The impact of ICT on rural communities in KwaZulu Natal

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DECLARATION

I, Nkonzenhle Ngcamu, declare that this research article is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the Graduate School of Business Administration, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Nkonzenhle Ngcamu

Signed at …Centurion……

On the ……30…… day of ……March…… 2022….

DEDICATION

This report is dedicated to every young woman who is constantly and consistently trying to break gender stereotypes and is working hard to be recognised as equals in our society.

My father, for laying a strong educational foundation for me and being my number one supporter.

ACKNOWLEDGEMENTS

Thank you to my supervisor Dr Keratiloe Mogotsi, for your support, supervision, guidance, motivation and believing in me. Thank you for celebrating my small wins throughout this process.

Thank you to my family for their constant support throughout this journey. Especially my daughter Sinovuyo, thank you for understanding when mommy couldn't play with you because of the studies.

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ABSTRACT

The importance of Information Communication and Technologies (ICT) as a driver of community development is increasing in South Africa, especially for the rural communities that have been neglected from technological infrastructure deployment. It is an urgent need for developing countries like South Africa to invest in ICTs in the rural areas to eradicate digital divide and to enable these communities to partake in the digital world. The main objective of this research study is to investigate the factors that impact the deployment of ICT infrastructure in the less dense communities of KwaZulu Natal province in South Africa. There are a number of factors that has an effect on the spread of ICT which then limits the rate of adoption of these technologies. Using Rogers's three attributes of diffusion of innovation theory, relative advantage, compatibility, and complexity, to explore the rate of ICT adoption in rural communities. Data was collected at three district municipalities, King Cetshwayo, eThekwini, and iLembe through a survey. A total of 396 people participated in this study and then a critical data analysis was computed.

It is found that relative advantage and complexity have a negative effect on adoption and compatibility has a positive impact on adoption. Though Mndzebele (2013) found that relative advantage has no relationship with adoption but (Marak et al., 2019) found it to be negatively significant. Complexity is found to be significant but with an inverse relationship to adoption of ICT. Previous researchers have found a similar output in regard to technological innovations (Fong, 2009; Ibrahim & Monsurat, 2015; Mndzebele, 2013). Also, the highest level of education and employment status are significant predictors of ICT adoption. On the other hand, age range and gender are insignificant predictors. The outcome of this study will assist ICT service providers with a developed framework they can use to successfully deploy infrastructure in these communities.

Keywords: Information Communication and Technology, development, infrastructure, rural communities, Relative advantage, Compatibility, Complexity, adoption.

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1. CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND AND CONTEXT OF THE STUDY

The emergence of Information Communication and Technology (ICT) infrastructure has become increasingly popular owing to the increase in the significance of technological advancements and the 4th Industrial Revolution. The society at large uses technology in business, academia, and social activities. The deployment of ICT infrastructure incorporates technologies that give access to high-speed transmission of multimedia and high band with information.

The South African Community joined the ICT infrastructure deployment but mostly at the urban areas. Rural areas are mostly negated in the deployment of technological infrastructures. Why? The distribution in the rural areas is uneven because provision of these infrastructures was considered as not easy or not profitable (Navas-Sabater, Dymond, and Juntunen, 2002). The private sector further noted that in the rural areas, the service demand is low (Strover, 1999, 2001) and are reluctant to provide them with ICT services because they believe that the rural communities will forever be alienated (Gruber, Hätönen, and Koutroumpis, 2014). Nonetheless, the South African government have plans in place to deliver ICT infrastructures and services to the underserved communities so that they can be able to partake in the digital world (Manwa, Mukeredzi, and Manwa, 2016).

1.1.1 INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN SA

ICTs are used as catalysts for sustainable development goals which include poverty eradication. In other words, they are used to improve livelihoods.

On the African continent, South Africa is one of the countries that is advanced in terms of technology. However, due to monopolistic policies and historical factors, most areas do not have access to ICTs. ICTs date a long way back evidenced in the apartheid era where black townships had telephone infrastructures with low or no maintenance and white urban areas had well maintained telecommunications infrastructures. However, the black rural communities had been alienated and had no infrastructure whatsoever

(Morris and Stavron, 1993). This was mostly an issue of affordability which had been the government's priority (Barendse, 2003).

Of late, organisations like the Accelerated and Shared Growth Initiative in South Africa (ASGISA) and ICT Research Priorities for South African National Research Foundation (NRF) have played a vital role in providing telecommunications to all people (Information and Communication Technology, 2002). ASGISA had stressed out most importantly about the government identifying the key factors that can drive SA to achieve 6% in the economic growth. One of the key factors was the provision of ICT infrastructure which gives an opportunity to economic growth and digitalisation in SA. The NRF pointed out mainly on the provision of ICT to the whole of SA despite the geographical location because ICT impacts on the way people live, learn, and do business.

1.1.2 TELECOMMUNICATIONS INDUSTRY IN SA

The telecommunications industry is not solely owned by one person or the government, but it has several main players like: the state, parastatals, private companies, co-operatives, sole proprietors and/or closed corporations (Benjamin, 2003). Moreover, the government has a huge percentage in the ownership of the telecommunication sector. The (HSRC, 2003) also noted "South Africa is the world's fourth fastest growing cellular communications market".

The telecommunications sector is highly regulated by Independent Communications Authority of South Africa (ICASA). Hence, the authority was formed in 2001 after a merger of two regulators, Independent Broadcasting Authority (IBA) and the South African Telecommunications Regulatory Authority (SATRA). This regulatory structure impacts the functioning and performance of the national telecommunications as well as global telecommunications performance (Fransman, 2006). ICASA's main objectives include boosting the growth of ICT in deprived areas, to promoting affordable telecommunications services, developing policy and regulatory frameworks and assisting in ICT human resources development (ICASA Annual Report 2008/2009).

Policies play an important role in the deployment of ICT infrastructure because they impact decision-making. The South African government acquires its

telecommunications mandate from different Acts, which include the Telecommunications Act of 1996, the Electronic Communications Act of 2005, the CRA Act of 2000, and the Broadcasting Act of 1999 (Gillwald, 2001). The National Department of Communications (DoC) ensures that telecommunication infrastructure and policies are well implemented. The main aim of these policies is to increase competition, which paves the way for better access to ICT and cheaper telecommunications services (Bauer, 2010).

The South African mobile industry consists of four main mobile network operators, namely: Telkom, Vodacom, MTN, and Cell C, with MTN and Vodacom considered the biggest market share holders. Furthermore, Vodacom has maintained its dominant position in the mobile industry by introducing innovative ideas without cutting the prices of their products (McLeod, 2015). These four Mobile Network Operators (MNO's) have extensive 3G networks and Long-Term Evolution (LTE). Through corporations, telecommunication firms share infrastructure are required to have the correct documentation in order to build telecommunications infrastructure (Papacharissi and Zaks, 2006). There are also a number of Independent Service Provides (ISP's) in the industry. For example, in Mankosi, a rural community in the Eastern Cape, there is the Zenzeleni Telecommunications Company that is helping the community with building infrastructure and providing ICT services for them.

According to (Westerveld, 2012), most mobile operators have taken the initiative to provide communication services in rural communities, but most of the connectivity services promised are still not met. Moreover, communication services (voice and data) remain unaffordable (Bidwell et al. 2011)

This study therefore aims to investigate the factors that impact the deployment of ICT infrastructure in the low-density communities of South Africa by studying the innovation adoption rate. Specifically, it will investigate a few rural communities in Kwa-Zulu Natal that are economically disadvantaged so they can be able to participate in the digital economy and improve their quality of life.

1.2 PROBLEM STATEMENT

South Africa, rural communities often have poor infrastructure, which generally leads to limited resources and services (Nkonki, 2007). Furthermore, they have no knowledge of global trends (Prahalad, 2010). The Internet Government Forum (2016) further elaborated that the telecommunication sector is skeptical about providing rural communities with technological infrastructure because there is a scarcity of basic infrastructure like electricity, there are no skilled technicians, low income per capita, underdeveloped social services like schools and hospitals, and the internet is extremely expensive to maintain in such areas. The telecommunications infrastructure is also perceived to be costly to deploy because there are few customers per area, which then translates to a low return on investment (ROI).

Rural communities are often poor, and they depend mostly on livestock and farming (UNDP, 2000). According to (Carr, 2004), digital technologies are development catalysts not only in information and communication, but also in infrastructure. The introduction of ICTs in these areas do not completely eradicate poverty and hunger, but it can be a transformative development tool that will empower the underserved communities.

Most of the residents in Mankosi, a rural area in the Eastern Cape, lives without basic electricity and must pay a fee to charge their phones at a local spaza shop (African Innovations, 2017). The residents of Mankosi spend 22% of their income on telecommunications (airtime and data), which is a huge challenge for them as most are unemployed or are earning a minimum wage and could use this money for basic needs (Tucker, 2017). This is a huge problem in the development of the country as it means that access to telecommunications depends on an individual's affordability, and it further perpetuates the digital divide in SA.

The study will look at evaluating the behavior of rural community members in response to technological innovations deployed in their communities. Furthermore, it will further look into bridging the gap between the needs of rural communities and the technology that can be provided by ICT organizations. This will help shape the future digital landscape in South Africa.

1.3 RESEARCH OBJECTIVES

- To examine the relative advantage factors that influence the adoption of ICT in the rural communities
- Investigate the compatibility factors that impact the adoption of ICT in the rural communities
- To assess complexity aspects that affect the adoption rate of ICT in the rural communities.
- To develop a framework for Diffusion of Innovation for ICT service providers to successfully deploy ICT infrastructure in the rural communities.

1.4 SIGNIFICANCE OF STUDY

This study will highlight the importance of ICT in the less dense areas of SA because rural communities face a lot of challenges in terms of infrastructure deployment.

It is important to have an in-depth study of telecommunications and ICT in rural communities because rural areas are alienated and lack access to ICT services (Conradie et al. 2003). Costello (2000) further notes that the geographical location of a certain area should not limit information access and the use of digital services because they help to promote businesses, training, and learning. Therefore, rural areas deserve to be connected to the digital world in the same way as urban areas. The study will survey the factors that impact the adoption of innovation in the rural communities for government and ICT organizations to effectively deploy infrastructure in rural South Africa. Building community networks will improve the quality of life, reduce the digital divide, and give these South African communities access to global trends.

1.5 DELIMITATION OF THE STUDY

This research will review prior literature that focused on the three factors of adoption: relative advantage, compatibility, and complexity. It will then look at the diffusion of innovation theory and develop a conceptual framework for ICT adoption in the rural community. The research will take a quantitative data analysis approach and use

surveys and questionnaires for data collection. The participants will be from three different rural communities in KwaZulu-Natal, with a population sample of approximately 384, who will reflect on their experiences on factors influencing technology adoption.

1.6 RESEARCH STRUCTURE

The study is organised as follows: Chapter 1 is the introduction of the study with the background context of the topic. Chapter 2 critically examines prior literature on the Diffusion of Innovation theory, the factors that influence adoption of technological innovation with the development of hypotheses. The conceptual framework will also be presented. Chapter 3 focuses on research methods, population sample, research instrument, data collection and data analysis procedures. Chapter 4 a detailed analysis of the data that was collected will be presented. Chapter 5 is the critical interpretation and the discussion of the results. Chapter 6 will provide conclusion, limitations and recommendations derived from the study. It will also highlight recommendation for future study.

2. CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

This section will cover the literature on the attributes that determine the process of adoption of technologies using Diffusion of Innovation (DOI) theory to answer the research questions emphasized in chapter 1 of this study. Although the literature regarding the diffusion of innovation is extensive, it is limited in the South African context, especially in the rural areas. The literature review will also present other countries with the same characteristics as South Africa.

The literature review is the basis of this study and will cover the diffusion of innovation attributes and the rate of adoption. Furthermore, this study will also bridge the gap in the literature by assessing the attributes that influence the adoption of innovation in rural areas in KwaZulu-Natal province in South Africa and will also develop a framework for ICT organisations to successfully deploy infrastructure to less dense communities in the future.

2.2 DEFINITION OF CONTRUCTS

Information Communication Technology (ICT): is a term that unifies tools and resources from information technology and telecommunications networks to enable information to be formed, distributed, communicated, stored, and managed.

Diffusion of Innovation (DOI): is the process in which an innovation is communicated thorough certain channels over time among the members of a group that shares the same values and interests (social system).

Relative Advantage: is the degree in which an innovation is seen as superior to the idea it supersedes.

Compatibility: is the degree of which potential adopters will adopt an innovation if it suits their lifestyle, interests and are able to afford it

Complexity: is the extent that the participants are willing to adopt a technology due to the level of difficulty or ease of use of the technologies

ICT Access Index: is an index that measures the level of access to ICT items of an individual or household in South Africa.

2.3 THEORECTICAL FOUNDATION

The Diffusion of Innovation model was introduced by Rogers (1995) and has since become very popular with researchers who want to investigate the behaviour of members of a society in adopting new technology or innovation in a particular time frame. As Dooley (1999) and Stuart (2000) mentioned, a large number of studies have been conducted across a wide range of disciplines such as communications, politics, history, public health, education, economics, and technology that have used it as a framework. In addition, technology and innovation are being introduced and integrated into organisations and personal lives on a daily basis (Barron et al. 2003).

2.3.1 DIFFUSION OF INNOVATION (DOI) ELEMENTS

The process in which an innovation is communicated thorough certain channels over time among the members of a social system, is known as diffusion (Rogers, 2003). Furthermore, the author also emphasised that there are four key components of DOI, namely: innovation, communication channels, time, and the social system.

- Innovation – is anything seen as a new development like a product, object, practice or idea (Rogers, 2003). If a person is introduced to an idea for the first time, it's considered as an innovation to them regardless of it being conceived ages ago.
- Communication channels are utilised to exchange information amongst different audiences using transmission mediums. An innovation has to be distributed across the communication channels for it to be known (Ibrahim & Monsurat, 2015). These channels can be mass media and interactive communication between members.
- Time – Inman (2000) describes time as the position an individual possesses during the development of an innovation and the rate the development happens.
- Social system – are entities, groups, establishments, subsystems, that come together to form a network of associations and have a common objective. A

persons' innovativeness can be influenced by the makeup of these societal groups which is the key standard for classifying adopters (Ibrahim & Monsurat, 2015).

The above key components were taken from different theories, which Rogers then combined to create the diffusion theory. He then produced the four most popularly used theories, which are: perceived attributes theory, rate of adoption theory, individual innovativeness theory, and innovation decision process (Rogers, 2003). This study will focus on the perceived attributes and the rate of adoption theory.

2.3.2 DIFFUSION SEGMENTS

Based on the diffusion study, there are five different segments that the market is divided into in relation to how the market inclines to adopting a new product or service. As seen on Figure 1 below, the segments are known as innovators, early adopters, early majority, late majority, and laggards (Robinson, 2012). These segments are stagnant and should be seen as such so service providers should not intend to change them. Once innovations fit into the requirements of each segment then they are able to successfully disperse (Robinson, 2012).

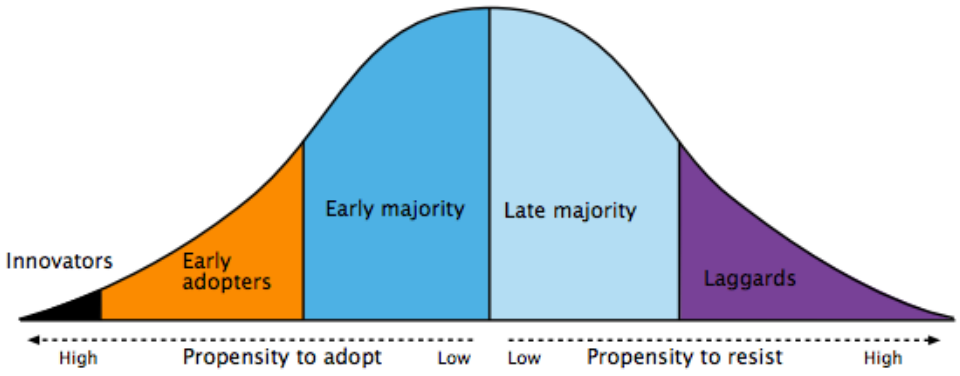

Figure 1: 5 Diffusion segments (Robinson, 2012)

The first segment are the innovators. They are a small number that find fulfilment from developing fresh ideas, owning new gadgets, and loving conversing on these topics. ICT service providers must identify and collaborate with innovators in the product design in order to appeal to them. According to what this scheme comprises, the innovators (2.5% of the population) begin using some innovation and emphasize that

people are characterized as independent risk-takers who are willing to risk failing. From people's behaviour, it is apparent that such a group has different characteristics, motivations, and needs from the other groups (Rogers, 1995).

When the evidence of the benefits of innovation becomes known then the early adopters segment follows. Early adopters, who are 13,5% of the population (Rogers, 1995), appreciate the finer things in life like fashion and being relevant amongst their peers. In order to appeal to this segment, ICT service providers need to do a behavioural analysis then include them as part of the trial process so they can assist to unlock information on products that are sought-after and convenient to buyers (Robinson, 2012).

Early majority then follows, 34% of the population (Rogers, 1995). This segment of the population is reluctant to take risks, cost sensitive and need proof that a product works before adopting it. Conventional marketing and recommendations from trustworthy people can entice this segment (Robinson, 2012). Jacobsen (1998) states that this stage is known as critical mass when 17 and 50% of the innovation is spread across the social system. The remaining segment of the society is generally linked to personal influence, and it is self-sustaining (Rogers, 1995)

Late majority group are traditionalists who are not open to new ideas or products. They are uncomfortable with change so they need products/services that will be suitable to their lifestyle and cost effective to convince them to adopt (Robinson, 2012). Finally, the laggards perceive new products as a risk. They first need to see others of the same segment using the product for them to adopt (Robinson, 2012).

This section will assist in understanding how innovation diffuse amongst different segments in the rural communities and how ICT service providers can utilise this information to market their products/services to the right segment.

2.4 PERCEIVED ATTRIBUTES OF INNOVATION

The diffusion of innovation theory is considered as one of the leading models to investigate the attributes that impact the ability of an individual to adopt an innovation. This theory intends to bring light to the rate of adoption within a certain group in society and the reasons to justify it (Al-Jabri & Sohail, 2012).

Atkinson (2007) states that there is a difference in how individuals adopt innovation, and it is usually described by the perception of the potential adopters on the features of the innovation. Hence, some innovations are spread and adopted faster than others. Rogers (2003) mentions that if the five themes (relative advantage, compatibility, complexity, trialability, and observability) are presented more, then that innovation will be adopted at a faster rate than others.

As seen in Figure 2 below, to accelerate the innovation-diffusion course, the availability of these attributes is of importance. Studies have disclosed that these aspects are likely to impact the adoption of an innovation/technology in a person's operations (Anderson et al., 1998; Surendra, 2001; Bennett, & Bennett, 2003), particularly relative advantage, complexity, and compatibility, as the generally prominent aspects on the mobile and internet technologies field (Al-Jabri & Sohail, 2012).

Rogers (2003), states adoption as a choice of "full use of an innovation as the best course of action available" and rejection is also a decision "not to adopt an innovation" (p. 177). It is cautioned that "getting a new idea adopted, even when it has obvious advantages, is difficult (Rogers, 2003).

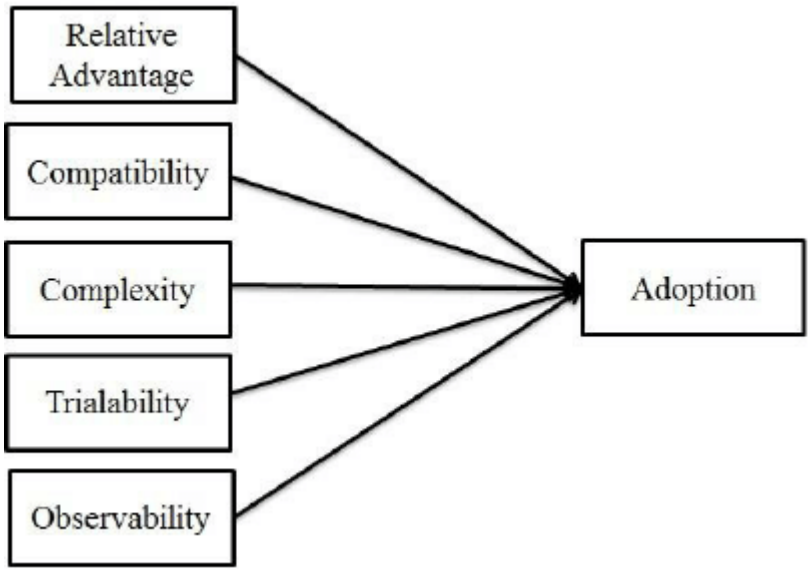

Figure 2: Diffusion of Innovation Theoretical Framework (Turan et al., 2015)

2.4.1 PERCEIVED RELATIVE ADVANTAGE ATTRIBUTE

Rogers (2003) explains relative advantage as “the degree to which an innovation is perceived as being better than the idea it supersedes” (p.233). Relative advantage is one of the five (5) perceived attributes of innovations. (Sahin, 2006) refers to relative advantage as the “cost and social status motivation aspects of innovation” because the late majority and laggards are not status driven whilst the early adopters and early majority are status driven.

Robinson (2012) also states that relative advantage is dependent upon the views of a group of users, and they consider convenience, financial benefit, and social status that they get from a service. Previous studies have found that relative advantage is a firm predictor for diffusion of innovation. In technological innovation, if potential adopters view a technology as an innovation that can improve their lives, the likelihood to adopt that potential technology is higher (Peltier, Zhao, & Schibrowsky, 2012). According to (Dibraa, 2015), relative advantage benefits can either be financial or not, it may be measured in different forms, for e.g., social status, financial well-being, etc. Relative advantage is basically dependant on the how a specific group perceives their needs (Robinson, 2012) and the more the degree of perceived relative advantage the faster is the spread of the innovation.

There is a slower rate of adoption in preventative innovations as their relative advantage is ambiguous than incremental innovations whose outcomes are beneficial in a short space of time. Incremental innovations are small improvements made to enhance a system/technology for reasons like performance, which then motivates people to adopt as they see value in it. Casmar (2001) gives an example of a university faculty adapting to technology due to new demands exerted upon them so the perceived value on the technology will make them adopt promptly.

In IT organisations, (Junglas, Goel, Ives and Harris, 2019) alludes that relative advantage is viewed in an individualist mode as the employees have a choice to choose and motivate on which system/technology to use based on their work, level of comfort, and competence. When employees are given a chance to make such technological choices, they feel in control and have a sense of IT empowerment

(Junglas et al., 2019). Empowered employees are motivated, innovative, and productive thus organisations see value in allowing employees to choose their own IT systems because it enhances performance.

Relative advantage constituents are also; low initial cost, economic viability, a decline in uneasiness, a saving of time and effort, social status, and closeness of results (Tanye, 2016). According to Rogers, relative advantage is perhaps the most grounded indicator of an adoption rate and statistically it's determined as the proportion of its advantages and the cost of the innovation being adopted. The proposition also recommended that adopter motivations can be utilised to build a benefit of an innovation, and this can be started by more elevated level of social association (Tanye, 2016)

Hypothesis 1 = There is a relationship between relative advantage and the success of ICT deployment in the rural communities.

2.4.2 PERCEIVED COMPATIBILITY ATTRIBUTE

Compatibility and relative advantage are regarded as similar in some diffusion studies, but theoretically are not the same. Rogers (2003) explains compatibility as “the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters” (p. 233). Mairura, Ngugi and Kanali (2016) also deduced that the compatibility attribute is associated with the costs of the benefit the innovation brings to the potential adopters. Organizations and individuals’ likelihood for adopting an innovation increases when the said innovation does not extremely disrupt their normal lifestyle and routines (Mairura et al., 2016).

It is almost certain that adoption will take place when innovation is suitable with the financial, sociocultural, and a set of belief systems of the potential adopter, their traditions and life necessities (Mndzebele, 2013). The needs and values of adopters must match with the positioning techniques in innovation to enable its introduction to society. Rogers (2003) mentions that an innovation that is viewed as incompatible with the major belief systems and standards of a particular group may possibly not be rapidly adopted than innovations that are seen as compatible unless a new belief system has been adopted prior. To increase the rate of adoption, innovation must be

suitable with the desires of the consumers which in turn will reduce the hesitation to adopt (Rogers, 2003). Sahin (2006) states that the naming and meaning of an innovation is important because there should not be any confusion or doubt in the mind of the consumers which may cause uncertainty.

Also, if potential adopters need to change or readjust their routines so that they match the new innovation, the likelihood of adopting decreases (Mairura et al., 2016). In automobile technology (Mairura et al., 2016) alludes that prior experience in adopting a new technology has a huge effect in a user's decision to adopt regardless if it was a positive or negative experience. Innovation scepticism can be a result of a negative prior experience hence a bad prior adoption experience may negatively influence future adoption decision.

Compatibility of a new technology to user's means they are less likely required to change their routine and conduct which then allows a more rapid adoption of the technology (Lippert & Forman 2012). This might be an important variable where an individual's prior technology adoption majorly impacts their view in adoption. Therefore, it is important that innovation aligns with a person's present belief system and practices.

Hypothesis 2 = There is a positive relationship between compatibility and the success of ICT deployment in the rural communities

2.4.3 PERCEIVED COMPLEXITY ATTRIBUTE

Complexity is "the degree to which an innovation is perceived as relatively difficult to understand and use" (Rogers, 2003, p. 15). If potential adopters have a view of possible difficulty in use of an innovation, they will reject adoption. Tanye (2016) mentions that the difficulty to use or operate a technology may rightly depend on the essence of the potential adopter.

In essence, an innovation should be user friendly because extreme difficulty can be perceived as a hindrance to adoption (Ibrahim and Monsurat, 2015). Complexity has an inverse relationship with adoption, the higher the perceived difficulty of an innovation then there will be a decrease in the rate of adoption. The opposite of

complexity is ease of use, hence (Al-Jabri & Sohail, 2012) explains ease of use as the extent in which a new innovation is viewed as easy to operate or understand.

In higher education, a technological innovation might confront members of a faculty with the challenge of changing their methodology to integrate the technological innovation into their instruction, so it might have different levels of complexity (Sahin, 2006). If the technology is user-friendly, then they might be adopted successfully for the delivery of course materials (Martin, 2003). Therefore, the simpler it is to understand an innovation, the quicker it will be to adopt it.

There is a less likelihood for adoption if an innovation is perceived as complex to use or comprehend and (Dibraa, 2015) also mentions that it may necessitate potential adopters to learn new skills and which may result in a decreased rate of adoption. Therefore, extreme difficulty of an innovation is mostly perceived as a hindrance to its rate of adoption.

Martin (2003) says, to assist in distinguishing the concept of complexity a question of; “will the planned technology be simpler to use and understand than the existing technology?” should be asked. When designing a product, the designer must try to make the product as basic and similar as possible to the current so it can be easier for the user to understand. Most technological products draws low interest because users have already labelled it as too hard to use and understand but a product that is designed to be easy to use and understand will draw adequate interest (Ibrahim & Monsurat, 2015). Therefore, when a product or service is perceived as difficult to use by potential adopters, it decreases the rate of adoption.

Hypothesis 3 = There is an inverse association between complexity and the success of ICT deployment in the rural communities

To conclude, (Rogers, 2003) disputes that innovations that offer further relative advantage, compatibility, complexity, trialability, and observability are at an advantage of being adopted quicker than innovations that offers less. He cautions that even if a new innovation has obvious advantages over others, it is still difficult to get it to the stage of it being adopted by society, it only speeds up the innovation-diffusion process.

Though other research has shown that all these attributes influences the possibility of adopting a new technology in their societal systems (Bennett, & Bennett, 2003; Ibrahim & Monsurat, 2015; Sahin, 2006; Surendra, 2001).

2.5 MEASURE OF ICT ADOPTION AND USAGE IN SA

A strong significant relationship has been evidenced by several studies between development and technology uptake. The United Nations Development Programme (UNDP) Human Development Report attested that a change in technology addresses a huge percentage of differences in development rates and innovation, specifically ICT, can enable development (UNDP, 2001). Moreover, another study from the World Bank said that between the periods of 1960 to 1990, 40-50% of mortality decreases were associated with technological progress and making innovation a more significant wellspring of gains than higher earnings or advanced levels of education amongst women (UNDP, 2001).

Numerous studies have since supported these statements that found that between the year 1985 and 2006, there was a significant association in the "development relationship between income gap and the adoption of the internet, mobile phone, personal computer, and telephones" (Fong, 2009, p. 1). According to the World Bank "a country could increase economic growth by 1,38% for every 10% increase in broadband penetration" (Department of Telecommunications and Postal Services, 2013, p. 2).

International Telecommunication Union (ITU) is a global body in charge "for collecting and disseminating of telecommunication and ICT statistics worldwide" has developed broad indicators to measure access and usage of ICT's (The International Telecommunication Union, 2020, p. 1). The ICT Access Index (IAI) is a combined index incorporated from ITU processes, it was established to measure and compare access to information and communication technology (ICT) across individuals, households, municipalities and provinces in South Africa (Lehohla, 2015).

The measurement of the Living Standard Measure is inherent within the context of the ICT Access Index. The Index measures three main pillars: ICT Readiness, which measures infrastructure access of a country; ICT Use, which examines the intensity

of use by individuals and households; and ICT Capability, which measures the skills necessary to use ICT's which were extracted from the ICT Development Index (The International Telecommunication Union, 2009).

It associates 12 ICT access indicators into one standard measure (Lehohla, 2015). The IAI growth process is grouped in three sub-indexes namely:

1. Active: measures the level of individuals or households' access to relatively technologically advanced ICT assets (Lehohla, 2015);
2. Passive: measures the level of individuals or households' access to basic broadcasting services and mail (Lehohla, 2015);
3. Readiness: measures households' relative skill levels and the ability to use ICT (Lehohla, 2015)

Below is the fomula that is used to calculate the ICT Access Index of an individual or hosehold:

ICT Access Index = ((L*0.65)+(M*0.20)+(N*0.15))*10

Where L = Active sub-index
M = Passive sub-index
N = Skills sub-index (Lehohla, 2015)

Please see the full table and the explanation of sub-indices in the Annexure A and B.

2.6 CONCEPTUAL FRAMEWORK

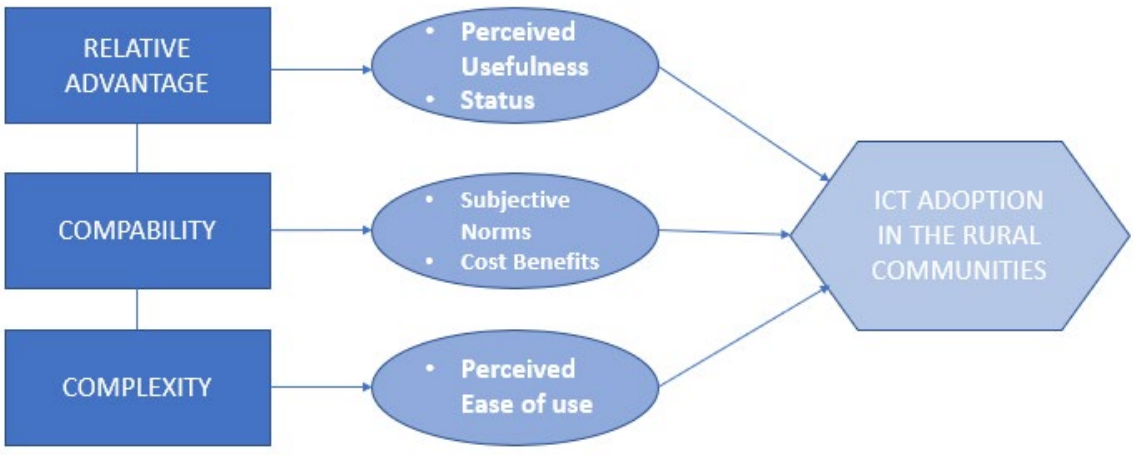

Figure 3: Conceptual Framework

The framework in the Figure 3 above is the proposed conceptual framework of the research model. This framework was established from the theoretical framework of the attributes of the diffusion of innovation model. This framework will be able to answer the research questions from Chapter 1, using the information obtained from the literature.

The first part of the model is the three attributes that influence a person's prospect to adoption of a new innovation/technology. The next section are the variables that emerged from literature that define the attribute. Finally, the last part is the product of all the variables that will decide how, an individual will react to and innovation and at what rate.

3. CHAPTER THREE: RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapters' intention is to discuss how the research is going to be conducted. The research methodology, design, data collection instruments, data analysis and population sample will be detailed. The methods used to reach the objectives and test the hypothesis proposed, will be also detailed.

3.2 RESEARCH DESIGN

The research design is a strategic plan that highlights the outline and is utilised to explain research objectives (Johnson and Christensen, 2004). Moreover, Mouton (2001) describes research design as a proposal or a summary that describes the detail on how a researcher is going to carry out the study. Mouton (2001) also concludes that a research design should be able to explain the type of research that will be used and the reasons why it is used.

Research design, therefore, give answers to the research questions by reasonably combining different parts of the research into one strategy. It contains all of the stages in the examination method which includes a functional plan, measurement and

analysis. The design of the research is reliant on the research problem so the process of getting a research design is dependent on the problem (Zikmund et al., 2010), objectives and the desired data (Hair et al., 2010). Hence, researchers must take time and think through carefully about the problem, objectives and the kind of data that is needed for the research study before they decide on the approach. Vosloo (2014) mentions that the aim of the design is for the researcher to understand decisions taken and rather increase the opportunity of getting results which are valid.

3.3 RESEARCH APPROACH

Research approach is the strategy and processes of a research study (Creswell, 2014). It is the methods of data collection, analysis and interpretation. Creswell (2014) further alludes to that an approach is chosen based on the problem, the investigator's previous practices and the audience that is intended for the study.

If the intention of the research is to describe the behavioural characteristics of a sample population regarding their adoption of innovation and the how innovation can improve their development, hence quantitative approach was more appropriate for this study.

Quantitative research approach is the investigation into the problem given, testing the predetermined hypothesis, measuring numbers and analysing statistical methods (William, 2011). The reason for this particular approach is to find out if the predicted generalisations of the theory are true.

According to Leedy and Ormond (2001) and (Williams, 2011), "quantitative research involves the collection of data so that information can be quantified and subjected to statistical treatment in order to support or refute alternative knowledge claims". William (2011) further highlights the process of quantitative research noting that it starts with the (1) problem statement, (2) generate research questions and a hypothesis, (3) review the related literature and (5) analyse the data/information acquired.

Quantitative research approach is numeric, and it is more likely to present accurate results of the effects of the situation generalised from the population. In collecting quantitative information, larger sample sizes are used so that more information can be collected. Quantitative data is advantageous to use because, according to (Gelo et al.,

2008), information from quantitative is reliable. If data is collected using the appropriate methods and analysing the available information critically it becomes reliable (Creswell, 2008). Moreover, this research approach is not only reliable but also it has strengths which include;

- Numeric value/estimates
- Verifiable data
- Comparable data
- Information provided does not need analytical judgment

However, quantitative research fails to give full information description of the circumstances but rather just gives numerical data (Voegtle et al., 2006), leaving gaps in data by not including issues associated with the situation, collecting data is labour intensive and there might be limited participants willing to comply with the researcher.

In addressing the research objectives and testing of the hypothesis, a descriptive research approach was used. It allows to describe and measure relationships between variables without the researcher influencing those (McCombes, 2021). Fox and Bayat (2007) state that, descriptive research is “aimed at casting light on current issues or problems through a process of data collection that enables them to describe the situation more completely than was possible without employing this method.” The major advantage of descriptive research is, it allows to analyse facts and helps in developing an in-depth understanding of the research problem. It also enables the researcher to determine the behaviour of people in a natural setting.

3.4 RESEARCH POPULATION AND SAMPLING METHOD

The quantitative research approach was used for this study. The most appropriate method for data collection was the survey research method because of the population size of this study. Therefore, the survey research method was applied.

3.4.1 Population

The study was carried out in KwaZulu Natal (KZN) Province in South Africa. KZN has the second highest population of 11 724 362 (StatsSA, 2020) after Gauteng Province and is one of the provinces with the highest rural population in the country. As of 2020,

the total rural population in KwaZulu Natal stood at 6 017 616 people and is spread across 11 district municipalities as in the table 1 below. Therefore, the population for this study is 6 017616 million rural residents in KZN.

Table 1: Total Rural Population in the District Municipalities

District Municipality	Total Demographic Population	Total Rural Population
eThekwini Metropolitan	4 100 546	700 895
Ugu (KZN)	768 772	612 684
uMgungundlovu (KZN)	1 170 777	486 946
uThukela (KZN)	737 634	505 435
uMzinyathi (KZN)	579 551	469 281
Amajuba (KZN)	567 420	260 354
Zululand (KZN)	882 901	701 899
uMkhanyakude (KZN)	709 943	666 111
King Cetshwayo (KZN)	999 988	815 975
iLembe (KZN)	693 220	404 222
Harry Gwala (KZN)	513 610	393 814

The population was inclusive of different types of people, young to old, rich and poor, employed and unemployed, educated and uneducated, as long as they lived or worked in the rural community.

3.4.2 Sampling Method

The process of selecting people who shall represent the total population is known as the sampling method (Polit-O'Hara et al., 2001, Neuman, 2011). Burns and Grove (2003) defines it as a method that assists in electing a group of people for the purposes of a study. There are two kinds of sampling techniques known as probability and non-probability sampling.

Probability Technique – this method offers the same chance to any one of the potential samples to be nominated and can actually mirror the whole population (Okonkwo, 2019), including:

- Random sampling

- Stratified sampling
- Cluster sampling
- Systematic sampling

Non-probability Technique – this method is the opposite of the probability technique, it offers unequal chance to the potential samples to be selected and there is uncertainty if the sample selected is a true reflection of the entire population (Oates, 2006). It includes:

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

In this research study, the probability cluster sampling technique was used because the research area (rural KZN) is too large, and it was not feasible to cover all municipalities. The rural population was divided to smaller parts (district municipalities) and three district municipalities were selected from the eleven in KwaZulu Natal. Two of the highest (King Cetshwayo and eThekwini) rural populated municipalities and one of the low populated (iLembe) were used as the sample. Then random sampling was used to select participants in those areas.

3.5 RESEARCH STRATEGY AND SIZE

There are several strategies available that can be functional in research that is: “case study, survey, experiment, action research, ethnography, grounded theory, archival research, longitudinal studies, cross sectional studies as well as participative enquiry” (Collis and Hussey, 2009; Creswell, 2009; Easterby-Smith et al., 2008; Saunders et al., 2009;)

The survey research method is generally related with quantitative studies as it comprises of collecting data from large cluster of people to allow the researcher to understand the insight of their study. Therefore, the survey method has been selected for this research as it aligns with the objectives the researcher desires to achieve.

3.5.1 Surveys

Check and Schutt (2012), defines survey findings as, “the collection of information from a sample of individuals through their responses to questions”. Survey method uses quantitative data approaches such as numerical rated item questionnaires. For example, how many people in the rural areas have installed fixed fiber in their homes?

Furthermore, (Sukamoloson, 2007) discusses how survey research is a form of quantitative method which involves sampling questionnaire, questionnaire design and questionnaire administration. These help to gather information and make an analysis. According to Kramer (1991), survey research has three basic principles, that is;

- Sampling a part of the population which will be used to conclude for the rest of the population
- Data can be obtained from people
- Describing a quantitatively a sectional feature of a population which examines the relationship

The collection of data from individuals living in the three pre-selected municipalities in KwaZulu Natal was conducted, in the effort to generalise the findings of the entire rural population of KZN.

3.5.2 Sampling Size

Sample size is the definite number of the population that is expected to participate in the study (Oates, 2006). Shapiro (2008) agrees to saying it is the final number of individuals selected from the overall sample population to partake in the research survey.

The population for this study was the number of people that live in the rural communities of KwaZulu Natal currently which is approximately 6 million. To calculate the sample size, the population of 6 017 616 million, a confidence level of 95% and margin of error of 5% was used. Using an online calculator, a sample size of 384 was obtained. The target of 384 out of 6 017 616 million responses was indeed obtained.

The sample size can also be calculated by using the formula below:

Sample Size (n) = N * [Z^2 * p * (1-p)/e^2] / [N – 1 + (Z2 * p * (1-p)/e^2]

where,

N = Population size,

Z = critical value of the normal distribution at the required confidence level,

p = Sample proportion, and

e = Margin of error

The sample surveyed was 394 rural residents in the three selected district municipalities who were at a consenting age of 18 years and older.

3.6 RESEARCH INSTRUMENT

When generating data for research purposes necessitates a suitable technique whilst having the topic of the study in mind. There are a numerous data collection methods that are linked to the survey method, these include interviews, questionnaire, documents and observations (Oates, 2006). Deciding on a technique is truly dependent on the topic of the study, the population size, surrounding settings and data required by the researcher. Because of the large population from this study, quantifiable data was required hence the questionnaire data collection method was the most suitable.

Questionnaire is a data collection method that is survey based and contains questions or statements that are to be answered by the participants of the study without any assistance from the researcher (Monette et al., 2011). These questions are pre-planned and are designed in a distinctive way based on the study. They can consist of both closed end and open-ended questions or either.

The questionnaire for this study was divided into two parts. Part A of the questionnaire consisted of eight questions which were for screening and demographics. They determined the right people to participate so the study can achieve its objectives. Part B consisted of a Likert scale type (strongly disagree “1” to strongly agree “5”) of questions where the participants were required to tick the relevant box. This scale type assisted in quantifying and simplifying the behaviour of the respondents pertaining to the diffusion of innovation attributes.

3.7 PROCEDURE FOR DATA COLLECTION

Since this study deals with the unavailability of ICT in the rural areas, traditional data collection procedure was followed. The questionnaires were printed on paper and were physically distributed in the different communities.

The researcher distributed the questionnaire in the three different rural district municipal areas in KZN namely: eThekwini, King Cetshwayo and iLembe with a target sample of 384 consenting people from the ages of 18 – 60 years old.

All data was written on the prepared papers. Random quality checks were done to ensure reliability of the data. After collection, the data was transferred to an excel spreadsheet and then exported to the SPSS tool for data analysis.

3.8 ETHICAL CONSIDERATIONS

Key ethical considerations are involved when deciding on what to research and how to conduct the research. These ethical considerations work to ensure protection of the rights of the participants, improve research legitimacy and uphold scientific integrity (Bhandari, 2021).

For this research project, no data will be collected before receiving ethics clearance certificate from the university's ethics committee as they approve if the research objectives and design is ethically acceptable and if they follow the university's code of conduct.

The following ethical principles will be followed:

- Voluntary involvement – All participants will be permitted to choose to partake with no pressure and they will be allowed to withdraw from the study at any given point in time without any obligations.
- Informed consent – Potential participants will be informed regarding the purpose, advantages, risks, and the time it will take to complete the survey before they can agree or decline to join (consent form attached).
- Anonymity - Data will be collected from different villages in KwaZulu Natal that were selected using the sample size calculator which makes it impossible to

know the identities of participants. No personally identifiable data will be like names and identity numbers, will be collected.

- Confidentiality – Participants have the right to privacy so all data that will be used during and after the study will be stored in lockable filing cabinet and then also stored in a password protected laptop.
- Potential for harm – the risk of potential harm is absolute minimal. Due to the Covid-19 pandemic, masks will always be worn, and extra masks will be available for participants who don't have any. Every participant will be sanitised before and after completion of the survey to mitigate the risk of infection.

3.9 DATA SCREENING AND ANALYSIS APPROACH

The Statistical Package for Social Sciences (SSPS) tool was used to analyse the quantitative data collected. This software is widely accepted and used by researchers in various disciplines like information systems and social sciences research (Zikmund, 2003). All the hypotheses from Chapter 2 were put to test and all required analysis conducted. The results are presented and discussed in detail in Chapter 4 and 5 respectively.

3.9.1 VALIDITY TESTING

Validity refers to the degree to which a study accurately reflects or assesses the specific concept that the researcher is attempting to measure, whether the results are generalised or transferrable (Rudestam & Newton, 2015).

3.9.1.1 External Validity

This validity demonstrates the ability for the research design to convey outcomes that can be generalised to various circumstances, in particular "real-life" conditions (Ricker, 2015).

Time and resources were limited for this study, so the research was designed to look at participants in the three district municipalities only. The screening question in the research instrument also ensured that only respondents that dwell or work in the rural communities participated in this study. This assisted to ensure that the population in

the context of the study was represented and increased the probability to generalise the results.

3.9.1.2 Internal validity

Internal validity is the ability that the research design is going to present an acceptable test of the hypothesis (Ricker, 2015). Rudestam and Newton (2015) also states that it ensures uniformity throughout the process with regards to the instruments used and that participants have the same instrument without compromising any information.

Saunders et al. (2009, pg. 189) discussed the four validity techniques as follows:

- Content validity – "shows the degree to which the measuring instrument fully assesses or measures the construct of interest" (Saunders et al, 2009)
- "Face validity – is a component of content validity and is established when an individual reviewing the instrument concludes that it measures the characteristic or trait of interest. In short, it looks as if it is indeed measuring what it is designed to measure" (Saunders et al, 2009)
- "Criterion-related validity – is assessed when the researcher is interested in determining the relationship of scores on a test to a specific criterion" (Saunders et al, 2009)
- "Construct validity – is the degree to which an instrument measures the trait or theoretical construct that it is intended to measure" (Saunders et al, 2009)

For this study, construct validity was used based of the nature of the literature review

3.9.1.3 Correlations Analysis

The Pearson Correlation analysis evaluates the hypothesis based on the strength of the relationship between two of the constructs with the assumption that the variables are linear. The results are shown in table 2 below.

Table 2: Pearson's Correlations

Correlations			
	Relative Advantage	Compatibility	Complexity

Relative Advantage	Pearson Correlation	1	.291**	-.136**
	Sig. (2-tailed)		.000	.007
	N	396	396	396
Compatibility	Pearson Correlation	.291**	1	-.154**
	Sig. (2-tailed)	.000		.002
	N	396	396	396
Complexity	Pearson Correlation	-.136**	-.154**	1
	Sig. (2-tailed)	.007	.002	
	N	396	396	396
**. Correlation is significant at the 0.01 level (2-tailed).				
*. Correlation is significant at the 0.05 level (2-tailed).				

In the analysis above a significant positive correlation exist between Relative Advantage and Compatibility with r = 0.291 and a p = 0.000). For a significant result, p must be below than 0.05 and the correlation coefficient be above than 0. In contrast, relationship between Relative Advantage and Complexity (r = -1,36 p = 0.007), Compatibility and Complexity (r = -1.54, p = 0.002), are not significantly associated with each other and their coefficients fall beyond the acceptable -0,1 to 0,1 range. It was noted also, there were no exceptionally high correlations amongst the constructs (>0.9) and therefore no danger of multicollinearity.

Table 3 below is the results of the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity. The values for the Relative Advantage and Complexity construct were above the minimum desired value of 0.6 and Compatibility construct with the value of just above 0.5. This implies that the sample is sufficient and a factor analysis can be conducted for each construct. Furthermore, the Bartlett's Test of Sphericity had p values of 0.000 which is less than the required 0.05, implying that the model is valid.

Table 3: KMO - Bartlett's Test of Sphericity

Relative Advantage		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.647
Bartlett's Test of Sphericity	Approx. Chi-Square	165.855

	df	6
	Sig.	.000
Compatibility		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.518
Bartlett's Test of Sphericity	Approx. Chi-Square	286,215
	df	6
	Sig.	.000
Complexity		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.743
Bartlett's Test of Sphericity	Approx. Chi-Square	333.379
	df	6
	Sig.	.000

This renders the instrument valid however validity is not sufficient alone, the ensuing section assess the reliability of the instrument.

3.9.2 RELIABILITY TESTING

Reliability is how dependable the results attained on a survey (Gratton & Jones, 2010). It measures if the instrument will give the same results from different participants in different settings and it is measured by the correlation coefficient (Salkind, 2017). Collis and Hussey (2009) claimed that there are 3 general methods that are used to estimate reliability of a research instrument and they are:

- Test re-test method
- Split-halves method
- The internal consistency method

For this study the internal consistency method was used where each variable was correlated against each other, and an inter-term correlation average was perceived as a reliability index.

3.9.2.1 Cronbach Alpha

The research instrument went through an internal consistency test using the Cronbach Alpha analysis. All variables under each of the three constructs were tested using

Cronbach Alpha Coefficient. The overall analysis of the results is shown in Table 4 below:

Table 4: Summary of Cronbach Alpha

Construct	No. of Items	Cronbach Alpha
Overall Scale	9	0.774
Relative Advantage	3	0.627
Compatibility	2	0.518
Complexity	4	0.738

In the table above, the overall instrument had the Cronbach's Alpha measured as 0.774 which was greater than 0.7. This illustrated that the research instrument was sufficiently reliable.

The Complexity construct had a reasonably high level of reliability since it measured a Cronbach's Alpha value of 0.738 which is greater than the desired value of 0.7. Relative Advantage and Compatibility constructs had Cronbach's Alpha values of 0.627 and 0.518 respectively. Although these constructs measured below the desired value of 0.7, they are still valid or acceptable since they are above 0.5 as reiterated by (Pallant, 2006). All variables that had a Cronbach alpha less than 0.5 were deleted and disregarded further in the analysis.

Therefore, the instrument for the study was both valid and reliable.

3.10 LIMITATIONS OF THE DATA COLLECTION METHOD

This study had a few limitations accompanying it. The first limitation was the global pandemic, COVID-19 virus, which was discovered late 2019 and diffused all over the world. Close contact between humans was not encouraged as it perpetuated the spread of the virus. On site surveys were a requirement to be able to carry out the study successfully. Majority of the people were hesitant to participate in the survey in fear of the risk of transmission of the virus. The researcher followed all the Covid-19 government regulations to help mitigate this risk. They ensured that all participants

were wearing face masks and there were extra masks for participants who did not have one. The researcher and the participants rigorously sanitized their hands before and after completion of the survey.

3.11 CHAPTER SUMMARY

This chapter outlined the research approach and methodology that was followed in this study. It then highlighted the research method and the data collection technique that was used. Ethical considerations, validity and reliability of this study are also presented. In the next chapter, will be the presentation of the analysis of the study conduct.

4. CHAPTER 4: PRESENTATION OF RESULTS

4.1 INTRODUCTION

Chapter 4 presents the results of the quantitative study attained in the research. The collected data was processed with the statistical data tool, SPSS. The presentation of the study will begin with the demographic profile of the respondents, then the results of the testing of each hypothesis.

4.2 PRESENTATION OF RESULTS

Through the traditional pen and paper method, 400 respondents participated in the survey. The study took 8 days to complete with an average of 2.5 days spent per municipality. There were 4 spoilt questionnaires due to duplication of answers by respondents hence the spoilt questionnaires were removed. A total of 396 responses were recorded for this study and this total sample size is marginally above the calculated 95% confidence level required for this study.

4.2.1 RESPONDENTS DEMOGRAPHIC PROFILE

Data collection was done during the December break where there were many people who did not permanently reside in these communities. Part A of the questionnaire was screening and demographic questions. Question 1 was a critical question because it identified the target participants. Hence, all 396 respondents answered “yes” to the “do you live here” question. All the respondents lived or worked in the rural communities. 53.3% of the respondents were female and 46.7% were males. Most of the participants were young people between the ages of 18 -25 years with 34.8%, followed closely by respondents between the ages of 26 – 35 years (30.1%), then the 46 – 60 years at 17.9% and the least were people between 36 – 45 years with 17.2%.

The highest percentage on the employment status question, was the unemployed category at 43.2%, whilst only 28.5% were employed, 24.7% were students and 3.5% were retired from work. A high portion of 47.5% of the respondents’ highest level of education was below Grade 12, 35.9% had Grade 12, only 6.3% and 4.8% respondents had a diploma and degree certificates respectively. Question 12 of the

instrument was the Living Standard Measure (LSM) of participants. Leading the LSM category was LSM 1-4 at 62.4%, followed by LSM 5-7 at 33.1% and a small portion of 4.5% of the sample were between LSM 8-10. In the table below is a summary of the demographic profile of the participants.

Table 5: Summary of Demographic Profile

Variable		**Frequency**	**% Percentage**
Gender	Female	211	53.3
	Male	185	46.7
Age Range	18 - 25 years	138	34.8
	26 - 35 years	119	30.1
	36 - 45 years	68	17.2
	46 - 60 years	71	17.9
Highest Level of Education	Below Grade 12	188	47.5
	Grade 12	142	35.9
	Higher Certificate	22	5.6
	Diploma	25	6.3
	Degree or above	19	4.8
Employment Status	Student	98	24.7
	Employed	113	28.5
	Unemployed	171	43.2
	Retired	14	3.5
Living Standard Measure (LSM)	LSM 1 - 4	247	62.4
	LSM 5 - 7	131	33.1
	LSM 8 - 10	18	4.5

4.2.2 MOBILE DEVICES

A very high percentage of 89%, of the respondents owned a mobile device. This was any type of mobile device including smartphones. Only a small fraction of the sample (43 out of 396) did not own any mobile device. It was noted that these communities use mobile devices a primary source of communication. Figure 4 below shows the graphical representation of these results.

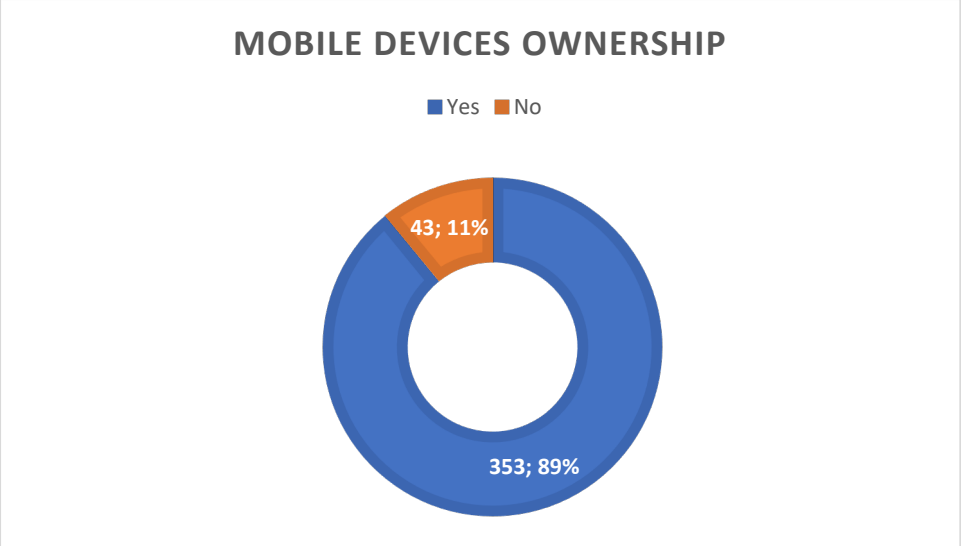

Figure 4: Mobile Device Ownership

4.2.3 INTERNET ACCESS

Figure 5 below highlights the penetration of internet accessibility in the communities. More than half of the respondents (67.7%) responded “Yes” to having access to the internet. They were able to access the internet through their smartphones, at work or at school. It was noted that 32% of the respondents indicated that they did not have any access to the internet and but depend on internet cafés to be able to use the internet.

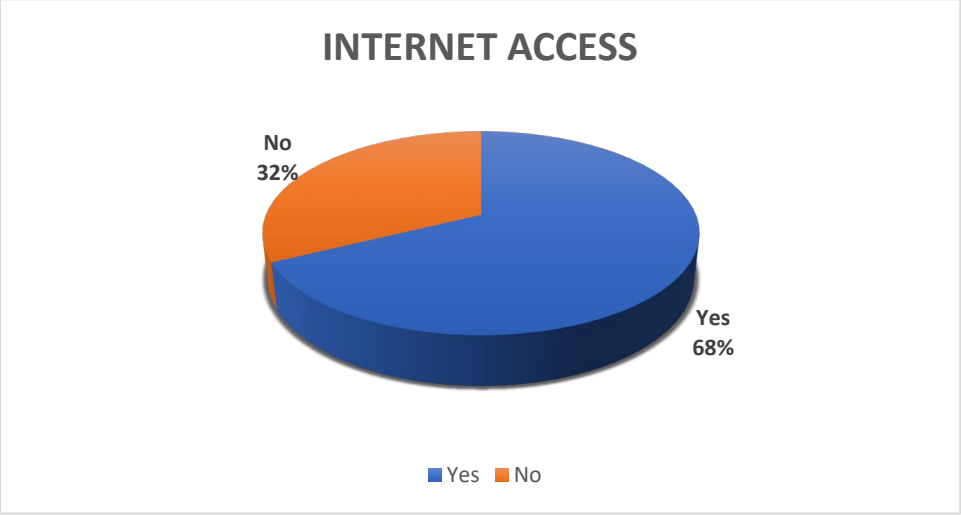

Figure 5: Internet Access

4.2.4 SOCIAL MEDIA APPLICATIONS USAGE

254 of 396 (64%) participants had social media applications like WhatsApp, Facebook, Twitter etc, in their mobile devices. They stated that it is easier to communicate via these social media applications because they are cheaper than voice calls. On the other hand, 142 (36%) respondents said they did not have any social media installed in their mobile phones and one of the reasons provided include being too old to learn new technologies. The results were almost similar to the number of people who have internet access as presented in section 4.2.3

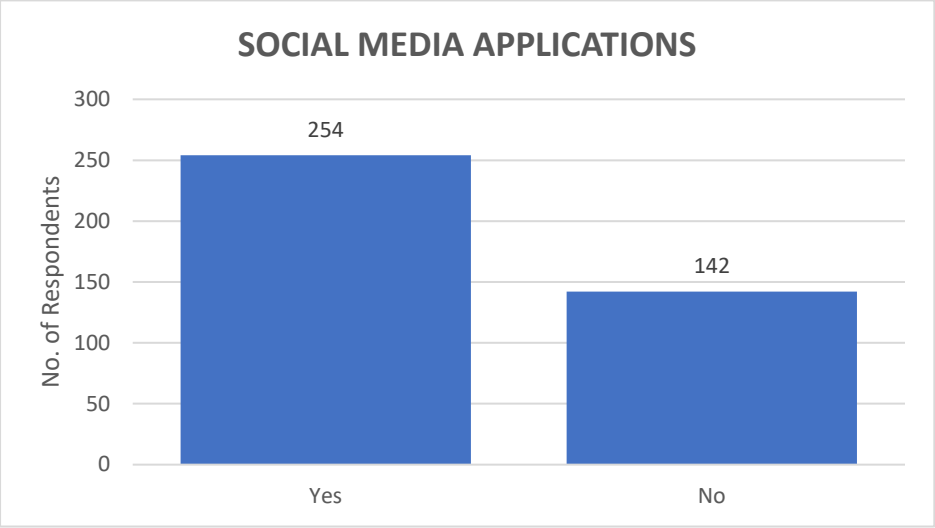

Figure 6: Social Media Usage

4.2.5 DIFFUSION OF ICT IN KZN RURAL COMMUNITIES

Part 2 of the questionnaire was diffusion of innovation and adoption questions which were presented on a Likert scale. Respondents had five choices (strongly agree, agree, neither agree/disagree, agree, and strongly agree) to choose from. The three attributes used to determine the participants perspective on the adoption and diffusion of ICT are relative advantage, compatibility, and complexity. The results are presented on Table 6 below.

Table 6: Diffusion and Adoption Results

Attribute	Question	Strongly Disagree	Disagree	Niether Agree/ Disagree	Agree	Strongly Agree	Mean
Relative Advantage	ICT technology will be a convenient way to connect with family or friends	1,52%	2,02%	1,77%	58,59%	36,11%	4.26
	Using ICT services will be more effective than current practice	1,77%	3,28%	3,28%	54,80%	36,87%	4.22
	ICT services will assist to strengthen my relationships	1,52%	6,57%	5,56%	46,46%	39,90%	4.17
Compatibility	ICT services are well matched with my values and interests	2,27%	4,04%	4,80%	53,54%	35,35%	4.16
	ICT services would be suitable to my current lifestyle	2,27%	5,30%	3,03%	51,26%	38,13%	4.18
Complexity	ICT services will be difficult to operate	21,46%	53,54%	3,03%	18,43%	3,54%	2.29
	Using ICT services will require a lot of effort	14,90%	39,65%	4,29%	37,63%	3,54%	2.75
	Using ICT services will require a level of technical skills	14,14%	34,34%	6,57%	37,12%	7,83%	2.90
	The use of ICT services will be frustrating	21,21%	58,08%	6,82%	11,11%	2,78%	2.16

From table 6 above, over half of the participants, 58,59% agreed and 36,11% strongly agreed that ICT's will be a convenient way to connect with their family and friends. Though a very small fraction of 1.52% strongly disagreed and 2,02% disagreed with this notion. Also, 54,80% agreed and 36,87% strongly agreed that using ICT services will be more effective than what is currently available. In contrast, 3,28% disagreed, 1,77% strongly disagreed and 3,28% were not so certain with this statement. It was noted that the mean ranges from 3.34 to 4.26, implying that relative advantage is an important attribute to adoption of ICT and that the communities will adopt ICT if they see them more beneficial than what they are currently using.

Compatibility attribute is the degree of which the respondents will adopt ICT's if it suits their lifestyle, interests and are able to afford the costs thereof. 53,54% of the participants agreed and 35,35% strongly agreed that ICT services were well matched with their values and interests. 4,04% disagreed and 2,27% strongly disagreed with view. In addition, 51,26% agreed and 38,13% strongly agreed that ICT services would be suitable to their current lifestyle whereas 5,30% disagreed and 2,27% strongly

disagreed. The mean range is between 2.68 and 4.18, suggesting that compatibility is an influential factor to the adoption of ICT and that the communities will most likely adopt if they believe ICTs match their values and are well suited with their interests.

Complexity is the extent that the participants are willing to adopt ICT's due to the level of difficulty or ease to use these technologies. It is noteworthy that 53,54% of the respondents disagreed and 21,46% strongly disagreed that ICT services will be difficult to operate whereas 18,43% agreed and 3,54% strongly agreed with this notion. Also, 37,12% of respondents agreed and 7,83% strongly agreed that using ICT services will require a level of technical skills. On contrary, 34,34% of the participants disagreed and 14,14% strongly disagreed to this view. Likewise, the mean range is 2.16 to 2.90, which is almost at the centre of the distribution, proved the split in views on this on the complexity attribute. In relation to the mean range on complexity, there seems to be an equal number of populations that agreed on the complexity attributes. Age could have been the contributing factor as the younger population are likely to adopt ICT despite the difficulty in operating then then the older population. Complexity is an important attribute in the adoption of ICTs in the rural communities.

4.3 FACTOR ANALYSIS

The approach to answer the research questions in this study was to use factor analysis embodied by principal component analysis. This approach explores the interrelations between sets of variables (Pallant, 2006). Hair et al (2006) states that it's a method to test interdependence, which its key objective is to outline the basic structure amongst the variables in an analysis. This technique also described as a multivariate statistical method that assists with assimilating information within the variables (Hair et al, 2006). The requirement in factor analysis is usually metrical data and this study satisfied this phenomenon by the use of the Likert-scale in the research instrument.

In the analysis of the parameters that influence adoption, the use of principal component, Varimax rotation, and Kaiser Normalization was adopted. The aim for conducting principal component analysis is to define the lowest number of factors that will explain the most variances (Costello & Kellow, 2008).

Kaiser's measure of eigenvalues that are >1 and the scree plot was used for the factors' extraction. The table 7 below presents the results of the factors' extraction based on all eigenvalues that are > 1 principle and two factors were identified. The 1st factor explained 31.297% of the overall variance, the second factor explained 21.317% which together explain 52.615%. Normally, in statistics the requirement was satisfied by all the factors (communality > 0.5). Costello & Kellow (2008), also suggests that the communalities above 0.4 are acceptable

Table 7: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,817	31,297	31,297	2,817	31,297	31,297	2,455	27,280	27,280
2	1,919	21,317	52,615	1,919	21,317	52,615	2,280	25,334	52,615
3	0,947	10,518	63,133						
4	0,734	8,154	71,287						
Extraction Method: Principal Component Analysis.									

The legend for the nine components utilized for the factor analysis test is:

- Component 1 – (RA_1) ICT technology will be a convenient way to connect with family or friends
- Component 2 – (RA_3) Using ICT services will be more effective than current practice
- Component 3 – (RA_4) ICT services will assist to strengthen my relationships
- Component 4 – (COMP_1) ICT services are well matched with my values and interests
- Component 5 – (COMP_2) ICT services would be suitable to my current lifestyle
- Component 6 – (COMX_1) ICT services will be difficult to operate
- Component 7 – (COMX_2) Using ICT services will require a lot of effort
- Component 8 – (COMX_3) Using ICT services will require a level of technical skills
- Component 9 – (COMX_4) The use of ICT services will be frustrating

The two factors that explained the most variance was Component 1: ICT technology will be a convenient way to connect with family or friends and Component 2: Using ICT services will be more effective than current practice

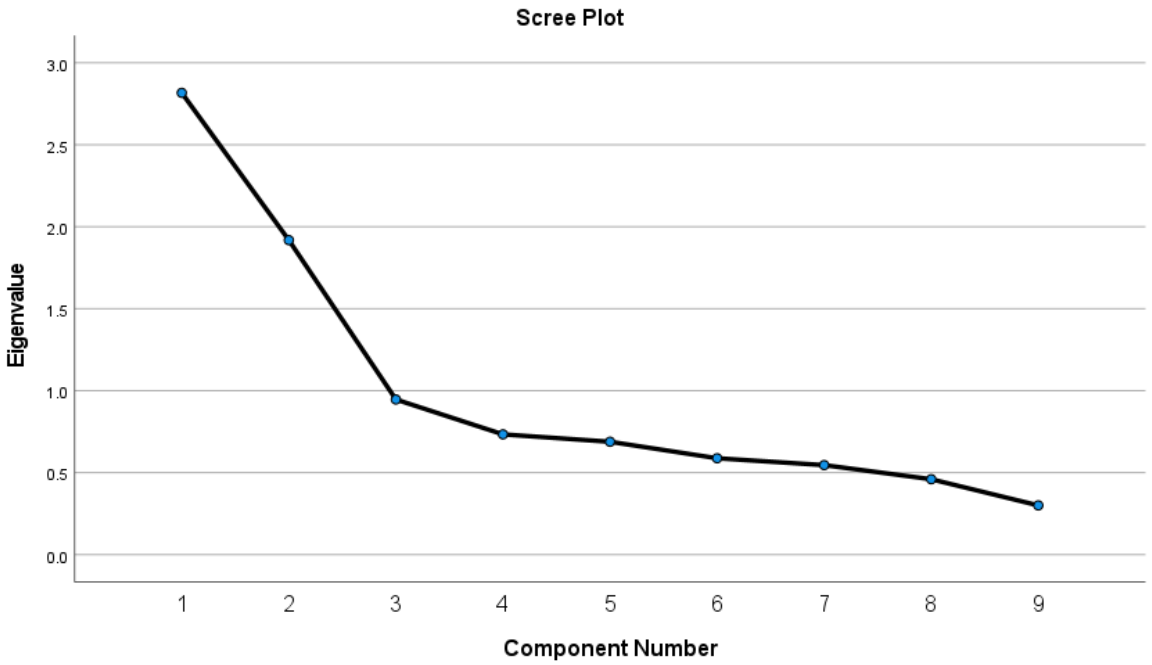

Figure 7: Scree Plot

Figure 7 above is the Scree Plot test that is used to prove the number of factors extracted by the Kaiser Normalization model with eigenvalues above one. The slop on the Scree plot also sees the extraction of the two factors which is the same as in Table 7.

Table 8 below, also confirms the results above by using the rotated component matrix. This is also a cross validity check. Throughout the analysis there was no significant difference between the factor structure of the bisected and complete data. Therefore, the results are valid.

Table 8: Rotated Component Matrix

	Component	
	1	2
RA_1	0,693	-0,024
RA_3	0,642	-0,050
RA_4	0,625	0,055
COMP_1	0,767	-0,160
COMP_2	0,752	-0,158
COMX_1	-0,078	0,737
COMX_2	-0,056	0,793
COMX_3	-0,084	0,733
COMX-4	-0,028	0,717

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

4.4 Regression Analysis

Regression analysis “is a statistical technique used to examine the relationship between the dependent variable(s) and independent variables” (Statistics Solutions, 2013). Due to the nature of the dependant variable chosen for this study, a linear regression was used. Linear regression is a predictive analysis that evaluate and describe a relationship between one or more independent variables and a dependent variable (Statistics Solutions, 2013).

There are five assumptions that the data must meet to perform a regression. This is required to be done so that the regression analysis results can be valid.

- A Linear relationship
- Multivariate normality
- No or little multicollinearity
- No autocorrelation
- Homoscedasticity

4.4.1 Hypothesis Testing

For the hypotheses test, a linear regression was performed with ICT access index (IAI) as the dependent variable and Relative Advantage, Compatibility and Complexity, including the demographics, as the independent variables. The results are on table 8. All the coefficients of independent variables were found to be statistically significant as their $p < .05$ hence Gender (p=0.801) and Age Range (p=0.261) were omitted.

Therefore, the regression equation is: ICT Access index = 6,636 + 0,807*Highest level of Ed – 0,637*Emp Status – 0.166*Relative Advantage 0,129*Compatibility – 0,139*Complexity

Table 7: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	6,636	1,062		6,248	0,000		
	Gender	-0,058	0,228	-0,011	-0,252	0,801	0,969	1,032
	Age Range	-0,136	0,121	-0,059	-1,127	0,261	0,713	1,402
	Highest Level of Ed	0,807	0,107	0,348	7,549	0,000	0,923	1,083
	Emp. Status	-0,637	0,152	-0,219	-4,180	0,000	0,716	1,396
	Relative Advantage	-0,166	0,053	-0,160	-3,126	0,002	0,907	1,103
	Compatibility	0,129	0,050	0,134	2,609	0,009	0,902	1,108
	Complexity	-0,139	0,037	-0,188	-3,783	0,000	0,967	1,034
a. Dependent Variable: ICT Access Index								

Multicollinearity is not a problem since the Variance Inflation Factor (VIF) values are <10 as seen on the collinearity statistics column above (if VIF>10, then multicollinearity exists). From the coefficient table above, the hypotheses can be answered. Table 9 below is the summary.

Table 8: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.496[a]	0,246	0,232	2,22350	1,640
a. Predictors: (Constant), Gender, Age Range, Highest Level of Ed, Emp. Status, Relative Advantage, Compatibility, Complexity					
b. Dependent Variable: ICT Access Index					

The model summary table above is used to determine how well a regression model fits the data. The results demonstrate that the predictors (Gender, Age Range, Highest Level of Ed, Emp. Status, Relative Advantage, Compatibility, Complexity) explain 24.6% of the variability of ICT Access Index (R^2 = 0.246)

Table 9: ANOVA Table

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	624,593	7	89,228	18,048	.000[b]
	Residual	1918,251	388	4,944		
	Total	2542,844	395			
a. Dependent Variable: ICT Access Index						
b. Predictors: (Constant), Gender, Age Range, Highest Level of Ed, Emp. Status, Relative Advantage, Compatibility, Complexity						

The ANOVA table displays if the independent variables are statistically significant to predict the dependent variable which is the ICT Access Index. The *F*-ratio = 18,048 and $p < 0.000$ (less than the required 0.005) depicts that the model is significant and a good fit of the data. The results also indicates that one or more of the predictors is significant to predict the diffusion and adoption of ICT's.

4.4.2 Results for Hypothesis 1 – Relative Advantage attributes

$H1_o$ = There is no relationship between relative advantage and the success of ICT deployment in the rural communities

$H1_a$ = There is a relationship between relative advantage and the success of ICT deployment in the rural communities.

From the coefficient table (Table 10): *Beta* = -0,160, *t* = -3,126, *p* = 0.002

Since $p < 0.05$ significance level and the beta coefficient is a negative which implies that as Relative Advantage increases, the ICT Access Index tends to decrease. Therefore, there is enough evidence to reject the null hypothesis and conclude that Relative advantage has a significant relationship with the success of ICT deployment in rural communities.

4.4.3 Results for Hypothesis 2 – Compatibility factors

$H2_o$ = There is no relationship between compatibility and the success of ICT deployment in the rural communities.

$H2_a$ = There is a positive relationship between compatibility and the success of ICT deployment in the rural communities

From the coefficient table (Table 10): *Beta* = 0,134, *t* = 2,609, *p* = 0.009

The values above show that $p < 0.05$ significance level and the beta coefficient is a positive which implies that as the Compatibility variable increases the mean ICT Access Index variable tends to increase also. Thus, rejecting the null hypothesis and concluding that there is a correlation between Compatibility and the success of ICT deployment in rural communities.

4.4.4 Results To Hypothesis 3 – The Complexity Aspects

$H3_o$ = There is no association between complexity and the success of ICT deployment in the rural communities

$H3_a$ = There is an inverse association between complexity and the success of ICT deployment in the rural communities

From the coefficient table (Table 10): *Beta* = -0,188, *t* = -3,783, *p* = 0.000

If $p < 0.05$ significance level and the beta coefficient is a negative which implies that as the Complexity variable increases the mean ICT Access Index variable tends to decrease. Hence, rejecting the null hypothesis and accepting the alternative. Concluding that there is an inverse association between Complexity and the success of ICT deployment in rural communities.

4.4.5 Summary Of Hypothesis

In the summary of hypothesis table below, it is noted that relative advantage, compatibility, and complexity factors were sustained by the data and have a significant association with ICT adoption and consequently the deployment of ICT in the rural communities.

Table 10: Hypothesis Summary Table

	Independent Variable	**Dependant Variable**	**Beta (β)**	**t-value**	**p - value**	**Result**
Hypothesis 1 (H0)	Relative Advantage	ICT Access Index	-0,16	-3,126,	0.002	Significant
Hypothesis 2 (H2)	Compatibility	ICT Access Index	0,134	2,609	0.009	Significant
Hypothesis 3 (H3)	Complexity	ICT Access Index	-0,188	-3,783	0.000	Significant

4.5 CHAPTER SUMMARY

The results of the data collection were presented on this chapter. The statistical analysis was done with the IBM SPSS v27 software. The analysis performed included was descriptive scale analysis where each the mean and standard deviation of all variables were computed. Then the principal component with Varimax rotation and Kaiser Normalization was used for factor analysis to determine the smallest factors that explain the most variances of the data. Regression, ANOVA, Coefficients and Model test. Finally, a regression analysis was performed, the coefficients, ANOVA and model summary tables were extracted. Therefore, the hypotheses were able to be answered. The results of the three attributes namely, Relative Advantage, Compatibility and Complexity were found to be statistically significant. These factors have a huge influence in the diffusion and adoption of ICTs in the KZN rural communities.

5. CHAPTER 5 – DISCUSSION OF RESEARCH FINDINGS

5.1 INTRODUCTION

The aim of this study was to survey the factors that impact the adoption of ICTs in the less density areas, commonly known as rural communities, so to enable ICT service

providers to effectively deploy infrastructure in these areas. In Chapter 4, the findings of the collected and tested data were presented. In the quest to understand the behaviour and attitude of rural dwellers with regards to adoption of ICT services, the results will be discussed in this Chapter. The findings are presented per research objective and hypothesis. The conceptual framework will also be discussed considering the findings then followed by the conclusion of the Chapter.

5.2 RELATIVE ADVANTAGE AND ICT ADOPTION

From the results (table 10) of the relative advantage factor, the mean values for the variables ranged from 3.34 to 4.26, implying that relative advantage is a strong factor to the adoption of ICT in the rural communities. The “ICT technology will be a convenient way to connect with family or friends” and the “Using ICT services will be more effective than current practice” variables rated the highest in this group which means that participants are willing to adopt if the ICT services will be convenient and if they are an improved version of their current use. Gollakota & Doshi (2014), alluded that relative advantage is a degree in which an innovation is seen as superior to the idea it supersedes.

Though it was important to note that the model was statistically significant at $p = 0.002$ but the coefficient was a negative and the t-value also negative. This means that if the adopters can have 0.16 degree of doubt or inconvenience regarding ICT, a 3.126 decrease in the adoption rate can be expected. Hence, it is imperative for ICT service providers to understand their customers’ needs and their attitudes towards new technology before deploying any infrastructure in these communities. Their perceived usefulness of a service/product will be highly dependent on how the product is introduced and promoted to them. Previous studies have evidenced that relative advantage is a function of perceived usefulness especially for new technologies and is a vital precursor of the intention to adopt a technology (Wang et al., 2008).

In the coefficients table (Table 8), it is noted that age is not statistically significant to the ICT Access Index implying that it does not affect the adoption of ICT in the rural communities. Nevertheless, looking at the age category, over 60% of the participants were between the ages of 18 and 35 years. This age category is labelled as the youth according to the 2021 Quarterly Labour Force Survey (Stats SA, 2021). Robinson,

(2012) states that relative advantage is dependent upon the views of a group of users, and they consider convenience, financial benefit, and social status that this group get from a service. In the rural areas, this age group still want to enjoy the relevancy amongst their peers and the financial benefit that will comes with the ICT services as the unemployment rate is very high. This group can be segmented as early adopters because early adopters and early majority groups usually value the status that comes with having new items (Sahin, 2006). Again, ICT organisations need to conduct a thorough study on this segment to establish what their needs are in order to produce products/services that are appealing and valuable to them.

Although (Mndzebele, 2013) contended that relative advantage does not have an association with adoption, other researchers found relative advantage to be significant in adoption of technology innovation (Sahin, 2006) (Junglas et al., 2019). In (Marak et al., 2019) findings, relative advantage was negatively associated to 3D printing which is similar to the results of this study.

The results of this study presented above shows that there is an association between relative advantage and adoption of ICT in rural communities. If the adopter's perception of an innovation is compromised, then the likelihood of adoption decreases immensely.

5.3 COMPATIBILITY AND ICT ADOPTION

Compatibility is the degree in which an innovation can be seen as a fit to the adopters' present values, lifestyle, and historical experiences (Gollakota & Doshi, 2014). According to this study, the compatibility attribute was found to be statistically significant as p = 0.009. The beta coefficient and the t-value were both positive at 0,134 and 2,609 respectively indicating that for every unit increase in compatibility there will be a 2,609 increase in the rate of adoption.

Table 8 indicates that the compatibility attribute has mean values of 4.17 and 4.16, this indicates a very strong association between compatibility and the adoption of ICTs. For the communities to adopt, these technologies must align to their values, lifestyles, and interests. KwaZulu Natal rural communities are generally known for being tradition and cultural custodians. They really honour and protect their heritage. Erumban & De Jong, (2006) found that cultural dimensions of a community which are

norms, practices, values, attitudes, etc have an influence in its ability to adopt ICT. Therefore, ICT service providers must be in cognisant of these cultural settings, so they are able to deploy suitable services that to these communities.

In the demographics summary table (table 5), only 28,5% of the sample are employed, the rest are either unemployed, students or retired. The unemployment rate is very high in these communities which means affordability is also a huge concern. Fong, (2009) alluded that affordability is a retraining factor due to the extensive income gap between urban and rural populations. From the results in table 8, employment status has a strong influence on adoption as $p = 0.000$. The beta coefficient and the *t*-value are both negative at -0,219 and -4,180 respectively, suggesting that an increase in unemployment results in a decrease in the adoption of ICTs. ICT service providers need to offer customised services that will appeal to the people in the rural areas but also services that they are able to afford. In order to accelerate the rate of ICT adoption in the rural areas (Fong, 2009) suggests that assistance needs to be provided to the rural residents to overcome this issue.

The findings of this study support prior findings by (Sahin, 2006, Mndzebele, 2013, Mairura et al., 2016) who concluded that compatibility is a significant factor in adoption of technological innovations. In contrast, (Elogie et al., 2015) contended that compatibility does not adequately explain adoption in smartphones.

According to the outcomes of this study and previous literature, compatibility is an important attribute in the adoption of ICT in the rural communities. Considering that their values, interests, and lifestyle of the residents needs to be considered before deploying any infrastructure.

5.4 COMPLEXITY AND ICT ADOPTION

Complexity is the extent that an innovation is viewed by the participants as difficult or easy to use for them to adopt. The table of coefficients shows that the complexity factor is statistically significant with $p = 0.000$, the beta coefficient negative at 0,188, and the t-value also negative at 3,783. These results infer that if the adopters perceive ICT services as difficult to use, the likelihood for adoption will decrease. This result clearly indicates that it is vital to consider ease of use of a product/service before introducing to the market.

There are a lot of influences that affect the ease of use of a product or service. The mean values of the variables under complexity were between 2.16 and 2.90, indicating a split in views on this attribute as the data is almost at the centre of the mean of the distribution. Age could be the contributing factor as the younger population (18-35 years) contributed the most in this study and they would probably adopt ICTs faster than the older generation. The older generation (36-60 years) can be segmented as the late majority and laggards. Late majors are conventional persons who are not comfortable to try new ideas and laggards generally perceive new innovation as high risk (Robinson, 2012). For them to adopt, ICT organisations need to convince them through cheaper costs, convenience, and expose them to other people who are in the same segment that have already adopted.

Taking note of the results of the “using ICT services will require a level of technical skills” variable in table 6, a percentage of the younger population may still feel the need to have some sort of technical skills to be able to fully adopt to ICT. Also, from the coefficient table, the highest level of education results indicates that the level of education is a significant factor in ICT adoption. It shows that if the level of education is increased by 0,348 unit, then the adoption rate will increase by 7,549 when all the other factors are kept constant. 47,5% of the participants did not have Grade 12 and they formed the majority in this category. This highlights how education is an important factor in ICT adoption. Previous studies have tested the association of level of education to internet usage and found that they have a linear relationship (Fong, 2009). Illiteracy in ICT is a major contributor to the low rate of ICT adoption in the rural areas. Fong, (2009) also mentioned that the lack of skilled IT educators in the rural areas results in a major impact in developing trained ICT users. ICT service providers in conjunction with the government should provide more resources to the rural areas for training and development of the residents in ICT.

Ease of use of a product/service increases the adoption rate and decreases doubt. The results from this study were anticipated and (Fong, 2009; Ibrahim & Monsurat, 2015; Marak et al., 2019; Mndzebele, 2013) had similar results supporting that ease of use is a significant attribute to the adoption of new technologies. However, (Wang et al., 2010) found that complexity is not a significant determinant to measure the adoption of RFID technology.

Therefore, complexity is a significant attribute in ICT adoption. If the product/service is perceived as easier to use, the higher the likelihood of adoption.

5.5 CONCEPTUAL FRAMEWORK

The conceptual framework presented in Chapter 2 is valid as all the Diffusion of Innovation constructs (relative advantage, compatibility, and complexity) presented on this study are significant. However, after the obtained results the following changes were made:

1. Highest level of Education and Employment Status from the demographic profile should be added as constructs as they were found to be significant and a huge influence in the adoption of ICT services in the rural areas.
2. Social influence should be added as a variable under the compatibility attribute as it has huge impact in the adoption of ICTs in rural settings.

Therefore, figure 8 below is the new adaptation of the conceptual framework.

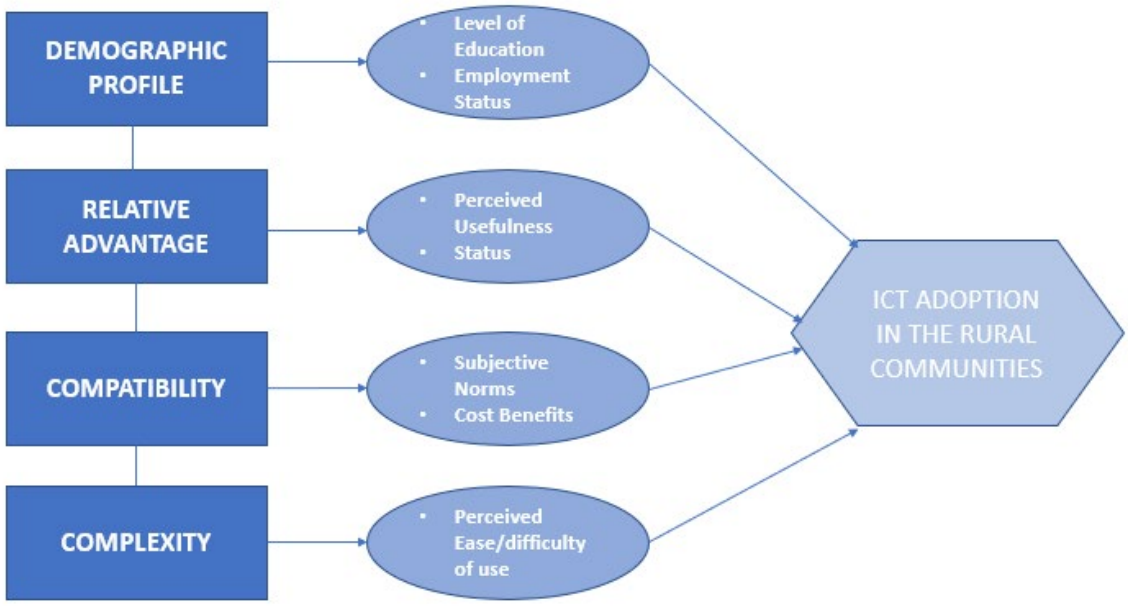

Figure 8: Adapted Conceptual Framework

5.6 CHAPTER SUMMARY

Key findings of the study were discussed in this Chapter. Majority of the respondents were the youth between the ages of 18-25 years and 26-35 years, who made up a total of 64,9% collectively. Furthermore, most of the respondents were unemployed, and their highest level of education was below Grade 12.

The research objectives were discussed in relation to the output findings of the hypotheses. The findings do reveal that rural residents are already users of ICTs to some extent via smartphones, social media applications and limited internet access. Rogers three diffusion of innovation attributes, relative advantage, compatibility, and complexity, discussed in this study were all supported and have significant associations. In addition, the highest level of education and employment status were found to be important factors in the adoption of ICTs in the rural communities.

ICT service providers need to do a thorough study of this market segment in order to understand their values, needs and interests. This will assist in providing products/services that are tailored, valuable and usable to the rural communities.

6. CHAPTER 6 – SUMMARY, CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

Chapter 6 covers the summary, conclusions, and limitations of this research study by looking at the key findings which were presented in Chapter 5. Limitations of the study, theoretical, and practical contributions will also be presented followed by the recommendation of future research.

6.2 CONCLUSIONS

The main objective of this research study was to assess factors that contribute to ICT adoption in the rural communities of KwaZulu Natal and establish a framework that will assist ICT service providers to successfully deploy ICT infrastructure in these less density areas.

Rogers Diffusion of Innovation theory was used to assess the factors that affect the adoption of ICTs in the rural areas. Rogers mentions five attributes but for this study the focus was on three which are Relative Advantage, Compatibility, and Complexity. The innovation-decision process was highlighted where the stages of how an innovation is introduced to a group, to when they decide to adopt or reject the innovation is discussed. Different segment groups and how their different characteristics associate with adoption is highlighted.

A descriptive research approach was used to assist in addressing research objectives and testing of the hypothesis. A survey questionnaire was created and distributed through traditional pen and paper method to explore the factors that impact the diffusion of innovation in the rural areas. The participants were from three selected district municipalities in KwaZulu Natal where two represented the highly rural populated municipalities and one represented the low rural populated municipality. These municipalities were King Cetshwayo, eThekwini and iLembe. A total of 396 people participated on this exercise.

The collected responses were then loaded to the IBM SPSS v27 data analysis software where several tests were performed including descriptive scale analysis, factor analysis, linear regression, etc. The hypotheses were also tested using ICT Access Index as a dependent variable and Relative Advantage, Compatibility and Complexity, including the demographic profile, as the independent variables. Gender and Age Range were found to be statistically insignificant to ICT Access Index and were removed. All the remaining variables were found to be statistically significant and were supported by previous literature.

For this study, it was concluded rural residents are willing to adopt ICT services/products if they are convenient and are better than the current practise. Also, the products and services must be well matched with their values with an affordability

benefit. ICT service providers must collaborate with the government to improve the illiteracy in ICT in the rural communities by building training centers that can train, teach, and develop local residents.

6.3 SUMMARY OF KEY FINDINGS

These are the key findings for this research study:

1. From the demographics responses, Age Range and Gender were found to be insignificant predictors to ICT adoption. Highest level of Education was found to have a positive association and Employment Status a negative association to ICT adoption.
2. The relative advantage attribute is a strong factor to the adoption of ICT in the rural communities and potential adopters are willing to adopt if the innovation is of value and convenience to them.
3. Compatibility has a strong association with adoption of ICTs. For the communities to adopt, the technologies must align with their values, lifestyles, and interests as rural dwellers are still conservative.
4. The complexity factor was found to have an inverse relationship to ICT adoption which indicates that if the adopters perceive ICT services as difficult to use, the likelihood for adoption will decrease.
5. ICT organisations should thorough understand the behaviour and needs of their potential clientele before introducing their products/services to the market. This will assist them to produce tailor made products that appeal to the community and in turn the community is able to consume them.

6.4 LIMITATIONS OF THE STUDY

Due to the nature of this study, a traditional pen and paper data collection method was used. This was not ideal because of the global Covid-19 pandemic where human contact was discouraged as it increased the risk of transmission of the virus. This research study was conducted during the peak wave of the Covid-19 omicron variant. Most people were not receptive due the uncertainty of the virus and did not want to risk contracting it. Also, the issue of security was encountered whereby some residents did not open their doors because of the fear of being robbed or scammed. Funding

was another limitation as this study required a lot of travelling and accumulated costs. These issues delayed the process of data collection yet overall, the study was a success.

6.5 RECOMMENDATIONS

There are several findings obtained in this research study which can be of assistance to these identified key stakeholders: the researchers, ICT service providers, government, and rural society

1. The researchers: There is no or very limited research that looks at the diffusion and the adoption of ICTs in the rural areas in South Africa. Most of the literature focuses on the government and policies that should be implemented for the deployment of ICT infrastructure in rural area. However, none focus on the attitude or behaviour of potential ICT adopters in the rural communities. This will add value to future researchers as they will understand influences that effect rural residents to adopt ICTs.

2. ICT service providers: this will assist to improve on their product/service offering as they will understand the needs and interests of the communities they want to serve. They will create products/services based on the need which can increase the rate of adoption of ICT services and improve their return on investment.

3. The government will better understand the communities they are serving and the need for the deployment of ICT infrastructure in these areas. This will also be of assistance as they can update their policies, implementation strategies and roll out plans to improve their efficiencies.

4. For the rural society, the adopters of ICTs, it will bring a deeper awareness into ICTs and their importance in this modern civilization. The findings should motivate them to strive and continue adopting ICTs to improve their lives and assist in eradicating digital divide in South Africa.

5. From this study, it can be recommended that the government collaborate with ICT service providers to assist deploy ICT infrastructure that is the same level of quality as urban areas but affordable to the rural residents. Also, they need to invest in ICT training and development of rural residents through their Corporate Social Responsibility (CSR) initiatives so residents can fully exploit the products/services when they are made available to them.

6. The proposed framework can be used as guideline by the identified stakeholders to be able to successfully deploy ICT infrastructure in rural areas in KwaZulu Natal and probably South Africa as a whole.

6.6 RECOMMENDATIONS FOR FUTURE RESEARCH

With the shift to 4th Industrial Revolution, it is vitally important that the rural areas are not left behind because digital divide. Rural residents are willing to learn and adopt technological innovations should the infrastructure be made available to them. This study focused on only three attributes of Rogers diffusion of innovation theory so future research can focus in these areas:

1. Extensive research focusing on the two attributes that were not included in this study which are observability and trialability, how they contribute to adoption of ICTs in the rural communities
2. Research on how income gap between urban and rural communities impacts the uptake of ICT in relation to economic development in South Africa
3. Research on the ability to optimise investments in infrastructure in rural areas. This can determine whether a wholesale open access Network (WOAN) deployed by the Government and used by service providers could ensure the reduction of investment required.

7. REFERENCES

Al-Jabri, I. M., & Sohail, S. M. (2012). Mobile Banking Adoption: Application of Diffusion of Innovation Theory. Journal of Electronic Commerce Research, 13(4), 379–391. https://www.researchgate.net/publication/258515458%0AMobile

Atkinson, R, & Flint, J. (2001). Social research update 33: Accessing hidden and hard-to-reach populations. http://sru.soc.surrey.ac.uk/SRU33

Atkinson, N. L. (2007). Developing a questionnaire to measure perceived attributes of eHealth innovations. American Journal of Health Behavior, 31(6), 612–621. https://doi.org/10.5993/AJHB.31.6.6

Barendse, A., (2004). Innovative regulatory and policy initiatives at increasing ICT connectivity in South Africa. Telematics and informatics, 21(1), 49-66

Barron, A. E., Kemker, K., Harmes, C., & Kalaydjian, K. (2014). Large-Scale Research Study on Technology in K–12 Schools. *Http://Dx.Doi.Org/10.1080/15391523.2003.10782398*, *35*(4), 489–507. https://doi.org/10.1080/15391523.2003.10782398

Bauer, J.M. (2010). "Regulation, public policy, and investment in communications infrastructure", in Proc. Telecommunications Policy Journal vol 34 issues 1-2 pp 65-79

Benjamin K.R, et al. (2003). Control of landmark events in meiosis by the CDK Cdc28 and the meiosis-specific kinase Ime2. Genes Dev 17(12):1524-39

Bidwell, N. J., Lalmas, M., Marsden, G., Dlutu, B., Ntlangano, S., Tucker, W. D., & Elizabeth, P. (2011). Please call ME.N.U.4EVER: Designing for 'Callback' in rural Africa. In Donald Day (Ed.), Proceedings of the 10th international workshop on internationalisation of products and systems (pp. 117–125). Kuching, Malaysia: Product & Systems Internationalisation.

Carr, A. (2004). Positive Psychology: The Science of Happiness and Human Strength. New York: Brunner-Routledge.

Casmar, S. P. (2001). *The adoption of computer technology by faculty in a college of education: An analysis of administrative planning issues*. WASHINGTON STATE UNIVERSITY.

Conradie, D.P., Jacobs, S.J. (2003). Challenges encountered when using ICTs (ICTs) in support of development in rural African communities.

Costello, J.B. (2000). Education: The fuel for tech's Golden Age. Electronic Business. http://www.e-insite.net/eb-mag/index.asp?layout=article&articleId=CA53574&stt=001

Creswell, J. W. (2009). Research Design. In *Research Design 3rd Ed* (3rd ed.). Sage Publications Inc.

Dibraa, M. (2015). Rogers Theory on Diffusion of Innovation - The Most Appropriate Theoretical Model in the Study of Factors Influencing the Integration of Sustainability in Tourism Businesses. *Procedia - Social and Behavioral Sciences*, *195*, 1453–1462. https://doi.org/10.1016/j.sbspro.2015.06.443

Elogie, A., Ikenwe, I. J., & Idubor, I. (2015). *Factors influencing the adoption of smartphones by undergraduate students at ambrose alli university, Ekpoma, Nigeria*. https://www.researchgate.net/publication/282949250_Factors_influencing_the_adoption_of_smartphones_by_undergraduate_students_at_ambrose_alli_university_Ekpoma_Nigeria

Erumban, A. A., & De Jong, S. B. (2006). *Cross-country differences in ICT adoption : A consequence of Culture ? December 2006*. https://www.researchgate.net/publication/44150728%0ACross-country

Fong, M. W. L. (2009). DIGITAL DIVIDE BETWEEN URBAN AND RURAL REGIONS IN CHINA. *The Electronic Journal on Information Systems in Developing Countries*, *36*(6), 1–12. https://doi.org/10.1002/j.1681-4835.2009.tb00253.x

Gillwald, A. (2005a), "Good intentions, poor outcomes: Telecommunications reform in South Africa",. Telecommunications Policy journal vol.29, 469-491.

Gollakota, K., & Doshi, K. (2014). Diffusion of Technological Innovations in Rural Areas. *Journal of Corporate Citizenship*, *2011*(41), 69–82. https://doi.org/10.9774/gleaf.4700.2011.sp.00006

Gruber, H., Hätönen, J., & Koutroumpis, P. (2014). Broadband access in the EU: An assessment of future economic benefits. *Telecommunications Policy*, *38*(11), 1046–1058. https://doi.org/10.1016/J.TELPOL.2014.06.007

Ibrahim, A. M., & Monsurat, M. F. (2015). Perceived Attributes of Diffusion of Innovation Theory as a Theoretical Framework for understanding the Non-Use of Digital Library Services Perceived Attributes of Diffusion of Innovation Theory as a Theoretical Framework for understanding the Non-Use of. *Journal of Information & Knowledge Management*, *5*(9), 82–87.

ICASA, "ICASA Annual report 2008/2009," https://www.icasa.gov.za

Junglas, I., Goel, L., Ives, B., & Harris, J. (2019). Innovation at work: The relative advantage of using consumer IT in the workplace. *Information Systems Journal*, *29*(2), 317–339. https://doi.org/10.1111/isj.12198

Lehohla, P. (2015). *GHS Series Volume VI Information and Communication Technologies (ICT): Vol. VI*.

Linton, J. (1998). Diffusion of innovations. In *Circuits Assembly* (5th ed., Vol. 9, Issue 4). Free Press. https://doi.org/10.4324/9780429424540-5

Lippert S.K. & Forman, H.(2012). Social e- Enterprise value creation through ICT. Longman.

Mairura, K. O., Ngugi, P. K., & Kanali, P. C. (2016). The Role of Compatibility in Technology Adoption among Automobile Mechanics in Micro and Small Enterprises in Kenya. *International Journal of Academic Research in Business and Social Sciences*, *6*(5), 503–511. https://doi.org/10.6007/IJARBSS/v6-i5/2166

Manwa, L., Mukeredzi, T. G., & Manwa, L. (2016). Rural school teaching in Zimbabwe: Mentoring experiences of “beginning” primary school teachers. *Australian and International Journal of Rural Education*, *26*(2), 63–76

Marak, Z. R., Tiwari, A., & Tiwari, S. (2019). ADOPTION OF 3D PRINTING TECHNOLOGY: AN INNOVATION DIFFUSION THEORY PERSPECTIVE. *International Journal of Innovation*, *1*(7), 87–103. https://doi.org/10.5585/iji.v7i1.393

Martin, M.H. (2003). Factors influencing faculty adoption of Web-based courses in teacher education programs within the State University of New York (Doctoral dissertation, Virginia Polytechnic Institute and State University, 2001). ProQuest DigitalDissertations. (UMI No. AAT 3089087)

McLeod, D. (2014). MTN haemorrhaging market share. 19 February 2014, TechCentral. http://www.techcentral.co.za/mtn-haemorrhaging-marketshare/46537/

Mndzebele, N. (2013). The Effects of Relative Advantage , Compatibility and Complexity in the Adoption of EC in the Hotel Industry. *International Journal of Computer and Communication Engineering*, *2*(4), 4–7. https://doi.org/10.7763/IJCCE.2013.V2.229

Morris, M.L & Stavron, S.E (1993). Telecommunication needs and provision to underdeveloped black areas in South Africa, Telecommunications policy. Republic of South Africa: Butterworth-Heinmann

Navas-Sabater, J., Dymond, A., & Juntunen, N. (2002). *Telecommunications and Information Services for the Poor: Towards a Strategy for Universal Access* (No. 432; World Bank Discussion).

Nkonki, L. L. (2007). *Measuring health inequity amoungst a cohort of HIV positive mother and childin South Africa: The relationship between household socio-economic status and child health outcomes*. University of Cape Town.

Okonkwo, C. W. (2019). *An investigation on the adoption and diffusion of mobile applications in Africa* (Issue July). North-West University.

Papacharissi, Z., Zaks, A. (2006). Is Broadband the future? An analysis of broadband technology potential and diffusion. Telecommunications Policy 30, 64–75

Prahalad, C. K. (2010). The fortune at the bottom of the pyramid: “Eradicating poverty through profits”

Robinson, L. (2012). *Changeology: How to enable groups, communities and societies to do things they’ve never done before*. UIT Cambridge Ltd.

Rogers, E. (1995). *Diffusion of innovations* (4th ed.). Free Press.

Rogers, E. (2003). *Diffusion of Innovations* (5th ed.). Free Press.

Sahin, I. (2006). Detailed Review of Roger's Diffusion of Innovations Theory and Educational Technology-Related Studies Based on Rogers' Theory. *The Turkish Online Journal of Educational Technology*, *5*(2), 14–23.

Stats SA. (2021). *Quarterly Labour Force Survey*. http://www.statssa.gov.za/publications/P0211/P02111stQuarter2021.pdf

Strover, S. (2001). Rural internet connectivity. *Telecommunications Policy*, *25*(5), 331–347. https://doi.org/10.1016/S0308-5961(01)00008-8

Sukamolson, S. (2007). Fundamentals of quantitative research. Language Institute Chulalongkorn University, 1-20.

Tanye, H. A. (2016). Perceived Attributes of Innovation: Perceived Security as an Additional Attribute to Roger's Diffusion of Innovation Theory. *International Journal of Multicultural and Multireligious Understanding*, *3*(6), 6. https://doi.org/10.18415/ijmmu.v3i6.57

Tucker, B. (2017). *How a rural community built South Africa's first ISP owned and run by a cooperative*. The Conversation Africa. https://theconversation.com/how-a-rural-community-built-south-africas-first-isp-owned-and-run-by-a-cooperative-87448

Turan, A., Tunç, A. Ö., & Zehir, C. (2015). A Theoretical Model Proposal: Personal Innovativeness and User Involvement as Antecedents of Unified Theory of Acceptance and Use of Technology. *Procedia - Social and Behavioral Sciences*, *210*, 43–51. https://doi.org/10.1016/j.sbspro.2015.11.327

Wang, Y., Meister, D., & Wang, Y. (2008). Relative Advantage and Perceived Usefulness : The Adoption of Competing ICTs. *DIGIT 2008 Proceedings*, 1–22. https://aisel.aisnet.org/digit2008/6

Wang, Y.-M., Yang, Y.-F., & Wang, Y.-S. (2010). Understanding the determinants of RFID adoption in the manufacturing industry. *Technological Forecasting and Social Change*, *77*(5), 803–815. https://doi.org/10.1016/j.techfore.2010.03.006

Westerveld, R. (2012). Inverse telecommunications: The future for rural areas in developing countries? In T.M. Egyedi, & D.C. Mehos (Eds.), Inverse infrastructures: Disrupting networks from below (pp. 187–207). Cheltenham, UK: Edward Elgar Publishing Ltd.