.2%)	382 (29.7%)	3.7	1.2
Two-way communication between two or more individuals	47 (3.7%)	120 (9.3%)	327 (25.4%)	427 (33.2%)	363 (28.2%)	3.7	1.1
Organisations where people are situated	80 (6.2%)	207 (16.2%)	391 (30.4%)	347 (27.0%)	260 (20.2%)	3.4	1.2
Conferences, trade shows or exhibitions	82 (6.4%)	242 (18.9%)	387 (30.2%)	336 (26.2%)	234 (18.2%)	3.3	1.1

The means of the information sharing variables vary from 3.3 to 3.7, indicating that all these mediums of information transfer are potential ways of sharing the information about mobile apps from one individual to another in the African social system. The results explained that through two-way communication, the Internet, mass media, conferences and organisations, one can transfer the information about mobile apps to other people, but the most used method is through two-way communication and conferences are the least used method. It is interesting that for both knowledge acquisition and knowledge transfer the top two mediums are the same.

The five ways of sharing the information about new mobile apps with people were described with some explanatory questions/items. The items were factor analysed using principal component analysis with direct Oblimin rotation. The analysis resulted in two factors covering 62.45% of the variance for the total set of variances. Table 5.14 shows the factor loading of information sharing.

Table 5.14: Factor loading of information sharing items

Items	**Factor 1**	**Factor 2**
Conferences, trade shows or exhibitions	0.804	
Organisations where people are situated	0.860	
A mass medium, such as TV, radio, or newspaper		0.783
Two-way communication between two or more individuals		0.832
Internet (websites)		0.425

Factor 1 was labelled Organisations and events due to the loading of the following items: Organisations where people are situated; Conferences, trade shows or exhibitions. The variance explained by this factor was 40.99% with an eigenvalue of 2.05.

Factor 2 was labelled Individual activities due to the loading of the following: A mass medium, such as TV, radio, or newspaper; Two-way communication between two or more individuals; Internet (websites). The variance explained by this factor was 21.49% with an eigenvalue of 1.07.

The average of the communalities of the variables is 0.623, indicating good relationships among the variables. The KMO adequate value is 0.680 and the Bartlett's significance is 0.000, indicating that the set of variables used is adequately related for the factor analysis. From Table 5.14, the identified clear patterns from the responses obtained from the adopters of mobile apps in Africa regarding the transmission of the information about new mobile apps to people in Africa are:

1. Organisations and events.
2. Individual activities.

The factors are internally consistent with the same alpha coefficient values of 0.6

5.5.2 Decision making

Decision making involves the adoption and rejection of mobile apps. In this stage, an individual/adopter of a mobile app chooses to adopt or reject the mobile app. In this section, the adopter's category and the reasons of rejection of mobile apps was measured. The results obtained from the investigation of decision making are presented below.

5.5.2.1 *Adopter's categories*

Rogers (2003) categorised a social system based on innovativeness. He defined innovativeness as the extent to which an individual is relatively earlier in adopting new innovations, products or ideas. Rogers' diffusion of innovation framework comprises five categories of adopters, namely innovators, early adopters, early majority, late majority and laggards. With reference to the diffusion of innovation framework, this study aimed to determine the adopter's category of the participants. The obtained results are shown in Table 5.15.

Table 5.15**:** Adopter's category

Items (Research variables)	**Scale rating**					**Mean**	**Std. dev.**
	Strongly disagree				**Strongly agree**		
	1	**2**	**3**	**4**	**5**		
Just because everyone else is using new technology, does not mean that I need to use it.	162 (12.6%)	156 (12.1%)	276 (21.5%)	367 (28.6%)	324 (25.2%)	3.4	1.3
I want to make sure that adopting a new technology would be easy for me.	91 (7.1%)	201 (15.6%)	352 (27.4%)	371 (28.9%)	270 (21.0%)	3.4	1.2
I share my experiences with new technologies with others.	129 (10.0%)	190 (14.8%)	330 (25.7%)	351 (27.3%)	285 (22.2%)	3.4	1.3
I want to see examples of successes of new technology before adopting it.	102 (7.9%)	221 (17.2%)	337 (26.2%)	351 (27.3%)	274 (21.3%)	3.4	1.2
I experiment with new technology to see if it might be useful to me.	104 (8.1%)	213 (16.6%)	365 (28.4%)	352 (27.4%)	250 (19.5%)	3.3	1.2
Other people often ask for my advice or help regarding new technologies.	108 (8.4%)	215 (16.7%)	354 (27.5%)	364 (28.3%)	244 (19.0%)	3.3	1.2
The fear of failing will not stop me from trying a new technology.	99 (7.7%)	253 (19.7%)	346 (26.9%)	323 (25.1%)	264 (20.5%)	3.3	1.2
I adopt a "wait and see" attitude toward new technologies.	111 (8.6%)	242 (18.8%)	342 (26.6%)	328 (25.5%)	262 (20.4%)	3.3	1.2
I want to make sure I have the necessary technical support and advice to learn and use a new technology before I adopt it.	112 (8.7%)	209 (16.3%)	370 (28.8%)	372 (28.9%)	222 (17.3%)	3.3	1.2

Table 5.15 (contd.): Adopter's category

Items (Research variables)	**Scale rating** Strongly disagree				Strongly agree	**Mean**	**Std. dev.**
I am willing to invest time and energy to learn on my own and adapt to new technologies.	119 (9.3%)	222 (17.3%)	327 (25.4%)	390 (30.4%)	227 (17.7%)	3.3	1.2
I tend to be an active information seeker with regard to new technologies.	96 (7.5%)	251 (19.5%)	349 (27.2%)	359 (27.9%)	230 (17.9%)	3.3	1.2
I accept new technology only when it becomes necessary.	136 (10.6%)	214 (16.7%)	342 (26.6%)	337 (26.2%)	256 (19.9%)	3.3	1.3
I accept new technology only after it has become established among most other people who I know.	130 (10.1%)	211 (16.4%)	380 (29.6%)	309 (24.0%)	255 (19.8%)	3.3	1.2
I tend to try new technology as soon as it is available to me.	116 (9.0%)	242 (18.8%)	358 (27.9%)	339 (26.4%)	230 (17.9%)	3.3	1.2
I am sceptical about new technologies.	148 (11.5%)	243 (18.9%)	331 (25.8%)	324 (25.2%)	238 (18.5%)	3.2	1.3
My daily life is functioning well without using new technology.	197 (15.3%)	200 (15.6%)	303 (23.6%)	315 (24.5%)	270 (21.0%)	3.2	1.4
I tend to be a risk-taker about new technologies.	196 (15.3%)	184 (14.3%)	324 (25.2%)	342 (26.6%)	239 (18.6%)	3.2	1.3
I am more interested in technology than with its use in specific situations.	156 (12.1%)	258 (20.1%)	323 (25.2%)	322 (25.1%)	225 (17.5%)	3.2	1.3
I see no use for new technology in my life.	227 (17.7%)	212 (16.5%)	323 (25.1%)	324 (25.2%)	199 (15.5%)	3.0	1.3
I am usually not interested in adopting new technologies.	217 (16.9%)	231 (18.0%)	313 (24.4%)	331 (25.8%)	192 (14.9%)	3.0	1.3
I am often one of the first persons to try new technologies.	244 (19.0%)	217 (16.9%)	344 (26.8%)	295 (23.0%)	185 (14.4%)	3.0	1.3

The research variables of the adopter's category of mobile apps innovation in Africa were factor analysed using principal component analysis with direct Oblimin rotation. The analysis resulted in five factors covering 56.85% of the variance for the total set of variances. The loading of the factors is shown in Table 5.16.

Table 5.16: Factor loading of adopter's category

Items	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**
I am sceptical about new technologies.	0.575				
I accept new technology only after it has become established among the majority of other people who I know.	0.704				
I accept new technology only when it becomes necessary.	0.490				
I am usually not interested in adopting new technologies.		0.612			
I see no use for new technology in my life.		0.759			
My daily life is functioning well without using new technology.		0.782			
Just because everyone else is using new technology, does not mean that I need to use it.		0.728			
I am often one of the first persons to try new technologies.			0.741		
I tend to be a risk-taker with regard to new technologies.			0.825		
I tend to be an active information seeker with regard to new technologies.			0.703		
I tend to try new technology as soon as it is available to me.			0.733		
I am more interested in technology than with its use in specific situations.			0.625		
I am willing to invest time and energy to learn on my own and adapt to new technologies.			0.433		
The fear of failing will not stop me from trying a new technology.				0.558	
I share my experiences with new technologies with others.				0.735	
Other people often ask for my advice or help regarding new technologies.				0.754	
I experiment with new technology to see if it might be useful to me.				0.697	
I adopt a "wait and see" attitude toward new technologies.					0.608
I want to see examples of successes of new technology before adopting it.					0.802
I want to make sure that adopting a new technology would be easy for me.					0.760
I want to make sure I have the necessary technical support and advice to learn and use a new technology before I adopt it.					0.457

Factor 1 was labelled *Late majority and Laggards* due to the loading of the following items: I am sceptical about new technologies; I accept new technology only after it has become established among most other people who I know; I accept new technology only when it becomes necessary. The variance explained by this factor is 12.76% and the eigenvalue is 4.88.

Factor 2 was labelled *Non-Adopters* due to the loading of the following items: I am usually not interested in adopting new technologies; I see no use for new technology in my life; My daily life is functioning well without using new technology; Just because everyone else is using new technology, does not mean that I need to use it. The variance explained by this factor is 23.23% and the eigenvalue is 2.68.

Factor 3 was labelled *Innovators* due to the loading of the following items: I am often one of the first persons to try new technologies; I tend to be a risk-taker with regard to new technologies; I tend to be an active information seeker with regard to new technologies; I tend to try new technology as soon as it is available to me; I am more interested in technology than with its use in specific situations; I am willing to invest time and energy to learn on my own and adapt to new technologies. The variance explained by this factor is 9.55% and the eigenvalue is 2.01.

Factor 4 was labelled *Early Adopters* due to the loading of the following items: The fear of failing will not stop me from trying a new technology; I share my experiences with new technologies with others; Other people often ask for my advice or help regarding new technologies; I experiment with new technology to see if it might be useful to me. The variance explained by this factor is 5.92% and the eigenvalue is 1.24.

Factor 5 was labelled *Early Majority* due to the loading of the following items: I adopt a "wait and see" attitude toward new technologies; I want to see examples of successes of new technology before adopting it; I want to make sure that adopting a new technology would be easy for me; I want to make sure I have the necessary technical support and advice to learn and use a new technology before I adopt it. The variance explained by this factor is 5.39% and the eigenvalue is 1.13.

The average of the communalities of the variables is 0.60, indicating good relationships among the variables. The KMO adequate value is 0.835 and the Bartlett’s significance is 0.000, indicating that the set of variables used is adequately related for the factor analysis. From Table 5.16, the identified clear patterns from the responses obtained from the participants regarding the adopter's category are:

1. Late Majority and Laggards.
2. Non-Adopters.
3. Innovators.
4. Early adopters.
5. Early majority.

The reliability of the factors was computed, and they are internally consistent. The obtained alpha coefficients are Late Majority and Laggards, 0.6, Non-Adopters, 0.8, Innovators, 0.8, Early Adopters, 0.7 and Early Majority, 0.7.

In section 5.5.2.1, the adopter's category with reference to Rogers' proposed categories were investigated using explanatory items. The minimum obtained mean value of the explanatory items is 3.0, indicating that the used items provided good explanation of the adopter's categories. These explanatory items were factorised and five adopters' categories of mobile apps in Africa were obtained. In the next section, the reason for non-adoption of mobile apps in Africa will be discussed.

5.5.2.2 *Reasons for non-adoption (Rejection)*

Rogers (2003) described rejection in two types, namely active rejection and passive rejection. In active rejection, a person tests an innovation and considers adopting it, but later he or she chooses not to adopt it. A discontinuance decision is considered to be an active rejection. In passive rejection, a person does not even consider adopting the innovation at all which is complete non-adoption. Rogers stated that these two types of rejection have not been studied adequately and have not been distinguished in previous diffusion research. This study investigates reasons for active rejection from the following perspectives:

- ✓ Using mobile apps is time-consuming.
- ✓ Using mobile apps takes a lot of phone memory.
- ✓ Using mobile apps distracts attention from other activities.
- ✓ Using mobile apps is expensive.

The obtained results are shown in Tables 5.17.

Table 5.17: Reasons for non-adoption

Research Variables	**Scale rating**					**Total**	**Mean**	**Std. dev.**
	Strongly disagree			**Strongly agree**				
	1	**2**	**3**	**4**	**5**			
Using mobile apps takes up a lot of phone memory	45 (3.5%)	95 (7.4%)	343 (26.7%)	417 (32.5)	385 (30.0%)	1285 (100%)	3.4	1.2
Using mobile apps is time-consuming	73 (5.7%)	123 (9.6%)	299 (23.3%)	363 (28.2%)	427 (33.2%)	1285 (100%)	3.3	1.3
Using mobile apps distracts attention from other activities	57 (4.4%)	139 (10.8%)	319 (24.8%)	371 (28.9%)	399 (31.1%)	1285 (100%)	3.3	1.3
Using mobile apps is expensive	130 (10.1%)	170 (13.2%)	285 (22.2%)	316 (24.6%)	384 (29.9%)	1285 (100%)	3.3	1.4

Table 5.17 shows that participants feel that using mobile apps takes up a lot of phone memory. The results obtained from participants' responses indicate 30.0% strongly agree, 32.5% agree, 26.7% is neutral, 7.4% disagree and 3.5% strongly disagree.

Regarding time-consuming, 427 (33.2%) strongly agreed, 363 (28.2%) agreed, 299 (23.3%) were neutral, 123 (9.6%) disagreed and 73 (5.7%) strongly disagreed.

Based on the perception that using mobile apps distracts attention from other activities, the results are 31.1% strongly agree, 28.9% agree, 24.8% neutral, 10.8% disagree and 4.4% strongly disagree.

With respect to the cost involved in using mobile apps, the obtained results depict that 29.9% and 24.6% of the participants strongly agree and agree respectively that mobile apps are expensive to use. 10.1% and 13.2% strongly disagree and disagree respectively. 22.2% of the participants stand neutral.

The means of the research variable for the reasons of non-adoption are between 3.3 and 3.4, suggesting that all the investigated reasons may cause rejection of mobile apps in Africa. This implies that the participants agree that they can stop the use of mobile apps or will not adopt mobile apps at all if they perceive that the adoption and use of mobile apps occupies a lot of memory space in their phone and consumes their time. Distracting their attention to other activities and the financial cost involved in the use of mobile apps can result in the rejection of mobile apps. Using mobile apps takes up a lot of phone memory and is the most influencing factor of rejection of mobile apps, followed by others.

5.5.3 Diffusion

Diffusion is the process of distribution, uses and discontinued use of mobile apps. In this section, the results obtained from the use of mobile apps, ways of using mobile apps and the reasons for discontinuation are discussed.

5.5.3.1 *Use of mobile apps*

As discussed in the literature, diffusion is associated with usage. The main target audience for this research is the mobile apps users in Africa. The study seeks to know if the participants are users of mobile apps. The result obtained is illustrated in Table 5.18.

Table 5.18: Use of mobile apps

Research variables	Scale rating					Total	Mean	Std. dev.
	Strongly disagree				Strongly agree			
	1	2	3	4	5			
I use mobile apps	54 (4.2%)	87 (6.8%)	227 (17.7%)	337 (26.2%)	580 (45.1%)	1285 (100%)	4.0	1.1

Table 5.18 indicates that 71.3% of the participants are mobile apps users, 11% are non-users, whereas 17.7% are neither users nor non-users. The mean value of 4.0 suggests that a large number (> 70%) of the participants is mobile apps users. This implies that there is a high rate of adoption and diffusion of mobile apps among the African social system. The finding compares well with some previous studies on the African context (Juma, 2011; Murugesan, 2013; GSMA, 2017).

The rate of adoption and diffusion of mobile apps is clearly noticeable, but how this adoption and diffusion of mobile apps in Africa occurs is not clearly known. This analysis and discussion of the adoption and diffusion of mobile apps in Africa as a whole and in the selected countries are addressed in the next chapter.

5.5.3.2 *Ways of using mobile apps*

Mobile apps are used for different purposes to perform various activities, including using mobile apps for:

- ✓ Social networking.
- ✓ Entertainment.
- ✓ Texting messages.
- ✓ Education.
- ✓ Commerce.
- ✓ Health care.
- ✓ Governance.
- ✓ Agriculture.

With a five-point Likert scale (1 – strongly disagree and 5 – strongly agree), these activities were investigated to determine how they are being performed, using mobile apps. The results obtained are shown in Table 5.19.

Table 5.19: Ways of using mobile apps

Mobile apps	Scale rating					Mean	Std. dev.
	Strongly disagree				Strongly agree		
	1	2	3	4	5		
Social networking	41 (3.2%)	83 (6.5%)	241 (18.8%)	334 (26.0%)	586 (45.5%)	4.04	1.09
Entertainment	83 (6.5%)	112 (8.7%)	254 (19.8%)	340 (26.5%)	496 (38.6%)	3.82	1.22
Texting messages	68 (5.3%)	139 (10.8%)	265 (20.6%)	314 (24.4%)	498 (38.8%)	3.81	1.21
Education	96 (7.5%)	151 (11.8%)	284 (22.1%)	347 (27.0%)	407 (31.7%)	3.64	1.25
Commerce	131 (10.2%)	177 (13.8%)	310 (24.1%)	331 (25.8%)	336 (26.1%)	3.44	1.29
Health care	119 (9.3%)	206 (16.0%)	312 (24.3%)	377 (29.4%)	270 (21.0%)	3.37	1.24
Governance	248 (19.3%)	217 (16.9%)	313 (24.4%)	309 (24.0%)	198 (15.4%)	2.99	1.34
Agriculture	263 (20.5%)	230 (17.9%)	296 (23.0%)	287 (22.3%)	209 (16.3%)	2.96	1.37

The results from Table 5.19 indicate that mobile apps are used for several purposes in different ways. The means values for the uses of mobile apps variable are ≥ 3.0 and ≤ 4.0. This implies that, In Arica, mobile apps are used for social networking, entertainment, text messages, education, commerce, health care, governance and agriculture. It was also observed that mobile apps are mostly use for social networking activities in Africa, whereas the uses of mobile apps for governance and agricultural activities are still low in Africa.

The eight obtained uses of mobile apps were factor analysed using principal component analysis with direct Oblimin rotation. The analysis resulted in two factors covering 56.10% of the variance for the total set of variances.

Factor 1 was labelled *Business Use* due to the loading of the following items: Commerce (banking, on-line shopping, money transfer, etc.); Agricultural (information and knowledge about farming practices); Governance (administering governmental duties); Health (getting health care information, first-aid and other medical help). The variance explained by this factor was 36.91% with an eigenvalue of 2.95.

Factor 2 was labelled *Individual Use* due to the loading of the following: Texting messages; Social networking (WhatsApp, Facebook, etc.); Education (internet surfing, e-learning, distance learning, etc.); Entertainment (music and movies). The variance explained by this factor was 19.18% with an eigenvalue of 1.54.

The average of the communalities of the variables is 0.561, indicating good relationships among the variables. The KMO adequate value is 0.778 and the Bartlett's significance is 0.000, indicating that the set of the variables used is adequately related for the factor analysis. From Table 5.19, the identified clear patterns from the responses obtained from the adopters of mobile apps in Africa regarding the purpose of using mobile apps in Africa are:

1. Business Use
2. Individual Use

The reliability of these factors was computed using Cronbach alpha coefficient analysis and the factors are internally consistent. The alpha coefficients are: Business Use, 0.8 and Individual Use, 0.7.

5.5.3.3 *Reasons for discontinuance*

As described in the literature, discontinuance means to stop the adoption and use of a mobile app. According to Rogers (2003), there are two forms of discontinuance, either replacement discontinuance or disenchantment discontinuance. Replacement discontinuance occurs when an individual rejects an innovation in favour of a better one replacing it, whereas disenchantment discontinuance occurs when an individual stops the use of an innovation due to lack of satisfaction with its performance. In this section, the reasons why African population chooses to discontinue the use of any mobile app are investigated. For instance, Mxit was a social networking mobile app developed in South Africa and used by Africans. The introduction of Facebook, WhatsApp and other mobile apps affected the adoption and diffusion of Mxit. For the purpose of the topic under study, discontinuance is measured using four (4) items, namely 1) There is a more enhanced one replacing it, 2) Its performance was not satisfactory, 3) It lacked support and 4) It was not easy to use. The results obtained are presented in Table 5.20.

Table 5.20: Reasons for the discontinuance of the use of mobile apps in Africa

Research variables	**Scale rating**					**Total**	**Mean**	**Std. dev.**
	Strongly disagree			**Strongly agree**				
	1	**2**	**3**	**4**	**5**			
There was a more enhanced mobile app replacing the exiting one	94 (7.3%)	175 (13.6%)	357 (27.8%)	349 (27.2%)	310 (24.1%)	1285 (100%)	3.5	1.2
Unsatisfactory performance	99 (7.7%)	151 (11.8%)	371 (28.9%)	349 (27.2%)	315 (24.5%)	1285 (100%)	3.5	1.2
It was not easy to use	173 (13.5%)	217 (16.9%)	291 (22.6%)	313 (24.4%)	291 (22.6%)	1285 (100%)	3.3	1.3
It lacked support	138 (10.7%)	244 (19.0%)	328 (25.5%)	315 (24.5%)	259 (20.2%)	1284 (100%)	3.2	1.3

Table 5.20 depictes that 24.1% and 27.2% of the participants strongly agree and agree respectively that they discontinued the use of a mobile due to a better one replacing it. 7.3% and 13.6% of the participants strongly disagree and disagree respectively on this factor. 27.8% of the participants neither agree nor disagree on this factor.

24.5% and 27.2% of the participants strongly agree and agree respectively that they discontinued the use of mobile apps because of unsatisfactory performance. 7.7% and 11.8% strongly disagree and disagree respectively on this factor. 28.9% stand neutral on the factor.

Regarding lack of support as a cause for the discontinuance of the use of mobile apps, 20.2% strongly agree, 24.5% agree, 25.5% is neutral, 19.0% disagree and 10.7% neither agree nor disagree on this factor.

Concerning the non-ease of use factor, it was observed that 22.6% strongly agree, 24.4% agree, 13.5% strongly disagree, 16.9% disagree and 22.6% neither agree nor disagree.

The results in Table 5.15 show that the mean values are ≥ 3.2 and ≤ 3.5, suggesting that all the examined reasons may cause discontinuance of the use of mobile apps in Africa. This explains that better features, satisfaction, support and non-ease of use may cause the discontinuance of the use of mobile apps. If a new mobile app with better and attractive features is released, the adopters tend to go favour it, while discarding the old one. Regarding satisfaction, if the performance of a mobile app is not meeting the needs of the adopters, there is the possibility of stopping the use of that mobile app for another one. Similarly, if the users are not getting the necessary assistance needed to use a mobile app, they may decide to stop the usage. Moreover, mobile apps should be made easy to use otherwise the users will stop using them.

5.5.4 Adopting unit

The adopting unit contains the individual adopting characteristics, including personality variables, socio-economic circumstances and communication behaviour. This unit has some influences on the innovation-decision process regarding the adoption and diffusion of mobile apps. The results obtained from the investigation of the adopting unit are discussed below.

5.5.4.1 *Personality variables*

Personality variables involve the personal/individual characteristics that are part of the factors influencing the outcome of the innovation-decision process. Adopters' attitudes and anxiety (degree of nervousness) are part of the personality variables.

5.5.4.1.1 *Adopters' attitudes towards new mobile apps*

For this research, attitude is defined as an individual's beliefs and feelings over an innovation. The attitudes of an adopter may be positive, negative, indifferent and showing signs of nervousness towards the adoption and rejection of a particular innovation. Wang et al. suggested that attitudes are a major predicting factor influencing the adoption of a new product, therefore there is a need for more understanding of attitudes in a well-defined manner (Prislin & Crano, 2008). Attitudes are considered to be a three-factor concept, comprising cognitive, affective and conative attitudes, covering thoughts and beliefs, feelings and actions respectively (Prislin & Crano, 2008). In this regard, this study aimed to investigate the attitudes of the participants whenever they heard about new mobile apps and their feelings about mobile apps innovations as well as their degree of nervousness about new mobile apps. The obtained results are conveyed in Tables 5.21-5.22.

Table 5.21: Adopters' attitudes towards new mobile apps

Attitudes	Positive	Negative	Indifferent	Total
Total	823 (64.1%)	238 (18.5%)	224 (17.4%)	1285 (100%)

Table 5.21 displays the participants' actions (positive, negative or indifferent) whenever they encountered a new mobile app. 64.1% shows a positive attitude, 18.5% shows a negative attitude and 17.4% shows an indifferent attitude towards a new mobile app.

Table 5.22: In general, mobile apps are good innovations

Country	Scale rating					Total
	Strongly disagree				Strongly agree	
	1	2	3	4	5	
Total	47 (3.7%)	136 (10.6%)	304 (23.7%)	388 (30.2%)	410 (31.9%)	1285 (100%)

Table 5.22 shows the feeling of participants on mobile apps as good innovations in Africa. 798 (62.1%) agree/strongly agree, 183 (14.3%) disagree/strongly disagree and 304 (23.7%) were neutral

Table 5.23: Degree of nervousness about new mobile apps

Anxiety	Scale rating					Total
	Strongly disagree				Strongly agree	
	1	2	3	4	5	
Total	319 (24.8%)	246 (19.1%)	326 (25.4%)	155 (12.1%)	239 (18.6%)	1285 (100%)

Table 5.23 showed the results obtained from the test on the participants' degree of nervousness whenever a new mobile app is introduced to them. 24.8% of the population

admitted to never being nervous, 19.1% were not nervous, 25.4% are neutral, 12.1% were nervous and 18.6% are very nervous.

5.5.4.2 *Socio-economic characteristics*

Socio-economic characteristics involve the external factors that may influence individuals' adoption and diffusion of mobile apps. Some of these characteristics are the effects/contributions/benefits of mobile apps, facilitating conditions and employment status. The employment status has been presented under the background information. In this section, the effects of mobile apps adoption and diffusion on the development in Africa and the predicting factors of mobile apps adoption and diffusion in Africa will be described.

5.5.4.2.1 *The effects of the adoption and diffusion of mobile apps on the development in Africa*

Mobile technology is rapidly changing the face of activities in the world. According to the GSMA 2018 report, there were over five billion mobile subscribers worldwide at the end of 2017 and mobile technology has a wider spread than any other technology. In Africa, the penetration of mobile services is increasing, and mobile apps formed the basis of all mobile services. As discussed in the literature, studies have promoted the adoption and diffusion of mobile apps in Africa regarding their effects on the development in Africa, but in a fragmented and unique form. Most of these reports are based on the investigation in a particular country with the focus on a specific type of mobile app. With respect to objective 3, the aim is to obtain a comprehensive view of the contributions of mobile apps services to the growth of Africa.

Firstly, a general question was asked to determine the general perceptions of the participants on the contribution of mobile apps to the development in Africa. The result obtained is shown in Table 5.24.

Table 5.24: Mobile apps contribute to the development of Africa

Research variables	Scale rating					Total	Mean	Std. dev.
	Strongly disagree				Strongly agree			
	1	2	3	4	5			
Mobile apps contribute to the development in Africa	41 (3.2%)	119 (9.3%)	294 (22.9%)	420 (32.7%)	411 (31.9%)	1285 (100%)	3.8	1.1

Table 5.24 indicates that 831 (64.6%) of the total participants strongly agree/agree that mobile apps contribute to the development in Africa, 124 (12.5%) strongly disagree/disagree and 294 (22.9%) are neutral. The mean value of the participants' responses on a five-point

scale is 3.8, indicating that mobile apps make a positive contribution to the development in Africa. In essence, the adoption and diffusion of mobile apps is significant for African development.

How and where do mobile apps effect the development of Africa?

To address this question, some explanatory questions that simplified the use of mobile apps in different sectors of the economy, including the health care, educational, commercial, political, social, agricultural, and economic sectors were provided. On a five-point Likert scale, participants rated the effect of mobile apps on these areas and the results obtained are shown in Table 5.25.

Table 5.25: Contributions of mobile apps to African development

Items (Research variables)	Scale rating					Mean	Std. dev.
	Strongly disagree			Strongly agree			
	1	2	3	4	5		
Mobile apps have transformed financial services in Africa.	50 (3.9%)	117 (9.1%)	264 (20.5%)	432 (33.6%)	422 (32.8%)	3.8	1.1
Mobile apps enable self-service banking in Africa.	66 (5.1%)	135 (10.5%)	226 (17.6%)	416 (32.4%)	442 (34.4%)	3.8	1.2
Mobile apps enable various ways of money transfer services in Africa.	69 (5.4%)	135 (10.5%)	270 (21.0%)	365 (28.4%)	446 (34.7%)	3.8	1.2
Mobile apps create various ways of communication, such as web, e-mail and chatting in Africa.	60 (4.7%)	131 (10.2%)	265 (20.7%)	414 (32.3%)	413 (32.2%)	3.8	1.1
Mobile apps enable e-learning services in Africa.	56 (4.4%)	143 (11.1%)	274 (21.3%)	422 (32.8%)	390 (30.4%)	3.7	1.1
Mobile apps facilitate access to digital books, on-line libraries and on-line databases in Africa.	57 (4.4%)	147 (11.4%)	284 (22.1%)	400 (31.1%)	397 (30.9%)	3.7	1.2
Use of mobile apps has transformed the way we live in Africa.	51 (4.0%)	139 (10.8%)	293 (22.8%)	466 (36.3%)	336 (26.1%)	3.7	1.1
Mobile communication spreads political speech in Africa.	66 (5.1%)	124 (9.6%)	291 (22.6%)	460 (35.8%)	344 (26.8%)	3.7	1.1
The mobile sector facilitates the creation of more jobs in Africa.	58 (4.5%)	127 (9.9%)	317 (24.7%)	441 (34.3%)	341 (26.6%)	3.7	1.1
Use of mobile apps increases transparency of political activities in Africa.	78 (6.1%)	151 (11.8%)	304 (23.7%)	382 (29.7%)	370 (28.8%)	3.6	1.1
Use of mobile apps to perform work activities improves individual productivity in Africa.	87 (6.8%)	148 (11.6%)	338 (26.4%)	392 (30.6%)	316 (24.6%)	3.6	1.2
Mobile apps facilitate easy access to health education in Africa.	73 (5.7%)	198 (15.4%)	299 (23.3%)	382 (29.7%)	333 (25.9%)	3.6	1.2
Mobile apps enable data gathering for disease surveillance in Africa.	77 (6.0%)	170 (13.2%)	329 (25.6%)	418 (32.5%)	291 (22.6%)	3.5	1.2

Table 5.25 (contd.): Contributions of mobile apps to African development

Items (Research variables)	Scale rating					Mean	Std. dev.
	Strongly disagree			Strongly agree			
	1	2	3	4	5		
The mobile industry is one of the major contributors to the economic growth of nations across Africa.	66 (5.1%)	175 (13.6%)	361 (28.1%)	372 (28.9%)	311 (24.2%)	3.5	1.2
I use mobile apps on-the-go to for a variety of tasks.	78 (6.1%)	167 (13.0%)	360 (28.0%)	384 (29.9%)	296 (23.0%)	3.5	1.2
Mobile apps improved health care management system in Africa.	93 (7.2%)	184 (14.3%)	307 (23.9%)	402 (31.3%)	299 (23.3%)	3.5	1.2
Mobile apps reduce barriers to sharing stories in Africa.	101 (7.9%)	141 (11.0%)	345 (26.8%)	442 (34.4%)	256 (19.9%)	3.5	1.2
Mobile apps facilitate training on efficient agricultural practices in Africa.	146 (11.4%)	181 (14.1%)	305 (23.7%)	374 (29.1%)	279 (21.7%)	3.4	1.3
Use of mobile apps enhances the provision of agricultural information in Africa.	114 (8.9%)	215 (16.7%)	351 (27.3%)	349 (27.2%)	256 (19.9%)	3.3	1.2
Mobile apps enable the provision of expert improvement services to farmers in Africa.	128 (10.05)	213 (16.6%)	304 (23.7%)	384 (29.9%)	256 (19.9%)	3.3	1.1

Table 5.25 illustrates the results obtained from measuring the items that described the effects of mobile apps on African development. All the mean values of the items are > 3, indicating a positive effect of mobile apps on African development. All the investigated contributions of mobile apps are positive contributions of mobile apps to African advancement.

Factor analysis was performed on these items and the results obtained are shown in Table 5.26.

Table 5.26: Contributions of mobile apps innovation to the development in Africa

Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Mobile apps facilitate easy access to health education in Africa.	0.756					
Mobile apps improved health care management system in Africa.	0.768					
Mobile apps enable data gathering for disease surveillance in Africa.	0.710					
Mobile apps create various ways of communication, such as web, e-mail and chatting in Africa.		0.438				
Mobile apps facilitate training on efficient agricultural practices in Africa.		0.569				
Mobile apps enable e-learning services in Africa.		0.436				
Mobile apps facilitate access to digital books, on-line libraries and on-line databases in Africa.		0.590				
Use of mobile apps to perform work activities improves individual productivity in Africa.			0.537			
The mobile sector facilitates the creation of more jobs in Africa.			0.810			
The mobile industry is one of the major contributors to the economic growth of nations across Africa.			0.777			
Use of mobile apps has transformed the way we live in Africa.			0.619			
Mobile communication spreads political speech in Africa.				0.711		
Use of mobile apps increases the transparency of political activities in Africa.				0.731		
Mobile apps reduce barriers to sharing stories in Africa.				0.660		
Mobile apps enable various ways of money transfer services in Africa.					0.833	
Mobile apps enable self-service banking in Africa.					0.740	
Mobile apps have transformed financial services in Africa.					0.356	
I use mobile apps on-the-go to for a variety of tasks.						0.792
Use of mobile apps enhances the provision of agricultural information in Africa.						0.694
Mobile apps enable the provision of expert improvement services to farmers in Africa.						0.416

20 questions related to the contributions of mobile apps innovation to the development of Africa were factor analysed using principal component analysis with direct Oblimin rotation. The analysis resulted in six factors covering 59.57% of the variance for the total set of variances.

Factor 1 was labelled *Contributions to the health care system* due to the loading of the following items: Mobile apps facilitate easy access to health education in Africa; Mobile apps improved the health care management system in Africa; Mobile apps enable data gathering for disease surveillance in Africa. The variance explained by this factor is 26.78% and the eigenvalue is 5.36.

Factor 2 was labelled *Contributions to education and social activities* due to the loading of the following items: Mobile apps create various ways of communication, such as web, e-mail and chatting in Africa; Mobile apps facilitate training in efficient agricultural practices in Africa; Mobile apps enable e-learning services in Africa; Mobile apps facilitate access to digital books, on-line libraries and on-line databases in Africa. The variance explained by this factor is 9.32% and the eigenvalue is 1.86.

Factor 3 was labelled *Contributions to economic activities* due to the loading of the following items: Use of mobile apps to perform work activities improve individual productivity in Africa; The mobile sector facilitates the creation of more jobs in Africa; The mobile industry is one of the major contributors to the economic growth of nations across Africa; Use of mobile apps has transformed the way we live in Africa. The variance explained by this factor is 6.63% and the eigenvalue is 1.33.

Factor 4 was labelled *Contributions to politics* due to the loading of the following items: Mobile communication spreads political speech in Africa; Use of mobile apps increases transparency of political activities in Africa; Mobile apps reduce barriers to sharing stories in Africa. The variance explained by this factor is 6.41% and the eigenvalue is 1.28.

Factor 5 was labelled *Contributions to finance* due to the loading of the following items: Mobile apps enable various ways of money transfer services in Africa; Mobile apps enable self-service banking in Africa; Mobile apps have transformed financial services in Africa. The variance explained by this factor is 5.37% and the eigenvalue is 1.07.

Factor 6 was labelled *Contributions to agriculture* due to the loading of the following items: I use mobile apps on-the-go to for a variety of tasks; Use of mobile apps enhances the provision of agricultural information in Africa; Mobile apps enable the provision of expert improvement services to farmers in Africa. The variance explained by this factor is 5.01% and the eigenvalue is 1.01.

The average of the communalities of the variables is 0.60, indicating good relationships among the variables. The KMO adequate value is 0.861 and the Bartlett's significance is 0.000, indicating that the set of variables used is adequately related for the factor analysis. The identified clear pattern from the responses obtained from the adopters of mobile apps in Africa regarding the contributions of mobile apps to the development of Africa are:

1. Contributions to the health care system
2. Contributions to education and social activities
3. Contributions to the economy
4. Contributions to politics
5. Contributions to finance
6. Contributions to agriculture

The reliability of these factors was tested using Cronbach alpha coefficient analysis and it was found that the factors are internally consistent. The obtained alpha values are contributions to the health care system, 0.8, Contributions to education and social activities, 0.5, Contributions to the economy, 0.9, Contributions to politics, Contributions to finance, and Contributions to agriculture, 0.7.

5.5.4.2.2 *Predicting factors of mobile apps adoption and diffusion in Africa*

Predicting factors are the elements that contribute positively towards the successful adoption and diffusion of an innovation, product or idea (Toor & Ogunlana, 2009). To improve the adoption and diffusion of mobile apps in Africa, it is essential to identify and consider the predicting factors. In chapter 2, section 2.9, the predicting factors concerning mobile apps adoption and diffusion were discussed. These factors were identified from previous studies conducted within the African context and outside the African context regarding unique domain and in relation to the specific type of mobile app. The influence of these factors on the adoption and diffusion of mobile apps in Africa were investigated from the perspectives of the representing population from different geographical locations in Africa. The results obtained are depicted in Table 5.27.

Table 5.27: Predicting factors of mobile apps adoption and diffusion in Africa

Items (Research variables)	Scale rating					Mean	Std. dev.
	Strongly disagree				Strongly agree		
	1	2	3	4	5		
Use of mobile apps is a personal decision.	48 (3.7%)	131 (10.2%)	279 (21.7%)	376 (29.3%)	451 (35.1%)	3.8	1.1
I would use mobile apps if the financial cost is bearable.	62 (4.8%)	148 (11.5%)	306 (23.8%)	360 (28.1%)	409 (31.8%)	3.7	1.2
I can be influenced to adopt and use mobile apps by my environment.	68 (5.3%)	152 (11.8%)	290 (22.6%)	399 (31.1%)	376 (29.2%)	3.7	1.6
I would like to use or continue to use mobile apps services if the charges on it are transparent.	70 (5.4%)	180 (14.0%)	275 (21.4%)	349 (27.2%)	411 (32.0%)	3.7	1.2
I can be influenced to adopt and use mobile apps by my close peers.	89 (6.9%)	124 (9.6%)	350 (27.2%)	396 (30.8%)	326 (25.3%)	3.6	1.2
I adopt and use mobile apps if they are in line with my societal norms.	95 (7.4%)	163 (12.7%)	325 (25.3%)	388 (30.2%)	314 (24.4%)	3.5	1.2
I would use mobile apps if I have the basic required knowledge of the innovation.	96 (7.5%)	162 (12.6%)	347 (27.0%)	348 (27.1%)	332 (25.8%)	3.5	1.2
I am concerned about the security aspects of using mobile apps.	85 (6.6%)	200 (15.6%)	277 (21.6%)	402 (31.3%)	321 (25.0%)	3.5	1.2
I perceive the use of mobile apps to be easy to perform my duties.	81 (6.3%)	182 (14.2%)	325 (25.3%)	403 (31.4%)	294 (22.9%)	3.5	1.2
Using mobile apps in my activities satisfies my expectations.	86 (6.7%)	154 (12.0%)	354 (27.5%)	413 (32.1%)	278 (21.6%)	3.5	1.2
I perceive the financial cost associated with the use of mobile apps to be high.	88 (6.8%)	187 (14.6%)	331 (25.8%)	361 (28.1%)	318 (24.7%)	3.5	1.2
I would effectively use mobile apps if I know how to use smartphones.	135 (10.5%)	164 (12.8%)	302 (23.5%)	368 (28.7%)	315 (24.5%)	3.4	1.3
I would effectively use mobile apps if I know how to use a computer.	127 (9.9%)	168 (13.1%)	313 (24.4%)	376 (29.3%)	301 (23.4%)	3.4	1.3
I perceive the use of mobile apps to be beneficial to all aspects of life.	94 (7.3%)	179 (13.9%)	381 (29.6%)	349 (27.2%)	282 (21.9%)	3.4	1.2
There are substantial supports from the developers ensuring proper use of mobile apps innovation.	82 (6.4%)	199 (15.5%)	362 (28.2%)	410 (31.9%)	232 (18.1%)	3.4	1.1
There are substantial supports from the developers ensuring proper use of mobile apps innovation.	82 (6.4%)	199 (15.5%)	362 (28.2%)	410 (31.9%)	232 (18.1%)	3.4	1.1
I do consider the rules and procedures at my workplace in deciding to adopt and use new mobile apps.	137 (10.7%)	156 (12.1%)	346 (26.9%)	385 (30.0%)	261 (20.3%)	3.4	1.2
I believed that my information in mobile transactions is safe.	86 (6.7%)	248 (19.3%)	339 (26.4%)	328 (25.0%)	284 (22.1%)	3.4	1.2

Table 5.27 (contd.): Predicting factors of mobile apps adoption and diffusion in Africa

Items (Research variables)	**Scale rating** **Strongly disagree** **1**	 **2**	 **3**	 **4**	 **Strongly agree** **5**	**Mean**	**Std. dev.**
There are substantial supports from the service providers which enable me to adopt and use mobile apps.	117 (9.1%)	225 (17.5%)	321 (25.0%)	361 (28.1%)	261 (20.3%)	3.3	1.2
I always feel anxious about using new technologies, such as computers and mobile phones.	143 (11.1%)	203 (15.8%)	316 (24.6%)	336 (26.1%)	287 (22.3%)	3.3	1.3
There are enough technical infrastructures to support the adoption and use of new technologies in my country.	86 (6.7%)	221 (17.2%)	418 (32.5%)	343 (26.7%)	217 (16.9%)	3.3	1.1
Use of mobile apps for inter-personal communications is risky.	122 (9.5%)	214 (16.7%)	345 (26.9%)	374 (29.1%)	229 (17.8%)	3.3	1.2
My cultural beliefs influence the adoption of mobile apps.	228 (17.7%)	177 (13.8%)	266 (20.7%)	351 (27.3%)	263 (20.5%)	3.2	1.4
My cultural beliefs determine my perception of new innovations.	180 (14.0%)	203 (15.8%)	337 (26.2%)	342 (26.6%)	223 17.4%)	3.2	1.3
I have negative feelings towards the use of mobile apps.	209 (16.3%)	211 (16.4%)	307 (23.9%)	307 (23.9%)	250 (19.5%)	3.2	1.6

In this section, the identified predicting factors from the literature review that influence the adoption and diffusion of mobile apps in Africa were investigated using explanatory items. The obtained results show that all the mean values of the items are > 3 which indicates that the predicting factors are all significant to the adoption and diffusion of mobile apps in Africa.

Factor analysis was performed on the items and the distribution of the factor loadings are shown in Table 5.28.

Table 5.28: Predicting factors of mobile apps adoption and diffusion in Africa

Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
I believed that my information in mobile transactions is safe.	0.687						
I always feel anxious about using new technologies, such as computers and mobile phones.	0.593						
I am concerned about the security aspects of using mobile apps.	0.590						
Use of mobile apps for inter-personal communications is risky.	0.462						
I would use mobile apps if I have the basic required knowledge of the innovation.		0.521					
I would effectively use mobile apps if I know how to use a computer.		0.468					
I would effectively use mobile apps if I know how to use smartphones.		0.410					
Use of mobile apps is a personal decision.		0.493					
I perceive the use of mobile apps to be easy to perform my duties.			0.615				
I perceive the use of mobile apps to be beneficial to all aspects of life.			0.768				
Using mobile apps in my activities satisfies my expectations.			0.658				
I can be convinced to adopt and use mobile apps by my family.				0.719			
I can be influenced to adopt and use mobile apps by my close peers.				0.782			
I can be influenced to adopt and use mobile apps by my environment.				0.499			
There are substantial supports from the developers ensuring proper use of mobile apps innovation.					-0.641		
There are substantial supports from the service providers which enable me to adopt and use mobile apps.					-0.707		
I have negative feelings towards the use of mobile apps.						-0.561	
I perceive the financial cost associated with the use of mobile apps to be high.						-0.740	
I would like to use or continue to use mobile apps services if the charges on it are transparent.						-0.412	

Table 5.28 (contd.): Predicting factors of mobile apps adoption and diffusion in Africa

Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
I adopt and use mobile apps if they are in line with my societal norms.							-0.605
I do consider the rules and procedures at my workplace in making a decision to adopt and use new mobile apps.							-0.429
My cultural beliefs determine my perception of new innovations.							-0.780
My cultural beliefs influence the adoption of mobile apps.							-0.724

The 25 items describing the predicting factors of mobile apps adoption and diffusion in Africa were factor analysed using principal component analysis with direct Oblimin rotation. The analysis resulted in seven factors covering 54.42% of the variance for the total set of variances.

Factor 1 was labelled *Perceived technology reliability* due to the loading of the following items: I am concerned about the security aspects of using mobile apps; I believed that my information in mobile transactions is safe; Use of mobile apps for inter-personal communication is risky; I always feel anxious about using new technologies, such as computers and mobile phones. The variance explained by this factor was 22.98% with an eigenvalue of 5.74.

Factor 2 was labelled *Self-efficacy* due to the loading of the following items: I would use mobile apps if I have the basic required knowledge of the innovation; I would effectively use mobile apps if I know how to use a computer; I would effectively use mobile apps if I know how to use smartphones; Use of mobile apps is a personal decision. The variance explained by this factor is 6.61% with an eigenvalue of 1.65.

Factor 3 was labelled *Relative advantage* due to the loading of the following items: I perceive the use of mobile apps to be easy to perform my duties; I perceive the use of mobile apps to be beneficial to all aspects of life; Using mobile apps in my activities satisfies my expectations. The variance explained by this factor is 5.84% with an eigenvalue of 1.46.

Factor 4 was labelled *Social influence* due to the loading of the following items: I can be convinced to adopt and use mobile apps by my family; I can be influenced to adopt and use mobile apps by my close peers; I can be influenced to adopt and use mobile apps by my environment. The variance explained by this factor is 5.61% with an eigenvalue of 1.40.

Factor 5 was labelled *Facilitating conditions* due to the loading of the following items: There are substantial supports from the developers ensuring proper use of mobile apps innovation; There are substantial supports from the developers ensuring proper use of mobile apps innovation. The variance explained by this factor is 4.59% with an eigenvalue of 1.15.

Factor 6 was labelled *Financial cost* towards the use of mobile apps due to the loading of the following items: I have negative feelings towards the use of mobile apps.; I perceive the financial cost associated with the use of mobile apps to be high; I would like to use or continue to use mobile apps services if the charges on it are transparent. The variance explained by this factor is 4.55% with an eigenvalue of 1.14.

Factor 7 was labelled *Cultural effect* due to the loading of the following factors: I adopt and use mobile apps if they are in line with my societal norms; I do consider the rules and procedures at my workplace in deciding to adopt and use new mobile apps; My cultural beliefs determine my perception on new innovations; My cultural beliefs influence adoption of mobile apps. The variance explained by this factor is 4.26% with an eigenvalue of 1.06.

The average of the communalities of the variables is 0.544, indicating good relationships among the variables. The KMO adequate value is 0.855 and the Bartlett's significance is 0.000, indicating that the set of variables used is adequately related for the factor analysis. From Table 5.27, the identified clear pattern from the responses obtained from the adopters of mobile apps in Africa regarding the predicting factors of the adoption and diffusion in Africa are:

1. Perceived technology reliability
2. Self-efficacy
3. User perception
4. Social influence
5. Facilitating conditions
6. Financial cost
7. Cultural effect

The factors are internally consistent with the following alpha coefficient values; Perceived technology reliability, 0.8, Self-efficacy, 0.6, Relative advantage, 0.7, Social influence, 0.6, Facilitating conditions, 0.6, Financial cost, 0.5, and Cultural effect, 0.6.

5.5.4.3 *Communication behaviour*

Communication behaviour involves the individual intention or motives of using and sharing the information about an innovation. It is one of the main objectives or targets that motivates an individual into the adoption and diffusion of mobile apps. For this research, it covers the purpose of information sharing as stated in the research conceptual model.

5.5.4.3.1 *Purpose of information sharing*

Two items were used to measure the purpose of information sharing regarding the diffusion of mobile apps in Africa. These items are:

- ✓ To facilitate my work activities.
- ✓ To enable easy communication.

The results obtained are detailed in Tables 5.29.

Table 5.29: The purpose of sharing information about mobile apps

Research variables	**Scale rating**					**Total**	**Mean**	**Std. dev.**
	Strongly disagree				**Strongly agree**			
	1	**2**	**3**	**4**	**5**			
To enable easy communication	53 (4.1%)	132 (10.3%)	259 (20.2%)	311 (24.2%)	530 (41.2%)	1285 (100%)	3.9	1.1
To facilitate my activities	94 (7.3%)	173 (13.5%)	316 (24.6%)	330 (25.7%)	372 (28.9%)	1285 (100%)	3.6	1.2

The results in Table 5.29 show that 28.9% of the participants strongly agree and 25.7% agree that the purpose of sharing information about a new mobile app is to facilitate their activities, whereas 7.3% strongly disagree and 13.5% disagree and 24.6% neither agree nor disagree.

It shows that 41.2% strongly agree and 24.2% agree that the purpose of sharing information about a new mobile app is to enable easy communication, whereas 4.1% strongly disagree and 10.2% disagree, whereas 20.2% neither agree nor disagree.

The mean values for communication behaviour research variables are 3.9 (to enable easy communication) and 3.6 (to facilitate my activities), indicating that the two purposes are essential for sharing the information about mobile apps in Africa. Thus, in Africa, individuals share the information about mobile apps more for the purpose of enabling easy communication than for the purpose of facilitating their activities. In the next section, the results of the investigation of the adopters' attitudes to mobile apps are presented.

From the results described in section 5.5, it can be seen that information about the existence of mobile apps is mostly acquired through interpersonal communication, the Internet, mass media and special events. According to participants, the information can be transferred to people through two-way communication, the Internet, mass media, conferences and organisations where people are situated. There are four methods of learning how to use mobile apps, namely interpersonal communication, the Internet, operational manual and informal training. Interpersonal communication is the easiest and fastest method to learn how to use mobile apps. Regarding decision making, there are five basic categories of adopters in Africa, namely late majority and laggards, non-adopters, innovators, early adopters and early majority. In addition, time-consuming, occupying a lot of phone memory, distraction of attention from other activities and high cost of usage are the possible factors that may cause rejection of mobile apps. Occupying a lot of phone memory poses the highest influence regarding non-adoption of mobile apps in Africa. It was revealed that a large number of the African population makes use of mobile apps and there are two main ways of using mobile apps, namely business use and individual use. Concerning discontinuance, the participants agree that they can stop the use of mobile apps due to the release of more advanced apps compared to the existing ones, unsatisfactory performance, lack of support and non-ease to use. The highest factor that may cause discontinuance is unsatisfactory performance and the existence of new, preferred mobile apps, whereas lack of support is the least likely to cause discontinuance. The individual adopting characteristics, such as personality variables, socio-economic circumstances and communication behaviour were also described.

5.6 Summary

In this chapter, the focus was on the statistical analysis performed on the collected data, including descriptive, Cronbach alpha, ANOVA, Robust test, Pearson Chi test, Cramer's V test, factor, Kaiser Meyer Olkin (KMO) and Bartlett's test analyses. The outputs of these analyses and general discussion regarding the African context were adequately presented.

The results indicate that mobile apps are good innovations contributing to the development in Africa and a large number of the African population is mobile apps adopters and users. The five characteristics of innovation stated by Rogers, namely relative advantage, compatibility, complexity, observability and trialability were agreed on as significant features of mobile apps.

Before the adoption and diffusion of mobile apps, there is a need for knowledge-awareness. Rogers (2003) stated two sources of information about an innovation, including interpersonal communication and mass media and it was confirmed in this study. In addition, this study revealed other sources of information, including the Internet, the organisation where one works and special events. Considering the current advancement in technology, these sources are potential means of information dissemination. These sources were factorised into two major sources of information about mobile apps in Africa, namely *eternal initiated actions and individual initiated actions*. When an individual acquires the information about the existence of mobile apps, he/she will transfer the information to other people, such as close peers, family, etc. In this study, this process is referred to as information sharing and two main ways of sharing the information about mobile apps were revealed, namely *organisations and events, and individual activities.* The methods of learning how to use mobile apps were also established, namely *interpersonal communication, the Internet, operational manual and informal training.*

Two purposes of information sharing were discovered 1) *To facilitate work activities* and, 2) *To enable easy communication.* To facilitate work activities explained that information about mobile apps is shared in order to improve services. To enable easy communication explained that information about mobile apps is shared in order to improve interactions.

In regard to the discontinuance of the use of already adopted mobile apps, the following factors that were discovered to be significant to the discontinuance of using mobile apps are involved:

- ✓ *Development of a more enhanced app*
- ✓ *Unsatisfactory performance*
- ✓ *Lack of support*
- ✓ *Not easy to use*

African mobile apps adopters reject to adopt mobile apps if they perceived the following:

- ✓ *The use of mobile apps is time-consuming.*
- ✓ *Mobile apps take a lot of space in the phone memory.*
- ✓ *Mobile apps distract their attention fromother activities.*
- ✓ *The use of mobile apps is expensive.*

It was discovered that Africans show positive attitudes towards the adoption and diffusion of new mobile apps without being nervous at all. It is, therefore, suggested that the positive perceptions and lack of nervousness increase the rate of adoption of mobile apps in Africa resulting in the high growth rate of mobile apps adoption and diffusion in Africa.

Concerning the effect of mobile apps on the development in Africa, six significant effects were found. These are:

- ✓ *The contributions of mobile apps to the health-care system*
- ✓ *The contributions of mobile apps to education and social activities*
- ✓ *The contributions of mobile apps to the economy*
- ✓ *The contributions of mobile apps to politics*
- ✓ *The contributions of mobile apps to financial services*
- ✓ *The contributions of mobile apps to agriculture*

Finally, the predicting factors of mobile apps adoption and diffusion in Africa were determined and the factors are:

- ✓ *Perceived technology reliability*
- ✓ *Relative advantage*
- ✓ *Facilitating conditions*
- ✓ *Financial cost*
- ✓ *Culture*
- ✓ *Social influence*
- ✓ *Self-efficacy*

Considering the adoption and diffusion of mobile apps in Africa, the research conceptual model and the obtained results, that the following adaptations will be implemented: perceived technology reliability, and financial cost should be added to the mobile apps innovations as features, Social influence should be under persuasion in the innovation-decision process, Culture and facilitating conditions should resort under socio-economic characteristics of the adopting unit, and self-efficacy should be moved to personality variables. In this regard, the adapted research conceptual model will be as shown in Figure 5.2.

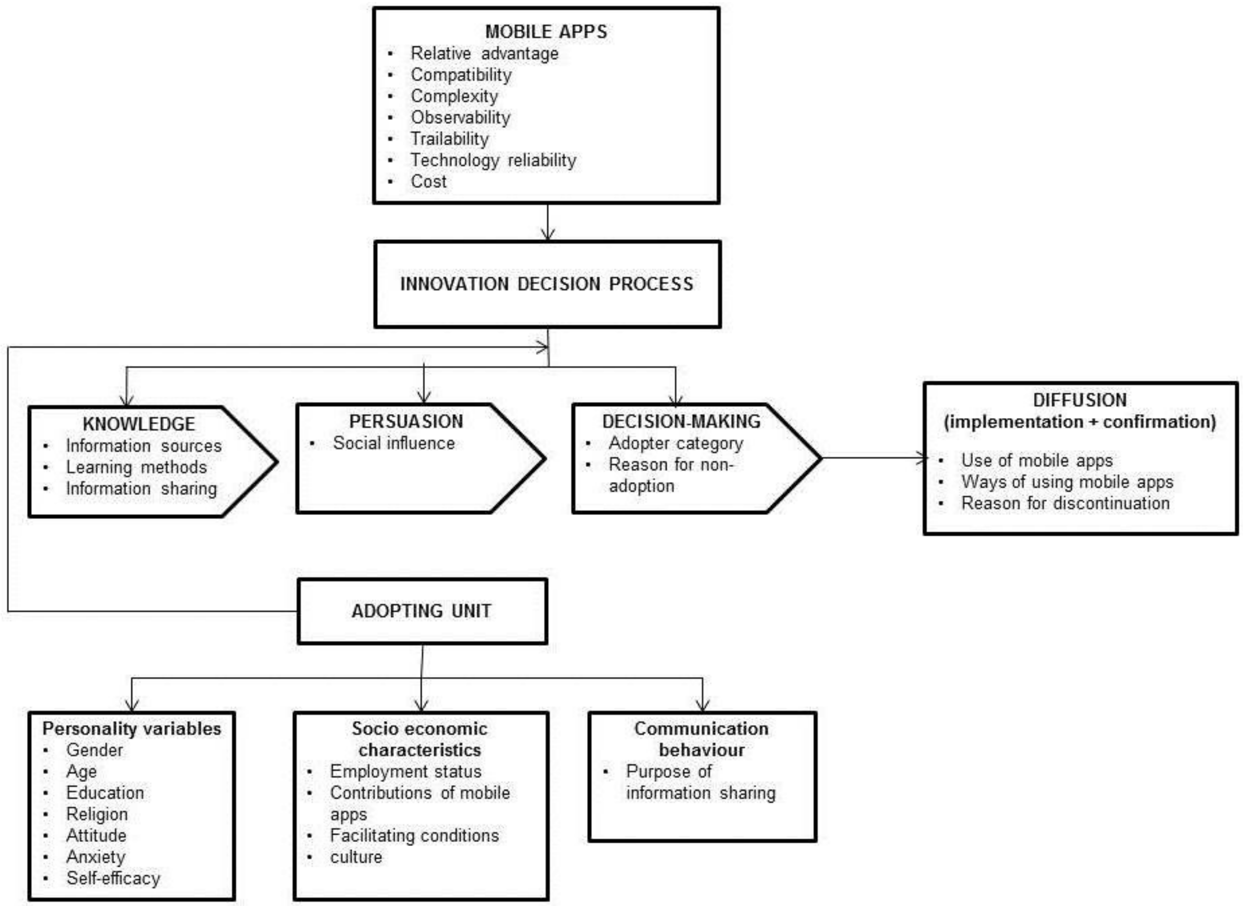

Figure 5.2: Final research conceptual framework

In Chapter 6, the detailed discussions of the results obtained from the data analysis regarding the selected countries will be provided.

Chapter 6

Adoption and diffusion of mobile apps in the selected countries

6.1 Introduction

The aim of this study is to investigate the adoption and diffusion of mobile apps in Africa. Five countries were selected from different locations in Africa, including South Africa from the southern region, Nigeria from the western region, Morocco from the northern region, Kenya from the southern region and the Democratic Republic of Congo from the central region of Africa. These countries were chosen because:

1. Each is located in one of the five regions/zones in Africa.
2. They have a substantial population.
3. The literature review made more references to them than to the others in their respective zones.
4. It is assumed that each region/zone has a related type of lifestyle.

In respect to these points, these countries represent their respective regions and the results obtained may be generalised to the regions respectively and to Africa as a whole.

To achieve the primary purpose of this study, the adoption of mobile apps in the selected countries as stated in objective 2 are examined. In sections A, B, C and G of the questionnaire, the quantitative data related to this objective were collected. The gathered information covered the following:

- ✓ Mobile apps innovation.
- ✓ Innovation decision.
- ✓ Adopting unit.

In this chapter, the survey results obtained regarding the selected countries based on the research conceptual model are discussed.

In section 6.2, the background information is discussed, in section 6.3, the focus is on mobile app innovations, in section 6.4, the innovation process is dealt with and in section 6.5, the adopting unit is discussed. A summary concludes the chapter in section 6.6.

6.2 Background information

In this section, the personal information of the participants is discussed, covering the country where they reside, gender, age group, education level, employment status and religion. This is carried out to acquire more knowledge of the individuals participating in the survey. The obtained results are discussed below.

Table 6.1: Gender

Participants	Gender		Total
	Male	**Female**	
South Africa	186 (55.5%)	149 (44.5%)	335 (100%)
Nigeria	205 (55.4%)	165 (44.6%)	370 (100%)
Morocco	69 (59.5%)	47 (40.5%)	116 (100%)
Kenya	128 (60.4%)	84 (39.6%)	212 (100%)
DRC	115 (45.6%)	137 (54.4%)	252 (100%)

From Table 6.1 it can be seen that,

South Africa – The formation of the sample population from South Africa involved 55.5% male and 44.5% female participants.

Nigeria – The formation of the sample population from Nigeria comprised 55.4% male and 44.6% female participants.

Morocco – The formation of the sample population from Morocco comprised 59.5% male and 40.5% female participants.

Kenya – The formation of the sample population from Kenya comprised 60.4% male and 39.6% female participants.

DRC – The formation of the sample population from the DRC comprised 45.6% male and 54.4% female participants.

there are therefore more female participants than male participants.

This indicates a fairly balanced representation of the gender components (male and female). Mobile apps are created for the general public and are expected to be equally adopted and used by everyone irrespective of gender.

Table 6.2: Age group

Country	Age group							
	Below 20	20-30	31-40	41-50	51-60	61-70	Above 70	Total
South Africa	78 (23.3%)	65 (19.4%)	120 (35.8%)	49 (14.6%)	20 (6.0%)	2 (0.6%)	1 (0.3%)	335 (100%)
Nigeria	34 (9.2%)	118 (31.9%)	115 (31.1%)	56 (15.1%)	25 (6.8%)	17 (4.6%)	5 (1.4%)	370 (100%)
Morocco	6 (5.2%)	23 (19.8%)	39 (33.6%)	23 (19.8%)	10 (8.6%)	9 (7.8%)	6 (5.2%)	116 (100%)
Kenya	17 (8.0%)	109 (51.4%)	42 (19.8%)	23 (10.8%)	7 (3.3%)	7 (3.3%)	7 (3.3%)	212 (100%)
DRC	23 (9.1%)	94 (37.3%)	63 (25.0%)	36 (14.3%)	15 (6.0%)	12 (4.8%)	9 (3.6%)	252 (100%)
Total	158 (12.3%)	409 (31.8%)	379 (29.5%)	187 (14.6%)	77 (6.0%)	47 (3.7%)	28 (2.2%)	1285 (100%)

From Table 6.2, different age groups participated in this study with the ages ranging from younger than 20 to older than 70 and all the age groups participated in various proportions (Table 5.3). Most of the participants are within the age range of 20-40 and the selected countries are represented according to the following proportions:

South Africa – Over 55% of the participating population came from the age group of 20-40.

Nigeria – 63% of the participants were in the age group of 20-40 years.

Morocco – 53.4% of the participants were in the age group of 20-40 years.

Kenya – 53.4% of the participants were in the age group of 20-40 years.

DRC - 62.3% of the participants were in the age group of 20-40 years.

All the age groups were involved in the survey, but the age group with the most participants was in the 20-40 range.

Table 6.3: Education level

Country	Education						
	Matric	Diploma	University	Masters	Doctorate	Other	Total
South Africa	149 (44.5%)	70 (20.9%)	66 (19.7%)	16 (4.8%)	4 (1.1%)	30 (9.0%)	335 (100%)
Nigeria	48 (13.0%)	105 (28.4%)	127 (34.3%)	49 (13.2%)	31 (8.4%)	10 (2.7%)	370 (100%)
Morocco	12 (10.3%)	35 (30.2%)	42 (36.2%)	20 (17.2%)	4 (3.4%)	3 (2.6%)	116 (100%)
Kenya	30 (14.2%)	44 (20.8%)	111 (52.4%)	12 (5.7%)	3 (1.4%)	0 (0.0%)	212 (100%)
DRC	33 (13.1%)	78 (31.0%)	66 (26.2%)	45 (17.9%)	27 (10.7%)	3 (1.2%)	252 (100%)

From Table 6.3, it can be seen that participants from all levels of education were involved in this research, including Matric, Diploma, University qualification, Masters, Doctorate and Other. 'Other' is the set of individuals that do not fall into these classifications and are considered to be uneducated.

South Africa - 81% of the participants are educated, whereas 9% are uneducated.

Nigeria – 97.3% of the participants are educated, whereas 2.7% are uneducated.

Morocco – 97.4% of the participants are educated whereas, 2.6% are uneducated.

Kenya – 98.6% of the participants are educated, whereas 1.4% is uneducated.

DRC – 98.8% of the participants are educated, whereas 1.2% is uneducated.

In general, the education level of most of the participants from South Africa is matric (44.5%), from Nigeria it is a university qualification (34.3%), as for the participants from Morocco (36.2%), and Kenya (52.4%) and from the DRC it is a diploma (31.0%). This indicates that over 90% of the participants are educated and the responses were obtained from the people who must have acquired some knowledge-awareness about mobile apps and their services. This is encouraging for this study because the main target audience is people with a good knowledge of mobile technology services.

Table 6.4: Employment

Country	**Employment**				
	Student	**Employed**	**Retired**	**Unemployed**	**Total**
South Africa	145 (43.3%)	121 (36.1%)	30 (9.0%)	39 (11.6%)	335 (100%)
Nigeria	70 (18.9%)	219 (59.2%)	44 (11.9%)	37 (10.0%)	370 (100%)
Morocco	23 (19.8%)	63 (54.3%)	12 (10.3%)	18 (15.5%)	116 (100%)
Kenya	59 (27.8%)	109 (51.4%)	14 (6.6%)	30 (14.2%)	212 (100%)
DRC	105 (41.7%)	103 (40.9%)	18 (7.1%)	26 (10.3%)	252 (100%)

From Table 6.4, it can be seen that

South Africa – More than 79% of the participants are students and/or employed, with 145 (43.3%) and 121 (36.1%) respectively. The remaining portion of the participants is unemployed 39 (11.6%) and retired 30 (9.0%) respectively.

Nigeria – 59.2% of the participants are employed, 18.9% are students, 11.9% are retired and 10.0% are unemployed.

Morocco – 54.4% of the participants are employed, 19.8% are students, 10.3% are retired and 15.5% are unemployed.

Kenya – 51.4% of the participants are employed, 27.8% are students, 6.6% are retired and 14.2% are unemployed.

DRC – 40.9% of the participants are employed, 41.7% are students, 7.1% are retired and 10.3% are unemployed.

Most of the participants from Nigeria, Morocco, Kenya and the DRC are employed, whereas from South Africa most of the participants were students. This is a good representation of various classes of individuals. These individuals are capable of adopting and using mobile apps even when it involves some financial costs. It is assumed that the students and the employed are more engaged with activities than the retired and unemployed, therefore they make more use of mobile apps in various tasks.

Table 6.5: Religion

Country	**Religion**					**Total**
	Christian	**Muslim**	**Hindu**	**Atheist**	**Other**	
South Africa	294 (87.8%)	14 (4.2%)	4 (1.2%)	4 (1.2%)	1 (5.7%)	335 (100%)
Nigeria	242 (65.4%)	106 (28.6%)	8 (2.2%)	9 (2.9%)	5 (1.4%)	370 (100%)
Morocco	6 (5.2%)	108 (93.1%)	1 (0.9%)	0 (0.0%)	1 (0.9%)	116 (100%)
Kenya	188 (88.7%)	17 (8.0%)	4 (1.9%)	2 (0.9%)	1 (0.5%)	212 (100%)
DRC	217 (86.1%)	18 (7.1%)	9 (3.6%)	4 (1.6%)	4 (1.6%)	252 (100%)

Table 6.5 indicates that most of the participants were Christians, followed by Muslims, Other, Hindu and Atheist.

South Africa – Christian, 87.8%, Muslim, 4.2%, Hindu, 1.2%, Atheist, 1.2% and Other, 5.7%

Nigeria - Christian, 65.4%, Muslim, 28.6%, Hindu, 2.2%, Atheist, 2.9% and Other, 1.4%

Morocco - Christian, 5.2%, Muslim, 93.1%, Hindu, 0.9%, Atheist, 0.0% and Other, 0.9%

Kenya - Christian, 88.7%, Muslim, 8.0%, Hindu, 1.9.2%, Atheist, 0.9% and Other, 0.5%

DRC - Christian, 86.1%, Muslim, 7.1%, Hindu, 3.6%, Atheist, 1.6% and Other, 1.6%

6.3 Mobile app innovation in Africa

According to Rogers, an innovation (mobile app, in this instance) has five basic influencing features/characteristics. In this section the results obtained from the investigation on the features of mobile apps from the perspectives of the participants from the different countries used for this research are reported.

6.3.1 Influencing features of mobile apps

For this study, influencing features are the characteristics of mobile apps that predict the outcome of decision making either to adopt or reject particular mobile apps. According to Rogers (2003), there are five features of innovation (mobile app), namely relative advantage, complexity, compatibility, observability and trialability. The adopters' perceptions of these features influences their decision making on the adoption and diffusion of mobile apps. This resarch investigate to determine the significance of each respective feature. The obtained results are discussed separately in respect of the African context

6.3.1.1 *Relative advantage*

Relative advantage tested the extent of adoption of a mobile app that adopters perceived as better than another mobile app.

Table 6.6: Relative advantage

Country	Scale rating					Total	Mean
	Strongly disagree				Strongly agree		
	1	2	3	4	5		
South Africa	17 (5.1%)	11 (3.3%)	70 (20.9%)	74 (22.1%)	163 (48.7%)	335 (100%)	4.2
Nigeria	23 (6.2%)	33 (8.9%)	78 (21.1%)	131 (35.4%)	105 (28.4%)	370 (100%)	3.7
Kenya	7 (3.3%)	22 (10.4%)	60 (28.3%)	57 (26.9%)	66 (31.1%)	212 (100%)	3.7
Morocco	8 (6.9%)	23 (19.8%)	25 (21.6%)	36 (31.0%)	24 (20.7%)	116 (100%)	3.4
DRC	18 (7.1%)	34 (13.5%)	66 (26.2%)	65 (25.8%)	69 (27.4%)	252 (100%)	3.2

From table 6.6, the mean value ranges from 3.2 to 4.2, indicating that all the countries agree that relative advantage is a significant feature of mobile apps. This implies that a mobile app that the users or adopters percieve to have some better features or advantages over others will gain more adoption than others, for instance the case of MxIT compared with WhatsApp and other social networking mobile apps. It is, therefore, necessary that the innovators or developers and other stakehoders of mobile apps development, adoption and diffusion should do proper feasibility studies on existing similar mobile apps to know what the adopters want. The existing mobile apps should constantly be upgraded in conjunction with the current requirements of the users. South Africa has the highest mean value of 4.2, followed by Nigeria, Kenya and Morocco, whereas the DRC has the smallest mean value of 3.2. This indicates that relative advantage has greater impact on the adopters of mobile apps in South Africa than in the other countries and the lowest impact on the DRC adopters of mobile apps. The result is consistent with the findings of (Nickerson *et al.*, 2014, Kiura & Solomon, 2012, Elogie, 2015, Al-Jabri & Sohail, 2012, Brown & Molla, 2015) and disagreed with Mndzebele (2013) who argues that relative advantage is not significant in the adoption of e-commerce mobile apps.

6.3.1.2 *Complexity (Ease of use)*

In this section, the extent to which participants perceive that adoption of mobile apps is influenced by how easy the app is to be used is discussed. Table 6.7 depicts the results.

Table 6.7: Complexity

Country	Scale rating					Total	Mean
	Strongly disagree				Strongly agree		
	1	2	3	4	5		
South Africa	6 (1.85%)	6 (1.8%)	111 (33.1%)	83 (24.8%)	129 (38.5%)	335 (100%)	4.0
Nigeria	14 (3.8%)	14 (3.8%)	85 (23.0%)	147 (39.7%)	110 (29.0%)	370 (100%)	3.9
Kenya	9 (4.2%)	19 (9.0%)	50 (23.6%)	66 (31.1%)	68 (32.1%)	212 (100%)	3.8
Morocco	2 (1.7%)	13 (11.2%)	32 (27.6%)	37 (3.9%)	32 (27.6%)	116 (100%)	3.7
DRC	14 (5.6%)	43 (17.1%)	65 (25.8%)	84 (33.3%)	46 (18.3%)	252 (100%)	3.4

Table 6.7 shows the mean values of complexity varies between 3.4 to 4.0, indicating practical significance. This means that complexity is an important feature of mobile apps. The adopters of mobile apps expected mobile apps to be simple and easy to understand and use. Mobile apps are developed for educated and non-educated, urban and rural dwellers, etc. If a mobile app is cretaed in such a way that anyone with common sense can easily understand and use it, it will attract more adopters across the whole social system of Africa. Ease of use reduces uncertainty and increases the rate of adoption. The finding agreed with the findings of (Tunmibi *et al.*, 2015, Mndzebele, 2013). South Africa has the highest mean value and the DRC obtained the lowest mean value, indicating that complexity has a higher influence in South Africa, followed by Nigeria, Morocco and Kenya, whereas in the DRC complexity has the least effect.

6.3.1.3 *Compatibility*

In this section, the extent to which participants perceive that compatibility of a mobile app influences adoption thereof is presented. Compatibility can be viewed as the fit of lifestyles and needs. Table 6.8 depicts the results.

Table 6.8: Compatibility

Country	Scale rating					Total	Mean
	Strongly disagree				Strongly agree		
	1	2	3	4	5		
South Africa	6 (1.8%)	34 (10.1%)	93 (27.8%)	86 (25.7%)	116 (34.6%)	335 (100%)	3.8
Nigeria	14 (3.8%)	27 (7.3%)	90 (24.3%)	126 (34.1%)	113 (30.5%)	370 (100%)	3.8
Kenya	8 (3.8%)	23 (10.8%)	48 (22.6%)	52 (24.5%)	81 (38.2%)	212 (100%)	3.8
Morocco	5 (4.3%)	18 (15.5%)	27 (23.3%)	38 (32.8%)	28 (24.1%)	116 (100%)	3.6
DRC	24 (9.5%)	37 (14.7%)	61 (24.2%)	69 (27.4%)	61 (24.2%)	252 (100%)	3.4

The mean values of the participants' responses from the five selected countries are ≤ 3.4 and ≥ 3.8. These are above average and support the importance of the compatibility feature of mobile apps. This implies that the compatibility aspect of mobile apps significantly influences the adopters' decision making on the adoption and diffusion of mobile apps. For a mobile app to be successfully adopted and used in the African community, the design should fit well with the existing values, experiences and needs of the African population. In this vein, a good local content is needed in the design and creation of mobile apps that can successfully be adopted and diffused in the African setting. This finding also supported the findings of some previous research conducted in the African context by Tunmibi *et al.* (2015), Mndzebele (2013), Brown & Molla (2015), but disagreed with the findings of Elogie (2015) who argues that compatibility is not adequate to predict adoption. These results show that South Africa is the country where the highest number of the participants agree that compatibility is an influential feature of mobile apps, followed by Nigeria, Kenya and Morocco, whereas the DRC is the country with the least number of participants who agree on this feature.

6.3.1.4 *Observability*

In this section, the extent to which the participants perceive that observing the effect of the use of mobile apps can influence the adoption of mobile apps in the African social system is addressed. The results obtained are illustrated in Table 6.9.

Table 6.9: Observability

Country	**Scale rating**					**Total**	**Mean**
	Strongly disagree				**Strongly agree**		
	1	**2**	**3**	**4**	**5**		
Nigeria	24 (6.5%)	36 (9.7%)	75 (20.3%)	119 (32.2%)	116 (31.3%)	370 (100%)	3.7
South Africa	44 (13.1%)	32 (9.6%)	69 (20.6%)	58 (17.3%)	132 (39.4%)	335 (100%)	3.6
Morocco	9 (7.8%)	14 (12.1%)	36 (31.0%)	25 (21.6%)	32 (27.6%)	116 (100%)	3.5
DRC	16 (6.3%)	53 (21.0%)	54 (21.4%)	72 (28.6%)	57 (22.6%)	252 (100%)	3.4
Kenya	37 (17.5%)	35 (16.5%)	51 (24.1%)	42 (19.8%)	47 (22.2%)	212 (100%)	3.1

Seeing other people using mobile apps can convince 56.7% of the participants from South Africa, 63.3% from Nigeria, 49.2% from Kenya and 51.2% from the DRC to adopt and use mobile apps. The mean values of the participants' responses from the five selected countries ranges from 3.1 to 3.9, supporting observeability as a significant feature of adoption of mobile apps. This is a positive result, indicating that observability can also influence the decision making either to adopt or reject mobile apps. It explained a situation whereby an individual lacks the knowledge-awareness or is uninterested in a particular mobile app but when he/she sees a friend using it, he/she will develop the interest to adopt and use that mobile app. This finding supports the findings of Tunmibi *et al.* (2015), Al-Jabri & Sohail (2012) and disagreed with Elogie (2015) who argues that observability is not adequate to predict adoption. South Africa has the highest number of participants who support observeability as a factor in the adoption of mobile apps, whereas DRC has the least number of participants supporting observeability. Regarding the African context, observability has its greatest effect on the adoption and diffusion of mobile apps in South Africa, followed by Nigeria, Morocco, the DRC and Kenya.

6.3.1.5 *Trialability*

In this section, the extent to which the participants perceive that trialability of a mobile app influences its adoption is discussed. Trialability is the extent to which a mobile app can be tested on a limited basis. The obtained results are shown in Table 6.10.

Table 6.10: Trialability

Country	Scale rating					Total	Mean
	Strongly disagree				Strongly agree		
	1	2	3	4	5		
South Africa	10 (3.0%)	13 (3.9%)	75 (22.4%)	107 (31.9%)	130 (38.8%)	335 (100%)	4.0
Nigeria	15 (4.1%)	38 (10.3%)	69 (18.6%)	119 (32.2%)	129 (34.9%)	370 (100%)	3.8
DRC	23 (9.1%)	34 (13.5%)	63 (25.0%)	67 (26.6%)	65 (25.8%)	252 (100%)	3.5
Morocco	7 (6.0%)	16 (13.8%)	21 (21%)	39 (33.6%)	33 (28.4%)	116 (100%)	3.4
Kenya	23 (10.8%)	27 (12.7%)	55 (25.9%)	50 (23.6%)	57 (26.9%)	212 (100%)	3.4

From Table 6.10, the mean values are above average (3.4-4.0). It implies that participants believe in experimentation as convincing proof, which can motivate the possible adopters to take a decision on the adoption and diffusion of mobile apps. Some African mobile apps adopters believe in a "Wait and See" attitude before adopting a new mobile app. This finding agrees with Tunmibi *et al.* (2015), Brown & Molla (2015), Al-Jabri & Sohail (2012) and disagrees with Elogie (2015) who argues that trialability is not adequate to predict adoption. These results show that South Africa is the country where the highest number of the participants agrees that trialability is an influential feature of mobile apps, followed by Nigeria, Kenya and Morocco, whereas the DRC is the country with the least number of participants who agree on this feature.

6.4 Innovation-decision process

In this sub-section, the results obtained from the participants' responses on the adoption and diffusion of mobile apps in Africa regarding knowledge-awareness, decision making and diffusion with respect to individual countries used for this research are discussed.

6.4.1 Knowledge-awareness

Knowledge-awareness of mobile apps was investigated to determine the sources through which the adopters of mobile apps in Africa get to know about the existence of new mobile apps, and to examine how they learn how to use new mobile apps, as well as how they disseminate the information amongst each other. The obtained results are discussed as follows.

6.4.1.1 *Sources of Information*

Five possible sources of information were investigated, namely interpersonal communication, the Internet, mass media, organisations and special events.

Table 6.11: Information sources of mobile apps

Country	Scale rating: Strongly disagree 1	2	3	4	Strongly agree 5	Total	Mean	Ave of mean
The Internet								
Nigeria	25 (6.8%)	41 (11.1%)	64 (17.3%)	103 (27.8%)	137 (37.0%)	370 (100%)	3.8	3.5
South Africa	34 (10.1%)	47(14.0%)	59 (17.6%)	65 (19.4)	130 (38.2%)	335 (100%)	3.6	
Morocco	4 (3.4%)	14 (12.1%)	28 (24.1%)	45 (38.8%)	25(21.6%)	116 (100%)	3.6	
Kenya	14 (6.6%)	39 (18.4%)	48 (22.6%)	65 (30.7%)	46 (21.7%)	212 (100%)	3.4	
DRC	32 (12.7%)	55 (21.9%)	63 (25.1%)	52 (20.7%)	49 (19.5%)	251 (100%)	3.1	
Interpersonal communication								
Morocco	0 (0.0%)	5 (4.3%)	23 (19.8%)	56 (48.3%)	32 (27.6%)	116 (100%)	4.0	3.7
South Africa	30 (9.0%)	20 (6.0%)	64 (19.1%)	93 (27.8%)	128 (38.2%)	335 (100%)	3.8	
Nigeria	20 (5.4%)	23 (6.2%)	86 (23.2%)	150 (40.5%)	91 (24.6%)	370 (100%)	3.7	
Kenya	4 (1.9%)	29 (13.7%)	55 (25.9%)	67 (31.6%)	57 (26.9)	212 (100%)	3.7	
DRC	17 (6.7%)	39 (15.5%)	79 (31.3%)	81 (32.1%)	36 (14.3%)	251 (100%)	3.3	
Mass media								
Nigeria	18 (4.9%)	29 (7.8%)	106 (28.6%)	123 (33.2%)	94 (25.4%)	370 (100%)	3.7	3.4
Morocco	5 (4.3%)	12 (10.3%)	37 (31.9%)	33 (28.4%)	29 (25.0%)	116 (100%)	3.6	
South Africa	20 (6.0%)	58 (17.3%)	93 (27.8%)	57 (17.0%)	107 (31.9%)	335 (100%)	3.5	
Kenya	12 (5.7%)	55 (25.9%)	51 (24.1%)	40 (18.9%)	54 (25.5%)	212 (100%)	3.3	
DRC	38 (15.1%)	46 (18.3%)	52 (20.6%)	62 (24.6%)	54 (21.4%)	251 (100%)	3.2	
The organisation								
Nigeria	26 (7.0%)	36 (9.7%)	89 (24.1%)	120 (32.4%)	99 (26.8%)	370 (100%)	3.6	3.0
DRC	19 (7.5%)	53 (21.0%)	58 (23.0%)	93 (36.9%)	29 (11.5%)	251 (100%)	3.2	
South Africa	64 (19.1%)	84 (25.1%)	79 (23.6%)	63 (18.8%)	45 (13.4%)	335 (100%)	2.8	
Morocco	17 (14.7%)	29 (25.0%)	40 (34.5%)	21 (18.1%)	9 (7.8%)	116 (100%)	2.8	
Kenya	49 (23.1%)	57 (26.9%)	39 (18.4%)	45 (21.2%)	22 (10.4%)	212 (100%)	2.7	
Special events								
Nigeria	34 (9.2%)	51 (13.8%)	96 (25.9%)	97 (26.2%)	92 (24.9%)	370 (100%)	3.4	3.0
DRC	20 (7.9%)	56 (22.2%)	65 (25.8%)	68 (27.0%)	43 (17.1%)	251 (100%)	3.2	
South Africa	50 (14.9%)	85 (25.4%)	88 (26.3%)	74 (22.1%)	38 (11.3%)	335 (100%)	2.9	
Morocco	24 (20.7%)	31 (26.7%)	36 (31.0%)	16 (13.8%)	9 (7.8%)	116 (100%)	2.6	
Kenya	50 (23.6%)	55 (25.9%)	55 (25.9%)	23 (10.8%)	29 (13.7%)	212 (100%)	2.7	

Table 6.11 depicts the participants' responses regarding sources that are used to receive information on mobile apps, namely the Internet, interpersonal communication, mass media, organisation and special events from the selected countries. The discussion below is according to the mean values obtained from individual countries on each of the information sources.

The Internet – This involves surfing or browsing the Internet for information purposes. The mean value obtained from the participants' responses on the Internet as a source of information for mobile apps is ≥ 3.1 and ≤ 3.8. Nigeria has the highest mean value of 3.8 and the DRC has the lowest of 3.1. This implies that all the countries are using the Internet to get information about mobile apps. Nigeria is the country where the Internet is used most, followed by South Africa, Morocco, and Kenya, whereas the DRC is the country where the use of the Internet is lowest.

Interpersonal communication – This is interaction between individuals. From the participants' responses, the mean values range from 3.3 to 4.0. Morocco has the highest mean value of 4.0 and the DRC has the lowest of 3.3. Interpersonal communication as a source is used in all the selected countries to obtain information about mobile apps. It is observed from the mean value that Moroccans make the highest use of interpersonal communication, followed by South Africa, Nigeria, Kenya and the DRC.

Mass media – This was also found to be another good source of information about mobile apps, having a mean value ranging from 3.2 to 3.7. Nigeria has the highest mean value of 3.7 and the DRC has the lowest mean value of 3.2. It indicates that mass media is a source of information about mobile apps in all the countries used for this research. Through radio, TV and advertisements, people can obtain knowledge about the existence of mobile apps. Nigeria is the country where the largest number of participants agrees that they can get information about mobile apps through mass media, whereas the DRC has the lowest number of participants that agrees to this.

The organisation – Use of the organisation as information source is getting the knowledge about the existence of mobile apps through the organisation where the individuals work or are associated with. From the participants' opinions, the mean values obtained are from 2.7 to 3.4. The highest mean value of 3.4 is from Nigeria and the lowest mean value of 2.7 is from Kenya. It is observed that only two countries, Nigeria and the DRC, have mean values that are more than 3.0 and the other three countries, South Africa, Morocco and Kenya, have mean values of less than 3.0. This indicates that the use of the organisation to gain information about mobile apps is higher or more active in Nigeria and the DRC, but in South Africa, Morocco and Kenya the use of the organisation as information source for mobile apps is relatively low.

Special events – There are occasions where information about new products is obtained. Examples are conferences and trade exhibitions. Such events are referred to as special events for information about mobile apps. The mean values obtained from the participants' responses on this source are between 2.7 and 3.4. Nigeria has the highest mean value of 3.4 and Kenya has the lowest mean value of 2.7. The mean values from Nigeria and the DRC are more than 3.0 and those from South Africa, Morocco and Kenya are less than 3.0. This indicates that the rate of using special events as information source for mobile apps is higher in Nigeria and the DRC, whereas in South Africa, Morocco and Kenya, it is low. Special events are more actively used in Nigeria and the DRC as information source for mobile apps than in South Africa, Morocco and Kenya, where it is rarely used.

The results on information sources about mobile apps show that the five sources of information, namely interpersonal communication, the Internet, mass media, the organisation, and special events are potential sources of information about mobile apps. The uses of these sources vary with respect to each country. The five sources are used more actively in Nigeria and the DRC, whereas in South Africa, Morocco and Kenya only three are actively used. The three actively used sources of information for mobile apps in all the countries used for this research are interpersonal communication, the Internet and mass media and the organisation and special events are less used. Interpersonal communication is the highest used source with an average mean value of 3.7, followed by the Internet with an average mean value of 3.5 and mass media with an average mean value of 3.4, whereas the organisation and special events are both the lowest with average mean values of 3.0.

Rogers (2003) stated two sources of information about an innovation, namely interpersonal communication and mass media and the results in this study supports that statement. In addition to what Rogers proposed, this study reveals other sources of information about mobile apps, including the Internet, organisation and special events. Concerning the Internet, every developed mobile app is deposited in the mobile app stores, such as App Store and Google Play. From these stores, it will be advertised on the Internet to reach the public. Organisations can develop their own mobile apps for their operations and disseminate the information to their clients and information about a new mobile apps can possibly be obtained at conferences or exhibitions. These sources are applicable to information sharing; the ways through which the information about mobile apps is disseminated to the entire population.

6.4.2.2 *Information sharing*

This involves the different ways of sharing the obtained information about the mobile apps among individuals in the African social system. When a person acquires the knowledge about a new mobile apps, what means does he/she use to transfer the information to another person(s)? Similar to the sources of information, the same items were used in measuring the information sharing and the same results were obtained. It was found that individuals shared the information about mobile apps among themseves through two-way communication, the Internet, mass media, organisations and conferences.

6.4.3.3 *Learning method of using mobile apps*

There are different types of mobile app with different operations and unique purposes. The practical use of mobile apps seems to be similar, but there are some variations due to their specific services. For the effective use of mobile apps, individuals require operational knowledge. Five ways to learn how to use mobile apps were investigated and results obtained from the participants' responses are illustrated in Table 6.12.

Table 6.12: Learning methods of using mobile apps

Country	Scale rating: Strongly disagree 1	2	3	4	Strongly agree 5	Total	Mean	Ave of mean
Formal training								
Nigeria	49 (13.2%)	63 (17.0%)	79 (21.4%)	96 (25.9%)	83 (22.5%)	370 (100%)	3.3	2.8
DRC	29 (11.5%)	71 (28.2%)	80 (31.87%)	43 (17.1%)	29 (11.5%)	251 (100%)	2.9	
South Africa	71 (21.2%)	62 (18.5%)	115 (34.3%)	42 (12.5%)	45 (13.4%)	335 (100%)	2.8	
Morocco	18 (15.5%)	28 (24.1%)	43 (37.1%	20 (17.2%)	7 (6.0%)	116 (100%)	2.7	
Kenya	78 (36.8%)	41(19.3%)	47 (22.2%)	36 (17.0%)	10(4.7%)	212 (100%)	2.3	
Informal training								
Nigeria	31 (8.4%)	40 (10.8%)	104 (28.1%)	107 (28.9%)	87 (23.5%)	370 (100%)	3.5	3.2
South Africa	44 (13.1%)	37 (11.0%)	109 (32.5%)	74 (22.1%)	71 (21.1%)	335 (100%)	3.3	
Morocco	20 (17.4%)	25 (21.7%)	30 (26.1%)	28 (24.3%)	12 (10.4%)	116 (100%)	2.9	
Kenya	34 (16.0%)	31 (14.6%)	66 (31.1%)	35 (16.5%)	46 (21.7%)	212 (100%)	3.1	
DRC	24 (9.5%)	49 (19.4%)	83 (32.9%)	65 (25.8%)	31(12.3%)	251 (100%)	3.1	
Operational manual								
Nigeria	29 (7.8%)	35 (9.5%)	90 (24.3%)	114 (30.8%)	102 (27.6%)	370 (100%)	3.6	3.2
South Africa	28 (8.4%)	48 (14.3%)	100 (29.9%)	66 19.7%)	93 (27.8%)	335 (100%)	3.4	
DRC	30 (11.9%)	46 (18.3%)	58 (23.0%)	67 (26.6%)	51 (20.2%)	251 (100%)	3.3	
Morocco	20 (17.4%)	25 (21.7%)	34 (29.6%)	19 (16.5%)	17 (17.5%)	116 (100%)	2.9	
Kenya	36 (17.0%)	36 (17.0%)	66 (31.1%)	37 (17.5%)	37 (17, 5%)	212 (100%)	3.0	
The Internet								
Nigeria	15 (4.1%)	31 (8.4%)	82 (22.2%)	137 (37.0%)	105 (28.4%)	370 (100%)	3.8	3.4
South Africa	28 (8.4%)	45 (13.4%)	102 (30.4%)	54 (16.1%)	106 (31.6%)	335 (100%)	3.5	
Morocco	10 (8.6%)	22 (19.0%)	35 (30.2%)	29 (25.0%)	20 (17.2%)	116 (100%)	3.2	
Kenya	16 (7.5%)	38 (17.9%)	58 (27.4%)	61 (28.8%)	39 (18.4%)	212 (100%)	3.3	
DRC	26 (10.3%)	53 (21.0%)	59 (23.4%)	70 (27.8%)	44 (17.5%)	251 (100%)	3.2	
Interpersonal communication								
Nigeria	10 (2.7%)	36 (9.7%)	86 (23.2%)	118 (31.9%)	120 (32.4%)	370 (100%)	3.8	3.5
Kenya	15 (7.1%)	31 (14.6%)	54 (25.5%)	64 (30.2%)	48 (22.6%)	212 (100%)	3.5	
DRC	16 (6.3%)	37 (14.7%)	69 (27.4%)	75 (29.8%)	55 (21.8%)	251 (100%)	3.5	
South Africa	36 (10.7%)	33 (9.9%)	94 (28.1%)	89 (26.6)	83 (24.8%)	335 (100%)	3.4	
Morocco	8 (6.9%)	14 (12.1%)	32 (27.6%)	45 (38.8%)	17 (14.7%)	116 (100%)	3.4	

Table 6.12 shows the participants' responses on the learning methods (how they learnt to use mobile apps). The investigated methods are formal training, informal training, operational manual, the Internet and interpersonal communication. The discussion below is according to the mean values obtained from individual countries on each of the information sources.

Formal training – this involves attending training courses to learn about the use of mobile apps. The mean values obtained from the participants' responses with respect to the five selected countries range from 2.3 to 3.3. Nigeria has the highest mean value and Kenya has the lowest mean value of 2.3. This indicates that formal training is rarely used to learn how to use mobile apps, especially in South Africa, Morocco, Kenya and the DRC. In Nigeria, formal training is recognised as a potential method.

Informal training – learning how to use mobile apps in an unorganised manner is referred to as the informal method. For instance, asking a friend or colleague in an office to teach you how to use a particular mobile app. The mean values are ≥ 2.9 and ≤ 3.5. This implies that the participants agree that they learn to use mobile apps through informal training. The highest mean value is from Nigeria and the lowest is from Morocco, indicating that Nigeria is the country where the largest number of participants agree on informal training, followed by South Africa, Kenya and the DRC. Morocco has the lowest number of responses, but agrees on informal training as a method of learning how to use mobile apps.

Operational manual – Mobile apps have always come with written guidelines on how to install and use a mobile app. This documentation is referred to as the operational manual. Knowing how to use mobile apps through this documentation is learning through the operational manual. From the participants' responses, the obtained mean values are between 2.9 and 3.6. This implies that an operational manual is a used as method of learning how to use mobile apps. Nigeria has the highest mean value of 3.6, indicating that this method is mostly used in Nigeria, more than in the other countries. The next countries are South Africa, the DRC and Kenya, whereas Morocco is the country with the lowest mean value of 2.9.

The Internet – this method involves getting the knowledge of using mobile apps through internet browsing or through the mobile apps websites. The mean values vary from 3.2 to 3.8, indicating that all the countries use the Internet as a method of acquiring knowledge of using mobile apps. Nigeria is the country where the largest number of participants agree on the use of the Internet as a method, followed by South Africa, and Kenya, whereas Morocco and the DRC have the lowest number of participants that agree to this method.

Interpersonal communication – Knowing how to use mobile apps through personal interaction between two of more people is referred to as interpersonal communication. From the participants' opinions on this method, the mean values are ≥ 3.4 and ≤ 3.8. This indicates that all the countries use interpersonal methods to acquire the knowledge of using mobile apps. Nigeria has the highest mean value of 3.8, whereas South Africa and Morocco have the lowest mean value of 3.4. This implies that the use of interpersonal communication is higher in Nigeria, follwed by Kenya and the DRC. South Africa and Morocco have the lowest use of this method.

Overall, five methods, formal training, informal training, operational method, the Internet and interpersonal communication, were tested to determine their degree of usage in learning how to use mobile apps. It was found that four methods, interpersonal communication, the Internet, operational manual and informal training, are the main methods used actively in all the selected countries to learn the use of mobile apps. Formal training is scarcely used and should not be considered as a learning method. From the average of the mean, interpersonal communication is the most used method, followed by the Internet, operational manual and informal training.

6.4.2 Decision making

In the decision-making stage of the innovation-decision process, the individual decides whether or not to adopt and use mobile apps. In this section, the adopters' categories and rejection of mobile apps are investigated. The participants were tested on these aspects of decision making and the results obtained are discussed below.

6.4.2.1 Adopter's category

The Pearson Chi-Square and Cramer's V values indicate strong relationships among the variables, but there is no significant variation on the obtained data from different countries, thus general discussion is presented.

Overall, the findings indicated five distinct categories of adopters of mobile apps in Africa. These factors were adequately internally consistent. The obtained adopters' categories in Africa are late majority and laggards, non-adopters, innovators, early adopters and early majority. It is observed that the results merged late majority and laggards together and produced a new category, non-adopters. The results agreed with Rogers' framework of five categories of adopters. Interestingly, the study revealed a new category, namely non-adopters. This is the set of people that do not adopt or use innovation at all. Rogers' framework deals only with the adopters of innovations, but does not clearly account for the non-adopters. Considering the context of this study, the African environment, the finding is possible. Besides, from the question to determine if the participants use mobile apps, 4.2% totally disagreed and 6.8% disagreed resulting in 11% of the total participants that disagreed. This implies that there are people in Africa that do not use mobile apps at all. It is possible because African nations are developing countries. In this regard, it is necessary to consider the non-adopters' category in the process of adoption and diffusion of an innovation (mobile apps).

6.4.2.2 *Reasons for non-adoption of mobile apps (Rejection)*

Rejection is the total refusal of a product/services or dismissal of already used product/services. Drawing from Rogers (2003), rejection follows discontinuance and he referred to such a rejection as an active rejection. In this sub-section, the results obtained from the investigation regarding the reasons for non-adoption of mobile apps in Africa are presented in Table 6.13.

Table 6.13: Reasons for non-adoption of moble apps

Country	**Scale rating**					**Total**	**Mean**	**Ave of mean**
	Strongly disagree				**Strongly agree**			
	1	**2**	**3**	**4**	**5**			
Using mobile apps takes up too much phone memory								
South Africa	18 (5.4%)	30 (9.0%)	91 (27.2%)	113 (33.4%)	83 (24.8%)	335 (100%)	3.6	3.4
Morocco	5 (4.3%)	25 (21.6%)	27 (23.3%)	30 (25.9%)	29 (25.0%)	116 (100%)	3.5	
Nigeria	50 (13.5%)	28 (7.6%)	111 (30.0%)	97 (26.2%)	84 (22.7%)	370 (100%)	3.4	
DRC	19 (7.5%)	41 (16.3%)	87 (34.5%)	64 (25.4%)	41 (16.3%)	252 (100%)	3.3	
Kenya	28 (13.2%)	65 (30.7%)	47 (22.2%)	33 (15.6%)	39 (18.4%)	212 (100%)	3.0	
Using mobile apps is time-consuming								
South Africa	22 (6.6%)	41 (12.2%)	82 (24.5%)	79 (23.6%)	111 (33.1%)	335 (100%)	3.6	3.3
Morocco	5 (4.3%)	9 (7.8%)	36 (31.0%)	49 (42.2%)	17 (14.7)	116 (100%)	3.6	
Nigeria	68 (18.4%)	44 (11.9%)	58 (15.7%)	108 (29.2%)	92 (24.9)	370 (100%)	3.3	
Kenya	47 (22.2%)	50 (23.6%)	54 (25.5%)	41 (19.3%)	20 (9.4%)	212 (100%)	2.7	
DRC	22 (8.7%)	54 (21.4%)	63 (25.0%)	66 (26.2%)	47 (18.7%)	252 (100%)	3.2	
Using mobile apps is distracting my attention from other activities								
Nigeria	58 (15.7%)	33 (8.9%)	86 (23.2%)	92 (24.9%)	101 (27.3%)	370 (100%)	3.4	3.2
DRC	19 (7.5%)	51 (20.2%)	48 (19.0%)	82 (32.5%)	52 (20.6%)	252 (100%)	3.4	
South Africa	34 (10.1%)	46 (12.7%)	105 (31.3%)	78 (23.3%)	72 (21.5%)	335 (100%)	3.3	
Morocco	15 (12.9%)	26 (22.4%)	30 (25.9%)	20 (17.2%)	25 (21.6%)	116 (100%)	3.1	
Kenya	43 (20.3%)	42 (19.8%)	55 (25.9%)	37 (17.5%)	35 (16.5%)	212 (100%)	3	
Using mobile apps is expensive								
South Africa	31 (9.3%)	37 (11.0%)	45 (13.4%)	83 (24.8%)	139 (41.5%)	335 (100%)	3.8	3.2
Nigeria	39 (10.5%)	61 (16.5%)	83 (22.4%)	94 (25.4%)	93 (25.1%)	370 (100%)	3.4	
Morocco	13 (11.2%)	19 (16.4%)	34 (29.3%)	32 (27.6%)	18 (15.5%)	116 (100%)	3.2	
Kenya	56 (26.4%)	52 (24.5%)	40 (18.9%)	41 (19.3%	23 (10.8%)	212 (100%)	2.6	
DRC	27 (10.7%)	52 (20.6%)	59 (23.4%)	60 (23.8%	54 (21.4%)	252 (100%)	3.2	

:***Storage perspective***: This depicts the participants' responses in respect of the rejection of mobile apps due to the fact that mobile apps take up too much phone memory. The mean values range from 3.0 to 3.6, indicating that rejection may occur if the use of mobile apps requires too much phone memory. In other words, if the size of the phone memory needed to install a mobile app is too large, it may result in the rejection or non-adoption of the mobile app. The result is possible because the adoption and diffusion of mobile apps involve installation of the software package into the mobile devices, thus memory space is taken. There are various kinds of mobile app with respective functions and the more mobile apps are adopted, the less the memory space of the mobile device. South Africa has the highest mean value of 3.6, whereas Kenya has the lowest mean value of 3.0. This implies that this factor has more impact on South Africans, followed by the participants in Morocco, the DRC and Kenya.

Time perspective: Using mobile apps is time-consuming. The results indicate that the mean values are between 2.7 and 3.6. This implies that the participants agreed that the adoption and use of mobile apps services consume their time. As a result, they may reject the adoption of the mobile app. This suggests that it is necessary to consider the operation period in the development of mobile apps. South Africa has the highest mean value, followed by Morocco, and Nigeria with Kenya having the lowest mean value. The fact that mobile apps are time-consuming has a higher effect on Moroccans with the lowest effect in Kenya.

Attention perspective: Using mobile apps may distract attention from other activities. The mean values obtained from the participants' responses are ≥ 3.0 and ≤ 3.4, indicating that distraction from other activities by the use of mobile apps may result in the rejection of mobile apps. If using mobile apps will cause the users to abondon other things, it may well cause the rejection of mobile apps. Nigeria and the DRC have the highest mean values, followed by South Africa and Morocco, whereas Kenya has the lowest mean value. This suggests that this factor has higher impact on Nigerian and DRC mobile apps adopters than in other countries. This may result in some personal and business issues and to resolve such issues, they will discontinue the use of mobile apps, hence rejecting them.

Cost perspective: Using mobile apps is expensive. Participants agreed that the adoption and diffusion of mobile apps involve considerable costs and the cost aspect of the process will make them reject mobile apps. It is, therefore, important for the government and other stakeholders to subsidise the costs of the adoption and diffusion of mobile apps in order to improve the use of mobile apps in Africa. The mean values obtained range from 3.8 to 2.6. South Africa has the highest mean value of 3.8, followed by Nigeria, Morocco and the DRC, whereas Kenya has the lowest mean value of 2.6. This suggests that the cost aspect of the rejection of mobile apps has a greater impact in South Africa, followed by Nigeria, Morocco and the DRC. The factor has a minor impact in Kenya.

In Africa, the mobile app is a rapidly growing innovation and many new mobile apps with local content are expected to be evolved into the software world. To improve the adoption and diffusion of mobile apps, all the stakeholders concerned will take part in reducing the effects of these factors that may cause rejection. In the next section, the diffusion aspect of the research model will be discussed.

6.4.3 Diffusion

Diffusion involves the processes of distribution, use and discontinued use of mobile apps. In this section, the results obtained from the use of mobile apps, ways of using mobile apps and the reasons for discontinuation are discussed.

6.4.3.1 *The use of mobile apps*

The results of the investigation to determine if the participatants are users of mobile apps are shown in Table 6.14.

Table 6.14: The use of mobile apps

Country	**Scale rating**					**Total**	**Mean**	**Ave. of mean**
	Strongly disagree			**Strongly agree**				
	1	**2**	**3**	**4**	**5**			
Nigeria	11 (3.0%)	9 (2.4%)	37 (10.0%)	112 (30.3%)	201 (54.3%)	370 (100%)	4.3	4.0
South Africa	7 (2.1%)	20 (6.0%)	57 (17.0%)	89 (26.6%)	162 (48.4%)	335 (100%)	4.1	
Morocco	5 (4.2%)	4 (3.4%)	20 (17.2%)	29 (25.0%)	58 (50.0%)	116 (100%)	4.1	
Kenya	9 (4.2%)	21 (9.9%)	61 (28.8%)	47 (22.2%)	74 (34.9%)	212 (100%)	3.7	
DRC	22 (8.7%)	33 (13.1%)	52 (20.6%)	60 (23.8%)	85 (33.7%)	252 (100%)	3.6	

Form Table 6.14, the mean values from the participants' responses ranges from 3.6 to 4.3, indicating that most participants are potential users of mobile apps. Nigeria has the highest mean value of 4.3 and the DRC has the lowest mean value of 3.6. This implies that Nigeria is the country where the highest number of participants agrees that they use mobile apps, followed by South Africa, Morocco, and Kenya, whereas the DRC is the country with lowest number of participants that agree that they use mobile apps.

6.4.3.2 *Ways of using mobile apps*

There is a rapid increase in the adoption and diffusion of mobile apps in Africa. As a result, there is a need to understand the reason for such tremendous growth in the adoption and diffusion of mobile apps services.

The descriptive statistics show that mobile apps are used for many activities, including social networking, texting messages, entertainment, eduaction, health care, commerce, government and agricultural activities. Factor analysis was performed on these uses. The finding indicated that there were two distinct factors underlying the ways of using mobile apps in Africa. The primary aim of mobile apps adoption and diffusion in Africa is for business use and individual use. These factors were adequately internally consistent.

Concerning business use, mobile apps are used to deliver commercial, agricultural, health care and government services. This finding agreed with the reports of (Qiang *et al.*, 2011, Murugesan, 2013, Juma, 2011, Hellström, 2012, Ghobakhloo *et al.*, 2011, Etzo & Collender, 2010, Aker & Mbiti, 2010).

Regarding individual use, mobile apps are adopted and used for the purpose of improving personal relations and activities, such as social networking, texting messages, learning and playing music and watching movies. This finding agreed with the reports of (Lenhart *et al.*, 2015, Asiodu *et al.*, 2015, Lee, 2015, Tracey *et al.*, 2015, Mtebe, 2015, Sobaih *et al.*, 2016).

6.4.3.3 *Reasons for Discontinuance*

Discontinuance means to stop using a mobile app after adopting it. In this section, the results obtained from the four possible reasons for discontinuance are presented. These reasons include: 1) There is a more enhanced mobile app replacing the existing one, 2) Its performance was not satisfactory, 3) It lacked support and 4) It was not easy to use. The results are described in Tables 6.15-18.

Table 6.15: There is a more enhanced mobile app replacing the existing one

Country	Scale rating					Total	Mean	Ave of mean
	Strongly disagree				Strongly agree			
	1	2	3	4	5			
Morocco	2 (1.7%)	11 (9.5%)	34 (29.3%)	46 (39.7%)	23 (19.8%)	116 (100%)	3.7	3.5
South Africa	27 (8.1%)	32 (9.6%)	95 (28.4%)	101 (30.1%)	80 (23.9%)	335 (100%)	3.5	
Kenya	14 (6.6%)	35 (16.5%)	53 (25.0%)	57 (26.9%)	53 (25.0%)	212 (100%)	3.5	
Nigeria	36 (9.7%)	51 (13.8%)	100 (27.0%)	86 (23.2%)	97 (26.2%)	370 (100%)	3.4	
DRC	15 (6.0%)	46 (18.3%)	75 (29.8%)	59 (23.4%)	57 (22.6%)	252 (100%)	3.4	

It is observed from Table 6.15 that the mean values are between 3.4 to 3.5, indicating that the participants agreed that they would discontinue the use of a mobile app if there is a more enhanced one. This implies that most mobile apps adopters in African may stop using particular mobile apps whenever a better one is developed. This is possible because there is a rapid growth in the advancement of mobile technology (Chen & Zhao, 2014, Asongu & Nwachukwu, 2016). That is probably why there is a constant upgrade of mobile apps in order to incorporate new features to avoid discontinuance. The developers of mobile apps should constantly keep track of the changes in technology and users' requirements in order to keep their product active in the software market. Morocco has the highest mean value, followed by South Africa and Kenya, whereas Nigeria and the DRC have the lowest mean values. This suggests that this factor has more impact in Morocco, South Africa and Kenya than in Nigeria and the DRC.

Table 6.16: Unsatisfactory performance

Country	**Scale rating**					**Total**	**Mean**	**Ave of mean**
	Strongly disagree				**Strongly agree**			
	1	**2**	**3**	**4**	**5**			
Morocco	1 (0.9%)	11 (9.5%)	31 (26.7%)	46 (39.8%)	27 (23.3%)	116 (100%)	3.8	3.5
Kenya	14 (6.6%)	28 (13.2%)	58 (27.4%)	47 (22.2%)	65 (30.7%)	212 (100%)	3.6	
South Africa	27 (8.1%)	24 (7.2%)	117 (34.9%)	92 (27.5 %)	75 (22.4%)	335 (100%)	3.5	
Nigeria	32 (8.6%)	48 (13.0%)	107 (28.9%)	97 (26.6%)	86 (23.2)	370 (100%)	3.4	
DRC	25 (9.9%)	40 (15.9%)	58 (23.0%)	67 (26.6%)	62 (24.6%)	252 (100%)	3.4	

The mean values of the participants' responses which vary from 3.4 to 3.8 show that unsatisfactory performance is a possible cause of discontinuance. It is expected that every mobile app meets the needs of its adopters with respect to the purpose of its development. Functionality is a predicting factor of mobile app development and to maintain the adoption and diffusion of a mobile app, developers should ensure that it performs well to satisfy the adopters. Morocco is the country with highest mean value, followed by Kenya and South Africa. Nigeria and the DRC have the lowest mean values. This indicates that unsatisfactory performance has more impact in Morocco than in the other countires and has the lowest impact in the DRC.

Table 6.17: Lack of support

Country	**Scale rating**					**Total**	**Mean**	**Ave of mean**
	Strongly disagree				**Strongly agree**			
	1	**2**	**3**	**4**	**5**			
DRC	17 (6.7%)	53 (21.0%)	50 (9.8%)	80 (31.7%)	52 (20.6%)	252 (100%)	3.4	3.2
Nigeria	40 (10.8%)	70 (18.9%)	89 (24.1%)	79 (21.4%)	92 (24.9%)	370 (100%)	3.3	
South Africa	40 (12.0%)	63 (18.9%)	81 (24.3%)	90 (26.9%)	60 (18.0%)	334 (100%)	3.2	
Morocco	8 (6.9%)	20 (17.2%)	45 (38.8%)	28 (24.1%)	15 (12.9%)	116 (100%)	3.2	
Kenya	33 (15.6%)	38 (17.9%)	63 (29.7%)	38 (17.9%)	40 (18.9%)	212 (100%)	3.1	

The mean values are between 3.1 and 3.4, indicating that most of the participants agree that a lack of support can make them stop the adoption and use of a mobile app. This is possibly because the provision of network coverage, mobile technology infrastructure and technical support from the stakeholders offer a substantial positive effect towards the adoption and diffusion of mobile apps in Africa (Mtebe & Raisamo, 2014, Joshua & Koshy, 2011). This factor has more impact in the DRC, followed by Nigeria and South Africa with less effect in Morocco and Kenya.

Table 6.18: Mobile apps are not easy to use

Country	Scale rating					Total	Mean	Ave of mean
	Strongly disagree				Strongly agree			
	1	2	3	4	5			
Nigeria	62 (16.8%)	57 (15.4%)	68 (18.4%)	84 (22.7%)	99 (26.8%)	370 (100%)	3.9	3.7
Kenya	43 (20.3%)	27 (12.7%)	61 (28.8%)	48 (22.6%)	33 (15.6%)	212 (100%)	3.8	
South Africa	42 (12.5%)	50 (14.9%)	73 (21.8%)	78 (23.3%)	92 (27.5%)	335 (100%)	3.7	
Morocco	10 (8.6%)	27 (23.3%)	26 (22.4%)	37 (31.9%)	16 (13.8%)	116 (100%)	3.7	
DRC	16 (6.3%)	56 (22.2%)	63 25.0%)	66 (26.2%)	51 (20.2%)	252 (100%)	3.2	

This measures the extent to which an individual can use a mobile app with reduced or no complexity. The mean values range from 3.2 to 3, indicating that the participants agreed that non-ease of use can cause discontinuance. Ease of use increases and encourages mobile apps adopters to continue using a particular mobile app, else they will discontinue the use of that mobile app. Ease of use has a significant influence on mobile apps adoption and diffusion in Africa (Mndzebele, 2013, Brown & Molla, 2015). It suggests that mobile apps should be designed and developed in a simple and easy form to enable the adopters to adopt and use them with less or no difficulty. Nigeria has the highest mean value of 3.9 and the DRC has the lowest mean value. This implies that ease of use has greater impact in Nigeria, followed by Kenya, South Africa and Morocco. Participants from the DRC report the lowest impact of this factor.

The reasons for the dicontinuance of the use of mobile apps in Africa are: not easy to use, there was a more enhanced one replacing the existing one, unsatisfactory performance, and lack of support. Difficulty of use is the highest cause of discontinuance with an average mean value of 3.7, followed by a more enhanced one replacing the existing one and unsatisfactory perfomance with an average mean value of 3.5, whereas lack of support is the lowest cause reported with an average mean value of 3.2.

6.5 Adopting unit

The adopting unit involves the individual adopting characteristics, including personality variables, socio-economic circumstances and communication behaviour. The results obtained from the investigation of the adopting unit regarding the selected countries are discussed below.

6.5.1 Personality variables

These variables include age, education, attitude, anxiety and self-efficacy. Age and education were discussed in section 6.5.2.2. Self-efficacy will be discussed under the predicting factors.

6.5.1.1 *Attitudes of the adopters towards the adoption and diffusion of mobile apps*

This research tested the attitudes of the participants towards the adoption and diffusion of mobile apps from three perspectives, namely positive, negative and indifferent. The obtained results are described as shown in Table 6.19.

Table 6.19: Attitudes of the adopters towards the adoption and diffusion of mobile apps

Country	Positive	Negative	Indifferent	Total
South Africa	221 (66.0%)	31 (9.2%)	83 (24.8%)	335 (100%)
Nigeria	201 (54.3%)	81 (21.9%)	88 (23.8%)	370 (100%)
Morocco	57 (49.1%)	35 (30.2%)	24 (20.7%)	116 (100%)
Kenya	153 (72.2%)	41 (19.3%)	18 (8.5%)	212 (100%)
DRC	191 (75.8%)	50 (19.8%)	11 (4.4%)	252 (100%)

Positive attitudes: In South Africa, 66.0%, in Nigeria, 54.3%, in Morocco, 49.1%, In Kenya, 72.2% and in the DRC, 75.8% of the participants feel positive whenever they hear about new mobile apps. This implies that they are willing and ready to adopt and use new mobile apps whenever they receive them.

Negative attitudes: In South Africa, 8.7%, in Nigeria, 21.9%, in Morocco, 30.2%, in Kenya, 19.3%, and in the DRC, 19.8% have a negative perception towards new mobile apps. This suggests that this portion of the participants is not keen about adopting and using new mobile apps.

Indifferent attitudes: In South Africa, 24.8%, in Nigeria, 23.8%, in Morocco, 20.7%, in Kenya, 8.5%, and in the DRC, 4.4% of the participants have indifferent perceptions of new mobile apps; that is, they are neither interested nor uninterested in the adoption and diffusion of new mobile apps.

The findings, therefore, indicate that most Africans are perceiving the mobile apps innovations as innovations that are bringing positive changes to Africa and its social system. This may contribute to the rapid penetration of mobile app services in Africa.

Table 6.20: Feeling of the participants' on mobile apps as good innovations

Country	Scale rating					Total	Mean
	Strongly disagree				Strongly agree		
	1	2	3	4	5		
South Africa	6 (1.8%)	11 (3.3%)	76(2.7%)	83 (24.8%)	159 (47.5%)	335 (100%)	4.1
Nigeria	7 (1.9%)	22 (5.9%)	53 (14.3%)	139 (37.6%)	149 (40.3%)	370 (100%)	4.1
Morocco	1 (0.9%)	20 (17.2%)	28 (24.1%)	37 (31.9%)	30 (25.9%	116 (100%)	3.7
Kenya	8 (3.8%)	33 (15.6%)	80 (37.7%)	59 (27.8%)	32 (15.1%)	212 (100%)	2.4
DRC	25 (9.9%)	50 (19.8%)	67 (26.6%)	70 (27.8%)	40 (15.9%)	252 (100%)	3.2

From table 6.20, the mean values range from 2.4 to 4.1 indicating that the participants feel that mobile apps are good innovations. In other words, the participants have a positive perception on mobile apps and positive perception of an innovation (mobile apps) increases the adopters' attitudes towards the adoption of mobile apps (Okonkwo et al, 2018). The paticipants from South Africa and Nigeria have the highest feelings of mobile apps as a good innovations followed by Morocco and DRC. The participants from Kenya have the lowest feeling regarding mobile apps as good innovations.

6.5.1.2 *Anxiety*

This study also investigated the degree of nervousness in an individual whenever he/she hears about new mobile apps. The results obtained are illustrated in Table 6.21.

Table 6.21: Anxiety or degree of nervousness

Country	**Scale rating**					**Total**	**mean**
	Not nervous at all				**Very nervous**		
	1	**2**	**3**	**4**	**5**		
South Africa	102 (30.4%)	73 (21.8%)	101 (30.1%)	23 (6.9%)	36 (10.7%)	335 (100%)	2.5
Nigeria	91 (24.6%)	66 (17.8%)	81 (21.9%)	61 (16.5%)	71 (19.2%)	370 (100%)	2.8
Morocco	33 (28.4%)	25 (21.6%)	28 (24.1%)	9 (7.9%)	21 (18.1%)	116 (100%)	2.7
Kenya	62 (29.2%)	34 (16.0%)	55 (25.9%)	27 (12.7%)	34 (16.0%)	212 (100%)	2.7
DRC	31 (24.8%)	48 (19.0%)	61 (24.2%)	35 (13.9%)	77 (30.5%)	252 (100%)	3.3

Table 6.21 shows the results obtained for the degree of nervousness. The mean values vary between 2.7 and 3.3. Less than 3.0 indicates not nervous and more than 3.0 shows that the participants are nervous. The DRC has the highest mean value of 3.3, which means that individuals in the DRC tend to be nervous whenever they hear about or encounter new mobile apps. Nigeria, Morocco, Kenya and South Africa have mean values of less than 3.0, indicating that the individuals in those countries are not nervous whenever they hear about or encounter new mobile apps. In general, it can be assumed that most Africans are not nervous in adopting and using new mobile apps.

6.5.2 Socio-economic characteristics

these characteristics involve the employment status and the contributions of mobile apps in Africa. The employment status was discussed in section 6.5.2.2. The results obtained from the investigation on the contribution of mobile apps to the development in Africa are discussed below.

6.5.2.1 *The contribution of mobile apps to the development in Africa*

The contribution of mobile apps to the development in Africa is categorised into seven broad areas, namely economic, social, agricultural, banking, education, health care, and political categories (Section 2.8). In order to obtain adequate and reliable data, 20 simplified questions (items) were used to describe the seven areas for easy understanding by the participants. The descriptive statistic indicated satisfactory mean values for these items. The Pearson Chi-Square and Cramer's V values indicate strong relationships among the variables but there is no significant variation on the obtained data from different countries. In this regard, a general discussion of the results obtained from the factor analysis performed on the measuring items is presented.

Overall, the findings suggested six ways that the adoption and diffusion of mobile apps affect the development in Africa. These ways were adequately internally consistent. They are contributions to:

***The Health care syst*em** - The use of mobile apps in the health care system has improved and changed the form of health care delivery services. Generally, Africa faces big challenges in offering good health care services to its people. The use of mobile health (m-health) services is addressing these issues. With m-health apps, individuals can get health care information that could address their health problems, such as information about hospital locations, qualified doctors, routine medication reminder messages, including personal home-care services. Point of care testing and serious games that address health issues are also facilitated by mobile apps. This finding is consistent with the finding of (Murugesan, 2013, Kearney, 2011).

Education and social activities – Mobile apps are used to administer educational services, such as e-learning and access to digital books and the library. Teaching tools that enable self-tutoring of different subjects, such as mathematics, physics, etc. are good contributions to the improvement of education in Africa. WhatsApp and Facebook apps have improved communication and other social activities in Africa. This finding compares well with the findings of (Kearney, 2011, Hellström & Tröften, 2010, GSMA, 2015b).

Economic contribution –The adoption and diffusion of mobile apps in Africa improves productivity. People can perform their tasks wherever they are, in the office, on the road and even at home. Through the use of mobile apps, doctors can render out-of-office services to their patients, and chief executives can pass instructions to workers while they are away and technicians can render support services by phone. There is a direct correlation between mobile diffusion and GDP, resulting in a contribution to the African countries' GDP. The mobile technology sector is among the top providers of jobs in Africa. With regard to research conducted on the African context, this result agreed with the findings of (Kearney, 2011, Murugesan, 2013).

Politics – The adoption and diffusion of mobile apps in Africa have improved dissemination of information, transparency, and lowering barriers to sharing stories in the political sector. M-government apps facilitate good governance and reduced corruption in Africa. The application of mobile governance enables citizens to access government communications and promotes the rule of law from a decentralised perspective. This finding supports the findings of (Murugesan, 2013, Hellström, 2011, Poblet, 2011).

Financial services - Mobile banking has revolutionised banking operations. Individuals can sit in the comfort of their homes and manage their banking transactions. Money transfer is made easy through the use of mobile apps services. The use of m-commerce has improved shopping activities and reduced the cost and stress of going to shops for commercial activities. This is consistent with the findings of (Murugesan, 2013, Mbiti & Weil, 2011, Hellström, 2011).

Agriculture – Mobile apps facilitate improved service to farmers. The use of mobile services in agriculture improves dissemination of agricultural information, knowledge and use of new technology, improved productivity and reduced poverty. This finding agreed with the findings of (Murugesan, 2013, Kearney, 2011, Hellström & Tröften, 2010).

6.5.2.2 *The predicting factors of mobile apps adoption and diffusion in Africa*

Predicting factors are the significant elements to be considered for successful adoption and diffusion of mobile apps in Africa. The identified factors from the literature were described using 25 simplifiied questions for easy understanding by the participants. The mean values obtained from the descriptive statistics on these items are all above 3.0, indicating that these items represented a good description of the factors. The Pearson Chi-Square and Cramer's V values indicate strong relationships among the variables, but there is no significant variation on the obtained data from the different countries. In this regard, a general discussion of the results obtained from the factor analysis performed on the measuring items is presented.

Overall, the finding indicated seven predicting factors underlying the adoption and diffusion of mobile apps in Africa, namely percieved technology reliability, self-efficacy, relative advantage, social influence, facilitating conditions, financial cost and culture. These factors were adequately internally consistent. These findings agreed with the following previous studies conducted on the African context.

Perceived technology reliability – Studies conducted in Kenya by Oluoch *et al.* (2012), Achieng & Ingari (2015), as well as in Ghana by Cudjoe *et al.* (2015) established that perceived technology reliability influences the adoption and diffusion of mobile banking services.

Self-efficacy – Studies conducted in Tanzania by Mtega *et al.* (2012) and in Ghana by Iddris (2013) suggested that self-efficacy is a predicting factor of e-learning and mobile banking adoption and diffusion respectively.

Relative advantage – Studies performed in Nigeria by Bankole *et al.* (2011), in Tunisia by Nasri & Charfeddine (2012) and in South Africa by Dagada (2012), Brown & Molla (2015) suggested that user perception is a significant factor in the adoption and diffusion of mobile banking.

Social influence – A study conducted in Ghana by Cudjoe *et al.* (2015) concluded that social influence is a predicting factor in mobile banking adoption.

Facilitating conditions - Mtebe & Raisamo (2014) noted in their report on the research conducted in Kenya on the adoption of mobile learning that facilitating conditions is a significant factor.

Financial cost – Studies conducted in Ghana, Kenya and South Africa agreed that financial cost is a predicting factor in mobile apps adoption and diffusion in Afrca (Iddris, 2013, Brown & Molla, 2015, Achieng & Ingari, 2015).

Culture – Studies conducted in Nigeria and South Africa concluded that culture is a determining factor in mobile apps adoption and diffusion (Lekhanya, 2013, Bankole *et al.*, 2011).

6.5.3 Communication behaviour

Communication behaviour involves the individual intention or motives of using and sharing the information about an innovation. This study investigated two main purpsoses of sharing the information about mobile apps, namely 1) to facilitate my work activities and 2) to enable easy communication. The results obtained are indicated below in Tables 6.22-23.

Table 6.22: To facilitate activities

Country	Scale rating					Total	Mean
	Strongly disagree				Strongly agree		
	1	2	3	4	5		
South Africa	12 (3.6%)	49 (14.6%)	84 (25.1%)	78 (23.3%)	112 (33.4%)	335 (100%)	3.7
Nigeria	43 (11.6%)	31 (8.4%)	66 (17.8%)	86 (23.2%)	144 (38.9%)	370 (100%)	3.7
Morocco	6 (5.2%)	20 (17.2%)	36 (31.0%)	35 (30.2%)	19 (16.4%)	116 (100%)	3.4
Kenya	13 (6.1%)	36 (17.0%)	59 (27.8%)	61 (28.8%)	43 (20.3%)	212 (100%)	3.4
DRC	20 (7.9%)	37 (14.7%)	71 (28.2%)	70 (27.8%)	54 (21.4%)	252 (100%)	3.4

Form Table 6.22, the results show that the information about mobile apps is shared to facilitate one's activities. The mean values obtained from the participnts' responses from the different countries used for this research ranges from 3.4 to 3.7, indicating that participants agreed to this purpose. South Africa and Nigeria have the highest mean values of 3.7, whereas Morocco, Kenya and the DRC have the lowest mean values of 3.4. The results imply that in South Africa and Nigeria, the information about mobile apps is shared to facilitate work activities more than in Morocco, Kenya and the DRC. It can be concluded that a large number of individuals in Africa shares information about mobile apps for the purpose of enabling their work activities.

Table 6.23: To enable easy communications

Country	**Scale rating**					**Total**	**Mean**
	Strongly disagree				**Strongly agree**		
	1	**2**	**3**	**4**	**5**		
South Africa	15 (4.5%)	24 (7.2%)	58 (17.3%)	53 (15.8%)	185 (55.2%)	335 (100%)	4.1
Nigeria	16 (4.3%)	22 (5.9%)	47 (12.7%)	105 (28.4%)	180 (48.6%)	370 (100%)	4.1
Morocco	3(2.6%)	20 (17.2%)	30 (25.9%)	37 (31.9%)	26 (22.4%)	116 (100%)	3.5
Kenya	4(1.9%)	29 (13.7%)	45 (21.2%)	54 (25.5%)	80 (37.7%)	212 (100%)	3.8
DRC	15 (6.0%)	37 (14.7%)	79 (31.3%)	62 (24.6%)	59 (23.4%)	252 (100%)	3.4

From Table 6.23, the results show that the participants agreed regarding sharing information about mobile apps is to enable easy communication. The obtained mean values range from 3.4 to 4.1, indicating strong agreement. South Africa and Nigeria have the highest mean values of 4.1, and the DRC has the lowest mean value of 3.4. This indicates that the participants from South Africa and Nigeria strongly agree on the fact that the information about mobile apps is shared for the purpose of enabling easy communication, followed by Kenya and Morocco. In the DRC, there is less agreement.

Overall, two main purposes of sharing information about mobile apps were identified, namely 1) to facilitate work activities, and 2) to enable easy communication. The option 'to facilitate work activities' shows that information about mobile apps is shared in order to improve services. Services can either be personal or organisational services. Concerning personal services, for instance, an individual could share information about the existence of the Instagram mobile app with a friend or family member when he/she wants to transfer photos to that person. Regarding organisational services, banks are sharing the information about their mobile banking apps and other services related to mobile apps, such as FNB eWallet with their clients to improve their services. Others are DSTV and IROKO TV mobile app services. 'To enable easy communication' shows that information about mobile apps is shared in order to improve interaction. Interaction can be personal or business interactions. Personal interaction involves letting a friend know about mobile apps that will enhance communication between two or more individuals, such as WhatsApp, Facebook messenger, etc., whereas business interaction involves communication with clients through mobile apps, such as e-mail, websites, etc.

6.6 Summary

The results of the statistical analyses performed on the quantitative data collected from the participants were interpreted with respect to the selected countries used for this study. In this chapter, the results in relation to objectives 2 and 3 of this study were discussed. The discussion explained the adoption and diffusion of mobile apps in the selected countires, covering the profiles of the participants, mobile app innovations in the selected countries, the innovation-decision process and the adopting unit. The results and findings regarding each country were discussed separately. The contribution of mobile app services to the development in Africa was discussed, as well as the predicting factors of mobile apps adoption and diffusion in Africa.. in the next chapter, the comparative analysis of the adoption and diffusion of mobile apps in the selected countries will be discussed.

Chapter **7**

Comparative analysis of the adoption and diffusion of mobile apps in the selected countries

7.1 Introduction

In the previous chapter, the adoption and diffusion of mobile apps in each of the selected countries were discussed, together with the effect of mobile apps adoption on African development. With descriptive statistic and factor analysis, some underlying factors of various aspects of mobile apps adoption and diffusion in Africa were discovered.

Objective 4 of this study required a comparison of the adoption and diffusion of mobile apps in the selected countries. Considering the research conceptual model, the adoption and diffusion of mobile apps in the respective selected countries discussed in Chapter 6 are compared with regard to the research variables presented in the model. In a similar order of discussion as in Chapter 6, the comparative analysis is presented, namely:

- ✓ Mobile app innovation
- ✓ Innovation-decision process
- ✓ Adopting unit

7.2 Participants' profiles

Participants' profiles involve gender, age group, education level, employment and religion. The results obtained from the five countries used for this study were comparatively examined and discussed in Table 7.1.

Table 7.1: ANOVA and Robust test results - Participants' profiles

Country	South Africa	Nigeria	Morocco	Kenya	DRC
Gender	Male (55.5%)	Male (55.4%)	Male (59.5%)	Male (50.4%)	Female (54.4%)
Age group	20 - 40 (55.2%)	20 - 40 (63.0%)	20 - 40 (53.4%)	20 - 40 (71.2%)	20 - 40 (62.3%)
Education level	Matric (44.5%)	University (34.3%)	University (36.2%)	University (52.4%)	Diploma (31.0%)
Employment	Students (43.3%)	Employed (59.2%)	Employed (54.3%)	Employed (51.4%)	Employed (41.7%)
Religion	Christian (87.8%)	Christian (65.4%)	Muslim (93.1%)	Christian (88.7%)	Christian (86.1%)

Table 7.1 shows the profiles of the participants involved in this study with respect to the five selected countries.

Gender – In South Africa, Nigeria, Morocco and Kenya, most of the participants are male, whereas more females participated in the DRC.

Age group – In all the countries, the most represented age group is 20-40 years, thus there is no significant difference in age group among the countries.

Education level – A greater number of participants from South Africa possesses matric/secondary education, whereas in Nigeria, Morocco and Kenya, a larger portion of the participants has obtained a university education. In the DRC, most of the participants are diploma holders.

Employment – In South Africa, a larger percentage of the participants is students, whereas in the other four countries, most of the participants are employed.

Religion – The participants from South Africa, Nigeria, Kenya and the DRC are mostly Christians, whereas in Morocco, a larger percentage of the participants is Muslims.

7.3 Analysis of variances (ANOVA) and Robust tests

The five countries used in this research study have very similar profiles, which supports the validity of the comparative analysis. For the purpose of comparison, some analyses were performed on the obtained factors (patterns), including ANOVA, a test of homogeneity of variances and a robust test. According to Creech (2003), ANOVA is a statistical analysis used to compare the mean of dependent variables. It can be used to compare up to three or more groups of variables. ANOVA was performed to determine the effect size, if there is any difference or similarity in the adoption and diffusion of mobile apps between the countries regarding their perceptions on the relevance of each of the obtained factors. Effect sizes indicate practical significance, that is, the extent to which a difference is large enough to have an effect in practice (Steyn, 2012, Ellis & Steyn, 2003). The mean comparison was done according to Cohen's effect sizes and the guidelines for effect size (d values) are as follows (Cohen, 1988): d = 0.2 (small effect); d = 0.5 (medium effect) and d ≥ 0.8 (large effect or practical significant). The homogeneity test indicted no variances among the variables, thus robust tests were performed. In the order of the research model, the results of ANOVA and the robust test are presented in Tables 7.2-7.10 for comparative analysis.

7.3.1 Mobile apps in Africa

Further analysis, including ANOVA and robust tests were performed on the collected data regarding the influencing features of mobile apps. The results obtained from the different countries are depicted in Table 7.2 and subsequently compared.

Table 7.2: ANOVA and robust test results - Influencing features of mobile apps

Items (Research variables)	Country	No. of participants	Mean	Std. dev.	p-value (ANOVA)	Robust test		Effect sizes			
						P-value (Welch)	P-value (Brown Forsythe)	1	2	3	4
Relative advantage	South Africa	335	4.0	1.1							
	Nigeria	370	3.7	1.2				0.3			
	Morocco	112	3.4	1.2	0.000	0.000	0.000	0.6	0.3		
	Kenya	212	3.7	1.1				0.3	0.0	0.3	
	DRC	252	3.5	1.2				0.4	0.2	0.1	0.2
Complexity	South Africa	335	4.0	1.0							
	Nigeria	370	3.9	1.0				0.1			
	Morocco	112	3.7	1.0	0.000	0.000	0.000	0.2	0.2		
	Kenya	212	3.8	1.1				0.2	0.1	0.1	
	DRC	252	3.4	1.1				0.5	0.4	0.3	0.3
Compatibility	South Africa	335	3.8	1.1							
	Nigeria	370	3.8	1.1				0.0			
	Morocco	112	3.6	1.1	0.000	0.000	0.000	0.2	0.2		
	Kenya	212	3.8	1.2				0.1	0.0	0.2	
	DRC	252	3.4	1.3				0.3	0.3	0.2	0.3
Observability	South Africa	335	3.6	1.4							
	Nigeria	370	3.7	1.3				0.1			
	Morocco	112	3.5	1.3	0.000	0.000	0.000	0.1	0.2		
	Kenya	212	3.1	1.4				0.3	0.4	0.3	
	DRC	252	3.4	1.2				0.1	0.3	0.1	0.2
Trialability	South Africa	335	335	1.0							
	Nigeria	370	370	1.1				0.1			
	Morocco	112	112	1.2	0.000	0.000	0.000	0.3	0.3		
	Kenya	212	212	1.3				0.4	0.3	0.2	
	DRC	252	252	1.3				0.4	0.3	0.1	0.0

Relative advantage – p = 0.000 indicated statistical significance. There is a medium effect in the statistical difference between South Africa and Morocco. Among the other countries, including Nigeria, Kenya and the DRC, a small effect difference was noticed. Generally, relative advantage is perceived to be a significant feature of mobile apps with minimal effect differences among the countries. This means that the relative advantage of a mobile app has a bigger impact on the adoption thereof in South Africa than in the other countries.

Complexity – p = 0.000 indicated statistical significance. There is a medium effect difference between South Africa and the DRC. Among the other countries, including Nigeria, Kenya and the DRC, a small effect difference exists. It suggests that the participants from all the countries perceived complexity to be an important feature of mobile apps. Participants from South Africa have greater perceptions of this feature regarding the adoption and diffusion of mobile apps. In other words, the effect of complexity in the adoption and diffusion of mobile apps is higher in South Africa, followed by Nigeria, Kenya and Morocco. The effect of complexity is less noticed in the DRC.

Compatibility – p = 0.000 indicated statistical significance. Comparing South Africa, Nigeria and Kenya with Morocco and the DRC, a small significance effect was observed. There is no significant difference between South Africa, Nigeria and Kenya. This indicates that all these countries hold this feature high as an important feature of mobile apps. South Africa, Nigeria and Kenya have the highest perceptions of this feature as an important feature of mobile apps, followed by Morocco and the DRC, having the lowest perception of the compatibility feature of mobile apps.

Observability – p = 0.000 indicated statistical significance. A small significant effect difference was observed among all the countries. This implies that all these countries perceived observability to be an important feature of mobile apps. Nigeria has the highest perception, followed by South Africa, Morocco and the DRC, whereas Kenya has the lowest perception of this feature.

Trialability – p = 0.000 indicated statistical significance. Comparing South Africa and Nigeria with the other countries, a small significant difference exists. There is no significant difference between Nigeria and South Africa. Generally, all these countries perceived trialability to be an important feature of mobile apps. The participants from South Africa have the highest perceptions, followed by Nigeria, Morocco and the DRC, whereas participants from Kenya have the lowest perception of this feature.

Overall, there is no practically significant difference in the perceptions of these countries regarding the features of mobile apps. It was observed that the participants from South

Africa have the highest perceptions of these features, except observability, more so than the other countries. Nigeria followed with a lead in observability and then come Kenya and Morocco. The DRC occupies the last position in relation to the perceptions of the mobile app features.

7.3.2 Innovation-decision process

This process includes knowledge-awareness, decision making and diffusion. The perceptions of the participants from the five selected countries were further analysed. The obtained results are discussed and subsequently compared.

7.3.2.1 Knowledge-awareness

Knowledge-awareness covers the information sources, learning methods and information sharing. The results of further analyses performed on these aspects of knowledge-awareness are shown in Tables 7.4-7.6.

Table 7.4: ANOVA and robust test results - Information sources

Items (Research variables)	Country	No. of participants	Mean	Std. dev.	p-value (ANOVA)	Robust test		Effect sizes			
						P-value (Welch)	P-value (Brown Forsythe)	1	2	3	4
External initiated actions	South Africa	335	3.1	1.0	0.000	0.000	0.000				
	Nigeria	370	3.6	0.9				0.5			
	Morocco	112	3.0	0.9				0.1	0.6		
	Kenya	212	2.9	1.1				0.2	0.6	0.1	
	DRC	252	3.2	0.7				0.1	0.4	0.3	0.3
Personal initiated actions	South Africa	335	3.7	1.1	0.000	0.000	0.000				
	Nigeria	370	3.8	1.0				0.0			
	Morocco	112	3.8	0.8				0.1	0.2		
	Kenya	212	3.6	0.9				0.2	0.2	0.3	
	DRC	252	3.2	0.9				0.5	0.5	0.7	0.4

External initiated actions – p = 0.000 showed statistical significance. There was a medium significant difference between South Africa and Nigeria and small significant difference between South Africa and the three other countries. Comparing Nigeria with Morocco, Kenya and the DRC, a medium significant effect exists. A small significant effect exists between Morocco and the DRC, as well as between Kenya and the DRC. It implies that Nigerians acquire information about mobile apps from external sources, such as mass media, organisations and conferences more than South Africans and participants from the other countries. This means that the use of external sources for acquisition of information about mobile apps has a highest positive effect in Nigeria followed by South Africa, Kenya and Morocco, whereas in the DRC it has the lowest positive effect.

Personal initiated actions – p = 0.000 indicated statistical significance. Comparing South Africa, Nigeria and Morocco with the DRC, a medium significant difference was observed. Between Nigeria and Kenya, Morocco and Kenya, as well as between Kenya and the DRC, there was a small effect difference. It suggests that there is more individual involvement in the acquisition of information about the existence of mobile apps in Morocco, Nigeria and South Africa than in Kenya and the DRC. In other words, the use of internet surfing and interpersonal communication to acquire information about mobile apps has a more positive effect in Morocco followed by Nigeria, South Africa and Kenya. The DRC showed the least effect of personal initiated actions.

There is no practically significant difference between the selected countries concerning the sources of information about mobile apps. It suggests that the ways of obtaining information about the existence of mobile apps are similar among the countries. The use of external sources to obtain information about mobile apps is higher in Nigeria, followed by South Africa, Kenya, Morocco and the DRC. Personal initiated actions are more effectively used in Morocco to acquire information about mobile apps than in the other countries, followed by Nigeria, South Africa, Kenya and the DRC.

Table 7.5: ANOVA and robust test results - Information sharing

Items (Research variables)	**Country**	**No. of participants**	**Mean**	**Std. dev.**	**p-value (ANOVA)**	**Robust test**		**Effect sizes**			
						P-value (Welch)	**P-value (Brown Forsythe)**	**1**	**2**	**3**	**4**
Organisations and events	South Africa	335	3.3	1.0							
	Nigeria	370	3.4	0.9				0.4			
	Morocco	112	3.1	0.9	0.000	0.000	0.000	0.2	0.6		
	Kenya	212	3.2	1.2				0.1	0.4	0.1	
	DRC	252	3.3	0.9				0.0	0.5	0.2	0.0
Individual activities	South Africa	335	3.9	0.8							
	Nigeria	370	3.8	0.8				0.1			
	Morocco	112	3.9	0.7	0.000	0.000	0.000	0.0	0.1		
	Kenya	212	3.6	0.9				0.3	0.3	0.4	
	DRC	252	3.2	0.8				0.8	0.8	0.9	0.4

Organisations and events – p = 0.000 indicated statistical significance. A small significant difference was observed between South Africa and all the other countries. Comparing Nigeria with Morocco and the DRC, a medium effect exists. There is a small significant difference between Morocco and the DRC. This implies that the degree of the use of organisations and events to spread the information about mobile apps is higher in Nigeria than in South Africa. This feature is also higher in South Africa than in the three other countries, followed by Morocco. No significant difference exists between Kenya and the DRC.

Individual activities – p = 0.000 showed statistical significance. A practically significant difference exists between South Africa and the DRC, between Nigeria and the DRC, and between Morocco and the DRC. This is a small significant effect difference between Morocco and Kenya, as well as between Kenya and the DRC. Comparing South Africa and Nigeria with Kenya, a small significant effect exists. This means that obtaining information about mobile apps from individual activities, such as interpersonal interaction and internet surfing is higher in Morocco, South Africa and Nigeria compared to the DRC and Kenya. This method of sharing information about mobile apps is more effective or mostly used in Morocco, followed by South Africa, Nigeria and Kenya, whereas in the DRC it is least used.

There are two ways of sharing the information about mobile apps, namely through organisations and events, and individual activities. There is no practically significant difference in sharing the information about mobile apps through organisations and events, whereas through individual activities, a practically significant difference exists. Organisations and events are effective and mostly used in Nigeria, followed by South Africa, Morocco, then Kenya and the DRC. The use of individual activities to share information about mobile apps in Africa has the highest impact in Morocco, followed by South Africa, Nigeria, Kenya and the DRC.

7.3.2.2 Decision making

Decision making comprises adopter category and reasons for non-adoption. The different categories of adopters and the causes of rejecting mobile apps in each respective country are presented and compared. The results obtained from ANOVA and robust tests are shown in Tables 7.7-7.8.

Table 7.7: ANOVA and robust test results - Adopter's category

Items (Research variables)	Country	No. of participants	Mean	Std. dev.	p-value (ANOVA)	Robust test		Effect sizes			
						P-value (Welch)	**P-value (Brown Forsythe)**	**1**	**2**	**3**	**4**
Late majority and Laggards	South Africa	335	3.4	1.0							
	Nigeria	370	3.5	0.9				0.0			
	Morocco	112	3.2	0.8	0.000	0.000	0.000	0.2	0.3		
	Kenya	212	2.8	1.0				0.7	0.7	0.5	
	DRC	252	3.1	0.8				0.3	0.4	0.1	0.4
Non-adopters	South Africa	335	3.2	1.2							
	Nigeria	370	3.2	1.1				0.1			
	Morocco	112	3.5	0.8	0.000	0.000	0.000	0.2	0.3		
	Kenya	212	2.8	1.0				0.4	0.3	0.6	
	DRC	252	3.3	0.7				0.1	0.2	0.1	0.5
Innovators	South Africa	335	3.2	0.9							
	Nigeria	370	3.4	0.9				0.2			
	Morocco	112	3.1	0.9	0.002	0.003	0.003	0.0	0.2		
	Kenya	212	3.1	1.0				0.1	0.3	0.1	
	DRC	252	3.1	0.7				0.0	0.3	0.0	0.0
Early adopters	South Africa	335	3.5	1.0							
	Nigeria	370	3.5	0.8				0.0			
	Morocco	112	3.1	0.8	0.000	0.000	0.000	0.4	0.5		
	Kenya	212	3.2	0.9				0.4	0.3	0.1	
	DRC	252	3.1	0.8				0.4	0.4	0.1	0.0
Early majority	South Africa	335	3.7	0.9							
	Nigeria	370	3.4	0.9				0.3			
	Morocco	112	3.2	0.9	0.000	0.000	0.000	0.6	0.3		
	Kenya	212	3.1	0.9				0.7	0.4	0.1	
	DRC	252	3.2	0.7				0.6	0.3	0.0	0.1

Late majority and laggards – p = 0.000 indicated statistical significance. Comparing South Africa, Nigeria and Morocco with Kenya, a medium significance was observed. A small effect was observed between South Africa and Morocco, between Nigeria and Morocco, and between Kenya and the DRC. No significant difference was found between South Africa and Nigeria. This implies that most of the late majority and laggard adopters in Africa are from Kenya and the DRC. A small portion can be found in Morocco.

Non-adopters – p = 0.000 indicated statistical significance. A medium significant difference was observed between Morocco and Kenya, as well as between Kenya and the DRC. Likewise, a small effect was observed between South Africa and Kenya, as well as between Nigeria and Kenya. A small effect is also observed between Nigeria and Morocco. There is no effect difference between South Africa and Nigeria. Although there are some percentages of non-adopters in all the countries, the result suggests that most of the non-adopters of mobile apps in Africa are from the DRC, followed by Kenya and Morocco (small portion). South Africa and Nigeria have the smallest number of non-adopters of mobile apps.

Innovators – p = 0.000 indicated statistical significance. A small significant difference exists between South and Nigeria, as well as between Nigeria and three other countries. There is small significant effect between Nigeria and the other countries and no significant difference between South Africa, Morocco, Kenya and the DRC. It implies that Nigeria seems to be a little more innovative than the other countries.

Early adopters – p = 0.000 indicated statistical significance. A medium effect was observed between Nigeria and Morocco. Comparing Nigeria with Kenya and the DRC, a small effect was observed, as well as between South Africa and the other countries (Morocco, Kenya and the DRC). No significant difference between South Africa and Nigeria, as well as between Morocco, Kenya, and the DRC was observed. This suggests that the early adopters' category is more prevalent in Nigeria and South Africa than in the other three countries. In other words, Nigerians and South Africans adopt and use mobile apps easily and faster than the adopters in Morocco, Kenya and the DRC.

Early majority – p = 0.000 indicated statistical significance. A medium significant difference exists between South Africa and three countries (Morocco, Kenya and the DRC) and there is a small effect between South Africa and Nigeria. A small effect was observed between Nigeria and three other countries (Morocco, Kenya and the DRC). This implies that South Africa leads the early majority category of mobile apps in Africa, followed by Nigeria and the three other countries (Morocco, Kenya and the DRC).

There are five categories of mobile apps adopters in Africa, namely late majority and laggards, non-adopters, innovators, early adopters and early majority. Concerning the five countries, most of the late majority and laggards in Africa are from Kenya and the DRC. The DRC also possesses the highest number of non-adopters of mobile apps among the five compared countries in Africa followed by Kenya and Morocco, whereas South Africa and Nigeria have a small portion of the non-adopters of mobile apps in Africa. Nigeria has the larger percentage of innovators, followed by South Africa and the three other countries with no significant difference among them. Nigeria and South Africa lead the early adopters' category, followed by the other countries. Regarding the early majority category, South Africa has the highest number, followed by Nigeria, Morocco, Kenya and the DRC.

Table 7.8: ANOVA and robust test results – Reasons for non-adoption

Items (Research variables)	Country	No. of participants	Mean	Std. dev.	p-value (ANOVA)	Robust test		Effect sizes			
						P-value (Welch)	P-value (Brown Forsythe)	1	2	3	4
Time perspective	South Africa	335	3.6	1.2							
	Nigeria	370	3.3	1.4				0.2			
	Morocco	112	3.6	1.0	0.000	0.000	0.000	0.1	0.2		
	Kenya	212	2.7	1.3				0.7	0.5	0.7	
	DRC	252	3.3	1.2				0.3	0.0	0.3	0.4
Storage perspective	South Africa	335	3.6	1.1							
	Nigeria	370	3.4	1.3				0.2			
	Morocco	112	3.5	1.2	0.000	0.000	0.000	0.2	0.1		
	Kenya	212	3.0	1.3				0.5	0.3	0.4	
	DRC	252	3.3	1.1				0.3	0.1	0.2	0.2
Attention perspective	South Africa	335	3.3	1.2							
	Nigeria	370	3.4	1.4				0.1			
	Morocco	112	3.1	1.4	0.000	0.000	0.000	0.2	0.2		
	Kenya	212	2.9	1.4				0.3	0.4	0.2	
	DRC	252	3.4	1.2				0.1	0.0	0.2	0.4
Cost perspective	South Africa	335	3.8	1.3							
	Nigeria	370	3.4	1.3				0.3			
	Morocco	112	3.2	1.2	0.000	0.000	0.000	0.4	0.1		
	Kenya	212	2.6	1.3				0.9	0.6	0.4	
	DRC	252	3.3	1.3				0.4	0.1	0.0	0.5

Time perspective – p = 0.000 indicated statistical significance. Comparing South Africa, Morocco and Nigeria with Kenya, a medium significant difference exists. A small significant effect exists between South Africa and Nigeria, South Africa and the DRC, and Morocco and the DRC. There is a small significant difference between Kenya and the DRC and no significant effect difference between South Africa and Morocco. This implies that the time perspective when using mobile apps has more effect on South Africans and Moroccans in the rejection of mobile apps, followed by Nigeria and Kenya. The least effect is in the DRC.

Storage perspective – p = 0.000 indicated statistical significance. There is a medium significant effect difference between South Africa and Kenya and a small effect difference with the other countries. A small effect difference exists between Nigeria and Kenya, and between the DRC and Kenya. Comparing Morocco with Kenya and the DRC, a small effect difference was observed. It implies that the storage perspective when using mobile apps has more impact on South Africans and Moroccans in the rejection of mobile apps than on participants from the other countries. The highest impact is observed in South Africa, followed by Morocco, Nigeria and the DRC. In Kenya, the storage effect has the least effect on the rejection of mobile apps.

Attention perspective – p = 0.000 indicated a statistically significant difference. Comparing Nigeria, the DRC and South Africa with Morocco and Kenya, a small significant effect difference exists. There is no significance difference between Nigeria, South Africa and the DRC. It implies that the effect of this factor (distraction of attention) is more prominent in Nigeria and the DRC than in South Africa, Morocco and Kenya, where there is the least effect. Experiencing the use of mobile apps as distracting one's attention from other activities, has greater influence on the rejection of mobile apps in Nigeria and the DRC than in the other countries.

Cost perspective – $p = 0.000$ showed statistical significance. There is a practically significant effect in South Africa and a medium significant effect in the other countries. This indicates that the cost of the use of mobile apps has more practically significant influence in South Africa than in the other countries in the rejection of mobile apps, followed by Nigeria, Morocco and the DRC, whereas in Kenya, the cost perspective has the least impact regarding the rejection of mobile apps in Africa.

Overall, the four causes of rejection of mobile apps, namely that it is time-consuming, takes up too much phone memory, distracts one's attention from other activities and is expensive are compared. The time perspective has greater effect on South Africans and Moroccans in the rejection of mobile apps than on participants from the other countries. The storage perspective of mobile apps has the highest impact in South Africa, followed by Morocco, Nigeria and the DRC. In Kenya, the storage perspective has the least effect on the rejection of mobile apps. Nigerians and the Congolese have the highest number of rejections due to the fact that mobile apps distract their attention from other activities than participants from the other countries, whereas the cost of using mobile apps has a greater effect in South Africa regarding the rejection of mobile apps, followed by Nigeria, Morocco, the DRC and Kenya.

7.3.2.3 Diffusion

Diffusion involves the use of mobile apps, ways of using mobile apps and the purposes of discontinuing the use of mobile apps. The diffusion of mobile apps in the five selected countries was further examined to determine the similarities and variations in the diffusion of mobile apps among the countries. The results are presented and compared in Tables 7.9-7.11.

Table 7.9: ANOVA and robust test results - The use of mobile apps

Items (Research variables)	**Country**	**No. of participants**	**Mean**	**Std. dev.**	**p-value (ANOVA)**	**Robust test**		**Effect sizes**			
						P-value (Welch)	**P-value (Brown Forsythe)**	**1**	**2**	**3**	**4**
I use mobile apps	South Africa	335	4.1	1.0							
	Nigeria	370	4.3	1.0				0.2			
	Morocco	112	4.1	1.1	0.000	0.000	0.000	0.0	0.2		
	Kenya	212	3.7	1.2				0.3	0.5	0.3	
	DRC	252	3.6	1.3				0.4	0.5	0.4	0.1

I use mobile apps – p = 0.000 indicated a statistically significant difference between the groups. Nigeria has a medium significant difference compared with Kenya and the DRC, as well as a small effect difference compared with South Africa and Morocco. Comparing South Africa and Morocco with Kenya and the DRC, a small effect difference was observed. There is no significant difference between South Africa and Morocco, as well as between Kenya and the DRC. The observed difference indicates Nigeria has the highest users of mobile apps followed by South Africa and Morocco, whereas in Kenya, the use of mobile apps is a little higher than in the DRC.

Table 7.10: Ways of using mobile apps

Items (Research variables)	**Country**	**No. of participants**	**Mean**	**Std. dev.**	**p-value (ANOVA)**	**Robust test**		**Effect sizes**			
						P-value (Welch)	**P-value (Brown Forsythe)**	**1**	**2**	**3**	**4**
Business use	South Africa	335	3.0	1.1	0.000	0.000	0.000				
	Nigeria	370	3.6	1.0				0.6			
	Morocco	112	3.2	0.9				0.3	0.3		
	Kenya	212	2.9	1.0				0.1	0.7	0.4	
	DRC	252	3.2	0.8				0.3	0.4	0.0	0.4
Individual use	South Africa	335	4.2	0.8	0.000	0.000	0.000				
	Nigeria	370	4.0	0.8				0.2			
	Morocco	112	3.9	0.7				0.4	0.1		
	Kenya	212	3.6	0.9				0.6	0.5	0.4	
	DRC	252	3.3	0.8				1.1	0.8	0.8	0.3

Business use – p = 0.000 indicated statistical significance. There is a medium significant difference between Nigeria and South Africa, as well as between Nigeria and Kenya regarding the use of mobile apps for business interactions. A small significant difference exists among the other countries. This implies that mobile apps are more often used for business interactions in Nigeria, followed by South Africa, Morocco and the DRC. Kenya has the least use of mobile apps for business purposes. In other words, there is a more advanced use of mobile apps in education, health care, commerce and agriculture in Nigeria than in the other countries.

Individual use – There was statistical significance between the countries in the use of mobile apps for personal activities, p = 0.000. A large significant difference exists in the use of mobile apps for personal interaction, such as social networking, SMS, watching movies, etc. in South Africa, Nigeria and Morocco compared to the use in the DRC. In Kenya, a medium significance was observed. Comparing South Africa with Nigeria and Morocco, a small effect difference exists. This implies that there is more individual use of mobile apps in South Africa than in the other countries.

There are two main reasons for using mobile apps in Africa, namely business use and individual use. There is no practically significant difference in the use of mobile apps for business purposes among the countries, but a practically significant difference exists in the use of mobile apps for individual purposes. Nigeria is the country that makes the most use of mobile apps for business use, whereas South Africa is the leading country for the use of mobile apps for individual interaction.

Table 7.11: ANOVA and robust test results – Reasons for discontinuation

Items (Research variables)	**Country**	**No. of participants**	**Mean**	**Std. dev.**	**p-value (ANOVA)**	**Robust test**		**Effect sizes**			
						P-value (Welch)	**P-value (Brown Forsythe)**	**1**	**2**	**3**	**4**
There is a more enhanced mobile app replacing the existing one.	South Africa	335	3.5	1.2	0.244	0.139	0.214				
	Nigeria	370	3.4	1.3				0.1			
	Morocco	116	3.7	1.0				0.1	0.2		
	Kenya	212	3.5	1.2				0.0	0.0	0.2	
	DRC	252	3.4	1.2				0.1	0.0	0.2	0.1
Unsatisfactory performance.	South Africa	335	3.5	1.2	0.063	0.022	0.053				
	Nigeria	370	3.4	1.2				0.1			
	Morocco	116	3.8	1.0				0.2	0.2		
	Kenya	212	3.6	1.2				0.1	0.1	0.2	
	DRC	252	3.4	1.3				0.1	0.0	0.1	0.1
It lacked support.	South Africa	335	3.2	1.3	0.068	0.071	0.058				
	Nigeria	370	3.3	1.3				0.1			
	Morocco	116	3.2	1.1				0.0	0.1		
	Kenya	212	3.1	1.3				0.1	0.2	0.1	
	DRC	252	3.4	1.2				0.1	0.1	0.2	0.2
It is not easy to use.	South Africa	335	3.4	1.4	0.023	0.024	0.018				
	Nigeria	370	3.3	1.4				0.1			
	Morocco	116	3.2	1.2				0.1	0.1		
	Kenya	212	3.0	1.3				0.3	0.2	0.1	
	DRC	252	3.3	1.2				0.1	0.0	0.1	0.2

There is a more enhanced mobile app replacing the existing one – p = 0.244, indicating no statistical significance. It is assumed that all the mean values are relatively the same. There is no practically significant difference in the effect of this factor on all the countries. The participants from all the countries have similar perceptions of this factor as a cause of discontinuance of the use of mobile apps in Africa. Similar perceptions are observed in the other factors including unsatisfactory performance (p = 0.063) and it lacked support (p = 0.068).

It is not easy to use – p = 0.023, indicating statistical significance. A small effect difference was observed in South Africa, Nigeria and Kenya. This implies that the impact of this factor on the discontinuation of the use of mobile apps in Africa is greater in South Africa, Nigeria and Kenya compared with Morocco and the DRC.

There are four causes of discontinuing the use of mobile apps, namely the existence of a more enhanced mobile app, unsatisfactory performance, lack of support and not easy to use. All the countries have similar perceptions regarding the first three causes, whereas not easy to use indicated some effect difference in practice. Not easy to use has considerable influence on South Africans, causing them to discontinue the use of mobile apps, followed by Nigeria and Kenya, then Morocco and the DRC.

7.3.3 Adopting unit

The adopting unit comprises the personality variables, socio-economic characteristics and communication behaviour. These aspects of the adopting unit were analysed and compared to determine the similarities and differences among the countries in the adoption and diffusion of mobile apps in Africa. The results are shown in Tables 7.12-7.15.

Table 7.12: ANOVA and robust test results – Personality variables

Items (Research Variables)	Country	No. of participants	Mean	Std. dev.	p-value (ANOVA)	Robust test		Effect sizes			
						P-value (Welch)	P-value (Brown Forsythe)	1	2	3	4
Attitude	South Africa	335	1.6	0.9	0.000	0.000	0.000				
	Nigeria	370	1.7	0.9				0.1			
	Morocco	112	2.4	1.4				0.6	0.5		
	Kenya	212	1.4	0.7				0.3	0.4	0.8	
	DRC	252	1.3	0.7				0.3	0.5	0.8	0.1
Anxiety	South Africa	335	2.5	1.3	0.000	0.000	0.000				
	Nigeria	370	2.9	1.4				0.3			
	Morocco	112	2.7	1.4				0.1	0.2		
	Kenya	212	2.7	1.4				0.2	0.1	0.0	
	DRC	252	3.3	1.4				0.6	0.3	0.5	0.4

Attitude - There was a statistically significant difference between groups, p = 0.000. A large effect was observed between the DRC and Kenya compared with Morocco. Comparing Morocco with South Africa and Nigeria, there was a medium effect. There was no significant difference between Kenya and the DRC, as well as between Nigeria and South Africa. This implies that in the DRC and in Kenya the participants showed a high degree of positive interest whenever they heard of new mobile apps compared with the participants from the other countries. In other words, they are keener in adopting and using new mobile apps, followed by South Africa and Nigeria. In Morocco, there is the least positive interest.

Anxiety – p = 0.000, indicating a statistically significant difference among the groups. There was a medium effect between the DRC and three other countries (South Africa, Morocco and Kenya), and a small effect between Nigeria and the DRC, as well as a small effect between Nigeria and South Africa. This implies that in the DRC they are more nervous in adopting and using mobile apps than in the other countries. Although they show more interest in the DRC whenever they hear of new mobile apps, when it comes to the adoption of the mobile apps into their daily activities, they become more nervous.

Overall, Africans show a positive attitude with less anxiety whenever they hear about new mobile apps, indicating their readiness to adopt and use them. The DRC has the highest positive interest in adopting and using new mobile apps, followed by Kenya, South Africa and Nigeria. Morocco has the least positive attitude. Even though the DRC has the greatest interest, it is the most nervous country and South Africa is the country with the least degree of nervousness on the adoption and diffusion of mobile apps.

Table 7.13: ANOVA and robust test results- Socio-economic characteristics (Effect of mobile apps on African development)

Items (Research variables)	**Country**	**No. of participants**	**Mean**	**Std. dev.**	**p-value (ANOVA)**	**Robust test**		**Effect sizes**			
						P-value (Welch)	**P-value (Brown Forsythe)**	**1**	**2**	**3**	**4**
Contributions to health care	South Africa	335	3.5	1.2							
	Nigeria	370	3.8	0.8				0.2			
	Morocco	112	3.6	0.9	0.000	0.000	0.000	0.1	0.2		
	Kenya	212	3.4	0.9				0.1	0.4	0.3	
	DRC	252	3.3	0.8				0.2	0.6	0.4	0.1
Contributions to education and social activities	South Africa	335	3.9	0.7							
	Nigeria	370	3.8	0.7				0.1			
	Morocco	112	3.6	0.6	0.000	0.000	0.000	0.5	0.3		
	Kenya	212	3.5	0.8				0.5	0.4	0.1	
	DRC	252	3.3	0.8				0.9	0.7	0.4	0.3
Contributions to the economy	South Africa	335	3.9	1.0							
	Nigeria	370	3.7	0.9				0.1			
	Morocco	112	3.7	0.7	0.000	0.000	0.000	0.1	0.0		
	Kenya	212	3.6	0.8				0.2	0.1	0.1	
	DRC	252	3.3	0.7				0.5	0.4	0.5	0.3
Contributions to politics	South Africa	335	3.8	0.8							
	Nigeria	370	3.6	0.9				0.2			
	Morocco	112	3.6	0.8	0.000	0.000	0.000	0.2	0.0		
	Kenya	212	3.5	0.9				0.3	0.1	0.1	
	DRC	252	3.3	0.7				0.6	0.3	0.4	0.3
Contributions to finance	South Africa	335	4.1	0.8							
	Nigeria	370	3.9	0.9				0.3			
	Morocco	112	3.6	0.7	0.000	0.000	0.000	0.7	0.3		
	Kenya	212	3.6	0.9				0.6	0.3	0.0	
	DRC	252	3.4	0.8				0.9	0.5	0.2	0.2
Contributions to agriculture	South Africa	335	3.3	1.1							
	Nigeria	370	3.6	0.9				0.3			
	Morocco	112	3.5	0.8	0.000	0.000	0.000	0.3	0.1		
	Kenya	212	3.4	0.9				0.1	0.3	0.2	
	DRC	252	3.2	0.8				0.0	0.4	0.4	0.2

Contributions to health care – p = 0.000 indicated statistical significance. There is a medium significant difference between Nigeria and the DRC, and a small effect difference with the other countries. Comparing Morocco with Kenya and the DRC, a small effect was observed, as well as between South Africa and the DRC. There is no significant difference between South Africa and Morocco, and between Kenya and the DRC. It suggests that Nigeria and Morocco feel the effect of mobile apps on the health care system more than South Africa, the DRC and Kenya. Thus, Nigeria perceived the use of mobile apps in the health care system to be more important than the other countries.

Contributions to education and social activities – p = 0.000 indicates statistical significance. A large significant difference was observed between South Africa and the DRC, whereas between Morocco and Kenya a medium significant effect was observed. Comparing Nigeria with the DRC, a medium significant difference was observed and there was a small effect between Morocco and the DRC. There was no significant difference between South Africa and Nigeria. This implies that South Africa and Nigeria perceived the effect of mobile apps on education and social activities higher than the other countries. In other words, South Africa and Nigeria have a higher belief that mobile apps improve their educational and social activities more than the other countries.

Contributions to the economy – p = 0.000 indicated statistical significance. A medium significant difference was observed in South Africa and Morocco compared with the DRC, whereas a small effect was indicated compared with Nigeria and Kenya. It suggests that South Africa and Morocco perceived the effect of mobile apps on economic activities higher than in Nigeria and Kenya. In the DRC, there is the least effect of mobile apps on the economy.

Contributions to politics – p = 0.000 indicated statistical significance. A medium significant difference was observed between South Africa and the DRC, whereas a small effect was noticed among the other countries. It suggests that South Africa perceived the effect of mobile apps on political activities higher, followed by Nigeria and Morocco, and then Kenya. In the DRC there was the least effect of mobile apps on politics.

Contributions to finance – p = 0.000 indicated statistical significance. A large significant difference was observed between South Africa and the DRC. Comparing South Africa with Morocco and Kenya, a medium significant difference was observed. Between South Africa and Nigeria, a small effect was observed. Likewise, a medium effect was observed between Nigeria and the DRC, and there was a small effect between Morocco and Kenya. It suggests that mobile apps have a larger effect on financial activities in South Africa, followed by Nigeria and then the other countries.

Contributions to agriculture – p = 0.000 indicated statistical significance. Comparing South Africa with Nigeria and Morocco, a small significant effect was observed. In a similar way, comparing Nigeria with Kenya and the DRC, small and medium effects were observed respectively. Between Kenya and DRC, a small effect was observed. There is no significant effect difference between South Africa, Kenya and the DRC. It suggests that Nigeria and Morocco perceived the effect of mobile apps in agriculture to be higher than in the other countries. Nigeria has the highest perception of the significance of mobile apps in agricultural practices, followed by Morocco, Kenya, South Africa and the DRC. Thus, Nigeria and Morocco have higher beliefs that mobile apps contribute to the development of agriculture in Africa than the other countries.

Overall, the participants' perceptions of mobile apps indicated that mobile apps contribute to the development in Africa. There is no practically significant difference in their perception of the contributions of mobile apps except on the effect of mobile apps on finance. Regarding the health care system, Nigeria and Morocco feel the effect of mobile apps on health care more than in South Africa, the DRC and Kenya. Thus, Nigeria perceived the use of mobile apps in the health care system to be important, more so than the other countries. Regarding education and social activities, South Africa and Nigeria have a higher belief that mobile apps improve their educational and social activities, more so than the other countries. In politics, South Africa and Morocco had higher perceptions than the other countries. Concerning finance, the use of mobile apps has a larger effect on financial activities in South Africa, followed by Nigeria and then the other countries. Lastly, on the contributions of mobile apps to African development, Nigeria and Morocco have higher beliefs that mobile apps contribute to the development of agriculture in Africa than the other countries.

Table 7.14: ANOVA and robust test results- Socio-economic characteristics (Predicting factors)

Items (Research variables)	**Country**	**No. of participants**	**Mean**	**Std. dev.**	**p-value (ANOVA)**	**Robust test**		**Effect sizes**			
						P-value (Welch)	**P-value (Brown Forsythe)**	**1**	**2**	**3**	**4**
Perceived technology reliability	South Africa	335	3.3	0.9							
	Nigeria	370	3.6	0.8				0.3			
	Morocco	112	3.3	0.7	0.000	0.000	0.000	0.0	0.3		
	Kenya	212	3.4	0.9				0.1	0.2	0.1	
	DRC	252	3.2	0.8				0.1	0.4	0.1	0.2
Self-efficacy	South Africa	335	3.9	0.8							
	Nigeria	370	3.7	0.7				0.3			
	Morocco	112	3.4	0.7	0.000	0.000	0.000	0.6	0.4		
	Kenya	212	3.4	0.8				0.5	0.3	0.1	
	DRC	252	3.3	0.8				0.7	0.5	0.1	0.1
Relative advantage	South Africa	335	3.5	1.0							
	Nigeria	370	3.6	0.9				0.1			
	Morocco	112	3.4	0.7	0.000	0.000	0.000	0.1	0.2		
	Kenya	212	3.5	1.0				0.1	0.2	0.0	
	DRC	252	3.3	0.8				0.3	0.4	0.2	0.2
Social influence	South Africa	335	3.7	0.9							
	Nigeria	370	3.6	1.1				0.1			
	Morocco	112	3.4	0.9	0.000	0.000	0.000	0.3	0.2		
	Kenya	212	3.6	0.9				0.1	0.1	0.2	
	DRC	252	3.3	0.8				0.4	0.3	0.1	0.3
Facilitating condition	South Africa	335	3.5	1.0							
	Nigeria	370	3.4	1.0				0.2			
	Morocco	112	3.5	1.0	0.003	0.003	0.003	0.1	0.1		
	Kenya	212	3.3	1.0				0.2	0.1	0.2	
	DRC	252	3.2	0.9				0.3	0.2	0.3	0.1

Table 7.14 (contd.): ANOVA and robust test results- Socio-economic characteristics (Predicting factors)

Items (Research variables)	**Country**	**No. of participants**	**Mean**	**Std. dev.**	**p-value (ANOVA)**	**Robust test**		**Effect sizes**			
						P-value (Welch)	**P-value (Brown Forsythe)**	**1**	**2**	**3**	**4**
Financial cost	South Africa	335	3.7	1.1	0.000	0.000	0.000				
	Nigeria	370	3.5	1.0				0.2			
	Morocco	112	3.4	0.8				0.3	0.1		
	Kenya	212	3.2	1.0				0.5	0.3	0.2	
	DRC	252	3.2	0.8				0.5	0.3	0.3	0.1
Cultural effect	South Africa	335	3.3	0.9	0.001	0.000	0.000				
	Nigeria	370	3.5	0.9				0.2			
	Morocco	112	3.3	0.7				0.1	0.2		
	Kenya	212	3.2	1.0				0.0	0.2	0.1	
	DRC	252	3.2	0.7				0.1	0.3	0.2	0.0

Perceived technology reliability – p = 0.000 indicated statistical significance. Comparing Nigeria with South Africa, Morocco, Kenya and the DRC, a small effect difference was observed. Between South Africa, Morocco, Kenya and the DRC, there was no effect difference. It indicates that the perceived technology reliability has more influence in Nigeria than in the other countries.

Self-efficacy – p = 0.000 indicated statistical significance. A medium significant difference was observed between South Africa and three other countries (Morocco, Kenya and the DRC), as well as between Nigeria and the DRC. A small significant difference was observed between South Africa and Nigeria, as well as between Nigeria, Morocco and Kenya. This implies that self-efficacy has more influence in the adoption and diffusion of mobile apps in South Africa than in the other countries, followed by Nigeria. Among the other three countries, no significant difference was indicated.

Relative advantage – p = 0.000 indicated statistical significance. There is a small significant effect between the DRC and the other four countries. Comparing Nigeria with Morocco and Kenya, a small effect as also observed. No significant difference exists between South Africa, Nigeria and Morocco. This implies that relative advantage has significant influence in all these countries concerning the adoption and diffusion of mobile apps in Africa. Nigeria has the highest effect of relative advantage, followed by South Africa and Kenya, then Morocco. The DRC has the lowest effect for this feature.

Social influence – p = 0.000 indicated statistical significance. Comparing South Africa with Morocco and the DRC, a small effect difference exists, as well as when comparing Nigeria with Morocco and the DRC. The effect difference between Morocco and Kenya, as well as between Kenya and the DRC also indicates a small significant difference. There is no significant difference between South Africa, Nigeria and Kenya, as well as between Morocco and the DRC. This implies that social influence has more impact on the adoption and diffusion of mobile apps in South Africa, followed by Nigeria and Kenya, before Morocco. In the DRC, social influence has the least impact.

Facilitating conditions – p = 0.000 indicated statistical significance. All the countries indicted a small significant difference with the DRC except Kenya where there was no effect difference. There is small effect difference between Morocco and Kenya. Comparing South Africa with Nigeria, and Kenya, a small significant difference exists. This implies that facilitating conditions are important predicting factors in all the countries but have more effect in South Africa and Morocco. In other words, South Africa and Morocco expected more support both from government and other stakeholders to facilitate the successful adoption and diffusion of mobile apps than the other countries.

Financial cost – p = 0.000 indicated a statistically significant difference. A medium significant difference was observed in the adoption and diffusion of mobile apps in South Africa compared with Kenya and the DRC, whereas a small effect was observed when comparing South Africa with Nigeria and Morocco. Comparing Nigeria with Kenya and the DRC, small effect difference was found. Likewise, comparing Morocco with Kenya and the DRC, a small effect difference exists. There is no significant difference between Nigeria and Morocco, as well as between Kenya and the DRC. This implies that the cost involved in the adoption and diffusion of mobile apps has more impact in South Africa than in the other countries, followed by Nigeria and Morocco. In Kenya and the DRC, financial cost has the least influence on the adoption and diffusion of mobile apps.

Culture – p = 0.001 indicated statistical significance. A small significant difference was observed between South Africa and Nigeria, as well as between Nigeria and three other countries (Morocco, Kenya and the DRC). There was no significant difference between South Africa, Morocco, Kenya and the DRC. This suggests that cultural effect has more impact on the adoption and diffusion of mobile apps in Nigeria, followed by South Africa and Morocco. Kenya and the DRC indicated the least effect of culture on the adoption and diffusion of mobile apps.

Overall, comparing the adoption and diffusion of mobile apps from the predicting factors perspectives, there is no practically significant difference among the countries. The perceived technology reliability, relative advantage and culture have more influence in Nigeria than in the other countries. In a similar way, self-efficacy, social influence, facilitating conditions and financial cost have more influence in the adoption and diffusion of mobile apps in South Africa than in the other countries. The predicting factors have more influence in South Africa and Nigeria than in Morocco, Kenya and the DRC regarding the adoption and diffusion of mobile apps.

Table 7.15: ANOVA and robust test results – Communication behaviour

Items (Research variables)	Country	No. of participants	Mean	Std. dev.	p-value (ANOVA)	Robust test		Effect sizes			
						P-value (Welch)	P-value (Brown Forsythe)	1	2	3	4
Facilitates my activities	South Africa	335	3.7	1.2	0.001	0.001	0.001				
	Nigeria	370	3.7	1.4				0.0			
	Morocco	112	3.4	1.1				0.3	0.3		
	Kenya	212	3.4	1.2				0.2	0.2	0.0	
	DRC	252	3.4	1.2				0.2	0.2	0.0	0.2
Enables easy communication	South Africa	335	4.1	1.2	0.000	0.000	0.000				
	Nigeria	370	4.1	1.1				0.0			
	Morocco	112	3.5	1.1				0.5	0.5		
	Kenya	212	3.8	1.1				0.2	0.2	0.3	
	DRC	252	3.5	1.2				0.6	0.6	0.1	0.3

Facilitates my activities – p =0.001 indicated statistical significance. Comparing South Africa and Nigeria with Morocco, Kenya and the DRC, a small significant difference was observed. There is a small effect difference between Kenya and the DRC, and no effect difference between South Africa and Nigeria, as well as between Morocco, Kenya and the DRC. This implies that South Africa and Nigeria mostly use mobile apps for the purpose of improving individual activities more than the other countries.

Enables easy communication – p = 0.000 indicated statistical significance. South Africa and Nigeria have medium effect difference compared with Morocco and the DRC, as well as a small effect with Kenya. There a small effect difference between Morocco and Kenya, as well between Kenya and the DRC. This implies that South Africa and Nigeria disseminate the information about mobile apps mostly for communication purposes, more so than in the other selected countries, followed by Morocco before Kenya and the DRC.

Therefore, the two purposes of sharing information about mobile apps are mostly profound in South Africa and Nigeria, and less so in Morocco, Kenya and the DRC.

7.4 Summary

In this chapter, a comparative discussion of the adoption and diffusion of mobile apps regarding the five selected countries was presented. ANOVA was performed on the collected data to obtain the effective sizes of the research variables on each respective country. Using the ANOVA results, the similarities and differences in the adoption and diffusion of mobile apps in the selected countries were pointed out, discussed and compared. The comparative analysis was done in the order of the research conceptual model, using the model components as the topics of the comparative discussions. These components covered all the research variables, namely mobile app innovations, innovation-decision process and the adopting unit. In the ANOVA analysis, there is no practically significant difference in the participants' perceptions of the mobile app innovations among the countries. Regarding the innovation-decision process, three out of 25 variables (Individual activities, Using mobile apps are expensive and Individual use) indicated practically significant differences between some countries. Concerning the adopting unit, only contributions to finance out of 17 variables indicated practical significance between some countries. In this regard, there is a larger percentage of similarities in the participants' perception of these variables than differences. Thus, the participants from the five selected countries have similar perceptions of the adoption and diffusion of mobile apps in Africa with little differences and the findings of this study may be generalised to the entire African social system.

In the next chapter, the framework for the successful adoption and diffusion of mobile apps in Africa will be presented.

Chapter 8

The framework for the adoption of mobile apps in Africa

8.1 Introduction

Mobile apps contain the innovative potential needed to improve human ways of performing activities across various sectors, namely the social, educational, health care, political, financial and agricultural sectors. As powerful tools that are embracing all the sectors in life, it is, therefore, required that the awareness of mobile apps should reach every individual and the knowledge be imparted to all. This will facilitate a wider adoption and diffusion of mobile apps, especially among the Africa population.

In the preceding chapters, the following were presented: a literature review of the study, data analysis, interpretations of the results and the comparative analysis regarding mobile apps adoption and diffusion in the selected countries.

In this section, a defined structure indicating the necessary aspects required for a successful adoption and diffusion of mobile apps in Africa is discussed and presented. Thus, objective 5 (Outline the guidelines and propose a framework for successful adoption and diffusion of mobile apps in Africa) of this study is addressed in this chapter.

The remaining part of this chapter is structured as follows: in section 8.2 the proposed guidelines for the successful adoption and diffusion of mobile applications in Africa will be presented on the basis of the results of previous chapters and in section 8.3, the factor analysis factors that will guide the reader through the results presented in this chapter are highlighted. In sections 8.4 and 8.5, the description of the adoption and diffusion of mobile apps to guide the reader are recalled. In section 8.6, the regression analysis is dealt with, in section 8.7, assumptions of the regression analysis are looked at, and in section 8.8, the output of the regression analysis is presented. In sections 8.9 and 8.10, ANOVA and t-test are presented respectively, whereas in section 8.11, the validation of the framework is discussed. The proposed framework is presented in section 8.12 and the application of the framework is discussed in section 8.13. Finally, the chapter is summarised in section 8.14.

8.2 Guidelines for the successful adoption and diffusion of mobile apps in Africa

From the descriptive statistical results of data analyses and the discussion presented in Chapters 5 and 6, the following guidelines for the adoption and diffusion of mobile apps in Africa are suggested.

1. Create mobile apps that possess the significant features.
   This study identified some significant features of mobile apps, including:
   - ✓ Relative advantage – Develop more enhanced mobile applications than existing ones.
   - ✓ Complexity – Develop easy-to-use mobile apps.
   - ✓ Compatibility – Develop mobile apps that correspond to the users' existing lifestyle and experience.
   - ✓ Observability – Develop mobile apps that others can watch when they are used.
   - ✓ Trialability – Develop mobile apps with a trial version before adoption.
   - ✓ Perceived technology reliability – Develop mobile apps with reliability.
   - ✓ Cost – Develop mobile apps that are cost-effective.
2. Identify the best sources of information about mobile apps.
   Regarding the adoption and diffusion of mobile apps in Africa, this study revealed two distinct sources of information about mobile apps:
   - ✓ External initiated actions.
   - ✓ Personal initiated actions.
3. Identify the essential means for the dissemination of information about mobile apps among the people. This study revealed two distinct means of information sharing:
   - ✓ Organisations and events.
   - ✓ Individual activities.
4. Define the most suitable method of learning how to use mobile apps.
   Some of the learning methods revealed by this research are:
   - ✓ Interpersonal communication.
   - ✓ The Internet.
   - ✓ Operation manual.
   - ✓ Formal training.
5. Identify the potential user's and adopter's categories.
   In Africa, there are five different categories of mobile apps adopters:

- ✓ Late majority and Laggards category.
- ✓ Non-adopters' category.
- ✓ Innovators category.
- ✓ Early adopters.
- ✓ Early majority.

6. Identify the possible causes of non-adoption or rejection.

   This study revealed the following reasons for non-adoption/rejection of mobile apps in Africa:

   - ✓ Using mobile apps is time-consuming.
   - ✓ Using mobile apps takes up too much phone memory.
   - ✓ Distraction of attention from other activities.
   - ✓ Using mobile apps is expensive.

7. Know the uses of the mobile apps.

   As revealed by this study, there are two distinct uses of mobile apps in Africa:

   - ✓ Business use.
   - ✓ Individual use.

8. Identify the possible causes of discontinuance of the use of the mobile apps.

   The findings of this research indicated four possible causes of discontinuance of the use of mobile apps:

   - ✓ There is a more enhanced one replacing the existing one.
   - ✓ Unsatisfactory performance.
   - ✓ Lack of support.
   - ✓ High complexity.

9. Have a good knowledge of their beliefs and feelings towards mobile apps which can be positive, negative and indifferent.

   This research revealed that there is a relationship between attitude and the features of mobile apps.

   - ✓ Understanding the adopters' attitudes.

10. Try to perceive their degree of nervousness on the adoption of new products.

    Anxiety is a personality characteristic that can influence the adoption and diffusion of mobile apps.

    - ✓ Understanding the degree of anxiety of the mobile app adopters over a new mobile app.

11. Identify the predicting factors that can influence the rate of adoption and diffusion or the growth of the mobile apps.

    This study confirms that some factors may influence the adoption and diffusion of mobile aps in Africa. These factors are:

- ✓ Perceived technology reliability.
- ✓ Self-efficacy.
- ✓ Relative advantage.
- ✓ Facilitating conditions.
- ✓ Social influences.
- ✓ Financial costs of using mobile apps.
- ✓ Cultural effect.

12. Have a good knowledge of the possible effects/contributions of the mobile app on the society.

    Some of the contributions of mobile apps towards the advancement of Africa established in this study are:

    - ✓ Contributions to the health care system.
    - ✓ Contributions to education and social activities.
    - ✓ Contributions to the economy.
    - ✓ Contributions to politics.
    - ✓ Contributions to finance.
    - ✓ Contributions agriculture.

13. Discover the purpose of information sharing.

    This research revealed two distinct purposes of sharing the information about the existence of mobile apps:

    - ✓ To facilitate one's activities.
    - ✓ To enable easy communication.

Subsequently, these suggested guidelines will be further explored in this chapter by performing a multi-linear regression analysis to determine their relationships with the adoption and diffusion of mobile apps in Africa.

8.3 Factor analysis results

A total of 27 factors were derived from the factor analysis performed and all these factors are associated with the conceptual model in the following ways as displayed in Table 8.1

Table 8.1: The identified factors linked to the conceptual model

Mobile apps Innovations	**Knowledge**	**Persuasion**	**Decision making**	**Diffusion**	**Adopting unit**
Features of mobile apps ✓ Relative advantage ✓ Observability ✓ Trialability	***Information sources*** ✓ External initiated actions ✓ Personal initiated actions ***Information sharing*** ✓ Organisations and events ✓ Individual activities	Social influence	***Adopter's category*** ✓ Late Majority and Laggards ✓ Non-Adopters ✓ Innovators ✓ Early adopters ✓ Early majority	***Use of mobile apps*** ✓ Business use ✓ Individual use	***Contributions of mobile apps*** ✓ Contributions to the health care system ✓ Contributions to education and social activities ✓ Contributions to the economy ✓ Contributions to politics ✓ Contributions to finance ✓ Contributions to agriculture ***Predicting factors*** ✓ Perceived technology reliability ✓ Self-efficacy ✓ Relative advantage ✓ Facilitating conditions ✓ Financial cost ✓ Cultural effect

These factors, together with other independent variables that are associated with the conceptual model, will be further examined using multilinear regression analysis to determine their fitness in the model.

8.4 Adoption

Drawing from the literature (1.4.3), adoption is the choice of complete acceptance and use of mobile apps. This study investigated the adoption of mobile apps in Africa from the adopter's category perspective. It was found that there are five adopters' categories, namely ***late majority and laggards, non-adopters, innovators, early adopters and early majority*** (6.10). These categories of adopters were defined based on their innovativeness. Innovativeness is the extent to which an adopter/individual or other unit of adoption is comparatively earlier to adopt new mobile apps. During the investigation of adoption of mobile apps in Africa through innovativeness, knowledge-awareness, persuasive conditions and diffusion were also determined. Mobile app adopters with similar innovativeness are grouped together under one category. The classification of adopters helps in understanding the behaviour or attitudes of the mobile apps adopter in the social system. Regarding the proposed framework, a test of a relationship is performed (regression analysis) on these categories as dependent variables and other variables as independent variables, excluding business use, individual use and the use of mobile apps which are also dependent variables.

8.5 Diffusion

As discussed in the literature, diffusion is the procedure of transferring an innovation through definite networks over time among the members of a social system. Concerning this research, it is a process of introduction, distribution and usage of mobile apps to the entire social system of Africa. This study investigated diffusion from the angle of usage of mobile apps. The findings indicated that Africans mainly use mobile apps for business and individual purposes. In regard to business use, it was discovered that mobile apps are used for commerce, health delivery services, agricultural services, and administering government services. Individual uses include social communications, text messages, educational activities and entertainment. In testing diffusion as a component of the proposed framework, ***general use of mobile apps***, ***business use, and individual use*** were the key dependent variables for the diffusion of mobile apps while other variables are the independent variables excluding adopters' categories.

8.6 Regression analysis

Regression analysis is a statistical technique used to examine the relationship between the dependent variable(s) and independent variables. It determines how the changes in the independent variables are related to the changes in the dependent variables. The coefficients describe these changes and the p-values indicate the significant level of the changes. $P < 0.05$ is the acceptable significant level. It indicates a 95% confidence interval (the probability of getting the correct effect). Any of the research variables (predictor) that has $p < 0.05$ is meaningful to be added into the model. The R^2 tells the fraction of the variation in the dependent variable predicted by the independent variables. According to Ellis & Steyn (2003), the effect sizes and the significant level of R^2 are shown in Table 8.2.

Table 8.2: Effect sizes and significant levels of R^2

Effect size (f^2)	**Effect**	**Values of** R^2	**Conclusions on** R^2
Smaller than 0.15	Small	Smaller than 0.13	Non-significant
0.15-0.35	Medium	0.13-0.25	Significant
Larger than 0.35	Large	Larger than 0.25	Practically important

Multiple linear regression analysis is applied in this research to examine the relationship between the adoption and diffusion of mobile apps (dependent variables) and the independent variables. The model equation is of this form:

Dvar = c1X1 + c2X2 +c3X3 …………. + K

Where,

Dvar = dependent variable

C1, c2, c3 = regression coefficients

X1, X2, X3 = independent variable

K = the predicted value of Dvar when all the independent variables are = 0

The dependent variables include the use of mobile apps, Business uses, Individual uses, and the adopters' categories. The independent variables are highlighted below with their link to the conceptual model in Table 8.2

Table 8.2: Independent variables with their link to the conceptual model

Mobile apps Innovations	Knowledge	Persuasion	Decision making	Diffusion	Adopting unit
Features of mobile apps ✓ Relative advantage ✓ Observability ✓ Trialability. ✓ It is advantageous. ✓ It is easy to learn and use. ✓ It suits my daily activities. ✓ I see my friends using them. ✓ I tested and liked it.	***Information sources*** ✓ External initiated actions ✓ Personal initiated actions ***Information sharing*** ✓ Organisations and events ✓ Individual activities **Learning methods** ✓ Informal training ✓ Operational manual ✓ The Internet ✓ Interpersonal communication	✓ Social influence	***Reason for non-adoption/rejection*** ✓ Using mobile apps is time-consuming. ✓ Using mobile apps takes up too much memory. ✓ Using mobile apps distracts attention from other activities. ✓ Using mobile apps is expensive.	**Reasons for discontinuation** ✓ There is a more enhanced one replacing the existing one. ✓ Unsatisfactory performance ✓ Lack of support ✓ It was not easy to use.	***Personality variables*** ✓ Attitude ✓ Anxiety ✓ Self-efficacy ***Socio-economic characteristics*** ✓ Contributions to the health care system ✓ Contributions to education and social activities ✓ Contributions to the economy ✓ Contributions to politics ✓ Contributions to finance ✓ Contributions to agriculture ✓ Perceived technology reliability ✓ Self-efficacy ✓ Relative advantage ✓ Facilitating conditions ✓ Financial cost ✓ Cultural effect ***Communication behaviour*** ✓ To facilitate activities ✓ To enable easy communication

For easy understanding and use for the study, these variables are further compressed as shown in Table 8.3.

Table 8.3: Independent variables

Independent variables	Compressed Independent variables
Mobile apps are good innovations	Good innovations
Mobile apps contribute to development in Africa	Adds to development
Formal training	Formal training
Informal training	Informal training
Operational manual	Working manual
Internet (websites)	Internet
Interpersonal communication	Interpersonal communication
Nervousness	Anxiety
It is advantageous.	Advantageous
It is easy to learn and use.	Simplicity
It suits my daily activities.	Fits well
I see my friends using them.	Used by others
I tested and liked it.	Tested correctly.
Using mobile apps is time-consuming.	Time-consuming
Using mobile apps takes up too much my phone memory.	Occupies phone memory
Using mobile apps is distracting my attention from other activities.	Distraction of attention
Using mobile apps is expensive.	Expensive to use
There was a more enhanced one replacing it.	A better replacement
Unsatisfactory performance	Unsatisfactory performance
It lacked support.	Lack of support
High complexity	High complexity
To facilitate my work activities	Enables work activities
To enable easy communication	Enables easy communication
External initiated actions	External initiated actions
Personal initiated actions	Personal initiated actions
Organisations and events	Organisations and events
Individual activities	Individual activities
Relative advantage and compatibility	Relative advantage and compatibility
Observability	Observability
Trialability	Trialability
Perceived technology reliability	Perceived technology reliability
Self-efficacy	Self-efficacy
Using mobile apps satisfies user expectations.	Using mobile apps satisfies user expectations.
Social influence	Social influence
Facilitating conditions	Facilitating conditions
Financial cost	Financial cost
Culture	Culture
Contributions to health care	Contributions to health care
Contributions to education and social activities	Contributions to education and social activities
Contributions to the economy	Contributions to the economy
Contributions to politics	Contributions to politics
Contributions to finance	Contributions to finance
Contributions to agriculture	Contributions to agriculture

8.7 Some of the assumptions for regression analysis

The following assumptions were considered to ensure that the obtained outputs from the regression analysis support the proposed model.

Multicollinearity

This occurs when two independent variables are closely related to each other. In such a case, one of the correlated variables is dropped from the analysis. To ensure that there is no or little multicollinearity, tolerance and variance inflation factors (VIF) were computed.

Tolerance (T)

$T = 1 - R^2$

If

$T \geq 0.2$, no multicollinearity and $T < 0.2$, multicollinearity occurs

Variance inflation factor (VIF)

VIF is the reciprocal of tolerance

$VIF = 1/T$

VIF should be close to 1 and under 5 is within the acceptable range. 5+ indicates that the variable may not be needed in the analysis.

In the regression analysis performed for this study, all the obtained tolerance factors are more than 0.4 and all the VIF scores are close to 1.

Normality

Normality was tested with the P-P plot and it was found that the variables were normally distributed (Appendix B).

8.8 The output of the regression analysis

Multiple regression analysis was performed to examine the association between the dependent variables and the independent variables. Two regression methods were applied, including Enter and Stepwise methods to ensure more reliable output. The results obtained from these methods are shown in Tables 8.3-8.25.

The test of the relationship between the independent variables and the dependent variable (General use of mobile apps) was performed and the results obtained are shown in Table 8.4.

Table 8.4: General use of mobile apps

Coefficients							
Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	0,618	0,205		3,023	0,003		
Good innovations	0,177	0,030	0,175	5,841	0,000	0,639	1,564
Adds to development	0,212	0,030	0,203	6,956	0,000	0,671	1,490
Formal training	-0,032	0,024	-0,037	-1,342	0,180	0,750	1,334
Informal training	0,024	0,025	0,027	0,954	0,340	0,735	1,361
Working manual	-0,008	0,024	-0,009	-0,338	0,735	0,751	1,331
Internet	-0,039	0,026	-0,042	-1,481	0,139	0,724	1,382
Interpersonal communication	0,042	0,026	0,043	1,597	0,110	0,771	1,297
Anxiety.	-0,028	0,020	-0,035	-1,395	0,163	0,911	1,098
Advantageous	0,019	0,027	0,020	0,709	0,479	0,726	1,377
Simplicity	0,064	0,031	0,060	2,029	0,043	0,657	1,523
Fits well	0,034	0,029	0,035	1,177	0,239	0,665	1,503
Use by others	0,003	0,024	0,004	0,135	0,893	0,728	1,373
Tested correctly.	0,010	0,027	0,011	0,383	0,702	0,735	1,360
Time-consuming	0,051	0,026	0,059	1,916	0,056	0,603	1,657
Occupies phone memory.	0,004	0,028	0,005	0,155	0,877	0,620	1,613
Distraction of attention	0,001	0,025	0,001	0,050	0,960	0,664	1,506
Expensive to use	-0,006	0,025	-0,007	-0,226	0,821	0,638	1,569
A better replacement	-0,058	0,027	-0,061	-2,139	0,033	0,700	1,429
Unsatisfactory performance	0,018	0,027	0,019	0,675	0,500	0,689	1,451
Lack of support	0,037	0,026	0,042	1,437	0,151	0,683	1,464
High complexity	-0,012	0,024	-0,014	-0,478	0,633	0,683	1,464
Enables work activities	0,015	0,032	0,016	0,482	0,630	0,647	1,546
Enables easy communication	0,042	0,031	0,044	1,384	0,167	0,710	1,408
External initiated actions.	0,065	0,040	0,054	1,597	0,111	0,611	1,636
Personal initiated actions	0,046	0,039	0,040	1,175	0,240	0,598	1,673
Organisations and events	-0,061	0,035	-0,054	-1,746	0,081	0,747	1,338
Individual activities	0,071	0,049	0,054	1,448	0,148	0,514	1,946
Relative advantage and compatibility	0,063	0,048	0,047	1,322	0,186	0,454	2,205
Observability	-0,039	0,041	-0,030	-0,953	0,341	0,570	1,755
Trialability	0,057	0,048	0,040	1,188	0,235	0,503	1,989

Table 8.4 (contd.): General use of mobile apps

Model	Unstandardised Coefficients		Standardised Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig	Tolerance	VIF
Perceived technology reliability	0,099	0,043	0,073	2,301	0,022	0,570	1,753
Self-efficacy	0,016	0,047	0,011	0,340	0,734	0,515	1,941
Satisfies user expectations.	0,085	0,040	0,067	2,122	0,034	0,572	1,748
Social influence	-0,041	0,038	-0,032	-1,075	0,283	0,627	1,595
Facilitating conditions	-0,018	0,032	-0,016	-0,559	0,576	0,714	1,402
Financial cost	-0,023	0,037	-0,018	-0,616	0,538	0,639	1,565
Culture	0,003	0,040	0,002	0,074	0,941	0,587	1,703
Contributions to health care	0,090	0,037	0,076	2,439	0,015	0,584	1,713
Contributions to education and social activities	0,060	0,055	0,040	1,088	0,277	0,433	2,312
Contributions to the economy	0,003	0,044	0,002	0,074	0,941	0,585	1,711
Contributions to politics	0,067	0,038	0,051	1,728	0,084	0,668	1,497
Contributions to finance	0,017	0,041	0,013	0,427	0,670	0,591	1,692
Contributions to agriculture	-0,038	0,038	-0,032	-0,981	0,327	0,554	1,806
a. Dependent Variable: General use of mobile apps							

Table 8.4 indicates that Good innovations, Add to development, Simplicity, A better replacement, Perceived technology reliability, Satisfies user expectations and Contributions to health care are the factors that showed statistical significant predictive capability. This means that these factors have a significant effect on the adoption of mobile apps in Africa and are possible important additions to the framework.

Table 8.5: Model summary of the general use of mobile apps

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.539[a]	0,291	0,270	0,967	0,291	13,746	37	1241	0,000

Table 8.5 shows that the R^2 is 0.291, so the significant independent variables accounted for 29.1% of the variation in the dependent variable (General use of mobile apps). $R^2 > 0.25$, which is practically significant.

Table 8.6: Stepwise model summary of the general use of mobile apps

Model	**R**	**R Square**	**Adjusted R Square**	**Beta**	**Std. Error of the Estimate**	**Change Statistics**				
						R Square Change	**F Change**	**df1**	**df2**	**Sig. F Change**
Adds to development.	.401[a]	0,161	0,161	0,215	1,037	0,161	245,393	1	1277	0,000
Good innovations	.459[b]	0,211	0,210	0,181	1,006	0,050	80,638	1	1276	0,000
Relative advantage and compatibility	.491[c]	0,241	0,240	0,064	0,987	0,030	51,148	1	1275	0,000
Perceived technology reliability	.505[d]	0,255	0,253	0,087	0,978	0,014	23,606	1	1274	0,000
Contributions to health care	.512[e]	0,262	0,259	0,063	0,974	0,007	11,873	1	1273	0,001
Occupies phone memory.	.517[f]	0,268	0,264	0,071	0,970	0,006	9,683	1	1272	0,002
Satisfies user expectations.	.521[g]	0,271	0,267	0,074	0,968	0,004	6,109	1	1271	0,014
Social influence	.523[h]	0,273	0,269	0,054	0,967	0,002	3,932	1	1270	0,048

Eight variables/predictors were entered into the model through a stepwise method which accounted for 27.3% of the total variance of the dependent variable (Use of mobile apps). These variables are Adds to development, Good innovations, Relative advantage and compatibility, Perceived technology reliability, Contributions to health care, Occupies phone memory, Satisfies user expectations and Social influence. Thus, R^2 = 28.2% indicating that the variables included in this model are practically significant for the proposed framework.

The results obtained from the test of the relationship between the independent variables and the dependent variable (Business use) are given in Table 8.7.

Table 8.7: Business use

Coefficients							
Model	**Unstandardised Coefficients**		**Standardised Coefficients**	**t**	**Sig.**	**Collinearity Statistics**	
	B	**Std. Error**	**Beta**			**Tolerance**	**VIF**
(Constant)	0,333	0,168		1,984	0,048		
Good innovations	-0,003	0,025	-0,004	-0,138	0,890	0,639	1,564
Adds to development.	0,134	0,025	0,145	5,333	0,000	0,671	1,490
Formal training	0,163	0,020	0,213	8,240	0,052	0,750	1,334
Informal training	0,075	0,021	0,095	3,648	0,000	0,735	1,361
Working manual	0,054	0,020	0,070	2,710	0,007	0,751	1,331
Internet	0,069	0,021	0,085	3,223	0,001	0,724	1,382
Interpersonal communication	0,055	0,022	0,065	2,555	0,011	0,771	1,297
Anxiety	0,066	0,016	0,094	3,994	0,000	0,911	1,098
Advantageous	-0,058	0,022	-0,069	-2,617	0,009	0,726	1,377
Simplicity	0,039	0,026	0,042	1,519	0,129	0,657	1,523
Fits well.	0,028	0,024	0,032	1,168	0,243	0,665	1,503
Use by others.	0,023	0,019	0,031	1,171	0,242	0,728	1,373
Tested correctly.	0,010	0,022	0,012	0,448	0,654	0,735	1,360
Time-consuming	0,000	0,022	0,001	0,023	0,982	0,603	1,657
Occupies phone memory.	0,043	0,023	0,053	1,862	0,063	0,620	1,613
Distraction of attention	-0,014	0,021	-0,019	-0,680	0,497	0,664	1,506
Expensive to use	-0,023	0,020	-0,031	-1,100	0,272	0,638	1,569
A better replacement	-0,019	0,022	-0,022	-0,838	0,402	0,700	1,429
Unsatisfactory performance	0,037	0,022	0,045	1,661	0,097	0,689	1,451
Lack of support	0,011	0,021	0,014	0,512	0,608	0,683	1,464
High complexity	0,012	0,020	0,017	0,611	0,541	0,683	1,464
Enables work activities.	0.073	0.024	0.088	3.045	0.002	0.647	1.546
Enables easy communication.	-0.042	0.023	-0.05	-1.81	0.071	0.71	1.408
External initiated actions	0.288	0.031	0.281	9.395	0.000	0.611	1.636
Personal initiated actions	0.034	0.03	0.034	1.136	0.256	0.598	1.673
Organisations and events	0.038	0.026	0.039	1.427	0.154	0.747	1.338
Individual activities	-0.103	0.037	-0.09	-2.773	0.006	0.514	1.946
Relative advantage and compatibility	0,107	0,039	0,090	2,715	0,007	0,454	2,205
Observability	0,084	0,034	0,074	2,500	0,013	0,570	1,755
Trialability	0,058	0,040	0,046	1,462	0,144	0,503	1,989

Table 8.7 (contd.): Business use

Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Perceived technology reliability	-0,057	0,035	-0,048	-1,610	0,108	0,570	1,753
Self-efficacy	-0,030	0,039	-0,024	-0,774	0,439	0,515	1,941
Satisfies user expectations.	0,087	0,033	0,078	2,651	0,008	0,572	1,748
Social influence	-0,088	0,031	-0,079	-2,801	0,005	0,627	1,595
Facilitating conditions	-0,005	0,027	-0,005	-0,181	0,856	0,714	1,402
Financial cost	0,026	0,030	0,024	0,863	0,388	0,639	1,565
Culture	0,149	0,033	0,132	4,518	0,000	0,587	1,703
Contributions to health care	0,042	0,030	0,041	1,397	0,163	0,584	1,713
Contributions to education and social activities	-0,116	0,045	-0,087	-2,564	0,010	0,433	2,312
Contributions to the economy	-0,012	0,036	-0,010	-0,329	0,742	0,585	1,711
Contributions to politics	-0,087	0,032	-0,075	-2,749	0,006	0,668	1,497
Contributions to finance	-0,086	0,033	-0,075	-2,580	0,010	0,591	1,692
Contributions to agriculture	0,107	0,031	0,102	3,406	0,001	0,554	1,806
a. Dependent Variable: Business use							

Table 8.7 indicates that Adds to development, Informal training, Working manual, Internet, Interpersonal communication, Anxiety, Advantageous, Enables work activities, Enables easy communication, External initiated actions, Individual activities, Relative advantage and compatibility, Observability, Satisfies user expectations, Social influence, Culture, Contributions to education and social activities, Contributions to politics, Contributions to finance and Contributions to agriculture are the factors that showed statistical significant predictive capability. It implies that these factors influence the use of mobile apps for business purposes.

Table 8.8: Model summary of Business use

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.617[a]	0,380	0,362	0,79478	0,380	20,574	37	1241	0,000

Table 8.8 shows that the R^2 is 0.380, so the significant independent variables accounted for 38.0% of the variation in the dependent variable (Business use). $R^2 > 0.25$, which is practically significant.

Table 8.9: Stepwise model for Business use

Model Summary										
Model	**R**	**R Square**	**Adjusted R Square**	**Beta**	**Std. Error of the Estimate**	**Change Statistics**				
						R Square Change	**F Change**	**df1**	**df2**	**Sig. F Change**
Enables work activities.	.371[a]	0,138	0,137	0,216	0,92416	0,138	203,844	1	1277	0,000
Relative and compatibility	.477[b]	0,227	0,226	0,108	0,87512	0,090	148,146	1	1276	0,000
Culture	.512[c]	0,262	0,261	0,138	0,85544	0,035	60,367	1	1275	0,000
Adds to development	.531[d]	0,282	0,280	0,149	0,84431	0,020	34,861	1	1274	0,000
Anxiety	.546[e]	0,298	0,295	0,088	0,83524	0,016	28,798	1	1273	0,000
Informal training	.557[f]	0,310	0,307	0,093	0,82809	0,013	23,072	1	1272	0,000
Internet	.565[g]	0,320	0,316	0,090	0,82289	0,009	17,144	1	1271	0,000
Contributions to finance	.574[h]	0,330	0,326	-0,082	0,81692	0,010	19,646	1	1270	0,000
Satisfies user expectations.	.580[i]	0,337	0,332	0,085	0,81312	0,007	12,898	1	1269	0,000
Working manual	.584[j]	0,341	0,336	0,079	0,81062	0,005	8,842	1	1268	0,003
Interpersonal communication	.588[k]	0,345	0,340	0,070	0,80834	0,004	8,156	1	1267	0,004
Advantageous	.591[l]	0,349	0,343	-0,074	0,80622	0,004	7,657	1	1266	0,006
Contributions to agriculture	.594[m]	0,353	0,346	0,111	0,80437	0,003	6,831	1	1265	0,009
Contributions to politics	.597[n]	0,356	0,349	-0,073	0,80259	0,003	6,645	1	1264	0,010
Observability	.600[o]	0,360	0,352	0,090	0,80058	0,004	7,345	1	1263	0,007
Social influence	.604[p]	0,364	0,356	-0,076	0,79822	0,004	8,488	1	1262	0,004
Contributions to educations and social activities	.606[q]	0,367	0,358	-0,077	0,79680	0,003	5,481	1	1261	0,019
Enables easy comm.	.608[r]	0,370	0,361	0,060	0,79546	0,003	5,246	1	1260	0,022

18 variables were entered into the model through a stepwise method which accounted for 37.0% of the total variance of the dependent variable (Business use). These variables are Enables work activities, Relative advantage and compatibility, Culture, Adds to development, Anxiety, Informal training, Internet, Contributions to finance. Satisfies user expectations, Working manual, Interpersonal communication, Advantageous, Contributions to agriculture, Contributions to politics, Observability, Social influence, Contributions to education and social activities and Enables easy communication. Thus, R^2 > 25.0%, indicating that the variables included in this model are practically significant for the proposed framework.

Table 8.10 shows the output from the relationship test between the independent variables and the dependent variable (individual use).

Table 8.10: Individual use

Coefficients							
Model	**Unstandardised Coefficients**		**Standardised Coefficients**	**t**	**Sig.**	**Collinearity Statistics**	
	B	**Std. Error**	**Beta**			**Tolerance**	**VIF**
(Constant)	0,465	0,136		3,415	0,001		
Good innovations	0,137	0,020	0,179	6,784	0,000	0,639	1,564
Adds to development.	0,182	0,020	0,230	8,942	0,000	0,671	1,490
Formal training	0,006	0,016	0,009	0,350	0,726	0,750	1,334
Informal training	0,022	0,017	0,032	1,289	0,198	0,735	1,361
Working manual	-0,004	0,016	-0,007	-0,272	0,786	0,751	1,331
Internet	0,047	0,017	0,066	2,674	0,008	0,724	1,382
Interpersonal communication	0,065	0,017	0,090	3,742	0,000	0,771	1,297
Anxiety	-0,020	0,013	-0,034	-1,537	0,124	0,911	1,098
Advantageous	0,014	0,018	0,020	0,806	0,421	0,726	1,377
Simplicity	0,025	0,021	0,031	1,192	0,234	0,657	1,523
Fits well	0,030	0,019	0,041	1,578	0,115	0,665	1,503
Use by others	0,006	0,016	0,010	0,405	0,685	0,728	1,373
Tested correctly.	0,031	0,018	0,044	1,779	0,076	0,735	1,360
Time-consuming	0,064	0,018	0,099	3,653	0,000	0,603	1,657
Occupies phone memory.	0,002	0,019	0,002	0,087	0,931	0,620	1,613
Distraction of attention	-0,028	0,017	-0,043	-1,657	0,098	0,664	1,506
Expensive to use	0,033	0,017	0,053	2,008	0,045	0,638	1,569
A better replacement	-0,009	0,018	-0,013	-0,499	0,618	0,700	1,429
Unsatisfactory performance	-0,006	0,018	-0,009	-0,343	0,732	0,689	1,451
Lack of support	-0,023	0,017	-0,035	-1,362	0,174	0,683	1,464
High complexity	-0,009	0,016	-0,015	-0,577	0,564	0,683	1,464
Enables work activities.	-0.031	0.020	-0.043	-1.535	0.125	0.647	1.546
Enables easy communication.	0.031	0.019	0.042	1.601	0.110	0.710	1.408
External initiated actions	0.071	0.025	0.079	2.777	0.006	0.611	1.636
Personal initiated actions	0.160	0.025	0.188	6.488	0.000	0.598	1.673
Organisations and events	-0.066	0.022	-0.078	-3.022	0.003	0.747	1.338
Individual activities	0.104	0.031	0.105	3.379	0.001	0.514	1.946
Relative advantage and compatibility	0,054	0,032	0,053	1,701	0,089	0,454	2,205
Observability	0,051	0,027	0,052	1,876	0,061	0,570	1,755
Trialability	0,065	0,032	0,060	2,022	0,043	0,503	1,989

Table 8.10 (contd.): Individual use

Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Perceived technology reliability	0,009	0,029	0,009	0,332	0,740	0,570	1,753
Self-efficacy	0,090	0,032	0,084	2,848	0,004	0,515	1,941
Satisfies user expectations.	0,015	0,027	0,016	0,559	0,576	0,572	1,748
Social influence	0,021	0,026	0,022	0,835	0,404	0,627	1,595
Facilitating conditions	-0,001	0,022	-0,001	-0,057	0,954	0,714	1,402
Financial cost	-0,017	0,024	-0,018	-0,687	0,492	0,639	1,565
Culture	-0,016	0,027	-0,016	-0,587	0,558	0,587	1,703
Contributions to health care	-0,043	0,024	-0,048	-1,754	0,080	0,584	1,713
Contributions to education and social activities	0,104	0,037	0,091	2,837	0,005	0,433	2,312
Contributions to the economy	-0,016	0,029	-0,015	-0,546	0,585	0,585	1,711
Contributions to politics	0,055	0,026	0,056	2,160	0,031	0,668	1,497
Contributions to finance	0,045	0,027	0,046	1,663	0,097	0,591	1,692
Contributions to agriculture	-0,070	0,026	-0,078	-2,733	0,006	0,554	1,806
a. Dependent Variable: Individual use							

Table 8.10 indicates that Good innovations, Add to development, Internet, Interpersonal communication, Time-consuming, Expensive to use, External initiated actions, Personal initiated actions, Organisations and events, Individual activities, Trialability. Self-efficacy, Contributions to education and social activities, Contributions to finance and Contributions to agriculture are factors that showed statistically significant predictive capability. This means that these factors have a positive effect on the individual adoption and diffusion of mobile apps.

Table 8.11: Model summary of Individual activities

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.669[a]	0,447	0,431	0,64418	0,447	27,126	37	1241	0,000

Table 8.11 shows that the R^2 is 0.447, so that the significant independent variables accounted for 47.7% of the variation in the dependent variable (Individual Activities). $R^2 > 0.25$, which is practically significant.

Table 8.12: Stepwise model for Individual use

Model Summary										
Model	**R**	**R Square**	**Adjusted R Square**	**Beta**	**Std. Error of the Estimate**	**Change Statistics**				
						R Square Change	**F Change**	**df1**	**df2**	**Sig. F Change**
Add to development.	.489[a]	0,239	0,238	0,239	0,74507	0,239	400,926	1	1277	0,000
Self-efficacy	.558[b]	0,311	0,310	0,093	0,70919	0,072	133,493	1	1276	0,000
Good innovations	.599[c]	0,359	0,357	0,195	0,68444	0,048	94,935	1	1275	0,000
Trialability	.617[d]	0,380	0,378	0,076	0,67304	0,022	44,557	1	1274	0,000
Internet	.628[e]	0,394	0,392	0,068	0,66584	0,014	28,694	1	1273	0,000
Interpersonal communication	.634[f]	0,402	0,399	0,096	0,66162	0,008	17,312	1	1272	0,000
Time-consuming	.641[g]	0,411	0,408	0,090	0,65709	0,009	18,606	1	1271	0,000
Contributions to finance	.646[h]	0,418	0,414	0,052	0,65340	0,007	15,377	1	1270	0,000
Tested correctly	.650[i]	0,422	0,418	0,047	0,65108	0,005	10,056	1	1269	0,002
Observability	.653[j]	0,426	0,421	0,062	0,64945	0,003	7,410	1	1268	0,007
Contributions to agriculture	.655[k]	0,428	0,423	-0,084	0,64825	0,003	5,701	1	1267	0,017
Contributions to education and social activities	.657[l]	0,432	0,427	0,099	0,64649	0,004	7,878	1	1266	0,005
Fits well.	.659[m]	0,434	0,429	0,059	0,64538	0,002	5,357	1	1265	0,021
Individual activities	.660[n]	0,436	0,430	0,057	0,64457	0,002	4,178	1	1264	0,041
Contributions to health care	.662[o]	0,438	0,431	-0,054	0,64380	0,002	4,052	1	1263	0,044

Table 8.12 shows that 15 variables entered into the model through a stepwise method accounted for 43.8% of the total variance of the dependent variable (Individual use). These variables are Adds to development, Self-efficacy, Good innovations, Trialability, Internet, Interpersonal communication, Time-consuming, Contributions to finance, Tested correctly, Observability, Contributions to agriculture, Contributions to education and social activities, Fits well, Individual activities and Contributions to health care. Thus, R2 > 25.0%, indicating that the variables included in this model are practically significant for the proposed framework.

Table 8.13 shows the results of the test of the relationship between the independent variable and the dependent variable (Late majority and Laggards).

Table 8.13: Late majority and Laggards

Coefficients							
Model	**Unstandardised Coefficients**		**Standardised Coefficients**	**t**	**Sig.**	**Collinearity Statistics**	
	B	**Std. Error**	**Beta**			**Tolerance**	**VIF**
(Constant)	0,665	0,176		3,787	0,000		
Good innovations	0,007	0,026	0,009	0,279	0,780	0,639	1,564
Adds to development.	0,006	0,026	0,007	0,242	0,809	0,671	1,490
Formal training	0,069	0,021	0,095	3,345	0,001	0,750	1,334
Informal training	0,036	0,022	0,047	1,647	0,100	0,735	1,361
Working manual	0,026	0,021	0,036	1,263	0,207	0,751	1,331
Internet	0,060	0,022	0,076	2,658	0,008	0,724	1,382
Interpersonal communication	0,000	0,022	0,000	0,017	0,986	0,771	1,297
Anxiety	0,005	0,017	0,008	0,317	0,751	0,911	1,098
Advantageous	0,014	0,023	0,017	0,602	0,547	0,726	1,377
Simplicity	-0,027	0,027	-0,031	-1,011	0,312	0,657	1,523
Fits well.	0,000	0,025	0,000	0,009	0,993	0,665	1,503
Use by others	0,075	0,020	0,106	3,690	0,000	0,728	1,373
Tested correctly.	0,016	0,023	0,020	0,717	0,473	0,735	1,360
Time-consuming	-0,032	0,023	-0,044	-1,392	0,164	0,603	1,657
Occupies phone memory.	0,064	0,024	0,083	2,661	0,008	0,620	1,613
Distraction of attention	-0,014	0,022	-0,019	-0,635	0,525	0,664	1,506
Expensive to use	0,006	0,021	0,008	0,262	0,793	0,638	1,569
A better replacement	-0,050	0,023	-0,063	-2,157	0,031	0,700	1,429
Unsatisfactory performance	0,005	0,023	0,006	0,196	0,845	0,689	1,451
Lack of support	-0,022	0,022	-0,029	-0,972	0,331	0,683	1,464
High complexity	0,058	0,021	0,082	2,770	0,006	0,683	1,464
Enables work activities.	0.021	0.027	0.026	0.771	0.441	0.647	1.546
Enables easy communication.	-0.014	0.026	-0.018	-0.556	0.578	0.71	1.408
External initiated actions	0.034	0.034	0.034	0.997	0.319	0.611	1.636
Personal initiated actions	-0.055	0.033	-0.057	-1.628	0.004	0.598	1.673
Organisations and events	0.096	0.030	0.101	3.258	0.001	0.747	1.338
Individual activities	0.032	0.042	0.028	0.756	0.450	0.514	1.946
Relative advantage and compatibility	-0,070	0,041	-0,062	-1,711	0,087	0,454	2,205
Observability	-0,027	0,035	-0,025	-0,780	0,436	0,570	1,755
Trialability	-0,019	0,041	-0,016	-0,465	0,642	0,503	1,989

Table 8.13 (contd.): Late majority and Laggards

Coefficients							
Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Perceived technology reliability	0,082	0,037	0,072	2,231	0,026	0,570	1,753
Self-efficacy	0,105	0,041	0,088	2,579	0,010	0,515	1,941
Satisfies user expectations.	-0,093	0,034	-0,087	-2,699	0,007	0,572	1,748
Social influence	-0,077	0,033	-0,073	-2,351	0,019	0,627	1,595
Facilitating conditions	0,023	0,028	0,024	0,814	0,416	0,714	1,402
Financial cost	0,160	0,031	0,156	5,091	0,000	0,639	1,565
Culture	0,053	0,034	0,049	1,527	0,127	0,587	1,703
Contributions to health care	-0,053	0,032	-0,054	-1,678	0,094	0,584	1,713
Contributions to education and social activities	0,034	0,047	0,027	0,721	0,471	0,433	2,312
Contributions to the economy	0,140	0,038	0,118	3,698	0,000	0,585	1,711
Contributions to politics	0,125	0,033	0,113	3,779	0,000	0,668	1,497
Contributions to finance	0,035	0,035	0,032	1,016	0,310	0,591	1,692
Contributions to agriculture	0,035	0,033	0,035	1,070	0,285	0,554	1,806
a. Dependent Variable: Late majority and Laggards							

Table 8.13 indicates that Informal training, Internet, Use by others, Occupies phone memory space, A better replacement, High complexity, Personal initiated actions, Organisations and events, Perceived technology reliability, Self-efficacy, Satisfies user expectations, Social influence, Financial cost, Contributions to the economy, and Contributions to politics are factors that showed statistically significant predictive capability. This means that these factors have a significant impact on the adoption of mobile apps by the late majority and laggard adopters' category.

Table 8.14: Model summary for the Late majority and Laggard category

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.506[a]	0,256	0,234	0,83069	0,256	11,555	37	1241	0,000

Table 8.14 shows that the R^2 is 0.256, so that the significant independent variables accounted for 25.6% of the variation in the dependent variable (Late majority and Laggard category). $R^2 >$ 0.25, which is practically significant.

Table 8.15: Stepwise model for the late majority and laggards

Model Summary										
Model	**R**	**R Square**	**Adjusted R Square**	**Beta**	**Std. Error of the Estimate**	**Change Statistics**				
						R Square Change	**F Change**	**df 1**	**df2**	**Sig. F Change**
Contributions to agriculture	.338[a]	0,114	0,113	0,161	0,89369	0,114	164,569	1	1277	0,000
Contributions to politics	.390[b]	0,152	0,151	0,118	0,87477	0,038	56,833	1	1276	0,000
Personal initiated actions	.423[c]	0,179	0,177	0,096	0,86117	0,027	41,623	1	1275	0,000
Used by others.	.443[d]	0,196	0,194	0,112	0,85221	0,018	27,946	1	1274	0,000
Self-efficacy	.455[e]	0,207	0,204	0,104	0,84697	0,010	16,831	1	1273	0,000
Contributions to the economy	.461[f]	0,213	0,209	0,121	0,84404	0,006	9,838	1	1272	0,002
Satisfies user expectations.	.467[g]	0,218	0,214	-0,109	0,84142	0,006	8,954	1	1271	0,003
Organisations and events	.474[h]	0,225	0,220	0,074	0,83826	0,006	10,604	1	1270	0,001
High complexity	.479[i]	0,229	0,224	0,072	0,83628	0,004	7,000	1	1269	0,008
Social influence	.483[j]	0,233	0,227	-0,072	0,83460	0,004	6,120	1	1268	0,013
Perceived technology reliability	.486[k]	0,237	0,230	0,070	0,83292	0,004	6,131	1	1267	0,013
A better replacement	.489[l]	0,239	0,232	-0,065	0,83166	0,003	4,840	1	1266	0,028
Occupies phone memory.	.492[m]	0,242	0,235	0,057	0,83034	0,003	5,020	1	1265	0,025
Informal training	.495[n]	0,265	0,237	0,055	0,82930	0,002	4,178	1	1264	0,041

Table 8.15 shows that 12 variables entered into the model through a stepwise method accounted for 26.7% of the total variance of the dependent variable (Late majority and laggards). These variables are Contributions to agriculture, Contributions to politics, Formal training, Use by others, Self-efficacy, Contributions to the economy, Satisfies user expectations, Organisations and events, High complexity, Social influence, Perceived technology reliability, A better replacement, Occupies phone memory, and Informal training. Thus, $R^2 > 25.0\%$, indicating that the variables included in this model are practically significant for the proposed framework.

Table 8.16 shows the results of the test of the relationship between the independent variable and the dependent variable (Non-adopter's category).

Table 8.16: Non-adopter's category

Coefficients							
Model	**Unstandardised Coefficients**		**Standardised Coefficients**	**t**	**Sig.**	**Collinearity Statistics**	
	B	**Std. Error**	**Beta**			**Tolerance**	**VIF**
(Constant)	0,984	0,182		5,402	0,000		
Good innovations	-0,036	0,027	-0,040	-1,342	0,180	0,639	1,564
Adds to development.	-0,035	0,027	-0,037	-1,298	0,195	0,671	1,490
Formal training	0,114	0,021	0,144	5,298	0,000	0,750	1,334
Informal training	0,013	0,022	0,016	0,575	0,566	0,735	1,361
Working manual	-0,006	0,022	-0,008	-0,289	0,773	0,751	1,331
Internet	-0,012	0,023	-0,015	-0,529	0,597	0,724	1,382
Interpersonal communication	0,018	0,023	0,020	0,757	0,449	0,771	1,297
Anxiety	0,004	0,018	0,006	0,237	0,813	0,911	1,098
Advantageous	-0,011	0,024	-0,013	-0,471	0,638	0,726	1,377
Simplicity	0,010	0,028	0,011	0,368	0,713	0,657	1,523
Fits well.	0,027	0,026	0,030	1,035	0,301	0,665	1,503
Use by others	0,073	0,021	0,096	3,470	0,001	0,728	1,373
Tested correctly.	0,016	0,024	0,019	0,688	0,492	0,735	1,360
Time-consuming	-0,017	0,024	-0,022	-0,732	0,464	0,603	1,657
Occupies phone memory.	0,043	0,025	0,052	1,729	0,084	0,620	1,613
Distraction of attention	0,053	0,022	0,068	2,364	0,018	0,664	1,506
Expensive to use	-0,022	0,022	-0,029	-0,999	0,318	0,638	1,569
A better replacement	0,032	0,024	0,037	1,330	0,184	0,700	1,429
Unsatisfactory performance	-0,036	0,024	-0,042	-1,483	0,138	0,689	1,451
Lack of support	0,086	0,023	0,106	3,723	0,000	0,683	1,464
High complexity	0,095	0,022	0,124	4,342	0,000	0,683	1,464
Enables work activities.	0.101	0.028	0.116	3.576	0.000	0.647	1.546
Enables easy communication.	0.016	0.027	0.019	0.603	0.546	0.71	1.408
External initiated actions	0.07	0.036	0.065	1.945	0.052	0.611	1.636
Personal initiated actions	-0.093	0.035	-0.09	-2.644	0.008	0.598	1.673
Organisations and events	-0.012	0.031	-0.012	-0.403	0.687	0.747	1.338
Individual activities	-0.049	0.044	-0.041	-1.117	0.264	0.514	1.946
Relative advantage and compatibility	-0,053	0,043	-0,044	-1,251	0,211	0,454	2,205
Observability	0,081	0,036	0,069	2,223	0,026	0,570	1,755
Trialability	-0,125	0,043	-0,097	-2,915	0,004	0,503	1,989

Table 8.16 (contd.): Non-adopter's category

Coefficients							
Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Perceived technology reliability	0,056	0,038	0,046	1,477	0,140	0,570	1,753
Self-efficacy	-0,006	0,042	-0,005	-0,146	0,884	0,515	1,941
Using mobile apps satisfies user expectations.	-0,148	0,036	-0,129	-4,151	0,000	0,572	1,748
Social influence	0,004	0,034	0,004	0,125	0,901	0,627	1,595
Facilitating conditions	0,127	0,029	0,122	4,395	0,000	0,714	1,402
Financial cost	0,175	0,033	0,158	5,378	0,000	0,639	1,565
Culture	0,158	0,036	0,136	4,436	0,000	0,587	1,703
Contributions to health care	-0,012	0,033	-0,011	-0,371	0,711	0,584	1,713
Contributions to education and social activities	-0,118	0,049	-0,087	-2,417	0,016	0,433	2,312
Contributions to the economy	0,094	0,039	0,073	2,383	0,017	0,585	1,711
Contributions to politics	0,062	0,034	0,052	1,798	0,072	0,668	1,497
Contributions to finance	-0,048	0,036	-0,040	-1,322	0,186	0,591	1,692
Contributions to agriculture	0,039	0,034	0,037	1,156	0,248	0,554	1,806
a. Dependent Variable: Non-adopter's category							

Table 8.16 indicates that Formal training, Use by others, Distraction of attention, It lacked support, High complexity, Enables work activities, Observability, Trialability, Satisfies user expectations, Facilitating conditions, Financial cost, Culture, Contributions to education and social activities, and Contributions to the economy are factors that showed statistically significant predictive capability. This means that these factors have an influencing effect on the non-adopter's category regarding mobile apps adoption and diffusion.

Table 8.17**:** Model summary for Non-adopter's category

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.559[a]	0,312	0,292	0,86144	0,312	15,234	37	1241	0,000

Table 8.17 shows that the R^2 is 0.312 so that the significant independent variables accounted for 31.2% of the variation in the dependent variable (Non-adopter category). $R^2 > 0.25$, which is practically significant.

Table 8.18: Stepwise model for Non-adopter's category

Model Summary										
Model	**R**	**R Square**	**Adjusted R Square**	**Beta**	**Std. Error of the Estimate**	**Change Statistics**				
						R Square Change	**F Change**	**df1**	**df2**	**Sig. F Change**
Financial cost	.329[a]	0,108	0,107	0,144	0,96715	0,108	154,727	1	1277	0,000
Formal training	.409[b]	0,167	0,166	0,146	0,93494	0,059	90,502	1	1276	0,000
High complexity	.450[c]	0,202	0,201	0,109	0,91525	0,035	56,509	1	1275	0,000
Use by others	.474[d]	0,224	0,222	0,111	0,90297	0,022	35,905	1	1274	0,000
Culture	.489[e]	0,239	0,236	0,140	0,89449	0,015	25,261	1	1273	0,000
Satisfies user expectations.	.500[f]	0,250	0,247	-0,139	0,88842	0,011	18,460	1	1272	0,000
Facilitating conditions	.512[g]	0,263	0,258	0,132	0,88149	0,012	21,091	1	1271	0,000
It lacked support.	.522[h]	0,273	0,268	0,105	0,87581	0,010	17,543	1	1270	0,000
Distraction of attention	.528[i]	0,279	0,273	0,075	0,87254	0,006	10,538	1	1269	0,001
Contributions to educations and social activities	.534[j]	0,285	0,279	-0,096	0,86903	0,006	11,263	1	1268	0,001
Contributions to the economy	.538[k]	0,289	0,283	0,077	0,86686	0,004	7,367	1	1267	0,007
Trialability	.541[l]	0,293	0,286	-0,094	0,86510	0,003	6,152	1	1266	0,013
Observability	.544[m]	0,296	0,289	0,072	0,86307	0,004	6,960	1	1265	0,008
Good innovations	.547[n]	0,299	0,291	-0,056	0,86195	0,002	4,300	1	1264	0,038
Perceived technology reliability	.549[o]	0,301	0,293	0,064	0,86071	0,003	4,645	1	1263	0,031

Table 8.18 shows that 15 variables entered into the model through a stepwise method accounted for 30.1% of the total variance of the dependent variable (Non-adopter's category). These variables are Financial cost, Formal training, High complexity, Use by others, Culture, Satisfies user expectations, Facilitating conditions, Lack of support, Distraction of attention, Contributions to educations and social activities, Contributions to the economy, Trialability, Observability, Good innovations, and Perceived technology reliability. Thus, R^2 > 25.0%, indicating that the variables included in this model are practically significant for the proposed framework.

Table 8.19 shows the results of the test of the relationship between the independent variable and the dependent variable (Innovator's category).

Table 8.19: Innovator's category

Coefficients							
Model	**Unstandardised Coefficients**		**Standardised Coefficients**	**t**	**Sig.**	**Collinearity Statistics**	
	B	**Std. Error**	**Beta**			**Tolerance**	**VIF**
(Constant)	0,493	0,156		3,155	0,002		
Good innovations	0,026	0,023	0,033	1,143	0,253	0,639	1,564
Adds to development.	-0,089	0,023	-0,109	-3,814	0,000	0,671	1,490
Formal training	0,061	0,018	0,090	3,340	0,001	0,750	1,334
Informal training	0,031	0,019	0,044	1,625	0,104	0,735	1,361
Working manual	-0,007	0,019	-0,010	-0,354	0,723	0,751	1,331
Internet	0,088	0,020	0,121	4,425	0,000	0,724	1,382
Interpersonal communication	-0,006	0,020	-0,008	-0,314	0,753	0,771	1,297
Anxiety	0,007	0,015	0,012	0,492	0,623	0,911	1,098
Advantageous	-0,007	0,021	-0,010	-0,354	0,724	0,726	1,377
Simplicity	0,027	0,024	0,032	1,107	0,269	0,657	1,523
Fits well.	0,044	0,022	0,057	1,987	0,047	0,665	1,503
Use by others.	-0,013	0,018	-0,020	-0,727	0,467	0,728	1,373
Tested correctly	0,040	0,020	0,053	1,959	0,050	0,735	1,360
Time-consuming	-0,017	0,020	-0,026	-0,865	0,387	0,603	1,657
Occupies phone memory.	-0,020	0,021	-0,028	-0,953	0,341	0,620	1,613
Distraction of attention	0,021	0,019	0,031	1,096	0,273	0,664	1,506
Expensive to use	-0,011	0,019	-0,016	-0,554	0,580	0,638	1,569
A better replacement	-0,002	0,021	-0,002	-0,090	0,929	0,700	1,429
Unsatisfactory performance	0,048	0,021	0,064	2,291	0,022	0,689	1,451
Lack of support	-0,018	0,020	-0,025	-0,895	0,371	0,683	1,464
High complexity	-0,058	0,019	-0,088	-3,120	0,002	0,683	1,464
Enables work activities.	0.018	0.023	0.026	0.787	0.431	0.647	1.546
Enables easy communication.	0.036	0.023	0.050	1.589	0.112	0.71	1.408
External initiated actions	0.07	0.03	0.080	2.355	0.019	0.611	1.636
Personal initiated actions	-0.033	0.029	-0.038	-1.121	0.263	0.598	1.673
Organisations and events	0.078	0.026	0.092	3.020	0.003	0.747	1.338
Individual activities	0.028	0.036	0.028	0.764	0.445	0.514	1.946
Relative advantage and compatibility	0,219	0,037	0,207	5,989	0,000	0,454	2,205
Observability	0,011	0,031	0,010	0,338	0,735	0,570	1,755
Trialability	0,011	0,037	0,010	0,292	0,770	0,503	1,989

Table 8.19 (contd.): Innovator's category

Coefficients							
Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Perceived technology reliability	0,048	0,033	0,045	1,473	0,141	0,570	1,753
Self-efficacy	0,050	0,036	0,045	1,387	0,166	0,515	1,941
Satisfies user expectations.	0,050	0,031	0,050	1,632	0,103	0,572	1,748
Social influence	0,009	0,029	0,009	0,311	0,756	0,627	1,595
Facilitating conditions	0,047	0,025	0,053	1,911	0,056	0,714	1,402
Financial cost	0,002	0,028	0,002	0,061	0,951	0,639	1,565
Culture	0,044	0,031	0,043	1,430	0,153	0,587	1,703
Contributions to health care	0,072	0,028	0,079	2,581	0,010	0,584	1,713
Contributions to education and social activities	-0,001	0,042	-0,001	-0,017	0,987	0,433	2,312
Contributions to the economy	0,082	0,034	0,074	2,436	0,015	0,585	1,711
Contributions to politics	-0,009	0,029	-0,009	-0,306	0,759	0,668	1,497
Contributions to finance	-0,042	0,031	-0,041	-1,341	0,180	0,591	1,692
Contributions to agriculture	0,044	0,029	0,047	1,507	0,132	0,554	1,806
a. Dependent Variable: Innovators							

Table 8.19 indicates that Adds to development, Formal training, Internet, Fits well, Tested correctly, Unsatisfactory performance, High complexity, External initiated actions, Organisations and events, Relative advantage and compatibility, Contributions to health care, and Contributions to economy showed statistical significant predictive capability. This means that these factors have a significant impact on the Innovator's perceptions of mobile apps adoption and diffusion.

Table 8.20: Model summary for Innovator's category

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.571[a]	0,326	0,306	0,73808	0,326	16,203	37	1241	0,000

Table 8.20 shows that the R^2 is 0.326, so the significant independent variables predicted 32.6% of the variation in the dependent variable (Innovator category). $R^2 > 0.25$, indicating practical significance.

Table 8.21: Stepwise model of the Innovator's category

Model Summary										
Model	**R**	**R Square**	**Adjusted R Square**	**Beta**	**Std. Error of the Estimate**	**Change Statistics**				
						R Square Change	**F Change**	**df1**	**df2**	**Sig. F Change**
Relative advantage and compatibility	.455[a]	0,207	0,206	0,228	0,78919	0,207	332,799	1	1277	0,000
Informal training	.485[b]	0,235	0,234	0,124	0,77516	0,029	47,646	1	1276	0,000
Contributions to health care	.507[c]	0,257	0,255	0,093	0,76447	0,022	36,935	1	1275	0,000
Perceived technology reliability	.519[d]	0,270	0,267	0,066	0,75817	0,013	22,284	1	1274	0,000
Formal training	.528[e]	0,278	0,275	0,096	0,75395	0,009	15,326	1	1273	0,000
Fits well.	.534[f]	0,285	0,281	0,063	0,75089	0,006	11,385	1	1272	0,001
Add to development.	.539[g]	0,290	0,287	-0,096	0,74813	0,006	10,405	1	1271	0,001
Facilitating conditions	.545[h]	0,297	0,292	0,064	0,74512	0,006	11,281	1	1270	0,001
High complexity	.550[i]	0,303	0,298	-0,102	0,74224	0,006	10,869	1	1269	0,001
Contributions to the economy	.555[j]	0,308	0,302	0,068	0,73997	0,005	8,822	1	1268	0,003
Culture	.557[k]	0,310	0,304	0,056	0,73880	0,003	5,006	1	1267	0,025
Unsatisfactory performance	.559[l]	0,313	0,306	0,055	0,73784	0,002	4,288	1	1266	0,039
Tested correctly.	.561[m]	0,315	0,308	0,051	0,73701	0,002	3,875	1	1265	0,049
Satisfies user expectations.	.563[n]	0,317	0,309	0,059	0,73617	0,002	3,862	1	1264	0,050

Table 8.21 shows that 14 variables entered into the model through a stepwise method accounted for 29.7% of the total variance of the dependent variable (Innovators). These variables are Relative advantage and compatibility, Informal training, Contributions to health care, Perceived technology reliability, Formal training, Fits well, Adds to development, Facilitating conditions, High complexity, Contributions to the economy, Culture, Unsatisfactory performance, Tested correctly and Satisfies user expectations. Thus, R^2 > 25.0%, indicating that the variables included in this model are practically significant for the proposed framework.

Table 8.22 shows the results of the test of the relationship between the independent variable and the dependent variable (Early adopters).

Table 8.22: Early adopter's category

Coefficients							
Model	**Unstandardised Coefficients**		**Standardised Coefficients**	**t**	**Sig.**	**Collinearity Statistics**	
	B	**Std. Error**	**Beta**			**Tolerance**	**VIF**
(Constant)	0,430	0,159		2,706	0,007		
Good innovations	0,043	0,023	0,053	1,822	0,069	0,639	1,564
Add to development.	-0,028	0,024	-0,034	-1,182	0,237	0,671	1,490
Formal training	0,035	0,019	0,051	1,889	0,059	0,750	1,334
Informal training	0,004	0,020	0,005	0,195	0,845	0,735	1,361
Working manual	0,008	0,019	0,012	0,450	0,653	0,751	1,331
Internet	0,013	0,020	0,017	0,623	0,533	0,724	1,382
Interpersonal communication	0,005	0,020	0,007	0,265	0,791	0,771	1,297
Anxiety	-0,027	0,016	-0,043	-1,737	0,083	0,911	1,098
Advantageous	0,016	0,021	0,021	0,773	0,440	0,726	1,377
Simplicity	-0,016	0,024	-0,019	-0,656	0,512	0,657	1,523
Fits well.	0,056	0,022	0,072	2,512	0,012	0,665	1,503
Use by others.	-0,006	0,018	-0,008	-0,302	0,763	0,728	1,373
Tested correctly.	0,017	0,021	0,023	0,840	0,401	0,735	1,360
Time-consuming	0,003	0,021	0,004	0,143	0,886	0,603	1,657
Occupies phone memory.	0,011	0,022	0,015	0,494	0,622	0,620	1,613
Distraction of attention	-0,028	0,020	-0,041	-1,440	0,150	0,664	1,506
Expensive to use	0,017	0,019	0,026	0,883	0,377	0,638	1,569
A better replacement	-0,022	0,021	-0,029	-1,036	0,300	0,700	1,429
Unsatisfactory performance	0,029	0,021	0,039	1,373	0,170	0,689	1,451
Lack of support	0,030	0,020	0,043	1,513	0,131	0,683	1,464
High complexity	-0,036	0,019	-0,054	-1,899	0,058	0,683	1,464
Enables work activities.	-0.001	0.023	-0.002	-0.047	0.963	0.647	1.546
Enables easy communication.	0.065	0.023	0.087	2.848	0.004	0.71	1.408
External initiated actions	0.056	0.03	0.062	1.876	0.061	0.611	1.636
Personal initiated actions	0.004	0.029	0.005	0.151	0.880	0.598	1.673
Organisations and events	-0.054	0.026	-0.062	-2.092	0.037	0.747	1.338
Individual activities	0.035	0.037	0.034	0.949	0.343	0.514	1.946
Relative advantage and compatibility	0,129	0,037	0,121	3,465	0,001	0,454	2,205
Observability	0,006	0,032	0,006	0,178	0,859	0,570	1,755
Trialability	0,028	0,037	0,025	0,762	0,446	0,503	1,989

Table 8.22 (contd.): Early adopter's category

Coefficients							
Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Toleranc e	VIF
Perceived technology reliability	-0,049	0,033	-0,045	-1,462	0,144	0,570	1,753
Self-efficacy	0,146	0,037	0,129	3,956	0,000	0,515	1,941
Satisfies user expectations.	0,087	0,031	0,087	2,798	0,005	0,572	1,748
Social influence	0,005	0,030	0,005	0,168	0,866	0,627	1,595
Facilitating conditions	-0,058	0,025	-0,064	-2,292	0,022	0,714	1,402
Financial cost	-0,054	0,028	-0,056	-1,892	0,059	0,639	1,565
Culture	0,111	0,031	0,109	3,567	0,000	0,587	1,703
Contributions to health care	0,040	0,029	0,043	1,396	0,163	0,584	1,713
Contributions to education and social activities	0,056	0,043	0,047	1,317	0,188	0,433	2,312
Contributions to the economy	0,007	0,034	0,006	0,207	0,836	0,585	1,711
Contributions to politics	0,110	0,030	0,106	3,674	0,000	0,668	1,497
Contributions to finance	0,038	0,032	0,037	1,213	0,225	0,591	1,692
Contributions to agriculture	0,086	0,030	0,091	2,881	0,004	0,554	1,806
a. Dependent Variable: Early adopter's category							

Table 8.22 indicates that Fits well, Enables easy communication, Organisations and events, Relative advantage and compatibility, Self-efficacy, Satisfies user expectations, Facilitating conditions, Culture, Contributions to politics and Contributions to agriculture are the factors that showed statistically significant predictive capability. This means that these factors are significant in predicting the adoption of mobile apps by the early adopter's category.

Table 8.23: Model summary of Early adopter's category

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.562[a]	0,316	0,296	0,75119	0,316	15,521	37	1241	0,000

Table 8.23 shows that the R^2 is 0.316, so the significant independent variables predicted 31.6% of the variation in the dependent variable (Early Adopter category). R^2 > 0.25, indicating practical significance.

Table 8.24: Stepwise model of Early adopter's category

Model Summary										
Model	**R**	**R Square**	**Adjusted R Square**	**Beta**	**Std. Error of the Estimate**	**Change Statistics**				
						R Square Change	**F Change**	**df1**	**df2**	**Sig. F Change**
Relative advantage and compatibility	.424[a]	0,180	0,179	0,150	0,81102	0,180	280,314	1	1277	0,000
Self-efficacy	.480[b]	0,230	0,229	0,130	0,78613	0,050	83,118	1	1276	0,000
Contributions to agriculture	.506[c]	0,256	0,255	0,091	0,77287	0,026	45,183	1	1275	0,000
Contributions to politics	.520[d]	0,270	0,268	0,119	0,76618	0,013	23,364	1	1274	0,000
Culture	.528[e]	0,278	0,276	0,104	0,76202	0,008	14,927	1	1273	0,000
Fits well	.534[f]	0,286	0,282	0,085	0,75846	0,007	13,002	1	1272	0,000
Contributions to education and social activities	.539[g]	0,291	0,287	0,087	0,75613	0,005	8,850	1	1271	0,003
Satisfies user expectations.	.542[h]	0,294	0,290	0,084	0,75457	0,003	6,247	1	1270	0,013
Facilitating conditions	.545[i]	0,297	0,292	-0,065	0,75314	0,003	5,835	1	1269	0,016

Table 8.24 shows that nine variables entered into the model through a stepwise method accounted for 29.7% of the total variance of the dependent variable (Early adopter's category). These variables are Relative advantage and compatibility, Self-efficacy, Contributions to agriculture, Contributions to politics, Culture, Fits well, Contributions to education and social activities, Satisfies user expectations, and Facilitating conditions. Thus, $R^2 > 25.0\%$ indicating that the variables included in this model are practically significant for the proposed framework.

Table 8.25 shows the results of the test of the relationship between the independent variable and the dependent variable (Early majority).

Table 8.25: Early majority category

Coefficients							
Model	**Unstandardised Coefficients**		**Standardised Coefficients**	**t**	**Sig.**	**Collinearity Statistics**	
	B	**Std. Error**	**Beta**			**Tolerance**	**VIF**
(Constant)	0,624	0,162		3,849	0,000		
Good innovations	0,017	0,024	0,021	0,694	0,488	0,639	1,564
Add to development.	-0,027	0,024	-0,033	-1,105	0,269	0,671	1,490
Formal training	0,015	0,019	0,022	0,769	0,442	0,750	1,334
Informal training	0,052	0,020	0,074	2,594	0,010	0,735	1,361
Working manual	0,015	0,019	0,021	0,760	0,448	0,751	1,331
Internet	0,037	0,021	0,052	1,802	0,072	0,724	1,382
Interpersonal communication	0,028	0,021	0,038	1,362	0,174	0,771	1,297
Anxiety	0,008	0,016	0,013	0,507	0,612	0,911	1,098
Advantageous	0,064	0,021	0,087	3,024	0,003	0,726	1,377
Simplicity	-0,010	0,025	-0,012	-0,406	0,685	0,657	1,523
Fits well	-0,011	0,023	-0,015	-0,498	0,618	0,665	1,503
Use by others.	-0,012	0,019	-0,018	-0,628	0,530	0,728	1,373
Tested correctly	0,062	0,021	0,084	2,959	0,003	0,735	1,360
Time-consuming	-0,004	0,021	-0,006	-0,178	0,859	0,603	1,657
Occupies phone memory.	0,069	0,022	0,097	3,122	0,002	0,620	1,613
Distraction of attention	-0,001	0,020	-0,001	-0,039	0,969	0,664	1,506
Expensive to use	-0,011	0,020	-0,017	-0,540	0,589	0,638	1,569
A better replacement	-0,070	0,021	-0,096	-3,274	0,001	0,700	1,429
Unsatisfactory performance	0,023	0,022	0,031	1,053	0,293	0,689	1,451
Lack of support	-0,015	0,020	-0,021	-0,720	0,471	0,683	1,464
High complexity	0,028	0,019	0,042	1,424	0,155	0,683	1,464
Enables work activities.	0.000	0.025	0.001	0.016	0.987	0.647	1.546
Enables easy communication.	0.025	0.024	0.033	1.036	0.301	0.71	1.408
External initiated actions	0.064	0.032	0.07	2.025	0.043	0.611	1.636
Personal initiated actions	0.026	0.031	0.029	0.833	0.405	0.598	1.673
Organisations and events	-0.018	0.027	-0.021	-0.673	0.501	0.747	1.338
Individual activities	0.048	0.039	0.047	1.239	0.216	0.514	1.946
Relative advantage and compatibility	-0,064	0,037	0,121	3,465	0,001	0,454	2,205
Observability	0,024	0,032	0,006	0,178	0,859	0,570	1,755
Trialability	0,070	0,037	0,025	0,762	0,446	0,503	1,989

Table 8.25 (contd.): Early majority category

Coefficients							
Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Perceived technology reliability	0,040	0,033	-0,045	-1,462	0,144	0,570	1,753
Self-efficacy	0,192	0,037	0,129	3,956	0,000	0,515	1,941
Satisfies user expectations.	-0,059	0,031	0,087	2,798	0,005	0,572	1,748
Social influence	-0,084	0,030	0,005	0,168	0,866	0,627	1,595
Facilitating conditions	-0,020	0,025	-0,064	-2,292	0,022	0,714	1,402
Financial cost	0,117	0,028	-0,056	-1,892	0,059	0,639	1,565
Culture	0,048	0,031	0,109	3,567	0,000	0,587	1,703
Contributions to health care	-0,015	0,029	0,043	1,396	0,163	0,584	1,713
Contributions to education and social activities	0,090	0,043	0,047	1,317	0,188	0,433	2,312
Contributions to the economy	0,053	0,034	0,006	0,207	0,836	0,585	1,711
Contributions to politics	0,062	0,030	0,106	3,674	0,000	0,668	1,497
Contributions to finance	0,053	0,032	0,037	1,213	0,225	0,591	1,692
Contributions to agriculture	0,011	0,030	0,091	2,881	0,004	0,554	1,806
a. Dependent Variable: Early majority's category							

Table 8.25 indicates that Informal training, Advantageous, Fits well, Occupies phone memory, A better replacement, External initiated actions, Relative advantage and compatibility, Self-efficacy, Satisfies user expectations, Facilitating conditions, Culture, Contributions to politics and Contributions to agriculture showed statistically significant predictive capability. This means that these factors have a significant impact on the early majority adopters' adoption of mobile apps.

Table 8.26: Model summary of Early majority category

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.509[a]	0,271	0,237	0,76663	0,259	11,741	37	1241	0,000

Table 8.26 shows that the R2 is 0.271, so that the significant independent variables predicted 27.1% of the variation in the dependent variable (Early Majority category). $R^2 > 0.25$, which is practically significant.

Table 8.27: Stepwise model of Early majority category

Model Summary										
Model	R	R Square	Adjusted R Square	Beta	Std. Error of the Estimate	Change Statistics				
						R Square Change	F Change	df1	df2	Sig. F Change
Self-efficacy	.385[a]	0,149	0,148	0,186	0,81027	0,149	222,809	1	1277	0,000
Financial cost	.414[b]	0,171	0,170	0,140	0,79970	0,023	34,979	1	1276	0,000
Contributions to education and social activities	.435[c]	0,189	0,187	0,096	0,79149	0,018	27,599	1	1275	0,000
Occupies phone memory.	.449[d]	0,202	0,199	0,101	0,78555	0,013	20,355	1	1274	0,000
Informal training	.460[e]	0,211	0,208	0,080	0,78112	0,010	15,504	1	1273	0,000
Tested correctly	.468[f]	0,219	0,216	0,077	0,77744	0,008	13,089	1	1272	0,000
A better replacement	.474[g]	0,225	0,221	-0,081	0,77496	0,006	9,130	1	1271	0,003
Advantageous	.480[h]	0,230	0,225	0,077	0,77264	0,005	8,670	1	1270	0,003
Contributions to politics	.484[i]	0,235	0,229	0,067	0,77069	0,004	7,434	1	1269	0,006
Internet (websites)	.488[j]	0,238	0,232	0,062	0,76940	0,003	5,260	1	1268	0,022
External initiated actions	.491[k]	0,241	0,234	-0,068	0,76818	0,003	5,008	1	1267	0,025
Culture	.493[l]	0,243	0,236	0,054	0,76730	0,002	3,898	1	1266	0,049
Satisfies user expectations.	.496[m]	0,246	0,238	-0,074	0,76634	0,003	4,197	1	1265	0,041
Trialability	.498[n]	0,257	0,240	0,063	0,76546	0,002	3,908	1	1264	0,048

Table 8.27 shows that 14 variables entered into the model through a stepwise method accounted for 25.7% of the total variance of the dependent variable (Early majority). These variables are Self-efficacy, Financial cost, Contributions to education and social activities, Occupies phone memory, Informal training, Tested correctly, A better replacement, Advantageous, Contributions to politics, Internet, External initiated actions, Culture, Satisfies user expectations and Trialability. Thus, R^2 > 25.0%, indicating that the variables included in this model are practically significant for the proposed framework.

Overall, multiple linear regression analysis was performed to determine the relationship between the dependent and independent variables with regard to the research conceptual model; that is, to establish if the variables are significant predictors of mobile apps adoption and diffusion in Africa. The obtained results indicated that the variables (predictors) explained more than 25.0% of the variance ($R^2 > 25.0\% < 51.0\%$), with the significance level, $p < 0.05$. This implies that the variables are practically significant, and they are meaningful predictors of mobile apps adoption and diffusion in Africa. The variables fit well in the proposed framework for the adoption and diffusion of mobile apps in Africa. The statistically predictive capability of the independent variable on the dependent variables is summarised in Table 8.28.

Table 8.28: Summary of the predictive capability of the independent variable on dependent variables

Independent variables	**Dependent variables**							
	Use of mobile apps	**Business use**	**Individual use**	**Late majority and Laggards**	**Non-adopters**	**Innovators**	**Early adopters**	**Early majority**
Good innovations	Sig (+)		Sig (+)		Sig (-)			
Adds to development.	Sig (+)	Sig (+)	Sig (+)			Sig (-)		
Formal training					Sig (+)	Sig (+)		
Informal training		Sig (+)		Sig (+)		Sig (+)		Sig (+)
Working manual		Sig (+)						
Internet		Sig (+)	Sig (+)					Sig (+)
Interpersonal communication		Sig (+)	Sig (+)					
Anxiety		Sig (+)						
Advantageous		Sig (-)						Sig (+)
Simplicity								
Fits well.			Sig (+)			Sig (+)	Sig (+)	
Use by others			Sig (+)		Sig (+)			
Tested correctly.			Sig (+)			Sig (+)		Sig (+)
Time-consuming			Sig (+)					
Occupies phone memory	Sig (+)			Sig (+)				Sig (+)
Distraction of attention					Sig (+)			
Expensive to use.								
A better replacement				Sig (-)				Sig (-)
Unsatisfactory performance						Sig (+)		
Lack of support					Sig (+)			
High complexity				Sig (+)	Sig (+)	Sig (-)		
Enables work activities.		Sig (+)						
Enables easy communication.		Sig (+)						

Table 8.28 (contd.) Summary of the predictive capability of the independent variable on dependent variables

Independent variables	**Dependent variables**							
	Use of mobile apps	**Business use**	**Individual use**	**Late majority and Laggards**	**Non-adopters**	**Innovators**	**Early adopters**	**Early majority**
External initiated actions								Sig (-)
Personal initiated actions			Sig (+)					
Organisations and events				Sig (+)				
Individual activities			Sig (+)					
Relative advantage and compatibility	Sig (+)	Sig (+)				Sig (+)	Sig (+)	
Observability		Sig (+)			Sig (+)			
Trialability			Sig (+)		Sig (-)			Sig (+)
Perceived technology reliability	Sig (+)			Sig (+)	Sig (+)	Sig (+)		
Self-efficacy			Sig (+)	Sig (+)			Sig (+)	Sig (+)
Satisfies user expectations.	Sig (+)	Sig (+)		Sig (-)	Sig (-)	Sig (+)	Sig (+)	Sig(-)
Social influence	Sig (+)	Sig (-)		Sig (-)				
Facilitating conditions					Sig (+)	Sig (+)	Sig (-)	
Financial cost					Sig (+)	Sig (+)		Sig (+)
Culture		Sig (+)			Sig (+)		Sig (+)	Sig (+)
Contributions to health care	Sig (+)		Sig (-)			Sig (+)		
Contributions to education and social activities		Sig (-)	Sig (+)		Sig (-)		Sig (+)	Sig (+)
Contributions to the economy				Sig (+)	Sig (+)	Sig (+)		
Contributions to politics		Sig (-)		Sig (+)			Sig (+)	Sig (+)
Contributions to finance		Sig (-)	Sig (+)					
Contributions to agriculture		Sig (+)	Sig (-)	Sig (+)			Sig (+)	

Table 8.28 shows the statistically predictive capability of independent variables on dependent variables. The shaded portions show that the independent variable affects the dependent variable. All variables with significant indicators have the ability to predict the adoption and diffusion of mobile apps in Africa (positive or negative). In other words, mobile adoption and diffusion can be influenced in one way or another by acceptance/rejection and use/discontinuance. In other words, these variables can influence mobile app adoption and dissemination in one way or another, resulting in acceptance/rejection and use/discontinuance.

This study examined the adoption of mobile apps in Africa from the category of adopters, whereas diffusion is examined from the point of view of the use of mobile apps. The dependent variables are the variables associated with the adoption and diffusion of the research model. The five categories of adopters measuring adoption are late majority and laggards, non-adopters, innovators, early adopters and early majority, while for the use of mobile apps, business use and individual use are the variables measuring diffusion.

Drawing from the regression analysis, the following independent variables, namely Good innovations, Adds to development, Informal training, Internet, Advantageous, Fits well, Use by others, Tested correctly, Occupies phone memory, Relative advantage and Compatibility, Observability, Trialability, Perceived technology reliability, Self-efficacy, Satisfies user expectations, Social influence, Culture, Contributions to health care, Contributions to education and social activities, Contributions to politics and Contributions to agriculture have the statistically predictive capability of influencing both the adoption and diffusion processes of mobile apps in Africa. Concerning adoption only, the variables Formal training, Distraction of attention, A better replacement, Unsatisfactory performance, Lack of support, High complexity, External initiated actions, Organisations and events, Facilitating conditions, Financial cost and Contributions to the economy influence the adoption process of mobile apps only. With regard to diffusion only, the variables Interpersonal communication, Time-consuming, Enables work activities, Enables easy communication, Personal initiated actions, Individual activities and Contributions to finance influence the diffusion process of mobile apps only.

It was observed that two variables, namely *Simplicity* and *Expensive to use* indicated no statistically predictive capability on the adoption and diffusion of mobile apps in Africa.

All variables with a statistically predictive capability can therefore be added to the proposed framework for the adoption and diffusion of mobile apps in Africa, while those variables without a statistically predictive capability are removed from the model. Interpretation of these results are presented in section 8.11.

8.9 ANOVA Test

An ANOVA test was applied to investigate the relationship between the participants' profiles and the dependent variables. It helps to determine the effect sizes or the statistical significance of age, education level, employment status and religion of the participants on the adoption and diffusion of mobile apps in Africa. With respect to the five selected countries, the ANOVA results obtained are illustrated in Tables 8.29-32.

Table 8.29: ANOVA on Age

Research variables	Age group	No. of participants	Mean	Std. Dev.	p-value	Effect sizes					
						1	2	3	4	5	6
Use mobile apps	Below 20	158	4.2	1.0	0.023						
	20 - 30	409	3.9	1.2		0.3					
	31- 40	379	4.0	1.1		0.2	0.1				
	41 - 50	187	4.2	1.1		0.1	0.2	0.2			
	51 - 60	77	3.9	1.3		0.3	0.0	0.1	0.2		
	61 - 70	47	4.0	1.2		0.2	0.0	0.0	0.2	0.0	
	Above 70	28	3.8	1.4		0.3	0.1	0.1	0.3	0.1	0.1
Business use	Below 20	158	2.9	1.1	0.000						
	20 - 30	409	3.1	1.0		0.2					
	31- 40	379	3.2	1.0		0.3	0.1				
	41 - 50	187	3.4	0.87		0.5	0.3	0.2			
	51 - 60	77	3.4	1.0		0.5	0.4	0.2	0.0		
	61 - 70	47	3.6	0.8		0.6	0.5	0.3	0.2	0.1	
	Above 70	28	3.3	0.8		0.4	0.3	0.1	0.1	0.1	0.3
Individual use	Below 20	158	4.1	0.7	0.000						
	20 - 30	409	3.7	0.9		0.5					
	31- 40	379	3.9	0.8		0.3	0.2				
	41 - 50	187	3.8	0.8		0.4	0.2	0.0			
	51 - 60	77	3.9	0.8		0.3	0.3	0.1	0.1		
	61 - 70	47	3.6	0.8		0.6	0.1	0.3	0.2	0.7	
	Above 70	28	3.7	0.9		0.5	0.0	0.2	0.2	0.3	0.0
Late majority and Laggards	Below 20	158	3.3	0.9	0.000						
	20 - 30	409	3.1	1.0		0.1					
	31- 40	379	3.3	1.0		0.1	0.2				
	41 - 50	187	3.4	0.9		0.1	0.3	0.1			
	51 - 60	77	3.4	0.9		0.1	0.3	0.0	0.0		
	61 - 70	47	3.3	0.8		0.01	0.2	0.1	0.1	0.1	
	Above 70	28	2.8	0.8		0.5	0.3	0.6	0.7	0.6	0.6

Table 8.29 (contd.): ANOVA on Age

Research variables	Age group	No. of participants	Mean	Std. Dev.	p-value	Effect sizes					
						1	2	3	4	5	6
Non-adopters	Below 20	158	3.2	0.9	0.000						
	20 - 30	409	3.0	1.1		0.2					
	31- 40	379	3.4	1.0		0.1	0.4				
	41 - 50	187	3.2	1.0		0.1	0.2	0.1			
	51 - 60	77	3.2	1.0		0.0	0.2	0.1	0.0		
	61 - 70	47	3.3	1.0		0.1	0.3	0.0	0.1	0.1	
	Above 70	28	3.2	0.8		0.0	0.2	0.1	0.0	0.0	0.1
Innovators	Below 20	158	3.3	0.9	0.176						
	20 - 30	409	3.2	0.8		0.1					
	31- 40	379	3.2	0.9		0.1	0.1				
	41 - 50	187	3.2	0.9		0.1	0.0	0.1			
	51 - 60	77	3.1	0.9		0.2	0.1	0.0	0.1		
	61 - 70	47	3.3	0.9		0.0	0.1	0.1	0.1	0.2	
	Above 70	28	2.8	1.0		0.5	0.4	0.4	0.4	0.4	0.5
Early adopters	Below 20	158	3.5	0.9	0.063						
	20 - 30	409	3.3	0.9		0.2					
	31- 40	379	3.3	0.9		0.2	0.0				
	41 - 50	187	3.4	0.9		0.1	0.1	0.1			
	51 - 60	77	3.5	0.9		0.0	0.3	0.2	0.1		
	61 - 70	47	3.3	0.9		0.3	0.0	0.0	0.2	0.3	
	Above 70	28	3.2	0.7		0.4	0.2	0.1	0.3	0.4	0.1
Early majority	Below 20	158	3.5	0.9	0.010						
	20 - 30	409	3.3	0.9		0.2					
	31- 40	379	3.4	0.9		0.1	0.1				
	41 - 50	187	3.3	0.9		0.2	0.0	0.1			
	51 - 60	77	3.5	0.9		0.1	0.3	0.1	0.3		
	61 - 70	47	3.1	0.9		0.3	0.2	0.3	0.2	0.5	
	Above 70	28	3.1	0.8		0.5	0.2	0.4	0.3	0.5	0.1

Table 8.30: ANOVA – Education

Variables	Education level	No. of participants	Mean	Std. Dev.	p-value	Effect sizes			
						1	2	3	4
Use of mobile apps	Matric	272	4.1	1.1	0.598				
	Diploma	332	4.0	1.1		0.1			
	University	412	4.0	1.2		0.0	0.0		
	Masters	142	4.1	1.1		0.0	0.1	0.1	
	Doctorate	78	3.9	1.3		0.1	0.0	0.1	0.2
Business use	Matric	272	2.8	1.1	0.000				
	Diploma	332	3.3	0.9		0.5			
	University	412	3.2	1.0		0.3	0.2		
	Masters	142	3.4	0.8		0.6	0.1	0.3	
	Doctorate	78	3.5	0.8		0.6	0.1	0.3	0.0

Table 8.30 (contd.): ANOVA – Education

Variables	Education level	No. of participants	Mean	Std. Dev.	p-value	Effect sizes			
						1	2	3	4
Individual use	Matric	272	4.0	0.8	0.000				
	Diploma	332	3.8	0.8		0.3			
	University	412	3.8	0.9		0.3	0.0		
	Masters	142	3.8	0.8		0.2	0.1	0.0	
	Doctorate	78	3.6	0.9		0.5	0.2	0.2	0.2
Late majority and Laggards	Matric	272	3.3	1.0	0.746				
	Diploma	332	3.2	0.9		0.0			
	University	412	3.2	1.0		0.0	0.0		
	Masters	142	3.3	0.8		0.0	0.1	0.1	
	Doctorate	78	3.3	0.8		0.0	0.0	0.1	0.1
Non-adopters	Matric	272	3.1	1.1	0.080				
	Diploma	332	3.3	0.9		0.1			
	University	412	3.1	1.1		0.1	0.2		
	Masters	142	3.2	1.0		0.1	0.1	0.1	
	Doctorate	78	3.2	0.8		0.1	0.0	0.1	0.0
Innovators	Matric	272	3.2	0.9					
	Diploma	332	3.2	0.9		0.1			
	University	412	3.2	0.9	0.835	0.0	0.1		
	Masters	142	3.2	0.8		0.0	0.0	0.0	
	Doctorate	78	3.2	0.8		0.1	0.0	0.0	0.0
Early adopters	Matric	272	3.4	0.9					
	Diploma	332	3.3	0.8		0.1			
	University	412	3.3	1.0	0.607	0.1	0.0		
	Masters	142	3.4	0.8		0.0	0.0	0.1	
	Doctorate	78	3.3	0.8		0.1	0.0	0.0	0.1
Early majority	Matric	272	3.4	0.9					
	Diploma	332	3.3	0.9		0.2			
	University	412	3.3	0.8	0.110	0.1	0.0		
	Masters	142	3.3	0.7		0.2	0.0	0.0	
	Doctorate	78	3.2	0.8		0.3	0.1	0.2	0.1

Table 8.31: ANOVA – Employment status

Variables	Employment status	No of participants	Mean	Std. Dev.	P-value	Effect sizes		
						1	2	3
Use of mobile apps	Student	402	4.0	1.10	0.442			
	Employed	615	4.0	1.1		0.0		
	Retired	118	4.1	1.2		0.1	0.1	
	Unemployed	150	3.9	1.2		0.0	0.1	0.2
Business use	Student	402	3.1	1.0	0.000			
	Employed	615	3.3	1.0		0.2		
	Retired	118	3.5	0.9		0.5	0.3	
	Unemployed	150	3.1	1.2		0.0	0.1	0.4
Individual use	Student	402	3.9	0.9	0.227			
	Employed	615	3.8	0.8		0.1		
	Retired	118	3.8	0.8		0.1	0.1	
	Unemployed	150	3.8	1.0		0.1	0.0	0.1
Late majority and Laggards	Student	402	3.2	0.9	0.090			
	Employed	615	3.3	1.0		0.2		
	Retired	118	3.3	1.0		0.1	0.0	
	Unemployed	150	3.3	0.9		0.2	0.0	0.0
Non-adopters	Student	402	3.0	0.9	0.004			
	Employed	615	3.2	1.1		0.2		
	Retired	118	3.3	1.0		0.3	0.1	
	Unemployed	150	3.3	1.1		0.3	0.1	0.0
Innovators	Student	402	3.2	0.8	0.777			
	Employed	615	3.2	0.9		0.1		
	Retired	118	3.2	0.9		0.0	0.1	
	Unemployed	150	3.2	1.0		0.0	0.1	0.0
Early majority	Student	402	3.4	0.9	0.197			
	Employed	615	3.4	0.9		0.0		
	Retired	118	3.4	0.9		0.1	0.1	
	Unemployed	150	3.2	0.9		0.2	0.2	0.2
FactorG_5	Student	402	3.4	0.8	0.572			
	Employed	615	3.4	0.9		0.0		
	Retired	118	3.2	0.9		0.	0.1	
	Unemployed	150	3.4	0.9		0.0	0.0	0.1

Table 8.32: ANOVA – Religion

Variables	Religion	No. of participants	Mean	Std. Dev.	P-value	Effect sizes			
						1	2	3	4
Use of mobile apps	Christian	947	4.0	1.1	0.066				
	Muslim	263	4.2	1.1		0.2			
	Hindu	26	3.7	1.2		0.2	0.4		
	Atheist	19	4.2	1.2		0.3	0.1	0.5	
	Other	30	4.0	1.1		0.1	0.1	0.3	0.2
Business use	Christian	947	3.1	1.0	0.000				
	Muslim	263	3.3	1.0		0.1			
	Hindu	26	3.5	0.8		0.4	0.3		
	Atheist	19	3.8	0.9		0.8	0.6	0.4	
Individual use	Christian	947	3.8	0.9	0.022				
	Muslim	263	3.9	0.8		0.1			
	Hindu	26	3.6	0.7		0.1	0.3		
	Atheist	19	4.1	0.8		0.4	0.3	0.5	
	Other	30	4.1	0.6		0.4	0.3	0.7	0.1
Late majority and Laggards	Christian	947	3.2	1.0	0.264				
	Muslim	263	3.2	0.9		0.0			
	Hindu	26	3.6	0.8		0.4	0.5		
	Atheist	19	3.2	1.1		0.0	0.0	0.4	
	Other	30	3.4	0.9		0.2	0.2	0.3	0.2
Non-adopters	Christian	947	3.1	1.0	0.012				
	Muslim	263	3.2	1.1		0.1			
	Hindu	26	3.5	0.8		0.4	0.3		
	Atheist	19	3.5	1.1		0.3	0.2	0.1	
	Other	30	3.8	0.9		0.5	0.5	0.2	0.2
Innovators	Christian	947	3.2	0.9	0.023				
	Muslim	263	3.2	0.9		0.0			
	Hindu	26	3.5	0.6		0.4	0.4		
	Atheist	19	3.7	1.0		0.5	0.5	0.1	
	Other	30	3.4	0.9		0.3	0.3	0.1	0.2
Early adopters	Christian	947	3.4	0.9	0.065				
	Muslim	263	3.2	0.9		0.1			
	Hindu	26	3.5	0.9		0.2	0.3		
	Atheist	19	3.8	0.8		0.5	0.6	0.3	
	Other	30	3.3	0.9		0.0	0.1	0.2	0.7
Early majority	Christian	947	3.4	0.9	0.313				
	Muslim	263	3.3	0.9		0.1			
	Hindu	26	3.4	0.9		0.0	0.1		
	Atheist	19	3.6	0.9		0.3	0.4	0.3	
	Other	30	3.4	0.8		0.1	0.2	0.0	0.3

From Table 27 to Table 32, the p-values of the variables (age, education, employment and religion) are summarised as shown in Table 8.33.

Table 8.33: ANOVA on Participants' profiles

Variables	p-values (ANOVA)			
	Age	Education level	Employment status	Religion
Use of mobile apps	0.023	0.598	0.442	0.066
Business use	0.000	0.000	0.000	0.000
Individual use	0.000	0.000	0.227	0.022
Late majority and laggards	0.000	0.746	0.990	0.264
Non-adopters	0.000	0.080	0.004	0.012
Innovators	0.176	0.835	0.777	0.023
Early adopters	0.063	0.607	0.197	0.065
Early majority	0.010	0.110	0.572	0.313

Table 8.33 indicates that age has a statistically significant effect on all the dependent variables except Innovators and Early adopters. Education level showed a significant impact on Business use and Individual use. Employment status has a significant effect on Business use and Non-adopters, whereas religion has a significant impact on Business use, Individual use, Non-adopters and Innovators regarding the adoption and diffusion of mobile apps. Interpretation of these results is presented in section 8.11.

8.10 T-test

A t-test analysis was performed on gender, but there is no statistical significance, thus gender showed no effect on the adoption and diffusion of mobile apps in Africa.

8.11 Interpretations and Validation of the proposed framework

A conceptual model was proposed and used as the basic framework for this research. The model consists of four components: 1) Mobile app Innovations, 2) Diffusion of Innovation process 3) Adopting unit, and 4) Diffusion. Each of these components comprises various factors which formed the research variables. Various statistical analyses have been performed on the quantitative data collected with respect to these variables. Regarding the proposed framework, some statistical analyses were performed in order to test their suitability for the model.

Factor analysis was performed to reduce the complexity of the data set. The result yielded 27 factors (Table 8.1). These factors are associated with the research model and were used in further analyses.

Multiple linear regression analysis was performed to investigate the relationship between the model variables. Eight factors obtained from the factor analysis, namely Use of mobile apps, Business use, and Individual use, Late majority and Laggards, Non-adopters, Innovators, Early adopters, and Early majority were considered as dependent variables. This is because they are obtained from the adoption and diffusion section of the model. The remaining factors were considered as independent variables. Considering the criteria for a significant relationship including the p-values, $R^{2,}$ normality, tolerance and VIF, the output from the regression analysis is discussed below:

The regression analysis examined whether the independent variables (predictors) could significantly predict participants’ adoption and diffusion of mobile apps in Africa. There are eight dependent variables resulting in eight models after the regression analysis. These models accounted for more than 25.0% of the variance (R^2 > 25.0% < 50.0%). The models' variance is discussed below.

Model for the general use of mobile apps - $R^2 = 0.273$ indicates that the model is practically significant to the general use of mobile apps. This means that the model explained 27.3% of the variance concerning the general use of mobile apps in Africa. The model included a total of eight positive predictors: Add to development, Good innovations, Relative advantage and compatibility, Perceived technology reliability, Contributions to health care, Occupies phone memory, Satisfies user expectations and Social influence. All these variables have a positive impact on Africa's overall use of mobile apps. The model therefore suggests that the response variable (general use of mobile apps) increases as predictive variables increase.

The model therefore suggests that the adopters' attitude towards adoption and use of mobile apps can be shaped by good mobile apps that can contribute to Africa's development. Competitive benefit and usability increase the opportunity for mobile apps to be adopted and used. Safety assurance and decreased risk of using mobile apps, as well as the conviction of close friends and family increase the general use of mobile apps, even though the use of mobile apps takes up a great deal of phone memory.

Model for Business use – $R^2 = 0.370$ indicates that the model is practically significant to the use of mobile apps for business purposes. This means that the model explained 37.0% of the variance in the use of mobile apps in Africa for business purposes. In the model, 14 predictors, namely Enables work activities, Relative advantage and compatibility, Culture, Adds to development, Anxiety, Informal training, Internet, Satisfies user expectations, Working manual, Interpersonal communication, Contributions to agriculture, Observability, Social influence and Enables easy communication have a positive relationship with the use of mobile apps for business purposes, while four predictors, Contributions to finance, Advantageous, Contributions to politics, and Contributions to education and social activities have a negative relationship with the use of mobile apps for business purposes.

This means that the use of mobile apps for business purposes requires mobile apps to be good, beneficial and business-friendly to improve their meaningful business activities. Enables work activities and Enable easy communication to improve the use of mobile apps for business interactions. Organisations, such as banks are sharing the information about their mobile banking apps and other service-related mobile apps, such as FNB eWallet with their clients to improve their services. Increasing these predictors will increase the rate of adoption and diffusion of these mobile apps meant for business purposes.

African countries are developing nations and developing mobile apps with local content containing social behaviour and norms will attract more adopters, especially rural dwellers and the less educated. Individuals can easily observe mobile apps created with local content, such as local language, and be convinced to use them. M-commerce apps in a local language can easily be adopted and used by people in remote areas to improve their lives in that area.

Interestingly, anxiety about the use of mobile apps for business purposes has been positive. It is possible because most mobile app users were nervous when using mobile apps, especially for business transactions. Using the banking apps, as well as M-commerce apps attracts some degree of fear and nervousness, but they facilitate easy, quick and comfortable transactions. Although people are anxious about using such apps, the number of users increases rapidly. Users need to learn how to use mobile apps adequately for business. Increasing the learning methods of how to use mobile apps will improve the adoption and diffusion of mobile apps. Unfortunately, the use of mobile apps for business is not profitable, and it attracts some costs. The more banking apps you use to carry out banking transactions, the more fees you pay. The use of mobile apps for business is also not affected by political, educational and social advancement.

Model for Individual use – R^2 = 0.438 indicates that the model is virtually important for the individual use of mobile apps. It implies that 43.8 % of the variance was explained by the model for individual use of mobile apps in Africa. The model included a total of 15 predictors, including 13 positive predictors (Adds to development, Self-efficacy, Good innovations, Trialability, Internet, Interpersonal communication, Time-consuming, Contributions to finance, Tested correctly, Observability, Contributions to education and social activities, Fits well, and Individual activities) and two negative predictors (Contributions to agriculture and Contributions to health care). Positive predictors have a positive relationship with the individual use of mobile apps, while negative predictors have a negative relationship with the use of mobile apps for individual purposes.

The model suggests that the attitude of mobile app adopters and their use thereof can be shaped by good mobile apps that can contribute to the development in Africa. The advantages of using mobile apps, including financial, educational and social benefits, affect the adoption and diffusion of mobile apps for individual purposes. The benefits of mobile social networking apps, for example have improved the adoption and use of mobile apps by individuals. Individual use of mobile apps involves the technical knowledge of how to use mobile technology, and the trial of new technology, as well as seeing others using it increases the adoption and diffusion of mobile apps. Users need to learn how to use mobile apps. The availability of learning methods, such as the Internet and interpersonal communication increase the rate of adoption and diffusion of mobile apps for individual use. The use of mobile apps demands more time. In contrast, the benefits obtained from the use of mobile apps for agricultural and health care activities decrease the individual use of mobile apps. This is possible because agricultural and health care activities may require the acquisition of technological devices involving financial costs.

Model for Late majority and Laggards category – $R^2 = 0.265$ indicates that the model is practically significant to the Late and Laggards category of mobile app adopters. It implies that 26.5% of the variance can be explained by the adopters of mobile apps in Africa's Late majority and Laggards category model. The model included a total of 12 predictors, including nine positives (Contributions to agriculture, Contributions to politics, Formal training, Used by others, Self-efficacy, Contributions to the economy, Organisations and events, High complexity, Perceived technology reliability, Occupies phone memory, and Informal training) and three negative predictors (A better replacement, Satisfies user expectations and Social influence). Any increase in positive predictors leads to an increase in the Late majority and Laggards category, while any increase in negative predictors leads to a reduction in the category of the Late majority and Laggards adopters in Africa.

The Late majority and Laggards category of adopters is the set of adopters that is sceptical about adopting new mobile apps and they adopt a “wait and see” attitude towards adopting new technology. For this category to adopt and use mobile apps, they need proper information sources, such as organisation and events, as well as seeing others using them and knowing the benefits of using mobile apps. In addition, they require training and reliability assurance on the adoption and diffusion of mobile apps. Since they are the local set in the social system, they become more discouraged by their close peers and are more afraid to adopt improved mobile apps.

Model for Non-adopter category – $R^2 = 0.301$ indicates that the model is practically significant to the non-adopter’s category of mobile apps adopters. This means that the model explained 30.1% of the variance. The model included a total of 15 significant predictors, containing 11 positives (Financial cost, Formal training, High complexity, Use by others, Culture, Facilitating conditions, Lack of support, Distraction of attention, Contributions to the economy, Observability, and Perceived technology reliability) and four negative predictors (Good innovations, Trialability, Satisfies user expectations and Contributions to education and social activities). The 11 predictors have a positive relationship with the category of non-adopters, while the four negative predictors have a negative relationship with the category of mobile app users in Africa who are not adopters.

The model explained that the high complexity, lack of support and the financial cost involved in the adoption and diffusion of mobile apps cause some in the social system of Africa not to adopt and use mobile apps. The cultural beliefs, as well as the extent of support from government and other stakeholders, and distraction from other activities increase the existence of non-adopters in Africa. It is expected that the perception of mobile apps as good innovations will change the attitudes of non-adopters. Providing a trial opportunity, satisfying users' expectations and the benefits of the use of mobile apps, especially in education and social activities, will reduce the number of non-adopters in Africa.

Model for Innovators' category – $R^2 = 0.317$ indicates that the model is practically significant to the innovators' category of mobile apps adopters. It implies that the innovator category model explained 31.7% of the variance. The model is related to 14 important variables/predictors, including 12 positive variables (Relative advantage and compatibility, Informal training, Contributions to health care, Perceived technology reliability, Formal training, Fits well, Facilitating conditions, Contributions to the economy, Culture, Unsatisfactory performance, Tested correctly and Satisfies user expectations) and two negative variables (Adds to development and High complexity). The positive variables increase the category of innovators as they increase, while the negative variables reduce the category as they increase.

The model explained that the challenge of competitive advantage, availability of necessary environment from government and other stakeholders, as well as trying to satisfy the consumers' demands results in the increase of the innovators' category of adopters in Africa. The advancement of technology increases users' experience and requirements, thus there is a need for innovators to create mobile apps that will suit the new improvements. For purposes of improving the economy, poor performance of mobile apps and social behaviour, more enhanced mobile apps are required. This increases the number of innovators in the social system. On the other hand, the higher the development progress and higher complication of mobile applications in Africa, the fewer innovators are needed.

Model for Early adopters' category – R^2 = 0.297 indicates that the model is practically significant to the early adopters' category of mobile app adopters. This implies that the model explained 29.7% of the variance. The model is related to nine predictors, including eight positive predictors (Relative advantage and compatibility, Self-efficacy, Contributions to agriculture, Contributions to politics, Culture, Fits well, Contributions to education and social activities and Satisfies user expectations) and one negative predictor (Facilitating conditions). Any increase in positive predictors leads to an increase in the category of the early adopter, while any increase in negative predictors leads to a reduction in the category of the early adopter.

The model shows that the capability to use mobile apps with a competitive edge and compatibility and appropriate mobile apps, will increase the category of mobile app adopters for early adopters. Furthermore, the effect of the use of mobile apps on agriculture, politics, education and social activities and the fulfilment of user expectations may increase the category of early adopters. In contrast, the provision of a suitable environment reduces the size of the early adopters' category.

Model for the Early majority category – R^2 = 0.257 shows that the model is virtually important for mobile apps adopters in the early majority category. This means that 25.7% of the variance was explained by the model. The model is associated with 14 predictors, including 11 positives (Self-efficacy, Financial cost, Contributions to education and social activities, Occupies phone memory, Informal training, Tested correctly, Advantageous, Contributions to politics, Internet, Culture, and Trialability) and three negative predictors (A better replacement, External initiated actions, and Satisfies user expectations). An increase in positive predictors increases the category of the early majority adopter, while an increase in negative predictors reduces the category of the early majority adopter.

The model shows that a user with the ability to use mobile apps can try out a new app and find it works very well and that it is useful in everyday life. This increases his/her interest in adopting and using the app, even if it takes up space his/her phone memory. The availability of the learning methods, such as the Internet and informal training improve the capability and knowledge of the user. By contrast, the development of better mobile apps and knowledge acquisition from external sources, such as TV and radio increases user demand, which in turn reduces the adoption of previous mobile apps.

Regarding the personality variables (age, education level, employment status and religion), ANOVA was performed to investigate the relationship between personality variables and the dependable variables. From the results, it was observed that age has a statistically significant effect on all the dependent variables, except Innovators' and Early adopters' categories. Education level showed a significant impact on Business use and Individual use. Employment status has a significant effect on business use and the non-adopter's category whereas religion has a significant impact on business use, individual use, non-adopter's and innovators' categories regarding the adoption and diffusion of mobile apps. Therefore, age, education level, employment status and religion have an important influence in various ways on the adoption and diffusion of mobile apps in Africa.

A t-test analysis was performed to investigate the effect of gender on the adoption and diffusion of mobile apps. The result showed no noticeable effect. There are no differences in the adoption and diffusion of mobile apps between male and female. Mobile apps are created for the general public, irrespective of gender.

Overall, the eight models explained different significant portions of the variance and all R^2 scores were more than 25.0% (R^2 > 25.0% < 50.0%). This shows that models are practically significant for the adoption and diffusion of mobile apps in Africa. All the predictors included in the models can be added to the proposed framework. Certain personality profiles, including age, education, employment status and religion were also shown to influence the adoption and diffusion of mobile apps in Africa. There is therefore a connection between them and the dependent variables. Generally, the relationship between the research variables suggests that they are important predictors of mobile app adoption and diffusion in Africa.

8.12 The Framework

Drawing from the results obtained from different statistical analyses and the suggestions, the final proposed framework for the successful adoption and diffusion of mobile apps in Africa is presented in Figure 8.1. The factors highlighted were derived from the study findings indicating the variation between the framework and the conceptual model.

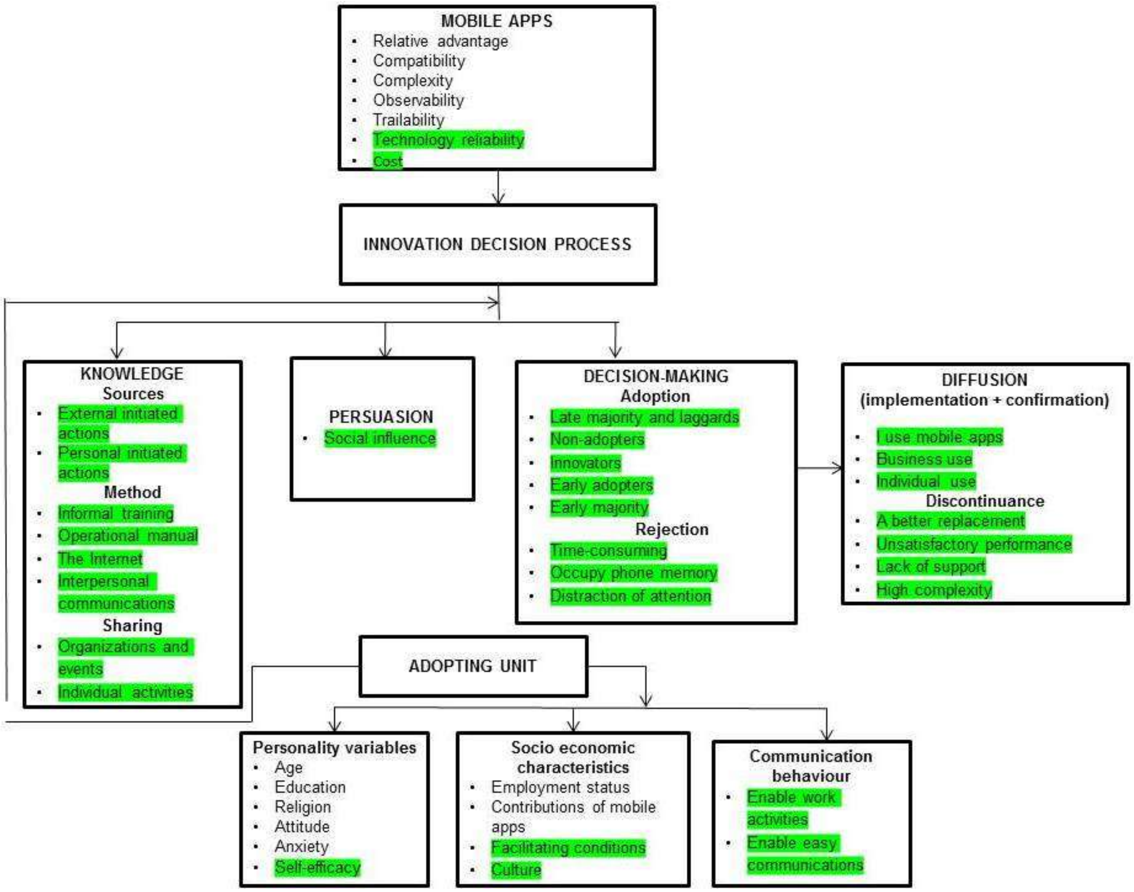

Figure 8.1: Validated Proposed Framework

8.13 Application of the framework

The proposed framework of this study formed the basis of the conceptual research model used to conduct a research study in an African context (South Africa) to determine the relationship between the characteristics of innovations and the adopters' attitudes. In this study, the adoption and diffusion of mobile commerce among the people living in a remote area of South Africa to determine the relationship between the characteristics of innovations and the adopters' attitudes are examined. Through a survey, the opinions of the participants living in Mbongolwane in the Uthungulu District Municipality in the KwaZulu-Natal province of South Africa were gathered. A total of 120 out of 300 questionnaires distributed, was returned, giving a response rate of 40%. It was found that the perceived attitudes of the rural dwellers are closely related to the characteristic of innovations as well as the adoption of mobile commerce. The findings indicate that though the people are very keen to receive a new technological invention, they are still late adopters (Okonkwo *et al.*, 2018). The proposed research model worked well with the study. It helped to understand the perceptions and perceived attitudes of the rural dwellers to new mobile apps which in turn improve their decision making in respect of the adoption and diffusion of mobile apps in Africa (Appendix C).

8.14 Summary

In this chapter, the guidelines and a proposed framework for the successful adoption and diffusion of mobile apps in Africa were presented. The guidelines and framework were constructed from the data analysis and discussions carried out in the preceding chapters (Chapters 5 and 6). The framework comprises three major components, namely mobile apps, the innovation-decision process and the adopting unit. The validation of the proposed framework was also discussed including a brief summary of the study conducted using the framework as the basis. In the next chapter, the study is concluded.

Chapter 9

Conclusion and recommendations for future study

9.1 Introduction

The primary purpose of this study was to investigate the adoption and diffusion of mobile apps in Africa. The diffusion of innovation framework was used as the basic framework to conduct the investigation. The positivist and post-positivist research paradigms were employed through a survey with a questionnaire as the instrument of data collection. The participants were drawn from five selected countries in Africa, representing different geographical areas of Africa. These countries were: South Africa from the southern region, Nigeria from the western region, Morocco from the northern region, Kenya from the eastern region and the DRC form the central region. Drop-off and electronic (on-line) methods were used in the distribution of the research questionnaires. A total of 2 300 questionnaires was distributed and 1 285 were returned, giving a response rate of 55.8%, comprising 957 drop-off and 328 electronically completed questionnaires.

In order to achieve the main aim of this research, certain objectives have been achieved, namely:

1. Conduct a literature review of the use of mobile apps in Africa.
2. Investigate the adoption and diffusion of mobile apps in the selected countries.
3. Investigate the effect of mobile apps on African development.
4. Compare the adoption and diffusion of mobile apps in the selected countries.
5. Outline the guidelines for successful adoption and diffusion of mobile apps in Africa.

These objectives were interrogated in order to answer the research question. The obtained results regarding each objective are summarised in the subsequent sections.

9.2 Theoretical overview of the use of mobile apps in Africa

Detailed theoretical information surrounding the topic under study was presented in Chapter 2. It covered how mobile apps are adopted and used in Africa, including descriptions of mobile apps, evolution and the development of mobile technology in Africa, the African mobile ecosystem, classification of mobile apps, mobile-enabling innovation, mobile-enabling digital inclusion, contributions of mobile apps to the development in Africa and the predicting factors of mobile apps adoption and diffusion in Africa. The literature review highlighted some information that formed the basis of the survey questions used in this study.

In Chapter 3, the descriptions of the theories/models used in conducting information system research were presented. These theories are the Expectation-Confirmation Model, the Theory of Reasoned Action, the Theory of Planned Behaviour, the Technology Acceptance Model, the Unified Theory of Acceptance and Usage of Technology, the Social Cognitive Theory (SCT), and the Diffusion of Innovation Theory. Regarding the topic under study, the diffusion of innovation theory was considered to be more suitable because:

- ✓ It is one of the most popular adoption models used in studying the adoption and diffusion of products from a broad variety of disciplines, including education, politics, health, economics, communication and technology.
- ✓ It aids to describe the adoption procedure of an innovation by modelling the whole process according to the aspects of communication and human information relations.
- ✓ The theory offers valued perceptions into the access, acceptance, circulation, and usage of mobile apps.

Hence, the diffusion of innovation theory proposed by Rogers was the basic framework used to conduct this research.

In Chapter 4, the detailed research design and methodology used for the study are presented. In Chapter 5, the focus is on the data analysis and the results are presented for easy interpretation. In Chapter 6, the results obtained from various data analyses performed are discussed according to the remaining objectives of this study as summarised below.

9.3 The adoption and diffusion of mobile apps in the selected countries in Africa

The 1 285 participants involved in this study were drawn from the selected countries in the following proportions: South Africa (335; 26.1%); Nigeria (370; 28.8%); Morocco (112; 9.0%); Kenya (212; 16.5%); the DRC (252; 19.6%). The formation of the sample population of this study involved 703 (54.71%) males and 582 (45.29%) females. This indicates a fairly balanced representation of the gender components (male and female) and a good representation of the African population. Mobile apps are created for the general public and are expected to be equally adopted and used by everyone, irrespective of gender.

It was observed that > 60% of the participating population came from the 20-40 age group. This is a core young age range. 93.3% of the participants were educated whereas 3.7% were uneducated. This indicates that the responses were obtained from the people who must have acquired some knowledge-awareness about mobile apps and their services.

In general, > 60% perceived mobile apps to be good innovations which contribute to the development in Africa. Noticeably, > 71% of the sample population were adopters of mobile apps, 11% were non-adopters and 18% did not respond to the question. It revealed the existence of non-adopters of mobile apps in Africa and demands the attention of the stakeholders for a wider campaign for the adoption and diffusion of mobile apps in Africa.

There were two distinct factors underlying the purpose of the adoption and diffusion of mobile apps in Africa, namely the primary aim of mobile apps adoption and diffusion in Africa is for business use and individual use. Concerning business interactions, mobile apps are used to deliver commercial, agricultural, health care and government services. This finding agreed with the findings of (Qiang *et al.*, 2011, Murugesan, 2013, Juma, 2011, Hellström, 2012, Ghobakhloo *et al.*, 2011, Etzo & Collender, 2010, Aker & Mbiti, 2010). Regarding individual interaction, mobile apps are adopted and used for the purpose of improving personal relations and activities, such as social networking, texting messages, learning and playing music and watching movies. This finding agreed with the findings of (Lenhart *et al.*, 2015, Asiodu *et al.*, 2015, Lee, 2015, Tracey *et al.*, 2015, Mtebe, 2015, Sobaih *et al.*, 2016).

Rogers (2003) stated two sources of information about an innovation, namely interpersonal communication and mass media and the finding in this study confirmed that statement. In addition, other sources of information, including the Internet, the organisation where one works and special events were revealed in this study.

Two distinct factors were essential for the dissemination of information about new mobile apps in Africa, namely organisations and events, and personal activities. Organisations and events involve organisational news or advertisements, conferences and public exhibitions whereas personal activities involve interpersonal communication and internet surfing.

Two purposes of information sharing were discovered 1) to facilitate work activities and, 2) to enable easy communication. The former explained that information about mobile apps is shared in order to improve services. Services can either be personal or organisational services. The latter explained that information about mobile apps is shared in order to improve interactions. Interactions can be personal or business interactions.

According to the participants' responses, it was found that individuals can gain the operational knowledge of mobile apps by means of four ways/methods. These are by means of informal training, an operational manual, the Internet and interpersonal communication. Interpersonal communication is the most used method followed by the Internet and formal training is the least used method.

Regarding the five features of innovation proposed by Rogers, namely relative advantage, complexity, compatibility, observability and trialability, it was discovered that the adopters' perceptions of these features influence their decision making on the adoption and diffusion of mobile apps in Africa. Thus, these features are significant to mobile apps. These findings agreed with the findings of previous fragmented studies performed using the diffusion of innovation framework. A fragmented study means research conducted in a particular country within a unique domain regarding a particular type of mobile app with respect to the African context (Tunmibi *et al.*, 2015, Mndzebele, 2013, Kiura & Solomon, 2012, Brown & Molla, 2015). However, the findings were contrary to the findings of Elogie (2015) who argues that compatibility, observability and trialability are not adequate to predict adoption, as well as to those of Mndzebele (2013) who argues that relative advantage is not significant in the adoption of E-commerce mobile apps.

With regard to the discontinuance of the use of already adopted mobile apps, certain were discovered to be significant to the discontinuance of using mobile apps, namely more enhanced app development, unsatisfactory performance, lack of support and not easy to use.

Similarly, adopters of African mobile apps refuse to adopt mobile apps if they perceive the use of mobile apps to be time-consuming, to take up too much space in the phone memory, to distract their attention from other activities, and if the use of mobile apps is expensive. The time dimension was measured and it was found that it takes between one week to three months to adopt and use mobile apps in Africa.

Regarding adopters' attitudes, it was discovered that Africans show positive attitudes towards the adoption and diffusion of new mobile apps without being nervous at all.

Finally, Rogers described five categories of adopters in his proposed framework, namely innovators, early adopters, early majority, late majority and laggards. In this study, five distinct categories of adopters of mobile apps in Africa were also discovered. It is observed that the results merged late majority and laggards together and produced a new category, non-adpters. However, Rogers' framework does not clearly account for the non-adopters' category, but in this study, the existence of such a category was revealed. The finding is possible, considering the context of the study, namely the developing African environment. It indicates that there are some people who do not or have not started to use mobile apps at all. Therefore, it is necessary to consider the non-adopters category in the process of adoption and diffusion of mobile apps in Africa.

9.4 Predicting factors of mobile apps adoption in Africa

Concerning the factors that influence the adoption and diffusion of mobile apps in Africa, seven predicting factors underlying the adoption and diffusion of mobile apps in Africa were discovered, including perceived technology reliability, self-efficacy, user perception, social influence, facilitating conditions, financial cost and culture. The findings agreed with the following previous studies conducted on the African context by (Mtebe & Raisamo, 2014, Lekhanya, 2013, Iddris, 2013, Brown & Molla, 2015, Achieng & Ingari, 2015).

9.5 The effect of mobile apps on African development

The effect of mobile apps on the development of African nations was investigated and it was observed that mobile apps do indeed contribute to growth in Africa. The findings indicated that the use of mobile apps in Africa has altered the way in which activities in various sectors of the African economy, namely the health care system, education and social activities, the economy, politics, finance and agriculture are carried out. Mobile technology services have digitalised the health care system through m-Health, education through m-Learning, social activities through social networking mobile apps, the economy through m-Commerce, politics through m-Governance, finance through m-Banking and agriculture through m-Agriculture. These contributions have improved development in Africa, thus adoption and diffusion of mobile apps have a favourable impact on Africa. Compared with the studies conducted on the Africa context, this result compared well with the findings of (Murugesan, 2013, Mbiti & Weil, 2011, Kearney, 2011, Hellström & Tröften, 2010, Aker & Mbiti, 2010).

9.6 Comparative analysis of the adoption and diffusion of mobile apps in the selected countries

A comparative discussion of the adoption and diffusion of mobile apps regarding the five selected countries was performed. An ANOVA was performed on the collected data to obtain the effective sizes of the research variables for each respective country. Using the ANOVA results, the similarities and differences in the adoption and diffusion of mobile apps in the selected countries were pointed out, discussed and compared. The comparative analysis was done in the order of the research conceptual model, using the model components as the topics of the comparative discussions. These components covered all the research variables, including mobile app innovations, the innovation-decision process and the adopting unit. In the ANOVA analysis, there is no practically significant difference in the participants' perceptions of the mobile app innovations among the countries. Regarding the innovation-decision process, three out of 25 variables, namely Individual activities, Using mobile apps are expensive and Individual use indicated a practically significant difference between some countries. A practically significant difference exists between Nigeria and the DRC, as well as between Morocco and the DRC in the individual use of mobile apps. Regarding the variable that mobile apps are expensive, there is a practically significant difference between South Africa and Kenya. Comparing South Africa, Nigeria and Morocco with the DRC in the individual activities, a practically significant difference was observed. Concerning the adopting unit, one out of 17 variables indicated a practically significant difference. In the contributions to finance, there is a practically significant difference between South Africa and Kenya. In this regard, there is a larger percentage of similarities in the participants' perceptions of these variables than differences. Thus, the participants from the five selected countries have similar perceptions in respect of the adoption and diffusion of mobile apps in Africa with few differences and the findings of this study may be generalised to the entire African social system.

9.7 The proposed framework for adoption and diffusion of mobile apps in Africa

Finally, a list of guidelines and a proposed framework for the successful adoption and diffusion of mobile apps in Africa concluded the study. The guidelines were constructed from the data analysis and discussions carried out in the preceding chapters (Chapters 5 and 6). The framework was based on the diffusion of innovation theory and comprises three major components, namely mobile apps, the innovation-decision process and the adopting unit. The mobile app innovations component explained the influencing features of mobile apps which are the key attributes expected in mobile apps for the successful adoption and diffusion by the users. The innovation-decision component details the process of adoption and diffusion, including knowledge-awareness of mobile apps, persuasion, decision making and diffusion. The adopting unit influences the innovation- decision process with its contents, including the personality variables, socio-economic characteristics and communication behaviour.

Multiple linear regression analysis was performed to investigate the relationship between the model variables. Eight factors from the adoption and diffusion section of the conceptual model, Use of mobile apps, Business use, and Individual use, Late majority and Laggards, Non-adopters, Innovators, Early adopters, and Early majority were considered as dependent variables. The remaining factors were considered as independent variables. The regression analysis examines whether the independent variables (predictors) could significantly predict participants' adoption and diffusion of mobile apps in Africa. There are eight dependent variables resulting in eight models after the regression analysis. Overall, the eight models explained different significant portions of the variance and the R^2 scores in all instances were more than 25.0% (R^2 > 25.0% < 50.0%). This shows that the models are practically significant for the adoption and dissemination of model applications in Africa. The final framework is similar to the study conceptual model. It contains all the variables in the conceptual research model except two variables (simplicity and expensive to use) which were found not to be practically significant to the adoption and diffusion of mobile apps in Africa. Figure 9.1 depicts the simplified proposed framework.

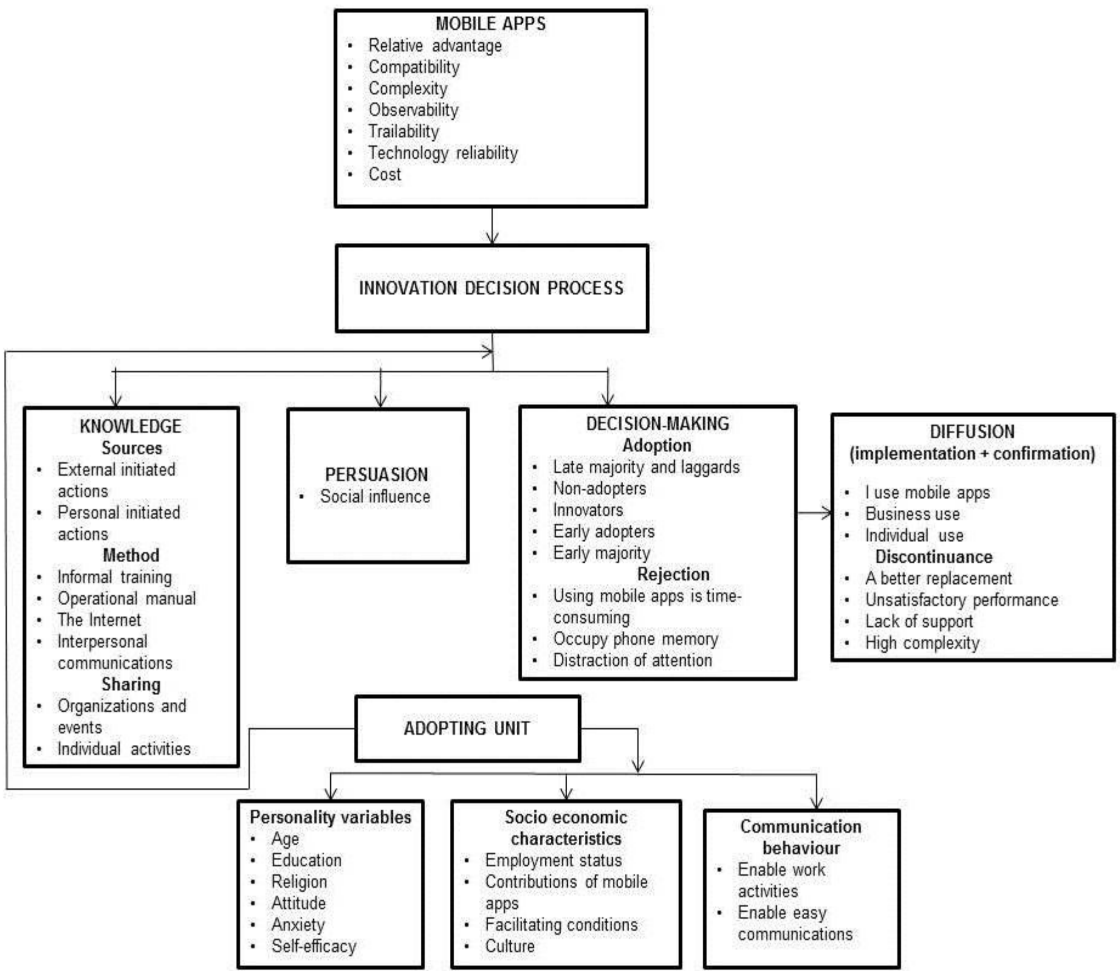

Figure 9.1: The simplified proposed framework.

9.8 The contributions of this study

In this study, a holistic investigation was presented of mobile apps adoption and diffusion in Africa, which may be the first of its kind because there is no other similar research that was encountered in the course of this study. There are many findings produced by this research which will be of interest to theorists, stakeholders of mobile apps development and the public.

- ✓ To the theorists it may be of interest because there is little or no literature that presently exists on the adoption and diffusion of mobile apps in Africa. It will add to the body of knowledge about adoption and diffusion of the innovation (mobile apps) in Africa by assisting in finding the perceived innovation features, impacts, hitches and relative advantage of mobile apps innovation in Africa.
- ✓ For the innovators, it will improve their innovativeness, thereby enabling them to create more successful mobile apps which can be widely adopted and used across the Africa continent and even beyond.
- ✓ For industries, it will be of help in evaluating the advantages and disadvantages of future decisions and approaches for implementing mobile app innovations. This will enhance the adoption of their mobile apps and improve their operations and productivity.
- ✓ For the public, the adopters of mobile apps, it may bring greater insight into mobile apps regarding the major features of mobile apps, how to gain the knowledge-awareness about mobile apps and the benefits of using mobile apps. The findings should encourage the adopters to continue using mobile apps and to help the non-adopters to start using mobile apps.
- ✓ Finally, the proposed framework will be used as a model and as guidelines by all the stakeholders involved in mobile apps adoption and diffusion to achieve success in the adoption and diffusion of mobile apps, especially in Africa. The framework and guidelines may also be useful to researchers as a model to conduct research in computer science and information system domains and other related domains.

9.9 Limitations

As this study was a broad research project that involved five different countries in Africa, funding was the major limitation. Other issues encountered during the course of this research were language barriers, cultural differences and political instability in most of the African nations that posed a security risk, especially in Kenya and the DRC. Lack of human assistance was problematic because, in some of the countries, such as the DRC, Morocco and Kenya, human assistance was needed in order to bridge the language and cultural gaps.

These problems hindered the extension of data collection from organisations, including government and private enterprises. Without these issues, there could perhaps have been interviews with some participants to understand the results better. Despite all these limitations, the study was successful.

9.10 Future work

Africa is a developing continent with people who are eager and ready to adopt an innovation (mobile apps). There is a need for more knowledge-awareness to enlighten the people about mobile apps. Mobile apps are increasingly becoming a major part of everyday life and as the existence of non-adopters in Africa was revealed by this study, more research is required in this area. The recommendations for future research are

- ✓ More research on the knowledge-awareness campaign of mobile apps adoption and diffusion to the remote areas of Africa.
- ✓ More research on mobile technology services and the extension of mobile network connections to the unconnected areas of Africa.
- ✓ Research to bridge the gap between educated and uneducated, urban and rural dwellers and, adopters and non-adopters of mobile apps in Africa.

These recommendations will help in achieving a strategic framework for the socio-economic transformation of the African continent over the next 50 years as stated in Agenda 2063.

9.11 Summary

In this final chapter, a three-year study on the adoption and diffusion of mobile apps in Africa is concluded. The sample population used for this research was obtained from the five selected countries representing the five geographical regions in Africa. A theoretical examination regarding previous related work on the topic under study was conducted and the results were discussed and reported. Investigation into the adoption and diffusion of mobile apps in the selected countries was performed, discussed and documented. The effect of the adoption and diffusion of mobile apps on African development was examined and the outcomes were discussed and reported. To determine the differences in the adoption and diffusion process in the selected countries, a comparative analysis was conducted on the results obtained from the investigation into the adoption and diffusion of mobile apps in the selected countries. Interestingly, there are no clear practically significant differences regarding the adoption and diffusion of mobile apps among the countries. The above investigations indicated that mobile apps are good innovations that contribute to the development in Africa and the adoption and diffusion of mobile apps need to be promoted or expanded, especially to the non-adopters. In this regard, a general framework for the adoption and diffusion of mobile apps in Africa was proposed. Overall, the aim and objectives of this research have been achieved.

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Appendices

Appendix A: Research questionnaire

A. Background information

1. Indicate the country where you reside in Africa.

☐ South Africa

☐ Nigeria

☐ Morocco

☐ Kenya

☐ Democratic Republic of Congo

2. Please select your gender.

○ Male ○ Female

3. What is your age group?

○ Below 20 ○ 21 - 30 ○ 31 - 40 ○ 41 - 50 ○ 51 - 60 ○ 61 - 70 ○ Above 70

4. What is your highest level of education?

○ Secondary/Matric/Grade 12 ○ Diploma ○ University degree ○ Masters

○ Doctorate ○ Others (specify)

5. What is your current employment status?

○ Student ○ Employed ○ Retired ○ Unemployed

6. What is your religion?

○ Christianinty ○ Muslim ○ Hinduism ○ Peganism ○ Atheist ○ Others (specify)

B. Mobile applications (Mobile apps)

Mobile applications are computer programs that run on mobile devices e.g. SMS, Facebook, Internet banking, WhatsApp, web browsing etc.

On a scale of 1-5 (1 - Not at all or strongly disagree and 5 – A great deal 0r strongly agree), answer questions 7 – 8

7. To what extent do you agree with the following statements?

Not at all ***A great deal***

In general, mobile apps are good innovations.	1	2	3	4	5
Mobile apps contribute to development in Africa.	1	2	3	4	5
I use mobile apps.	1	2	3	4	5

8. I use mobile apps for?

Not at all ***A great deal***

Texting messages	1	2	3	4	5
Social networking (WhatsApp, Facebook etc).	1	2	3	4	5
Commerce (banking, online shopping, money transfer etc).	1	2	3	4	5
Agricultural (information and knowledge about farming practices).	1	2	3	4	5
Education (internet surfing, e-learning, distant learning etc).	1	2	3	4	5
Governance (administering governmental duties).	1	2	3	4	5
Health (getting healthcare information, first aid and other medical help).	1	2	3	4	5
Entertainment (music and movies).	1	2	3	4	5

C. Adoption and diffusion of mobile apps innovation

On a scale of 1-5 (1 - Not at all or strongly disagree and 5 – A great deal 0r strongly agree), answer questions 9 – 18

9. I acquire information about the existence of mobile apps through:

Strongly disagree ***Strongly agree***

The Internet (websites).	1	2	3	4	5
Interpersonal communications e.g. Friends and family.	1	2	3	4	5
Mass media e.g. TV, radio and newspaper.	1	2	3	4	5
The organization where I am situated.	1	2	3	4	5
Special events e.g. conferences, trade show and exhibition.	1	2	3	4	5
Other means (specify).	1	2	3	4	5

10. I learnt how to use mobile apps correctly through:

Strongly disagree ***Strongly agree***

Formal training.	1	2	3	4	5
Informal training.	1	2	3	4	5
Operational manual.	1	2	3	4	5
The Internet (websites).	1	2	3	4	5
Interpersonal communications e.g. Friends and family.	1	2	3	4	5
Other means (specify).	1	2	3	4	5

11. How do you react whenever you hear about new mobile apps? (Choose one)

Positive.	1
Negative.	2
Indifferent and uninterested.	3

12. To what degree are you nervous about using new mobile apps?

Not at all ***Very nervous***

1	2	3	4	5

13. I use mobile apps, because?

Strongly disagree ***Strongly agree***

It is advantageous.	1	2	3	4	5
It is easy to learn and use.	1	2	3	4	5
It suits my life activities.	1	2	3	4	5
I see my friends using them.	1	2	3	4	5
I tested and liked it.	1	2	3	4	5

14. I tried mobile apps and considered adopting them, but later I decided not to adopt them, because:

Strongly disagree ***Strongly agree***

Using mobile apps is time-consuming.	1	2	3	4	5
Using mobile apps takes a lot of my phone memory.	1	2	3	4	5
Using mobile apps is distracting my attention from other activities.	1	2	3	4	5
Using mobile apps is expensive.	1	2	3	4	5

15. I discontinued the use of a particular mobile app because:

Strongly disagree ***Strongly agree***

There was a more enhanced one replacing it.	1	2	3	4	5
Its performance was not satisfactory.	1	2	3	4	5
It was not meeting my needs and expectations.	1	2	3	4	5
It did not deliver a perceived relative advantage.	1	2	3	4	5
It lacked support.	1	2	3	4	5
It was not easy to use.	1	2	3	4	5

16. I share information about mobile apps with others in order to:

Strongly disagree ***Strongly agree***

Facilitate my work activities.	1	2	3	4	5
Enable easy communications.	1	2	3	4	5

17. Information about a new mobile app innovation can be transferred to people, through?

Not at all ***A great deal***

A mass medium such as TV, radio, or newspaper.	1	2	3	4	5
Two-way communication between two or more individuals.	1	2	3	4	5
The Internet (websites).	1	2	3	4	5
Conference, trade shows or exhibition.	1	2	3	4	5
Organizations where people are situated.	1	2	3	4	5
Other means, specify.	1	2	3	4	5

18. Since the time I first became aware of a mobile app, I normally adopt and use it within a period of?

○ 1 Week ○ 2 Weeks ○ 1 Month ○ 3 Months ○ 6 Months ○ 1 Year

○ Above 1 Year ○ Never

D. Mobile apps innovation characteristics

On a scale of 1-5 (1 - strongly disagree and 5 – strongly agree), answer questions 19 – 22.

19. To what extent do you agree with the following statements?

Strongly disagree ***Strongly agree***

a. Using mobile apps enable me to accomplish my tasks more quickly.	1	2	3	4	5
b. Using mobile apps enable me to gain more knowledge on the way I perform my tasks.	1	2	3	4	5
c. Using mobile apps to do my work improve my efficiency.	1	2	3	4	5
d. Using mobile apps make my work easier.	1	2	3	4	5
e. Use of mobile apps fit well with the way I like to do my work.	1	2	3	4	5
f. Using mobile apps is compatible with all aspects of my lifestyle.	1	2	3	4	5
g. I have no difficulty learning how to use mobile apps.	1	2	3	4	5
h. I like to use mobile apps on a trial basis to see what it can offer.	1	2	3	4	5
i. A trial of mobile apps quickens my decision to adopt it.	1	2	3	4	5
j. I like to see the trial demo of mobile apps before accepting to use it.	1	2	3	4	5
k. It is/was easy for me to perform my daily activities using mobile apps.	1	2	3	4	5
l. Using mobile apps enable me to have more control over my activities.	1	2	3	4	5
m. I am using mobile apps because I can see other people using it.	1	2	3	4	5
n. I was encouraged to use mobile apps because of the benefits I observed in it.	1	2	3	4	5

E. Predicting factors of mobile apps adoption and diffusion in Africa

20. To what extent do you agree with the following statements

Strongly disagree ***Strongly agree***

a. I can be convinced to adopt and use mobile apps by my family.	1	2	3	4	5
b. I can be influenced to adopt and use mobile apps by my close peers.	1	2	3	4	5
c. I can be influenced to adopt and use mobile apps by my environment.	1	2	3	4	5
d. Use of mobile apps is a personal decision.	1	2	3	4	5
e. I adopt and use mobile apps if they are in line with my societal norms.	1	2	3	4	5
f. I do consider the rules and procedures at my workplace in making a decision to adopt and use new mobile apps.	1	2	3	4	5

g. My cultural beliefs determine my perception on new innovations.	1	2	3	4	5
h. My cultural beliefs influence adoption of mobile apps.	1	2	3	4	5
i. I perceive the use of mobile apps to perform my duties to be easy.	1	2	3	4	5
j. I perceive the use of mobile apps to be beneficial in all aspect of life.	1	2	3	4	5
k. Using mobile apps in my activities satisfy my expectations.	1	2	3	4	5
l. I am concerned about the security aspects of using mobile apps.	1	2	3	4	5
m. I believed that my information in mobile transactions is safe.	1	2	3	4	5
n. Use of mobile apps for inter-personal communications is risky.	1	2	3	4	5
o. There are enough technical infrastructures to support the adoption and use of new technologies in my country.	1	2	3	4	5
p. There are substantial supports from the developers ensuring proper use of mobile apps innovation.	1	2	3	4	5
q. There are substantial supports from the service providers which enable me to adopt and use mobile apps.	1	2	3	4	5
r. I would use mobile apps if I have the basic required knowledge of the innovation.	1	2	3	4	5
s. I would effectively use mobile apps if I know how to use a computer.	1	2	3	4	5
t. I would effectively use mobile apps if I know how to use smartphones.	1	2	3	4	5
u. I always feel anxious about using new technologies like computers and mobile phones.	1	2	3	4	5
v. I have negative feelings towards the use of mobile apps.	1	2	3	4	5
w. I perceive the financial cost associated with the use of mobile apps to be high.	1	2	3	4	5
x. I would like to use or continue to use mobile apps services if the charges on it are transparent.	1	2	3	4	5
y. I would use mobile apps if the financial cost is bearable.	1	2	3	4	5

F. Contributions of mobile apps innovation to the development of Africa.

21. To what extent do you agree with the following statements?

Strongly disagree ***Strongly agree***

a. Use of mobile apps to perform work activities improve individual productivity in Africa.	1	2	3	4	5
b. The mobile sector facilitates the creation of more jobs in Africa.	1	2	3	4	5
c. The mobile industry is one of the major contributors to the economic growth of nations across Africa.	1	2	3	4	5
d. Use of mobile apps has transformed the way we live in Africa.	1	2	3	4	5
e. Mobile apps create various ways of communication like web, email and chatting in Africa.	1	2	3	4	5
f. I use mobile apps on-the-go to for a variety of tasks.	1	2	3	4	5
g. Use of mobile apps enhances the provision of agricultural information in Africa.	1	2	3	4	5
h. Mobile apps enable the provision of expert improvement services to farmers in Africa.	1	2	3	4	5
i. Mobile apps facilitate training on efficient agricultural practices in Africa.	1	2	3	4	5

j. Mobile apps enable various ways of money transfer services in Africa.	1	2	3	4	5
k. Mobile apps enable self-service banking in Africa.	1	2	3	4	5
l. Mobile apps have transformed financial services in Africa.	1	2	3	4	5
m. Mobile apps enable e-learning services in Africa.	1	2	3	4	5
n. Mobile apps facilitate access to digital books, online libraries and online databases in Africa.	1	2	3	4	5
o. Mobile apps facilitate easy access to health education in Africa.	1	2	3	4	5
p. Mobile apps improved healthcare management system in Africa.	1	2	3	4	5
q. Mobile apps enable data gathering for disease surveillance in Africa.	1	2	3	4	5
r. Mobile communication spreads political information in Africa.	1	2	3	4	5
s. Use of mobile apps increases transparency of political activities in Africa.	1	2	3	4	5
t. Mobile apps reduce barriers to sharing stories in Africa.	1	2	3	4	5

G. Adopter's category

22. To what extent do you agree with the following statements?

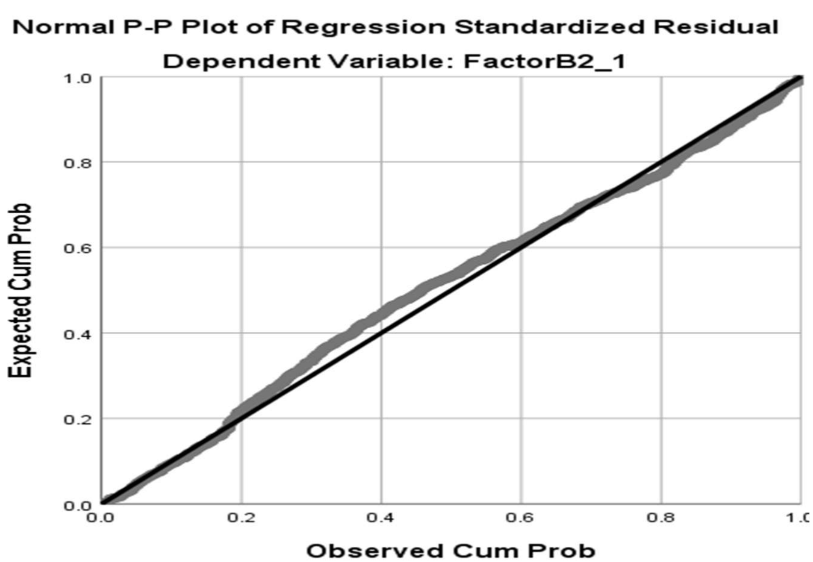
Strongly disagree ***Strongly agree***

a. I am often one of the first persons to try new technologies.	1	2	3	4	5
b. I tend to be a risk-taker with regard to new technologies.	1	2	3	4	5
c. I tend to be an active information seeker with regards to new technologies.					
d. I tend to try new technology as soon as it is available to me.	1	2	3	4	5
e. I am more interested in the technology than with its use in specific situations.	1	2	3	4	5
f. I am willing to invest time and energy to learn on my own and adapt to new technologies.	1	2	3	4	5
g. The fear of failing will not stop me from trying a new technology.	1	2	3	4	5
h. I share my experiences with new technologies with others.	1	2	3	4	5
i. Other people often ask for my advice or help regarding new technologies.	1	2	3	4	5
j. I experiment with new technology to see if it might be useful to me.	1	2	3	4	5
k. I adopt a "wait and see" attitude toward new technologies.	1	2	3	4	5
l. I want to see examples of successes of new technology before adopting it.	1	2	3	4	5
m. I want to make sure that adopting a new technology would be easy for me.	1	2	3	4	5
n. I want to make sure I have the necessary technical support and advice to learn and use a new technology before I adopt it.	1	2	3	4	5
o. I am skeptical about new technologies.	1	2	3	4	5
p. I accept new technology only after it has become established among the majority of other people who I know.	1	2	3	4	5
q. I accept new technology only when it becomes necessary.	1	2	3	4	5
r. I am usually not interested in adopting new technologies.	1	2	3	4	5
s. I see no use for new technology in my life.	1	2	3	4	5
t. My daily life is functioning well without using new technology.	1	2	3	4	5
u. Just because everyone else is using new technology, does not mean that I need to use it.	1	2	3	4	5

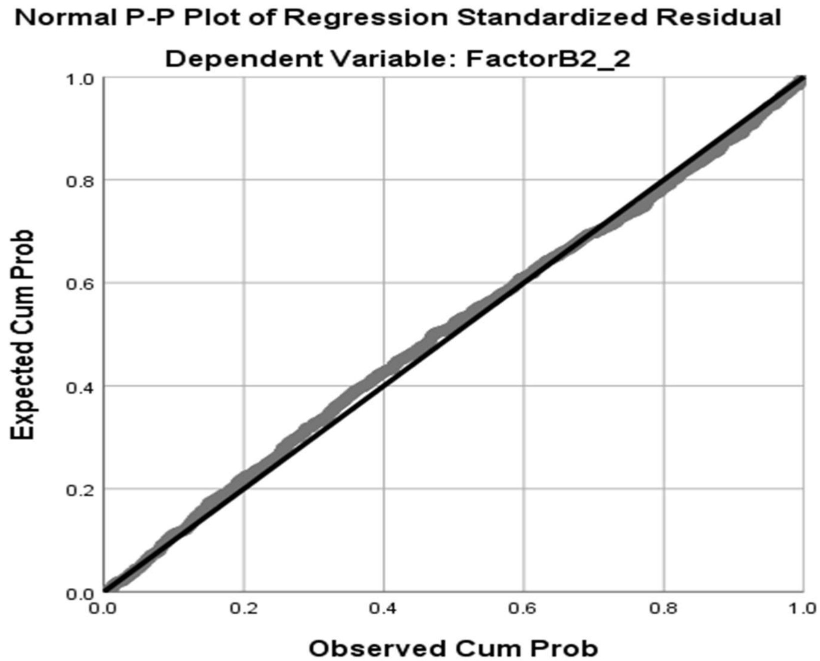
Appendix B: Normality of regression analysis

1. **General use of mobile apps**

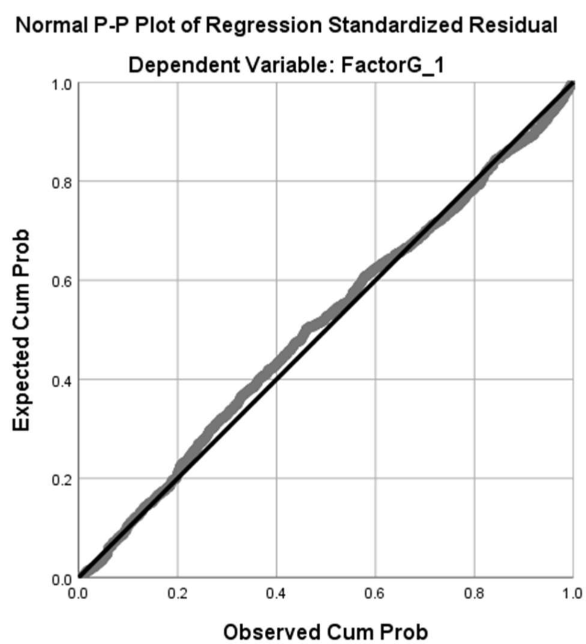
2. **Business use**



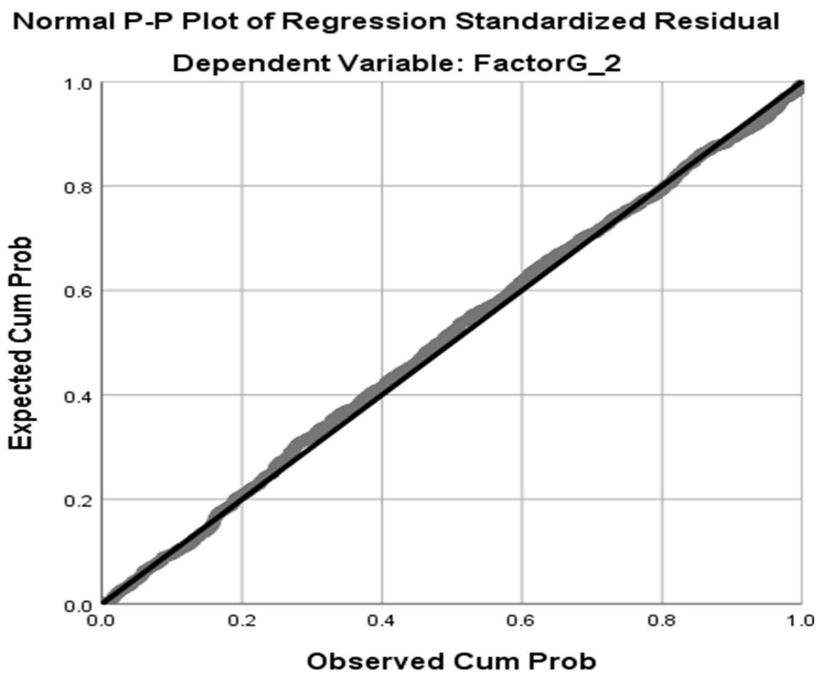
3. **Individual use**



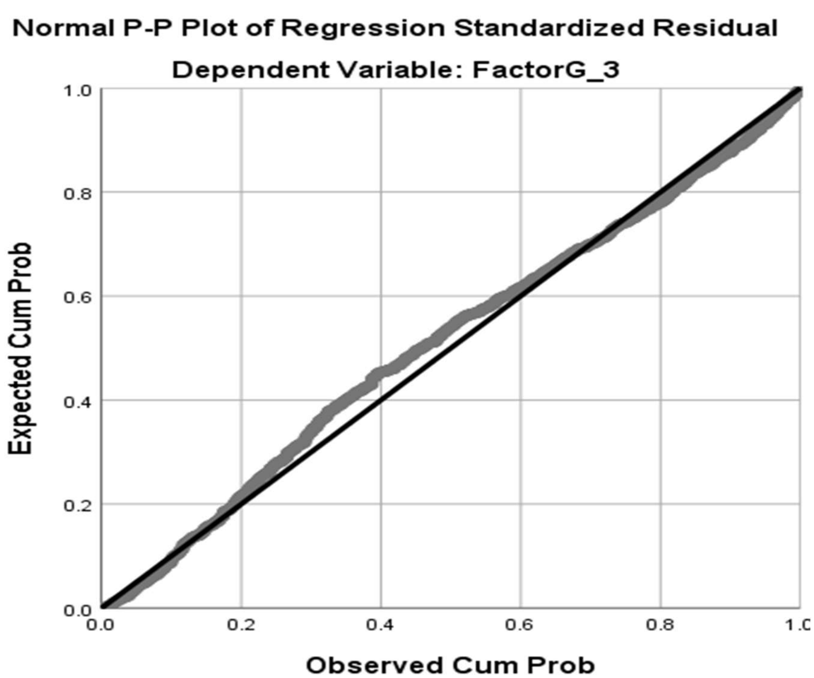
4. **Late majority and Laggards category**



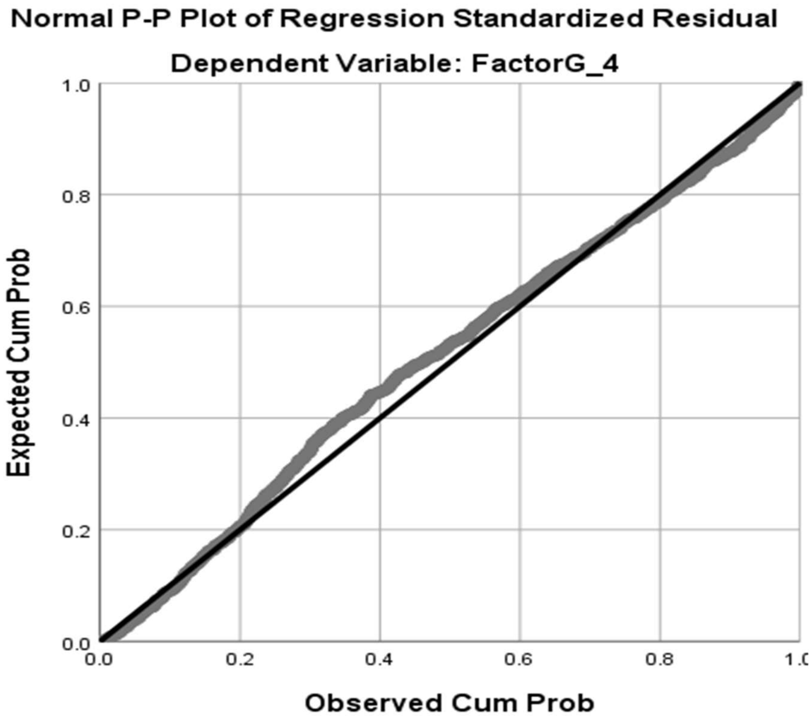
5. **Non-adopters category**



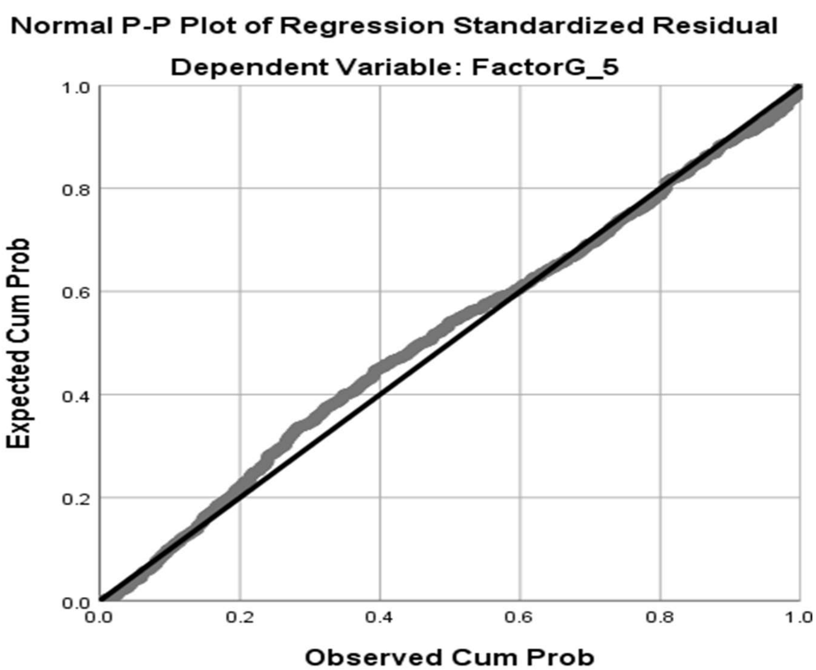
6. **Innovators category**



7. **Eaarly adopters category**



8. **Late adopters category**



Appendix C: Conference paper

THE ADOPTION OF M-COMMERCE APPLICATIONS: RURAL DWELLERS' PERSPECTIVES

ABSTRACT

In recent years, mobile applications (mobile apps) have gained widespread acceptance. Mobile apps services have effectively encircled most of the human activities, with the purpose of improving the living standard of the entire public. The adoption and diffusion of a mobile app are influenced by its characteristics. This study examines the adoption and diffusion of mobile commerce among the people living in a remote area of South Africa to determine the relationship between the characteristics of innovations and the adopters' attitudes. Through a survey that used diffusion of innovation as the basic framework, the opinions of the participants living in Mbongolwane in the Uthungulu District Municipality in the KwaZulu-Natal province of South Africa were gathered. A total of 120 out of 300 questionnaires distributed, were returned, giving a response rate of 40%. It was found that the perceived attitudes of the rural dwellers are closely related to the characteristic of innovations as well as the adoption of mobile commerce. Also, the findings indicate that though the people are very keen to receive a new technological invention, they are still late adopters. This research work offers a support in improving the adoption and diffusion of mobile apps among the rural inhabitants.

KEYWORDS**:** Mobile applications; Adoption and diffusion; Rural dwellers; characteristics of innovations; M-commerce; Attitudes.

1. INTRODUCTION

The introduction of mobile devices like mobile phones, personal digital assistants, computers etc., has triggered the development of various kinds of mobile apps. It's a common belief that an owner of a mobile device is also an adopter and user of mobile apps. For instance, every mobile phone can be used to send an SMS message. Mobile technology services have seen extensive growth in many aspects of life activities including education, economic, government and social (Murugesan (2013), Hellstrom (2011), GSMA (2017)). In developing countries like Africa, mobile technology diffusion has seen the highest growth-rate between 2012-2017 (ITU (2017)). Mobile apps are created to be used by the public covering the urban and rural dwellers. The global economic development, in particular, the African continent, is mainly propelled by the mobile technologies (Murugesan (2013), Qiang et al. (2011)) and extending these life-changing innovations to the remote areas is highly needed. The major challenges in deploying mobile apps to rural environments include technology infrastructural costs, computer costs and internet fees and the dwellers' low computer literacy (Liu et al. (2014)).

Several studies have been conducted on the adoption and diffusion of mobile technologies (Nickerson et al. (2014), Chang (2010), Brown et al. (2003)). Most of these studies centered on the opinions of the urban dwellers. Urban areas include town and cities which are characterized by their advanced civic amenities, better education opportunities, improved transport facilities, business and social interaction and generally improved standard of living. On the hand, rural areas include villages and hamlets which are characterized by lack of overall amenities and poor standard of living. There is rapid penetration of mobile phones, especially smartphones among the rural dwellers and this has improved the adoption of mobile apps among them. In a study on the diffusion of mobile apps among rural dwellers in China, Liu et al. (2014) noted that there is a lack of empirical research on the perceptions of the rural dwellers to adopt mobile apps in the developing countries like India, China and Africa. Rogers (2003) proposed some characteristics of innovations and stated that individuals' perceptions of these characteristics predict the rate of adoption of innovations. Also, it was suggested that the perceptions of the characteristics of a new mobile app and other technologies (Mannan and Nordan (2014)) influence the adoption rate.

However, the relationship between the perceptions of these characteristics and the adopters' attitudes (positive, negative and nervousness) towards the adoption of mobile apps is not clear. To our knowledge, there is no study to substantiate such a relationship and it is important to conduct such a study. In this light, this study seeks to investigate the relationship between the rural dwellers' attitudes and the characteristics of innovations towards the adoption of m-commerce apps. Based on the diffusion of innovations framework, a research model was developed and used for this study. Through a survey, quantitative data was collected and empirically evaluated.

The remainder of this paper is structured as follows: In section two the background information is presented, followed by a discussion of the research methodology in section three. In the fourth section, the data analysis is discussed whereas the results are interpreted in the fifth section. Finally, the sixth section concludes the paper.

2. BACKGROUND INFORMATION

Mobile apps are the mobile technological innovation of computer programs that run on mobile devices enabling users to perform their economic, political, educational and social activities irrespective of the location and context of the user. Mobile apps are developed to facilitate the functionalities of various mobile technology devices for the purpose of data gathering, information dissemination, and other activities (Okonkwo and Huisman (2018), Mc Namara (2009)).

There are different types of mobile apps including mobile commerce (Bhatti (2007), Abdelkarin and Nasereddin (2010)), mobile learning (Hwang and Chang (2011)), mobile governance (Poblet (2011)), mobile agriculture (Murugesan (2013), Hellström and Tröften (2010)) and mobile health (Kumar et al. (2013)). These mobile apps are widely adopted and used in various contexts and activities across the globe (Wang et al. (2013)). This study centers on the adoption and diffusion of mobile commerce among rural dwellers.

2.1 Mobile commerce (m-commerce)

M-commerce involves any commercial transaction performed through different kinds of mobile devices over a wireless network connection or telecommunication (Bhatti (2007), Joubert and Van Belle (2013), Chong (2013)). According to Bhatti (2007), there are two categories of m-commerce namely content delivery m-commerce and transactions m-commerce. The former involves reporting, notification and consultation while the later covers data entry, purchasing and promotions. GSMA (2015) reported that m-commerce is on a rise in African region due to rising growth of internet penetration and that 20% of South African internet users have made purchases online and another 48% are expected to do so in the future. M-commerce is important to economic growth in Africa because of ubiquitous and unison access to information and services, and the likelihood of a unique and personalized exchange of information (Bhatti (2007), San Martin et al. (2012)). The significant of m-commerce has resulted in the establishment of digital commerce sites across the African region. In 2012, Jumia was launched in Nigeria with funding from Rocket Internet. The company has expanded beyond its original base, with local sites across many other African countries including Cameroon, Senegal, Kenya, Tanzania, Ghana and Uganda. It is also in partnership with MTN and Millicom to drive future growth and facilitates the efficiency of m-commerce among increasing mobile users (GMSA (2015)). Hellström and Tröften (2010) point out some key drivers of m-commerce as including: Increased diffusion and penetration of mobile phones; falling prices of mobile phones and services; cost-effectiveness of mobile solutions; strong branding of easy to use mobile apps; user demand and needs; need for banks to reach out and get more customers; need for operators to keep customers (loyalty); scalable agent distribution for cash-in cash-out; and fast and simple customer registration process.

There are many m-commerce apps developed and functioning actively in Africa. These include all online shopping mobile apps like Zando, Ackerman, Spree online shopping apps and many others. The purpose of this study is to investigate the association between the attitudes and perceptions of the rural dwellers on the adoption of m-commerce apps in South Africa using the people living in Mbongolwane in the Uthungulu District Municipality in the KwaZulu-Natal province as the sample population.

The use of mobile-phone-based business transaction services offers a lot of benefits including but not limited to these; long distance coverage, consumer deals, savings and easy to use and on-time service delivery (Kim (2006), Siau et al. (2003).

2.2 Adoption

Rogers (2003) defined adoption as a choice of complete acceptance and usage of a mobile technological innovation such as mobile apps. GSMA (2015) stated that adoption is acceptance and making use of a new invention. It is the user's acceptance (Lule et al. (2012)) and usage (Taylor et al. (2011)) of an innovative product such as mobile apps. Adoption was also described as a process of decision-making by individuals that need awareness, i.e. it entails the use of personal abilities to observe, comprehend, and interrelate with their environment in an intelligent way (Botha and Atkins (2005)). Therefore, we defined adoption as the acceptance and usage of an idea or product that is perceived to be new by the adopters.

2.3 Diffusion of innovation theory

Rogers (2003) proposed a framework that has been using to measure the adoption and diffusion of technological innovations. The framework consists of four key components of the diffusion of innovations including innovation, communication channels, time, and social system. In addition, there are five categories of adopters centered on time to adoption: innovators, early adopters, early majority, late majority, and laggards. He went further to determine that adopters were unevenly spread in these categories. Also, the framework involves five characteristics of innovation that influence the rate of innovation adoption including relative advantage, compatibility, complexity, trialability and observability. Finally, he described the processes involved in innovation decision-making including knowledge, persuasion, decision, implementation and confirmation.

3. METHODOLOGY

Moore and Benbasat (1991) developed an instrument used to measure user's perceptions of adopting an IT innovation with diffusion theory as its basis. They noted that relative advantage and complexity are like usefulness and ease of use: hence they changed complexity to ease of use. In conclusion, they added two extra characteristics, which they believed to be significant in the adoption decision including image and voluntariness. Tan and Teo (2000) integrated the decomposed theory of planned behavior and diffusion of innovations theory to develop a framework that identified factors that may influence the adoption of internet banking. In conclusion, they included some factors to innovations characteristics which they believed to be important factors in the adoption decision including subjective norms, facilitating conditions, perceived risk and self-efficacy. Brown et al. (2003) applied the diffusion of innovations theory to determine the predictors of cell phone banking. They concluded that relative advantage, trialability, banking needs and perceived risk are the major predicting factors of cell phone banking adoption in South Africa.

The above factors were derived from the diffusion of innovation theory. These characteristics measured the adoption and diffusion of technologies in relation to the user’s perception which in effect cause the perceived attitudes of the adopters. Drawing from the above previous studies, the relevant innovation characteristics which may be used to determine the relationship between the characteristics of innovations and rural dwellers adopters’ attitudes on the adoption of mobile commerce include: *relative advantage, compatibility, ease of use, voluntariness, facilitating conditions, self-efficacy, subjective norms and perceived risk.*

A questionnaire was used as an instrument of data collection. The questionnaire contained closed-ended questions with 5-point Likert scale rating of 1 (strongly disagree) to 5 (strongly agree). The sections of the questionnaire included: Background information, mobile applications, adoption and diffusion of mobile apps, innovation characteristics, and adopter’s category.

To ensure that the questionnaire adequately addressed the significant matters, a pilot test was conducted among selected mobile apps users and the participants were asked to comment on how to enhance the questionnaire. Also, a statistician was consulted, and the questionnaire was professionally vetted.

The target audience is mobile apps users residing in the rural area of Mbongolwane, a town in Uthungulu District Municipality in the KwaZulu-Natal province in South Africa. The questionnaire was administered to the participants through a self-approach system (drop off) whereby the participants were approached and convinced to complete the questionnaire. To achieve validated responses to the survey, 2 persons from that area were employed to assist us to collect responses from the participants. Also, they served as interpreters used to explain the questions in their local language to some of the participants who do not understand the English language very well. Before the survey, the interpreters were educated on the research protocol and explained the study purpose. A total of 300 questionnaires were distributed to different participants and 120 (40%) responses were returned. This research was conducted between February and March 2018. The final sample population comprises of 72 (60%) males and 48 (40%) females. Concerning the level of education, 88 (73.33%) of the participants have grade 12, 18 (15%) have a diploma, 13 (10.83%) are university degree holders and 1 (0.83%) has a master's degree. Most of the participants are within the age range of 31-40.

4. DATA ANALYSIS

A descriptive analysis was performed to describe the frequency and percentage of responses from the study population. A Pearson correlation analysis was performed to determine if linear relationships exist between the research variables. Cronbach alpha reliability analysis was used to compute reliability coefficients for each of the examining variables. The criterion for Cronbach's coefficient alpha for reliability is $\alpha \geq 0.6$ (Sethi and King (1991), Nunally (1978)). That is if the obtained $\alpha \geq 0.6$ then the data obtained from that particular item is reliable. In addition, multiple linear regression analysis was performed to test the relationship between the characteristics of innovation and the rural dwellers' attitudes' towards adopting mobile apps with 0.05 as significant level criteria.

4.1 Reliability

A reliability analysis was performed on the construct items. Cronbach's alpha indicates that the used questions reach acceptable reliability, $\alpha = 0.72$. This showed that the instrument of measurement is reliable. Also, the correlation scores of all the items are identical (r=1) which indicates that the construct items correlate with each other. This is possible because the study was conducted in a unique domain where the perceptions and attitudes of the participants are similar. The reliability results are: Compatibility ($\alpha = 0.68$), Relative advantage ($\alpha = 0.67$), Voluntariness ($\alpha = 0.64$), Subjective norms ($\alpha = 0.64$), Ease of use ($\alpha = 0.72$), Perceived risk ($\alpha = 0.64$), Facilitating conditions ($\alpha = 0.8$) and Self-efficacy ($\alpha = 0.69$).

4.2 Survey results

The obtained results from the collected data are presented as follows:

Mobile apps – this section tested the knowledge of, and the use of mobile apps. A larger percentage of the participants agreed to know about mobile apps and have used them in various activities including 120(100%) for SMS, social networking and entertainment, 10% for agriculture, 40% for education and 20% for commerce.

Adoption and diffusion of mobile apps – this section tested the participants' attitudes towards a new mobile app. With regards to the individual reaction whenever he/she heard of a new mobile app, 60 (50%) are positive, 13 (10.8%) are negative and 47 (39.2%) are indifferent. Concerning nervousness on adopting a new mobile app, 61 (50.8) are not nervous, 26 (21.6%) are nervous and 33 (27.5%) are neutral. 93 (77.5%) of the participants strongly agreed that their main purpose of using mobile apps is for easy communications while 44 (36.6%) used mobile apps for other activities including online shopping. Also, 96 (80%) agreed that, from the time they get to know about a new mobile app, it takes them between 1-3 months to adopt and use it.

Innovation characteristics – this section tested the perceptions of the participants on the characteristics of innovations.

Relative advantage – is the extent to which an innovation is observed to be better than the existing ones. The obtained results are: 47 (39.2%) of the participants agreed that the relative advantage of a mobile app influences their adoption of that mobile app, 49 (40.8%) are neutral about the impact of this factor and 24 (20%) disagreed on this factor.

Compatibility – is the degree to which the innovation fits well with the existing values, experiences, and needs of possible adopters. The obtained results are: 57 (47.5%) of the participants agreed that the compatibility of a mobile app influences their adoption of that mobile app, 45 (37.5%) are neutral about the impact of this factor and 18 (15%) disagreed on this factor.

Ease of use – is the extent to which the innovation seems easy to be used. The obtained results are: 57 (47.5%) of the participants agreed that the ease of use of a mobile app influences their adoption of that mobile app, 39 (32.5%) are neutral about the impact of this factor and 24 (20%) disagreed on this factor.

Voluntariness – is the degree to which use of the innovation is perceived as being of free will. The obtained results are: 59 (49.1%) of the participants agreed that the voluntariness of a mobile app influences their adoption of that mobile app, 37 (30.9%) are neutral about the impact of this factor and 24 (20%) disagreed on this factor.

Facilitating conditions – are the supports provided by service providers and the government. The obtained results are: 63 (52.5%) of the participants agreed that the facilitating conditions of a mobile app influence their adoption of that mobile app, 33 (27.5%) are neutral about the impact of this factor and 24 (20%) disagreed on this factor.

Self-efficacy – is the individual ability to use an innovation. The obtained results are: 87 (72.2%) of the participants agreed that the self-efficacy of a mobile app influences their adoption of that mobile app, 11 (9.2%) are neutral about the impact of this factor and 22 (18.4%) disagreed on this factor.

Subjective norms – is the individual perception that most people who are important think that he/she should perform a behaviour. The obtained results are: 61 (50.9%) of the participants agreed that the subjective norms of a mobile app influence their adoption of that mobile app, 48 (40%) are neutral about the impact of this factor and 11 (9.2%) disagreed on this factor.

Perceived risk – is the danger involves in using an innovation. The obtained results are: 49 (40.8%) of the participants agreed that the perceived risk of a mobile app influences their adoption of that mobile app, 49 (40.8%) are neutral about the impact of this factor and 22 (18.4%) disagree on this factor.

Adopter's category – this section determines the types of adopter each of the participants is.

Innovators – they are the set of adopters that are willing to experience a new innovation irrespective of the profit, loss or risk involved. The obtained results are: 22 (18.3%) of the participants agreed to be in this category of adopters, 11(9.2%) are neutral about the category and 87 (72.5%) are not in this category.

Early adopters – they are leaders and advisers of the social system and their actions are limited within the boundaries of the social system. The obtained results are: 11 (9.2%) of the participants agreed to be in this category of adopters, 11 (9.2%) are neutral about the category and 98 (81.6) are not in this category.

Early majority – they are non-leaders with good interpersonal networks, deliberate in adopting an innovation and they are neither the first nor the last to adopt the innovation. The obtained results are: 49 (40.8%) of the participants agreed to be in this category of adopters, 35 (29.2%) are neutral about the category and 36 (30%) are not in this category.

Late majority – they are the set of adopters that are skeptical about adopting an innovation and wait for most people to adopt it first. The obtained results are: 83 (69.2%) of the participants agreed to be in this category of adopters, 13 (10.8%) are neutral about the category and 24 (20%) are not in this category.

Laggards – they are the most localized group in the social system with traditional view and very much skeptical about adopting a new idea. The obtained results are: 71 (59.2%) of the participants agreed to be in this category of adopters, 38 (31.7%) are neutral about the category and 11 (9.2%) are not in this category.

4.3 Adopters attitudes

For this research, attitude is defined as an individual's beliefs and feelings over an innovation. The attitudes of an adopter may be positive, negative and nervousness towards the adoption and rejection of an innovation. Wang et al. (2008) suggested that attitudes are a major predicting factor influencing the adoption of a new product, therefore there is a need for more understanding of attitudes in a well-defined manner. Attitudes are considered to be a three-factor concept comprising of cognitive, affective and conative covering thoughts and beliefs, feelings and actions respectively (Prislin and Crano (2008)).

This study seeks to determine the relationship between the characteristics of innovations and adopters' attitudes among rural dwellers on the adoption of m-commerce. Applying regression analysis to the research model whereby the characteristics of innovations are the independent variables and the perceived attitudes are the dependent variable, the results obtained are shown in Table 1 – Table 3.

Table 1: Positive attitudes

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.190	.614		3.565	.001
	Compatibility	-.200	.121	-.137	-1.646	.103
	Relative advantage	.569	.127	.527	4.475	.000
	Voluntariness	-.792	.175	-.641	-4.519	.000
	Subjective norms	1.839	.213	1.018	8.615	.000
	Ease of use	-.115	.100	-.077	-1.143	.255
	Perceived risk	.314	.157	.220	1.998	.048
	Facilitating conditions	-.579	.108	-.357	-5.356	.000
	Self-efficacy	-.694	.115	-.643	-6.029	.000

Table 1 indicates that relative advantage, voluntariness, subjective norms, perceived risk, facilitating conditions and self-efficacy characteristics showed statistical significant predictive capability. This means that these characteristics have an impact on the positive attitudes of the rural dwellers towards the adoption of m-commerce apps.

Table 2: Negative attitudes

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	3.160	.673		4.697	.000
	Compatibility	-.054	.133	-.052	-.406	.686
	Relative advantage	-.660	.139	-.858	-4.739	.000
	Voluntariness	.531	.192	.603	2.764	.007
	Subjective norms	-.371	.234	-.288	-1.588	.115
	Ease of use	.157	.110	.147	1.423	.158
	Perceived risk	.028	.172	.027	.162	.871
	Facilitating conditions	.112	.118	.097	.943	.348
	Self-efficacy	.015	.126	.020	.123	.903

Table 2 indicates that relative advantage and voluntariness characteristics showed statistical significant predictive capability. This means that these characteristics have an impact on the negative attitudes of the rural dwellers towards the adoption of m-commerce apps.

Table 3: Nervous attitudes

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	3.493	.364		9.606	.000
	Compatibility	.182	.072	.150	2.535	.013
	Relative advantage	-1.380	.075	-1.538	-18.327	.000
	Voluntariness	1.240	.104	1.208	11.950	.000
	Subjective norms	-1.438	.126	-.957	-11.377	.000
	Ease of use	.332	.059	.268	5.580	.000
	Perceived risk	.846	.093	.712	9.082	.000
	Facilitating conditions	.092	.064	.068	1.438	.153
	Self-efficacy	-.060	.068	-.067	-.882	.380

Table 3 indicates that compatibility, relative advantage, voluntariness, subjective norms, ease of use and perceived risk characteristics showed statistical significant predictive capability. This means that these characteristics have an impact on the nervous attitudes of the rural dwellers towards the adoption of m-commerce apps.

5. INTERPRETATION OF THE RESULTS

Generally, the results indicated that the rural dwellers have a good knowledge of what mobile apps are about, though not familiar with using all. For instance, all the participants are users of the SMS app. This is because they are using mobile phones for telephony and messages communications. With regards to m-commerce, a little portion (20%) of the sample population has knowledge of it and has used it. This implies that there is a lack of awareness-knowledge of m-commerce apps among the rural inhabitants and there is a need to create more awareness-knowledge about m-commerce and other related mobile apps.

A larger number of the rural dwellers perceived m-commerce app to be a good technological innovation and are willing to adopt and use them without being nervous at all. In addition, the results revealed that the rural dwellers show positive attitudes when they hear of a new mobile app. Therefore, it implies that they are willing, ready to accept, learn how to and practically use an innovation that get to their reach. They adopt and use mobile apps mostly for communications purposes like SMS, social networking and entertainments. Although they have limited awareness-knowledge of m-commerce apps, they demonstrated to have a high rate of interest in adopting and using m-commerce apps such that it takes an average range of 1-3 months for them to adopt and use a new mobile app.

Eight characteristics of innovations were used to examine the perceptions and attitudes of the rural dwellers on the adoption and diffusion of m-commerce including relative advantage, compatibility, ease of use, voluntariness, facilitating conditions, self-efficacy, subjective norms and perceived risk. The obtained results revealed that the rural dwellers perceived the innovation characteristics to be significant factors in their decision-making either to accept or reject m-commerce. Thus, the characteristics of innovations influence the attitudes of the rural dwellers towards decision-making on the adoption and diffusion of m-commerce apps.

The rural dwellers demonstrated a good intention of embracing a new technological innovation but still, they fall in the late majority and laggards categories. Probably because they live in a remote area and extension of the knowledge about a new innovation comes late. This suggests that if the information about an innovation like m-commerce apps is being disseminated to the rural areas in due time as it is done in the urban areas, there is the possibility that some rural dwellers will be in the early adopters and innovators categories.

Multiple linear regression analysis was performed to investigate the relationship between the characteristics of innovations and the rural dwellers' attitudes. The obtained results indicated that all the 8 tested characteristics of innovations have statistical significant capabilities of influencing the rural dwellers' attitudes (positive, negative or nervous) towards the adoption of m-commerce.

Concerning positive attitudes, the relative advantage, voluntariness, subjective norms, perceived risk, facilitating conditions and self-efficacy characteristics have significant influences towards the positive attitudes of the rural dwellers' adopters. This suggests that changes to these characteristics result in changes to the adopters' attitudes. With respects to the negative attitudes, the relative advantage and voluntariness characteristics have significant influences towards the negative attitudes of the rural dwellers' adopters. In relation to nervous attitudes, the compatibility, relative advantage, voluntariness, subjective norms, ease of use and perceived risk characteristics have a significant influence on the nervous attitudes of the rural dwellers' attitudes.

The analyses show that there exists a clear relationship between the perceived attitudes of the rural dwellers and the characteristics of innovations. From the perspectives of the rural dwellers, the adopters of mobile apps believe that an innovation should have a relative advantage over the existing ones, fits well into their lifestyle, be easy for them to learn and use, and with necessary support both from the innovators and the government. Furthermore, with the acquisition of the required knowledge and free decision to use the innovation, it must be in line with their societal norms and with reduced risk. Moreover, the rural dwellers exhibit positive interest whenever they get to know about a new mobile app which activated their enthusiasm to adopt and use the mobile app without panic.

6. CONCLUSION

The purpose of this study was to investigate the relationship between the characteristics of innovations and the rural dwellers' attitudes toward adopting and using m-commerce apps. A research model of adoption of innovations based on the diffusion of innovations theory was developed and used to examine the research objectives. A survey was conducted among the people living in Mbongolwane, in the KwaZulu-Natal province of South Africa. The descriptive statistics revealed that > 50% of the participants showed a positive interest in the adoption of an innovation (mobile app) without being nervous at all. It therefore, implies that they are enthusiastic, ready to accept, learn how to and practically use an innovation that get to their reach. Noticeably, despite the high degree of eagerness to adopt new innovations among the rural dwellers, there is a lack of awareness-knowledge of new innovations in the remote locations of South Africa. As a result, the adopters fall within the adopter's category of late majority and laggards. On the part of the relationship, it was observed that the characteristics of innovations have statistically significant predictive capabilities on the attitudes of the rural dwellers. Precisely the following facts were established: i) The relative advantage, voluntariness, subjective norms, perceived risk, facilitating conditions and self-efficacy characteristics have effects on the positive attitudes, ii) The relative advantage and voluntariness characteristics have significant influence towards the negative attitudes, and iii) The compatibility, relative advantage, voluntariness, subjective norms, ease of use and perceived risk characteristics have an effect on the nervous attitudes of the adopters. This indicates that the characteristics of innovations are closely related in different ways (positively, negatively and nervously) to the rural dwellers' adopters' attitudes on the adoption of m-commerce. This study, therefore, confirms that the diffusion of innovations theory is a good framework to investigate the adoption and diffusion of mobile apps among rural dwellers. It helps to understand the perceptions and perceived attitudes of the rural dwellers toward new innovations which in turn improves their decision-making and increases the growth rate of mobile apps adoption.

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