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The impact of network related factors on Internet based technology in South Africa: A Cloud Computing perspective

Madisa Ramagoffu

29613656

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Abstract

Outsourcing, consolidation and cost savings of IT services, are increasingly becoming an imperative source of competitive advantage and a great challenge for most local and global businesses. These challenges not only affect consumers, but also the service providers' community. As IT is slowly becoming commoditised, consumers, such as business organisations, are increasingly expecting IT services that will mimic other utility services such as water, electricity, and telecommunications. To this end, no one model has been able to emulate these utilities in the computing arena.

Cloud Computing is the recent computing phenomenon that attempts to be the answer to most business IT requirements. This phenomenon is gaining traction in the IT industry, with a promise of advantages such as cost reduction, elimination of upfront capital outlay, pay per use models, shared infrastructure, and high flexibility allowing users and providers to handle high elasticity of demand. The critical success factor that remains unanswered for most IT organisations and its management is: What is the effect of the communication network factors on Internet based technology such as Cloud Computing, given the emerging market context.

This study therefore, investigates the effect of four communication network factors (price, availability, reliability and security) in the adoption of Cloud Computing by IT managers in a South African context, including their propensity to adopt the technology. The study investigates numerous technology adoption theories, in which Technology, Organisation and Environment (TOE) framework is selected due to it having an organisational focus as opposed to an individual focus.

Based on the results, this study proposes that Bandwidth (Pricing and Security) should be included into any adoption model that involves services running on the Internet. The study makes an attempt to contribute to the emerging literature of Cloud Computing, Internet in South Africa, in addition to offering organisations considering adoption and Cloud Providers' significant ideas to consider for Cloud Computing adoption.

Keywords

Cloud Computing, Internet in SA, Cloud Bandwidth, Cloud Communication Network, TOE Framework, TAM,

Declaration

I declare that the research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Masters of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other university. I further declare that I have obtained the necessary authorisation to carry out this research.

Name: Madisa Ramagoffu

Signature: _____

Date: 07 November 2012

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1.1 Research Title

The impact of network related factors on Internet based technology in South Africa: A Cloud Computing perspective.

1.2 Research Problem

Cloud Computing is an information technology revolution in which computing resources are sold or offered as a service to the users over the Internet (Armbrust, Fox, Griffith, Konwinski, Lee, Patterson, Rabkin, Stoica, & Zaharia, 2010). For services to run over the Internet, network access bandwidth is required on both the user's and destination server's side. Bandwidth refers to the amount of data that could be carried between two points. The more data the customer is required to transfer, the more bandwidth is going to be required to carry the traffic. Therefore, for an Internet based innovation like Cloud Computing to flourish, Internet bandwidth is a necessity.

A bandwidth definition at this stage is vital so as to straighten out the terms of reference; particularly because most terms are interchangeably used. Bandwidth, also called digital bandwidth, network bandwidth or communications network, according to Optimus (2012), refers to the amount of data that can be carried from one point to another in a network link at a point in time. In some other cases, bandwidth is used interchangeably with the Internet or the communication network from a user perspective.

Access to the Internet, including the increasing bandwidth requirements of interactive applications, comes at a price, particularly in developing countries like South Africa, where telecommunication costs are exorbitant, technology is unreliable and the footprint is limited (Tobin & Bidoli, 2006; Brown, Letsididi, & Nazeer, 2009; Senatore, 2010). A further concern is the questionable security of the Internet. According to Bisong and Rahman (2011), hosting services over the Internet is the next boundary for viruses, worms, hackers and cyber-terrorists to fire-up attacks on organisations and their services. These four factors (price, reliability, availability and security) are bound to have an impact on Internet or network dependent innovations.

With that said, many studies have been conducted that involve the diffusion of Internet based technologies (Tobin & Bidoli, 2006; Low & Chen, 2011; Jianyuan & Zhaofang, 2009; Wu & Subramaniam, 2009; Ross, 2010). These studies used empirically validated technology adoption frameworks like the technology acceptance model (TAM), diffusion of information framework (DIO) and technology organisational environmental framework (TOE) (Tornatzky, Fleischer, & Chakrabarti, 1990; Rogers, 1995; Venkatesh & Bala, 2008; Davis, 1989; Venkatesh, Morris, Davis, & Davis, 2003). However, to the best of the researcher's knowledge, none of these studies used bandwidth, or rather, the communication network, as an important construct, or even as a unit of analysis.

Whilst it was initially thought that bandwidth (Arinze & Anandarajan, 2010), including its security issues, was applicable only to developing countries as opposed to developed countries, it comes as a surprise to see headlines from developed countries' websites such as follows:

Bandwidth

"The Skinny Straw: Virtualization's bottleneck was server memory; new servers address this. With Cloud Computing, the bottleneck is bandwidth to and from the cloud provider." (Golden, 2009)

"Bandwidth bottlenecks loom large in the cloud" (Gittlen, 2012)

"After Security, Network bandwidth is the next cloud bottleneck" (Golden, 2009)

Security

"Cloud safety: Internets storage service Dropbox admits security breach as fears grow over storing information online" (MailOnline, 2012).

Apple iCloud breach proves Wozniak's point about cloud risks. Not even a complex, 16-character password guarantees that your cloud-based data and devices are secure (InforWorld, 2012)

It is therefore against the above backdrop, that the communication network is an issue worth investigating, particularly if organisations wish to benefit from Internet based innovations like Cloud Computing. The overarching question to Internet/cloud service providers, the Internet community and corporate organisations is: Are enterprises ready to move their services to the cloud (CSA, 2012)?

1.3 Research Objectives

The ultimate question that the research seeks to answer is as follows:
Is the communication network a key component to consider in the adoption models/frameworks when assessing adoption of Internet based innovation?

The following are the research steps:

- Assess models/frameworks used for adoption of different Internet based technologies
- Assess bandwidth related literature that focuses on adoption.
- Characterise Cloud Computing using Internet as an underlying platform of Cloud Computing in South Africa.
- Run the following tests
    - Determine if the decision of IT leaders (CIO/IT manager) to recommend Cloud Computing technology is dependent of their perception of communication network **pricing** in South Africa.
    - Determine if the decision of IT leaders (CIO/IT manager) to recommend Cloud Computing technology is dependent of their perception of communication network **availability** in South Africa.
    - Determine if the decision of IT leaders (CIO/IT manager) to recommend Cloud Computing technology is dependent of their perception of communication network **reliability** in South Africa.
    - Determine if the decision of IT leaders (CIO/IT manager) to recommend Cloud Computing technology is dependent of their perception of cloud communication network **security** effectiveness.

- Suggest or dismiss the communication network as a critical criterion to assess when conducting studies on Internet based innovation.

1.4 Research Aim

The aim of the research is to come up with a unique construct that could be added to future Internet based adoption models, additionally to provide IT leaders with necessary insights to analyse their computer needs and the viability of new IT trends for their organisational benefit. Lastly, to contribute to the small amount of Internet literature from a South African perspective that is available in academia.

1.5 Research Motivation

The information age, brought about by the advances in computing technology, has led to significant changes in the way business is conducted worldwide. From the start of computing, the introduction of personal computers (PCs) led to most offices being equipped with PCs as business support tools. The introduction of computer networks has led to workers performing their duties outside the traditional working spaces (Nortje, 2009) and the Internet enabled organisations to tap into a globalised business footprint without brick and mortar operations in all locations.

Like the examples above, Cloud Computing is a phenomenon that has the potential to have a significant impact on business. In fact, according to Julisch and Hall (2010), Cloud Computing has the potential to transform the IT industry in many ways, including the ways in which hardware and software are designed and used in business today. From a developing country's point of view, Cloud Computing levels the globalised business field. It can theoretically be seen as a vehicle for emerging market organisations to access the same computing resources as their western counterparts, without the normal initial capital outlay.

It is generally believed that network bandwidth costs are high in developing countries, in particular in South Africa (Irwin, Siebörger, & Wells, 2010). According to Comptrib (2012), in August 2012 Telkom SA, the incumbent Telco in South Africa, was found guilty of anti-competitive behaviour, complainants, including the Internet Service Providers Association (ISPA) were complaining that Telkom SA was charging exorbitant wholesale prices, which made it difficult for these organisations to compete on the retail side, whilst keeping their own retail prices low. One then wonders how the communication network factors will affect a phenomenon like Cloud Computing, in particular its cost reduction characteristics.

According to Wang, Rashid, & Chuang (2011), due to the infancy of the Cloud Computing concept, there are currently no research boundaries in the field. A plethora of academic and non-academic studies have been conducted to uncover as many cloud characteristics and applications as possible. These studies are divided into two categories, namely, the organisational and the technical aspects. Most of the research conducted has largely focused on adoption issues. The table below, adopted from Wang, Rashid, & Chuang (2011), gives a summary of studies conducted from the organisational and technical view. Some of the references are, as cited, originally from Wang, Rashid, & Chuang (2011).

Figure 1.1: Current Cloud Computing Research

Topic	Current Status	Related References
Analytical (Business Intelligence) using Cloud	Very Few	Mircea *et al,* 2011
Reliability of Cloud	Very Few	Vogels, 2009
Social Issues of Cloud Computing	Few	Kim *et al*, 2008; Provos *et al*; 2009
Cloud Workflow management	Few	Liu *et al*, 2010; Wu *et al*, 2010
Privacy, Security and Trust issues in Cloud Computing	Abundance	Anthens, 2010; Carlin and Curran, 2011; Grobauer *et al*, 2011; Kaufman, 2009
Service Oriented Design and Development	Abundance	Chen and Meixell, 2003; Curle, 2006; Elfatatry ans layzell, 2004; Huhns and Singh, 2005; Hirschheim *et al*, 2010; Perepeltchikov, 2008
Cloud Computing Adoption	Abundance	Grossman *et al*, 2009; Low *et al*, 2009; Misra and Mondal, 2010; Tuncay,2010; Kim, *et al*, 2009; Low and Chen, 2011

Although Cloud Computing research is not limited to what is outlined above, clearly some work still needs to be done to fully understand the concept, particularly in areas of limited research. It is therefore this researcher's view that Cloud Computing is the future of IT, and therefore a worthwhile topic to study in the Information Technology, Business Operation & Strategy, and Technology Management fields of study. Lastly the studies on Internet and Cloud Computing can never be enough in academia, primarily because these are quickly developing and rapidly evolving technologies.

2 Chapter 2: Literature Summary

2.1 Introduction

The literature provided a significant amount of academic research investigating a wide range of IT technology adoption determinants and usage among users and organisations (Venkatesh & Bala, 2008). For any information technology system to add value to any organisation, it must be effectively adopted and used (Nazari & Karim, 2011). Various theoretic models have been used in different IT studies to investigate the adoption of a variety of IT innovations (Oliveira & Martin, 2011).

This chapter starts off by exploring some of the theoretical models used in IT adoption, in particular TAM, due to its popularity, followed by a comprehensive look into the TOE model selected for this study. Included in the TOE model are the constructs of the original model and additional constructs to be considered, that are relevant to the developing country context. The literature review then explores the concept of Cloud Computing. Lastly, the literature looks into the Internet in South Africa, which is the underlying technology that enables to Cloud Computing.

2.2 Theoretical Technology Adoption Models

According to Tan, Tyler, & Manica (2007) and Oliveira & Martin (2011), theories that are featured in most past researches include the following:

- Technology acceptance model TAM (Davis, 1989)
- Theory of planned behaviour (TBP) (as cited by Oliveira & Martin (2011)
- Unified theory of acceptance and use of technology (Venkatesh, *et al.,* 2003).
- Technology acceptance model 3 (TAM3) (Venkatesh & Bala, 2008).
- Institutional Theory (as cited by Alam (2009)
- Resource-based Theory (as cited by Alam (2009)
- (DOI) diffusion of Innovation (Rogers, 1995)
- (TOE) Technology, Organisational, Environmental framework (Tornatzky, Fleischer, & Chakrabarti, 1990)

A brief summary of five of these models follows.

2.2.1 Technology acceptance model TAM1&2

The Technology Acceptance Model (TAM) created by Davis (1989), is one the most used theories in technology adoption. According to King and Gribbins (2002), the TAM model has successfully predicted and explained users' intention to adopt and the actual adoption across a wide range of technology adoption studies. They further argue that this model has been tested on behaviour-oriented variables measured in a laboratory type setup, and using self-reported measures on surveys. Furthermore, longitudinal technology adoption studies have been conducted using this model (King & Gribbins, 2002).

Davis (1989), who crafted this model, suggests that any individual's intention to use IT is determined by three beliefs, i.e. the perceived usefulness (PU), the perceived ease of use (PEOU) and attitude. Perceived usefulness is defined as the degree to which a person believes that using IT systems improves performance on the job, while perceived ease of use is defined as the degree to which a person believes that using IT systems will be free of effort. Attitude on the other hand is defined as an individual's positive or negative impression in performing a targeted behaviour (Davis, 1989).

This theory argues that the user's perception of usefulness and the ease of use of an IT system determine the user's behavioural intention to use the system. Behavioural intention is therefore a predictor of system use (Davis, 1989; Venkatesh *et al.*, 2003). Although TAM has been widely used and developed by a majority of IT adoption studies, the model has been criticised by several commentators for its limitation, for instance, a study on the HDtv adoption in which the authors argued that TAM results show whether the survey participants find technology useful or easy to use, however it does not give insights into why (Baaren, Van der Winjngaert, & Huizer, 2011).

In essence, the characteristics of the target technology and contextual factors that determined the PU and PEOU remain vague (Baaren *et al.,* 2011). A much more significant critique of the model which clearly confirms or emphasises the point made by the HDtv study is the study by Wu, (2012). Wu argues that, although TAM's popularity stems from its theoretical simplicity and the robustness of its standardised measurement, it has a limitation of being dominated by quantitative studies. This is exacerbated by its extensive use of questionnaire based survey methods. The model therefore leads the researcher to overlook some unexpected but potentially important new discoveries that could have been discovered through qualitative enquiries (Wu, 2012).

Lastly, TAM is further criticised for being more focused on individuals as opposed to organisations (Oliveira & Martin, 2011) . This might be the reason why this model is constantly being reviewed and extended by Davis, the originator, and other researchers, for instance TAM2, UTAUT, TAM3 and others (Venkatesh & Bala, 2008; Venkatesh *et al.* 2003)

2.2.2 Unified theory of acceptance and use of technology

The Unified theory of acceptance and use of technology (UTUAT) was created by Venkatesh, *et al.*, (2003). The creation of this model was motivated by information technology acceptance research that has generated many competing models among researchers. In this model, Venkatesh and partners investigated the literature behind the eight prominent user acceptance models, empirically compared the models and their extensions, formulated the UTUAT using constructs from the eight and finally empirically tested the UTUAT model (Venkatesh, *et al.* 2003).

The eight models used in formulating the UTUAT were: technology acceptance model (TAM), the theory of reasoned actions (TRA), motivational model (MM), the theory of planned behaviour (TBP), a combination of TAM and TBP, the model of PC utilisation (MPCU), Innovation Diffusion Theory (IDT) and the social cognitive theory (SCT). From one or more of these models, seven constructs were found to be direct determinants of intention or usage. That said, the following four were selected as the ones that seem to be noteworthy direct determinants of user acceptance and usage behaviour: performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh, *et al*, 2003).

Performance expectancy is defined in this model as the degree to which an individual believes that using the system will enhance his or her performance on the job. In this study, this construct was found to be the strongest predictor of user acceptance and the intention to use. Secondly, the effort expectancy construct is defined in UTUAT as the degree of ease in using the targeted IT system. Thirdly, the social influence is defined as the degree to which an individual perceives that “important others” believe he or she should use the new system. Lastly, the facilitating conditions refer to the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system (Venkatesh, *et al.*, 2003).

Furthermore, included as part of the model are key moderators to the constructs such as gender, age, experience and voluntariness of use. According to Venkatesh *et al.* (2003), the labels or names given to these constructs specifically describe the construct and are independent of any theoretical model. As can be inferred from the usage of moderators like age and gender, this model is also more focused on individuals than organisations. It is worth noting that a model like the UTUAT is very dynamic, however it does not cover the ever changing IT adoption context. This is clearly evident through the introduction of UTUAT2, which introduces three new constructs that bring in the consumer context, which has been lacking in the previous version of the model, including TAM and its extensions (Venkatesh, Thong, & Xu, 2012).

2.2.3 Technology acceptance model 3 (TAM3)

In an effort to close the gap of individualistic focus of the models above, Venkatesh & Bala (2008) came up with a new variation of TAM called TAM3. They argue that, what is of essence to an organisation is how management of an organisation make decisions about interventions that can lead to better acceptance and utilisation of targeted IT systems. These researchers further acknowledge the gaps that exist in literature that are supposed to assist managers or organisation in technology adoption decision making (Venkatesh & Bala, 2008).

TAM3 is a model that is anchored on TAM1 & 2 models, adding three new theoretical extensions on the original TAM2. The authors argued that the determinants of both the perceived usefulness and the perceived ease of use constructs do not influence each other. This therefore implies that there is no cross-over effect between the constructs (Venkatesh & Bala, 2008). Although the core constructs of TAM are still intact on TAM3, new constructs that determine the perceived usefulness and the perceived ease of use are added to the model.

The new determinants added into this model that are mainly on the perceived ease of use are as follows: computer self-efficacy, perception of external control, computer anxiety, computer playfulness, perceived enjoyment and objective usability making. Experience is the main moderator variable for this model (Venkatesh & Bala, 2008). Although some of these constructs can contribute to a better understanding on IT adoption in organisations, the model is mainly based on the rigid core constructs of TAM i.e. perceived usefulness and perceived ease of use. Due to the existence of these core constructs of TAM, Baaren, Van der Winjngaert, & Huizer (2011) argue that the model still does not shed any new light on the question of why people adopt the technology.

2.2.4 (DOI) diffusion of Innovation

Diffusion of innovation theory, as propagated by Rogers (1995), seeks to explain how, why and at what rate new ideas proliferate through culture. Rogers describes diffusion as a process in which innovation is communicated through certain channels over time within a social system. Based on the point in time at which organisation adopt innovation, diffusion theory classifies organisations into five groups of technology or innovation adopter relative to other organisations. Organisations can either be innovators, early adopters, early majority, late majority or laggards (Rogers, 1995).

As opposed to the individual level, innovation at organisational level includes not only individuals in support of the innovation because opponents play a pivotal role in the innovation decision. At organisational level, the theory includes three major constructs namely: the individual characteristics of a leader, the internal characteristics of organisational structure and the external characteristics of an organisation. These constructs can be further broken down into more specific independent variables, for instance, the characteristics of a leader includes the following sub-constructs: attitude of a leader towards change; Internal characteristics of an organisation: centralisation, complexity, formalisation and so on; and lastly the external characteristics of the organisation refers to the openness of a system (Rogers, 1995).

2.2.5 (TOE) Technology, Organisational, Environmental framework

The adoption theories as outlined above, by design, have differences in their focus and examine different characteristics of technology adoption (Alam, 2009). Some of these theories explore technological adoption with a focus on the external environment, while others are more internally focused (Alam, 2009). For instance, TAM and its variants are completely inwardly focused, such that, external factors like suppliers, customers, competitors or context are not specifically or adequately addressed in these models (Van Akkeren & Cavaye, 1999).

Furthermore, some of these theories, in particular TAM, which is widely used in many technology adoption studies, focus primarily on the understanding of individual behaviour, as opposed to the adoption behaviour of an entire organisation (King & Gribbins, 2002). Adoption of technology may require resources that are way beyond individual control and therefore it is of the utmost importance that researchers investigate the decisions made by those in a position to influence technology adoption for an entire organisation (King & Gribbins, 2002).

For this study, the TOE framework will be adopted and extended to Cloud Computing, particularly because it is one of the models outlined above that is firm level focused, as opposed to the other models that are more at the individual level (Oliveira & Martin, 2011). Some of the constructs or attributes that overlap between models will be highlighted.

2.2.6 Major critique of the adoption models

In contrast to the wide usage of some of the models outlined above, Tan, Tyler and Manica (2007) in their study of business to business adoption of ecommerce in China, argued that most models do not adequately address organisational factors, such as the complexity of the managerial structure, centralisation, formalisation, the quality of the human resources and the inefficiencies that might exist (Tan, *et al.*, 2007). Clearly no model addresses every aspect of the organisational context.

Tan, *et al.* (2007) also highlight the main deficiencies of these models from a developing country's perspective as being the fact that they were developed in developed countries for developed economies. Therefore they might overlook some of the important issues that are developing country specific. Contextual issues such as bandwidth prices, availability, reliability and security might be negligible to developed economies when it comes to Internet based technology adoption.

2.3 TOE framework

2.3.1 TOE Literature

To decipher the management decision to adopt Cloud Computing, the Technology Organisational Environmental (TEO) framework adoption theory is being considered. The model was originally developed for innovation adoption (Tornatzky *et al*, 1990). It has since been adopted and adapted by many information technology (IT) researchers to test adoption of different kinds of information systems. Some of the studies that used and promoted the TOE model include studies by Oliveira & Martin (2011). In each of these studies the constructs were modified to suit the context of the specific study. See a comprehensive list of studies that used TOE later in the text.

According to Low & Chen, (2011); Jianyuan & Zhaofang, (2009) and Wu & Subramaniam, (2009), TOE framework has three context groups in which it looks into technology adoption namely: the technological context, organisational context and the environmental context. The technological context refers to the internal and external technologies applicable to the firm. It includes the relative advantage, complexity and compatibility, observability and trialability of

the technology in question (Low & Chen, 2011). Some of these attributes are consistent with the theory of innovation diffusion attributes (Rogers, 1995).

Secondly, the organisational context refers to the several constructs regarding the organisation such as the firm size, scope, centralisation, formalisation and complexity of the management structure and the quality of the human resources. Lastly, the environmental context refers to the organisation's industry, competitors, and government policy or intentions. This basically is how the TOE explains the adoption of innovation. A number of studies have used this model in interpreting adoption of specific technology (Low & Chen, 2011).

2.3.2 Studies that used the TOE framework

Anand and Kulshreshtha (2007) in their study of B2C (business to consumer) platform adoption in retail firms in India using TOE framework, concluded that the higher value proposition of technology makes the firm adopt B2C platform, firms with larger scope encourage B2C adoption, competition from other retail firms encourages the firm to adopt the B2C platform and, lastly, the governmental environment is a critical environmental factor in B2C platform adoption. Oliveira and Martin (2010), in the e-business adoption in the EU countries, concluded that in the perceived benefits and obstacles of e-business, technology readiness, competitive pressure and trading partner collaboration are the major adoption factors of e-business.

The results from a study conducted by Chong and Ooi (2008) indicate that trading partner's power, trust and products' characteristics have a significant and positive impact on adoption of RosettaNet standards. It should be noted that although these studies, as outlined above, and others, use the TOE framework, each of these studies does not test or use all the constructs as outlined on the original framework.

For instance, the constructs and sub-constructs used in the study by Oliveira and Martins (2010), compared to the study by Low and Chen (2011) are different. It is therefore important to understand that constructs are selected to suit the context of the technology or study in question. Wang, Wang and Yang (2010) have criticised the TEO framework for lacking consistency or for not explicitly outlining the major constructs in the framework and variables in each context. Secondly they highlighted that specific sub-constructs identified in the three contexts may vary across different studies.

Although the framework has received its share of criticism, studies that used this framework consider it to have consistent empirical support (Wang, Wang, & Yang, 2010). Low and

Chen (2011) considered the framework to be more exhaustive due to its consideration for the environmental context. Below are constructs that have been selected for this study.

2.3.3 Technological context

Relative advantage: as defined by Low and Chen (2011) refers to the degree to which a technological factor is perceived as providing great benefit to an organisation. This definition is similar to what the TAM model calls "perceived usefulness". Perceived usefulness refers to the benefits or the efficiencies that will be enabled through the use of the system (Comline, 2008) . This is the very basis of adopting any technology in an organization; the adopted technology must assist the company to fulfil its goals (Low & Chen, 2011). The benefits that are expected from Cloud Computing include the following (Armbrust, *et al*., 2010):

- shared infrastructure,
- on-demand self-service,
- elastic pricing,
- flexibility of services,
- pay-per-usage service,
- dynamic and virtualised computing

Complexity: Complexity refers to the degree of difficulty users encounter in understanding or using an innovation (Jianyuan & Zhaofang, 2009). Because Cloud Computing is a fairly new phenomenon, most IT organisations might not have confidence in implementing it (Buyya, Yeo, Venugopal, Broberg, & Brandic, 2009). Studies, as cited by Jianyuan and Zhaofang (2009), indicate that the complexity of an IT system has a negative correlation with the final adoption of the system. They further pointed out that, the more difficult it is to use or train users on an IT system, the less likely it is for the organisation to adopt the new system. Thus, the complexity of an IT system can be seen as having a negative impact on adopting innovation (Low, & Cheng, 2011)

Compatibility: Compatibility refers to the degree to which innovation is consistent with the adopter's current culture, processes and technological requirements (Rogers, 1995). Cloud Computing involves changing the way IT organisations operate (Armbrust *et al*., 2010). The lack of compatibility had led many organisations to doubt the potential of the innovation in relation to their current environment (Jianyuan & Zhaofang, 2009).

Cost effectiveness: Cost effectiveness is one construct that is not addressed by many past studies when considering technology adoption. All the studies such as Wu and Subramaniam (2009); Jianyuan and Zhaofang (2009); Oliveira and Martins (2010); Low and

Cheng (2011); Chong and Ooi (2008), do not include cost effectiveness as one of the constructs. Only a study conducted by Ross (2010) has cost effectiveness as one of the constructs; however this study did not use the TOE framework. One of the major advantages of Cloud Computing as stated in one of the points above is the pay-per-usage ability.

This means upfront capital outlay is not required. Cloud Computing becomes an operational expense (Armbrust *et al.*, 2009). Other attractive cost components of Cloud Computing include the savings on space, utilities (water & electricity), and maintenance staff (Ross, 2010). According to McDougall (as cited by Ross, 2010), energy costs are predicted to be sixty per cent lower when using Cloud Computing as opposed to traditional computing.

Technology Maturity: refers to the degree to which technology is matured to be adopted by many organisations. As indicated earlier, Cloud Computing is still in its infant state, particularly in emerging markets (Buyya *et al.*, 2009. According to Wu & Subramaniam (2009), the technology maturity is hardly discussed in any of the adoption models. Researchers focus more on the characteristics of the technology and ignore the impact of technology development in relation to its adoption (Wu & Subramaniam, 2009).

2.3.4 Organisational context

Top management support: Top management support ensures allocation of resources to any new innovation (Oliveira & Martin, 2010). Top management have the ability to send innovation importance and acceptance massages across the organisation (Wang, Wang, & Yang, 2010). Innovations that receive management support are therefore easily adopted in organisations.

Firm Size: refers to the number of employees, size of the target market and capital invested in an organisation (Anand & Kulshreshtha, 2007). Anand and Kulshreshtha (2007) further point out that, large organisations have more resources that can be used to finance innovation. Consequently, large organisations stand to benefit greatly out of technology adoption.

Technology readiness: of an organisation refers to the degree to which technological infrastructure and human resources are ready to support Cloud Computing (Oliveira & Martin, 2010). These are the installed networks and enterprise systems required to support Cloud Computing. The IT human resources provide the skills and knowledge to implement Cloud Computing infrastructure. It can thus be assumed that firms that are technologically ready are more prepared to adopt Cloud Computing (Low & Chen, 2011).

2.3.5 Environmental Context

Bandwidth availability and price: Cloud Computing services require access to the Internet (Armbrust, *et al.*, 2010), and therefore bandwidth. Bandwidth and its costs is the most evident shortcoming in most developing countries (Gillwald, 2007). This can be seen as a limiting factor for Cloud Computing adoption (Parikh, 2009). High bandwidth is especially important to allow speedy document retrieval and to be able to transfer large files such as high quality voice and video applications. The challenge in the developing countries is therefore the bandwidth shortage and lack of reliable broadband connectivity (Gillwald, 2007).

Competitive and trading partner pressure: Competitive pressure refers to the degree of pressure experienced by organizations within the industry (Oliveira & Martin, 2010). Various studies have indicated that the intensity of competition in an industry is a major adoption determinant factor (Wu & Subramaniam, 2009; Jianyuan & Zhaofang, 2009; Oliveira & Martin, 2010; Low & Chen, 2011; Chong & Ooi, 2008). Trading partner pressure has also received much attention in adoption from various studies (Wu & Subramaniam, 2009; Jianyuan & Zhaofang, 2009; Oliveira & Martin, 2010; Low & Chen, 2011; Chong & Ooi, 2008). Trade partner pressure refers to the vendors or any party with whom the organisation conducts business (Anand & Kulshreshtha, 2007). Organisations are more likely to adopt new technology if their trading partner adopts compatible technology (Anand & Kulshreshtha, 2007).

2.4 Cloud Computing Concept

Although a Cloud Computing definition is still a point of discussion, it is expected to evolve over time amongst scholars and IT industry leaders. As a computing phenomenon in its infancy, it is therefore generally accepted that there are no existing common standards or definitions (Sultan, 2011; Voas & Zang, 2009). Cloud Computing is widely accepted as referring to a cluster of computers and software which provides a shared pool of configurable computer resources and services over the Internet or a networked medium (Armbrust, *et al.*, 2010; Sultan, 2010; Buyya, *et al.*, 2009). The resources and services are in the form of hardware, software, application, network, storage and applications. A key requirement in relation to Cloud Computing in developing countries is the requirement for reliable connection to the Internet i.e. reliable broadband bandwidth (Arinze & Anandarajan, 2010).

2.4.1 Cloud Computing System Architectures

- Cloud Computing offers services in the following three main architectures: Software as a Service (SaaS), Infrastructure as a Service (IaaS) and Platform as a service (PaaS) (Armbrust, *et al.*, 2010; Sultan, 2010; Buyya, *et al.*, 2009; Low & Chen, 2011; Bhat, Bashir, Shah, & Bhat, 2010; Sultan, 2010)
-
- Software as a Service (SaaS): Also known as "Software on demand" is software that is offered over the Internet (Bhat, et al., 2010). Some of the commonly referenced examples of SaaS are: Document sharing: offered by Adobe, IBM, Google and Microsoft; Email: gmail, yahoomail,
- Platform as a Service (PaaS). This is a set of development tools that are offered on the cloud to consumers for application building. Example of services are Google Apps, Amazon Web service, Microsoft Azure and Force.com.
- Infrastructure as a Service (IaaS) can be thought of as an outsourcing of all equipment used to support the business operations. Examples include virtual machines, storage, networks, etc. Some of the services commonly used are Amazon's EC2 & storage, Gogrid Cloud Servers and Joynet.

2.4.2 Cloud Deployments

Cloud Computing is characterised by the following: It uses shared infrastructure, provides on-demand self-service, is elastic and flexible, is a pay-per-usage service and it uses dynamic and virtualised computing (Armbrust *et al.*, 2009; Buyya *et al.,* 2009). With reference to the implementation, there are four major types of cloud deployment; the internal cloud, private cloud, public cloud and hybrid cloud.

- Public cloud refer to cloud typologies where IT capability i.e. infrastructure and other services is offered by cloud providers to any consumer over the public Internet (Hilgendorf, Reeves, & Blakley, 2012). All components are owned by the cloud service provider who offers services on pay-per-usage basis. In this deployment, due to its usage of the public Internet, security and privacy is a major concern for most organisations (Youssef, 2012). Youssef (2012) argues that by default users on the public Internet are treated as untrustworthy.

  Another characteristic of public cloud is that, services are not hosted on the customer premises, and therefore, this reduces risk and cost through the flexible extension of the enterprise infrastructure (Bhat, Bashir, Shah, & Bhat, 2010). Examples of public

cloud services includes amongst others, the Amazom EC2, S3, Google AppEngine, and Force.com (Dillon, Wu, & Chang, 2010; Youssef, 2012)

- Private cloud is a cloud service that is offered to a selected group of consumers. The services can be offered on the public Internet or a private network. The internal IT department or a third party can be classified as a service provider in this case (Hilgendorf, Reeves, & Blakley, 2012). Private cloud is the IT capabilities offered as a service by an IT organisation solely to its own business components. The infrastructure is therefore purchased and owned by the consuming organisation. According to Youssef (2012) private clouds are considered more secure than public clouds, primarily because the systems are generally used by trusted people inside the organisation.

  Similarly, Wang, Rashid & Chuang (2011) argue that, due to organisations not trusting the data security on the public cloud, most organisation resort to implementing private clouds on their own premises. Contrary to most commentators, Armbrust, *et al.* (2010) posit that private clouds are not true cloud offerings, primarily due to their inelasticity, limited resources and the requirements for capital outlay.

- Community Cloud refers to cloud infrastructure built and shared by multiple organisations that have a similar mission, policy and security requirements. The infrastructure could be hosted by the organisations themselves or by a third party. This is one way in which organisations, particularly those that are worried about the public cloud security, have an opportunity to take advantage of cloud services in a secure environment. In this deployment, advantages of the real cloud i.e. pay-per-usage, scalability, multi-tenancy, economies of scale, mobility and efficient resource usage can be realised by organisations (Dillon, Wu, & Chang, 2010; Youssef, 2012).

  Surprisingly most cloud researchers do not mention anything about community clouds (Bhat, Bashir, Shah, & Bhat, 2010; Wang, Rashid, & Chuang, 2011; Armbrust, *et al.,* 2010). If it is mentioned, there are very limited details on the concept (Dillon, Wu, & Chang, 2010; Youssef, 2012; Chebrolu, 2010). Observations are that the majority of the literature recognises only three deployment models i.e. public, private and hybrid.

- Lastly, a hybrid cloud is a combination of any of the three typologies above (Chebrolu, 2010). The services work together and are managed as a single service cloud offering, whilst each cloud deployment remains a unique entity (Youssef, 2012). Through this deployment, organisations can keep their mission critical

systems or applications on the private cloud, whilst non-critical systems can be deployed in the public cloud (Dillon, Wu, & Chang, 2010).

According to Dillon, Wu and Chang (2010), hybrid clouds have introduced issues of standardisation and cloud interoperability. This is seen as one of the inhibitors of cloud diffusion in organisations (Buyya *et al.,* 2009).

2.4.3 Cloud Computing Drivers

Erdogmus (2009) argues that the main drivers of the Cloud Computing approach are economics and the simplification of software delivery and operation. Others see potential cost saving or reduced IT cost that comes with Cloud Computing, freeing up resources and saving on the expenses of installing and maintaining applications internally (Leavitt, 2009; Buyya, *et al*., 2009). The pay-per-usage model is seen as a way to cushion organisations from an upfront capital outlay that is inherent in the traditional way of funding IT projects. Organisations can focus on their core business or competencies if most of their services are hosted and supported on the cloud (Di Giacomo & Brunzel, 2010).

2.4.4 Cloud Computing Cons

Though there are existing commercial implementations and Cloud Computing seems to be a great avenue for organisations to explore, it however has its fair share of criticism. Larry Allison (as cited by Sultan, 2011), the founder of Oracle systems, once criticized the rash of Cloud Computing as “fashion driven and complete gibberish”. He further commented that it will be hard to make money out of Cloud Computing, which he saw as lacking a clear business model. As with any other new technology of this scale and complexity, there are fears, uncertainty and concerns, in particular about its maturity (Sultan, 2011; Oliveira & Martin, 2011)

Some of the criticism includes amongst others, lack of standards, lack of service level agreements, risk (security and privacy) of transacting over the Internet or entrusting your services to a third party and internal IT losing control. Given some of the Cloud Computing advantages stated above, the rate of growth or adoption is still very low, and is mainly in large organisations (Low & Chen, 2011; Buyya, *et al.,* 2009; Goscinski & Brock, 2010).

One of the major sources of performance issues on Cloud Computing is the communication time between the client’s computer and the Web server in the cloud (Kim, Kim, Lee, & Lee, 2009). The issue is exacerbated by an increase in a number of simultaneous accesses to the server, and the amount of data transferred between the client and the cloud (Kim *et al*,

2009). These sentiments are also shared by Parikh, (2009), where he recommends the SaaS model for rural software installations and updates. He however pins the slow uptake of the model on unreliable broadband connectivity that is experienced in the rural developing world. It is therefore the aim of this study to investigate the role of bandwidth in influencing Cloud Computing adoption.

2.4.5 Cloud Computing Adoption

According to Ross (2010), firms, particularly large ones, have showed early reluctance or little interest when it comes to Cloud Computing. However, with the maturity of many of the underlying technologies, for instance virtualisation, interest in Cloud Computing is gaining momentum. Numerous firms are joining the Cloud Computing wave. Since there are no open standards on Cloud Computing companies, academic organisations are coming together in defining standards (Sultan, 2011; Voas & Zang, 2009). The standards will cover areas such as security, portability, interoperability, management and monitoring (NIST, 2011)

In her study on Cloud Computing adoption, Ross (2010) identified the following four key adoption constructs that affect Cloud Computing adoption: cost effectiveness, the need for Cloud Computing, reliability and security. She found that there was a strong correlation between the decision to adopt Cloud Computing and all four independent variables. Low and Chen (2011) in understanding determinants of Cloud Computing adoption in Taiwan's high-tech industries found that relative advantage, top management support, firm size, competitive pressure and trading partner pressure have a significant effect on Cloud Computing adoption.

In another study, conducted by Behrend, Wiebe, London and Johnson (2011), which used the TAM model in understanding Cloud Computing adoption in community colleges, the following constructs were highlighted and tested: usefulness and ease of use. Some of the findings were as follows: usefulness did not show any significant relationship with students using Cloud Computing whilst ease of use showed a strong relationship with Cloud Computing usage.

Although Cloud Computing is an Internet based technology which requires high speed network bandwidth, none of the three studies above Ross (2010); Low & Chen, (2011) and Behrend, Wiebe, London & Johnson, (2011) considered bandwidth prices, availability, reliability and security as key constructs to determine adoption. Interesting enough, none of the studies that tested Internet or network based innovation considered bandwidth related constructs (Anand & Kulshreshtha, 2007; Chong & Ooi, 2008; Jianyuan & Zhaofang, 2009; Oliveira & Martin, 2010).

2.5 Network issues on the Cloud

2.5.1 Network bandwidth in relation to Cloud Computing

The concepts of SaaS and PaaS or public clouds by definition means that services will move from being internally hosted on organisations resources into the cloud (Low, & Chen, 2011; Buyya *et al., 2009* ; Goscinski, & Brock, 2010; Sultan, 2011; Voas & Zang, 2009; Armbrust *et al.,* 2010). It can therefore be inferred that the growth or the adoption of Cloud Computing by users and organisations will increase the demand for network bandwidth by users, in particular Internet bandwidth.

According to Rose (2011) the demand for bandwidth on the Internet or rather the cloud cannot only be attributed to Cloud Computing. Unprecedented growth is anticipated with the growth in tele-workers who work from home or from virtual offices. Rose (2011) further suggests that further Internet growth will be coming from normal home users, particularly those with an appetite for online Blue-Ray quality movies, gaming or gambling applications that are bandwidth demanding. The growth in portable communication devices like smart mobile phones and tablets will increase the demand for bandwidth. Although it is not evident, at least not yet, the Nemetes research as cited by Rose (2011) maintains that by 2012, demand for bandwidth exacerbated by the points mentioned above, will exceed the capacity of the Internet.

Kim, Kim, Lee, and Lee (2009) identified seven types of cloud adoption issues, included in the seven are three factors that are pertinent to this study; the availability, the performance, the cost and security. According to the IDC survey (as cited by Feuerlicht, Burkon and Sebesta 2010) 87% of the respondents felt that security is the number one cloud adoption concern, followed by availability, performance and cost, all at 83%. However, the results from the same study found that from a Czech Republic perspective, network bandwidth issues were not highlighted as a cloud adoption barrier. We look into these factors from the network perspective in the sections below.

2.5.2 Communications Network Prices

As stated by Armbrust *et al., (2009),* the primary aim of Cloud Computing from a network perspective is to reduce WAN (wide area network) cost, which comprises the high-end-routers that are two-thirds of the cost and the interconnecting fibre network that is one-third of the network bandwidth cost. Similarly, Dillon, Wu and Chang (2010), highlight that, whilst migrating services to the cloud can significantly reduce general computing infrastructure costs, it can on the other hand raise network communication costs. In some cases

orgainations realise the need to significantly increase their network bandwidth in the early stages after adopting cloud services to maintain satisfactory perfomance levels, these might lead to unplanned escalating costs (Kim, Kim, Lee, & Lee, 2009).

The same sentiments are shared by Leavitt (2009), when he alluded to the fact that cloud adopters could incur high network bandwidth charges from their service providers. Consequently applications like ERP/CRM (Enterprise Resource Planning/ Customer relationship management) might not be suitable for the cloud purely from an economic point of view, particularly if the cost saving from cloud cannot offset the network communication costs. Therefore, organisations will rather host their ERP/CRM systems internally as opposed to in the cloud (Dillon, Wu, & Chang, 2010).

2.5.3 Communications Network Infrastructure availability

According to Arinze and Anandarajan (2011), many developing countries do not have adequate network infrastructure coverage for personal computing and businesses. In most cases network bandwidth is highly concentrated on major urban centres. In developing countries most DSL deployment are in large cities, in particular coastal cities where the undersea Internet cable terminates. Due to limited fixed network cabling coverage in the developing countries, consumers and businesses alike have resorted to mobile broadband which has larger coverage from an infrastructure point of view and can cover a wider population (Arinze & Anandarajan, 2010). More details will be covered in the Internet section below.

2.5.4 Communications Network Performance

Some of the major challenging areas when it comes to Cloud Computing are the performance, latency and reliability of the network (Leavitt, 2009). Of key to Cloud Computing is the reliable connection to the Internet (Arinze & Anandarajan, 2010). Reliability in the cloud refers to the ability of the network infrastructure to ensure reliable data communication between nodes in the cloud. Due to the flexibility of the cloud, network infrastructure should be responsive, i.e. adapt to changes in the cloud topology, this can negatively impact reliability of services (Idowu, Shi, Merabti, & Kifayat, 2012). Lin and Chang (2011) argued that to offer stable network performance in the cloud, service providers should guarantee good network quality of services (QOS) that will satisfy customers at all times.

Cloud providers tend to under-estimate or over-estimate their cloud resources, i.e. in peak demand, providers might over provision their servers or over utilise their Internet or network bandwidth. This can lead to undesired poor performance of the services on the cloud. Other

instances in which latency or poor performance, particularly in the public cloud, can be experienced are inherent in the cloud design architecture. Data in the cloud can be stored in data centres across the globe, which will require high speed links for data retrieval between clouds (Leavitt, 2009).

With reliable Internet connections, cloud providers are able to provide services that are similar to non-cloud or internally hosted services (Arinze & Anandarajan, 2010). Youseff (2012) feels that reliability in the cloud is achievable through multiple redundancy site. That said, the more redundancy is required within or across clouds, the higher the network bandwidth costs. Similarly, availability of infrastructure to cater for the required performance might be a challenge, particularly in developing countries (Arinze & Anandarajan, 2010).

2.5.5 Communications Network Security

Although Cloud Computing seems to be a disruptive innovation with deep implications for the Internet services and the IT fraternity as a whole, there are still some issues around its growth and diffusion, such as security and privacy. Despite much hype surrounding the Cloud Computing phenomenon, small, medium and large sized organisations are reluctant to move their services to the cloud, due to uncertainties in the security of the cloud. For large organisations in particular, it is perceived that the security concerns and risks outstrip the perceived benefits as outlined in earlier sections above (Subashini & Kavitha, 2011).

According to Zissis and Lekkas, (2012) Cloud Computing has the ability to address security vulnerabilities that exist in the traditional IT, however its unorthodox dynamic nature deters the effectiveness and efficiencies of traditional security countermeasures. They further argued that security in computing is largely founded on trust boundaries, which by and large will be eroded by the outsourced nature brought about by Cloud Computing. Under Cloud Computing, governance of infrastructure, data and application is entrusted to an external provider outside the owner's strict control

Trust therefore, depends largely on the type of cloud deployment model preferred by organisations. In the case of private clouds, the owners still possess control over their data resources in their own premises even if they are managed or operated by a third party. Trust stays within the company parameter, which will not result in additional new security concerns. Other deployment models are therefore prone to extra security challenges that are exacerbated by the loss of control that comes with the cloud, for instance the trusted perception of parameter control (Zissis & Lekkas, 2012).

Bisong and Syed, (2011) expressed a number of security concerns in relation to Cloud Computing, adopted from the Cloud Security Alliance as follows:

- Abuse and nefarious use of Cloud Computing
- Insecure application programming interfaces
- Malicious insider
- Shared technology vulnerabilities
- Data loss/ leakages
- Account, service & traffic hijacking
- Unknown risk profile

For Cloud Computing to succeed, it is imperative for cloud providers to ensure that the above issues are effectively addressed to protect their customers' data and files across all cloud platforms (Ross, 2010). From a research perspective, there are a plethora of studies that have investigated different security measures and information for Cloud Computing security, for instance:

- A survey on security issues (Subashini & Kavitha, 2011)
- Usage of Trusted Third Party (Zissis & Lekkas, 2012)
- Cloud Computing Security Threats, Risks & Vulnerabilities (Bisong & Rahman, 2011)
- Cloud Network Threats and Countermeasures (Qaisar & Khawaja, 2012)

These studies and others address numerous cloud security issues such as

- Data Security
- Network Security
- Data Locality
- Data Integrity
- Data Segregation
- Data Access
- Authentication & Authorisation
- Data Confidentiality
- Web Application Security
- Data breaches
- Virtualisation Vulnerabilities
- Availability
- Backup & Business Continuity
- Identity Management and Sign-on process
- Storage Securing
- Cookie Manipulation

2.6 Internet in South Africa

As indicated above, the Internet is the underlying technology that drives Cloud Computing (Armbrust *et al*., 2009; Sultan, 2010; Buyya *et al.,* 2009). Cloud Computing applications in most cases require fast reliable broadband Internet connections (Arinze & Anandarajan, 2010). The ability of developing countries to benefit from Cloud Computing relies heavily on infrastructure availability, reliability of Internet connections, price and its security (Arinze & Anandarajan, 2010). The context, in which a potential technology, in this case Cloud Computing, operates, will therefore shape the decision to accept or reject the innovation (Corrales & Westhoff, 2006). A

In order to clearly comprehend the context in which Cloud Computing is being studied, it is essential to explore literature around Internet diffusion in South Africa. That said, Internet diffusion literature is very limited in South Africa, leading researchers to rely on "grey literature" in an attempt to bridge the literature gap (Senatore, 2010). Grey literature refers to non-academic literature, i.e. studies with limited distribution, news articles, company reports, policy reports and working papers (as cited by Senatore, 2010). The following are the Internet access methods available in South Africa (Senatore, 2010):

- ADSL
- Leased lines
- 3G
- Wimax
- WiFi
- WCDMA

A study conducted by Grobler and Dlamini (2012) that looked into the cyber trends in South Africa, indicated that South Africa had one of the highest online activities when compared to other African countries. In this study, they posit that in 2007 and 2008, SA online activities were estimated to be 67% of the online activity in the whole of Africa. The remainder of the percentage activity was attributed to Morocco and Egypt. Their literature further indicates that for the first time, mobile Internet subscriber numbers exceeded the fixed broadband subscribers in 2007.

According to the Internetworldstats (2012), by December 2010, South Africa had 6.8 million Internet users, which equates to 13.9% of the population. Further statistics indicates that by the end of 2011, South Africa had approximately 4.8 million Facebook users. Overall, this equates to a 9.8% Internet penetration for South Africa. These stats show that South Africa,

as one of the more developed countries, lags behind countries like Egypt, Morocco and Tunisia with penetration of 26.4%, 49% and 36.3% respectively (Internetworldstats, 2012).

Despite having had the largest share of percentage in the Internet activities in 2007 and 2008 South Africa is currently ranked fourth in the Africa Top Internet Countries, the leader being Nigeria. In a study called “Negotiating the Net”, Lewis (2005) analysed the factors that impact the diffusion of the Internet in South Africa. The study concluded that the following aspects were pertinent to the slow diffusion of the Internet in South Africa:

- Competition between ISP (Internet Service Providers) and IAP (Internet Access Providers)
- Access to facilities
- Telecommunication liberalisation
- Privatisation and deregulation
- E-commerce policy

According to Jagun (2007), low bandwidth in a country is a reflection of poor telecommunication infrastructure. Furthermore, Jagun (2007) attributes the population’s gain to Internet access to technological conditions of a country. The following are the technological conditions given by the study:

- The level of telecommunication development in a country
- The penetration or deployment of the telecommunication infrastructure across the population of the country.
- The overall bandwidth capacity of the country
- The number of Internet hosts in the country
- The presence or lack of regional network backbone capacity between/across countries
- The presence or lack of international network backbone infrastructure

In contrast to poor telecommunication infrastructure, Fourie (2008) argues that, although South Africa’s telecommunication network is beleaguered by access problems and high costs, which might result in poor performance, the state of the physical infrastructure is of good standard. However, when comparing South Africa to other countries in terms of telephone lines per 100 main lines, the country is ranked at 48 faults, which is worse than the world average of 37 faults. The country further performed worse compared to middle-income countries at an average of 25 faults. Consequently the quality of Internet services will be affected.

Another study conducted by Irwin, Sieboërger and Wells (2010) alluded to community networks in South Africa being plagued by limited capacity connections to the Internet. They further suggest that the Internet in South Africa, as in many African countries, is a luxury, and therefore not widely used as in developed economies. A study was conducted in 2005 to compare South Africa's telecommunication costs to the developed countries and an international peer group of countries. A follow up study was conducted in 2007 to check for any improvements (as cited by Irwin, Sieboërger and Wells, 2010).

The peer countries in the study were considered to have advanced communication infrastructure and they were further similar to South Africa with regards to geographic dispersion of population, market structure and income dispersion. The studies concluded that, although South African international leased line prices had dropped by 44%, the prices were relatively high by 404.7% compared to other countries on average. The national leased lines had reduced their cost by 102% in 2005 to 25.5% in 2007 compared to other countries. Furthermore, business broadband was the third most expensive compared to 15 other countries surveyed. Although South Africa is plagued by high telecommunications prices, the demand for home and business ADSL is growing (as cited by Irwin, Sieboërger & Wells, 2010). That said, the facts eluded to by Arinze and Anandarajan (2010) still stand, high telecommunication prices are a hindrance to Cloud Computing diffusion.

The high prices do not only affect access to Internet or Cloud Computing, all Internet based technologies are affected. A study by Tobin and Bidoli (2005), found high bandwidth cost to be a key barrier to the adoption of voice over IP (VoIP). Brown *et al*., (2009) in their study of the Internet to South African homes attributed the slow uptake of the Internet in South Africa to prohibitive cost and poor infrastructure by the fixed line telecom incumbent, Telkom SA. The high cost and poor infrastructure has not only led to low Internet diffusion in households, but it is also affecting big business and SMMEs (Senatore, 2010). Although many studies show cost as the major factor that hinders Internet diffusion, Senatore (2010), in his study believes that few of these studies provide details or insights into factors influencing the high cost in South Africa. A study conducted by Dube (2007), attributed the communication networks high prices as a result of essentially having only one provider of fixed line services.

On the regulatory front, the Independent Communication Authority of South Africa (ICASA), which was established in 2001, is the regulator of telecommunications in South Africa. According to Senatore (2010), the blame has been put at the door of the regulator by market commentators, ISPs, industry experts and advocates for failing to bring down high telecommunication costs in South Africa. This consequently results in high broadband and Internet prices and slow Internet diffusion in the country. The regulator is further criticised for protecting the incumbent Telco, Telkom SA. This study seeks to test whether the

bandwidth high costs and availability have a significant impact on the overall Cloud Computing adoption in South Africa.

2.7 Conclusion

In conclusion of the literature review above, the following findings and implications can be drawn.

The literature review extensively outlined the theoretical models widely used in Information Technology adoption. Examples of studies that used these models are highlighted. Some authors put forward major flaws with these models, and suggest some new constructs that can be added to enhance these models. In addition to these flaws, some researchers have argued that the models have only been extensively tested in Western Countries. Therefore, they do not adequately address adoption issues related to developing or so called Third World Countries.

The models are inadequate in explaining specific characteristics of a technology that determines adoption, therefore specific reasons why the technology is adopted or not adopted are not clear. From this study, one model has been selected for this study namely the TOE model. The model was selected mainly because more extensively researched models like TAM are more focused on individuals as opposed to organisations. TOE framework is fully explained and augmented with the theory of some of the new constructs that were used for this study.

Next, the literature went into Cloud Computing, the test technology for this study, wherein the technology was explained, focusing on the issues such the system architecture of Cloud Computing. Secondly, different deployment models were explored. Thirdly and fourthly, the pros and cons of this new technology were outlined. Lastly, different studies that dealt with the adoption of Cloud Computing were explored to identify the gaps that were addressed in this study.

From the literature thus far, it was deduced that the communication network and its sub-constructs, such as it's pricing, availability, reliability and security are not recognised or considered as major constructs. None of the models outlined above specifically address the communication network as a major construct, in particular, the studies that use the Internet or the communication network as an underlying technology. From a western perspective, communication networks seem to be a given, and therefore this is not addressed as an adoption issue. Thus, the literature review explores communication networks as a major

construct. Furthermore, the Internet was explored in order to paint contextual challenges that it's diffusion face.

This research aimed to investigate the significance of the communication network as a major construct that should be considered by all models that are used to test adoption of IT technology that have a network component or use the Internet as an underlying technology.

3 Chapter 3: Research Model and Hypothesis

3.1 Proposed Model

In line with the literature outlined in the previous section, a conceptual framework was developed for Cloud Computing based on the TOE framework. Here, Cloud Computing adoption refers to the management decision to recommend Cloud Computing in their organisation. In this framework, IT leaders' willingness to adopt Cloud Computing was the dependent variable. This study took into consideration that other constructs have already been proven by Ross (2010) and by Low and Chen (2011), and therefore the focus was mainly on Bandwidth or communication network in the developing country context. The following were the four new sub-constructs of the communication network introduced, that represented the independent variables to be tested.

- Network Bandwidth Pricing (current)
- Network infrastructure Availability
- Network infrastructure performance
- Network Security

The four variables, including the dependent, were tested, formulating the hypothesis in the next sub-sections below.

A research normally follows a specific research problem, question or hypothesis (Leedy & Ormrod, 2010). Zikmund, (2003) explained hypothesis as a formulation of unproven propositions that explains some facts into statements that can be empirically tested. Hypothesis can also be "explained as a reasonable guess, logical suppostition or an educated conjucture" (Leedy & Ormrod, 2010, p. 4). In simpler terms, an hypothesis can be thought of as statements that outline unproven relationships between two or more variables, that needs to be scientifically proven.

According to Blumberg, Cooper and Schindler, the function of a hypothesis is to specify, the 'what' or 'who' will be studied and the context in which they will be studied (as cited by Tshaka, 2011).

3.2 Hypothesis 1

$H_0$1: IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTR_{CC}) is independent of their perception of bandwidth pricing in South Africa (BW_{pr}).

H_a1: IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTR_{CC}) is dependent of their perception of bandwidth pricing in South Africa (BW_{pr}).

$H_0$1: $(DTR_{CC}) \neq (BW_{pr})$
H_a1: $(DTR_{CC}) = (BW_{pr})$

3.3 Hypothesis 2

$H_0$2: IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTR_{CC}) is independent of their perception on infrastructure availability (BW_{av}).

H_a2: IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTR_{CC}) is dependent of their perception on infrastructure availability (BW_{av}).

$H_0$2: $(DTR_{CC}) \neq (BW_{av})$
H_a2: $(DTR_{CC}) = (BW_{av})$

3.4 Hypothesis 3

$H_0$3: IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTR_{CC}) is independent of their perception on network performance (BW_{rel}).

H_a3: IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTR_{CC}) is dependent of their perception on network performance (BW_{rel}).

$H_0$3: $(DTR_{CC}) \neq (BW_{rel})$
H_a3: $(DTR_{CC}) = (BW_{rel})$

3.5 Hypothesis 4

$H_0$4: IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTR_{CC}) is independent of their perception on communication network security effectiveness (BW_{sec}).

H_a4: IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTR_{CC}) is dependent of their perception on communication network security effectiveness (BW_{sec}).

H_04: $(DTR_{CC}) \neq (BW_{sec})$
H_a4: $(DTR_{CC}) = (BW_{sec})$

4 Chapter 4: Research Methodology

4.1 Introduction

The primary purpose of this study was to assist the IT organisation's leaders and/or people responsible for IT decision making to take cognisance of appropriate solutions and their variables, when it comes to selecting Internet/network/cloud based IT solutions for their organisations. This study in particular focused on the factors that influence IT leadership's decision to recommend Cloud Computing. The adoption of new technology should therefore be considered in relation to the contextual factors, in this case, the developing country context that might be very different from where most technology originated.

The study could further assist providers of IT services in understanding what their customers deem important factors when considering new Internet/network/cloud based IT solutions. This would thus empower service providers in introducing appropriate solutions for their customers.

This chapter discusses the methodology that was used for this study by looking into the research approach, the design used, the data collection and analysis thereof. The study therefore followed a three-pronged approach:

- First, an extensive coverage of the literature, with regards to the various adoption models used in IT technologies, followed by sections going deeper into one of models i.e. the TOE model. Then literature covering different aspects in describing Cloud Computing was interrogated. The study then ended the literature review by painting a picture of the Internet in a South African context.
- Secondly, collection of data by means of a survey, which comprised open ended questions, followed by analysis of the data through various statistical concepts and measurements to answer the research hypothesis.
- Lastly, the data interpretation and discussion with the aim to make management recommendations and a summary of the academic findings.

4.2 Research Method & Design

The research design selected for this study was quantitative and descriptive in nature. According to Saunders and Lewis, (2012), a descriptive study seeks to produce an accurate presentation of a person, event or solution. Quantitative research is "generally characterized by a methodology of formulating hypotheses that are tested through controlled experiment or

statistical analysis". Zikmund, (2003), on the other hand, describes a descriptive research as a study in which characteristics of a population or a phenomenon is described, and further it is normally conducted in situations where there is previous understanding of the concept in question. Zikmund (2003) goes on to explain that the quantitative study as a study that focuses on determining or describing data in a form of numbers.

Though the concept of Cloud Computing is still at an emerging stage, this study attempted to describe reasons for adoption of a phenomenon that has already been explored. Most of the studies presented in the literature review above, in particular a study by Armbrust *et al.* (2009), managed to define Cloud Computing in as much detail as possible, therefore allowing a study like this one to dig deeper into constructs related to the adoption of Cloud Computing .

The quantitative research approach is fairly criticised by Wu (2012), particularly in the IT adoption using TAM. According to Wu (2012), the quantitative approach follows data reduction principles, through statistical techniques, consequently losing the complexity of a phenomenon and "inter-dependent human-technology interaction to quantifiable, linear, and deterministic relation". Furthermore Wu (2012) argued that those quantitative measuring instruments are not flexible, particularly during the research process, which might lead researchers to overlook some unexpected but vital discoveries.

The main objective in selecting a quantitative approach as opposed to qualitative or mixed approach was primarily to unearth conclusive evidence rather than just provide information (Zikmund, 2003). The researcher was of an opinion that a mixed approach would have been time consuming and costly, given the time constraints. The mixed approach will form part of the future research recommendation in the next section, mainly to unearth more contextual variables.

The study focused on measuring the independent variables (Network Bandwidth Pricing (BWpr), Network infrastructure Availability (BWav) i.e. bandwidth availability, Network Infrastructure Performance (BWrel) i.e. reliability or quality of the infrastructure and Network Security(BW_{sec}) effect on the dependent variable Cloud Computing adoption (DTRCC).

4.3 Universe/Population

Population refers to a totality of the entities of interest to the study; it can be a collection of individuals, objects or events, which researchers might be required to make inferences about (Albright, Wiston, & Zappe, 2009). The population for this study came from a variety of public and private companies in South Africa, which have an IT budget. The reason for selecting

this population was that Cloud Computing can be used by any organisation (e.g. SMMEs, education institutions, medium to large enterprises, large enterprises, etc.).

The study was targeted at the medium to large sized organisations in South Africa. This was done because companies with resources, particularly financial resources, tend not to look into technologies that have not yet matured. Thus these types of organisations miss the opportunity to save costs or take early advantage of the innovation. There are many types of organisations that can benefit from Cloud Computing, however the medium to large organisations give a good spectrum of organisations across industries, including government departments.

4.4 Unit of Analysis

The term unit of analysis in this study refers to individuals who were approached for this study (Diamatopoulos & Schlegelmilch, 2000). The unit of analysis were the CIOs or IT managers in the targeted population. In most cases smaller organisations will not have a dedicated IT manager or a CIO. The focus of the study was on large enterprises as opposed to SMME.

4.5 Sampling

4.5.1 Sample

Sampling is a process of selecting a portion of the population to formulate a conclusion about the population (Zikmund, 2003). According to Saunders and Lewis (2012), the following two ways can be used to sample data for a study: probability sampling versus non-probability sampling. Probability sampling refers to a variety of sampling techniques for selecting a sample where a complete list of the population is known. Non-probability will therefore be for samples where a complete list of the population was not known.

For this study, a non-probability sampling technique was used due to the fact that the researcher had no way of forecasting or guaranteeing that all elements of the population would be represented (Motloutsi, 2009). A subset of non-probability sampling called purposive sampling was used for this study. Purposive sampling is a type of non-probability sampling in which the researcher's judgement is used to select sample members based on a range of possible reason. For the purpose of this study a sample that was used was the medium to large organisations in South Africa.

The aim of this study was to survey as large a number of participants as possible to ensure that the results could be generalised to the entire population. Furthermore, the intention was to ensure validity of the results with a sample size of n>30 as specified in the central limit theorem (Albright, Wiston, & Zappe, 2009).

4.5.2 Sample size

In order to compile a list of possible respondents, a list of 300 CIOs from the CIO directory 2012, published annually by Brainstorm magazine, was used to contact all 300 CIO's listed. This was done with the aim of soliciting email addresses that was used as a distribution list for the survey. Out of the 300, a total of 172 did not participate, 50 CIOs did not agree to participate, 60 could not be reached and 62 of the calls were stopped by PAs (personal assistants).

Therefore, a total number of a hundred and twenty eight (128) respondents were targeted for this study, however only fifty six (56) respondents participated in the study.

4.6 Research Instrument

4.6.1 Survey Questionnaire

The data for this study was collected using an online survey, which was distributed to the selected sample through surveymonkey.com. Participants received an invitation email detailing the web link to surveymonkey.com. Included in the email were the instructions on completing the survey and an assurance of confidentiality. Participants were offered access to the survey results. Questions on the questionnaire were adopted and modified to suit the relevant constructs as per this study from a study conducted by Ross (2010). Permission to use the questionnaire was formally granted by Ross. A further request was sent to Dr Lease who originally drew the questionnaire used by Ross.

The reason for using this questionnaire was that the instrument was extensively tested by the original developer, Lease (as cited by Ross 2010). It was subjected to two sequential field tests. The final test of the two had 100% participation and tested for validity with a Cronbach's alpha of 0.94, indicating that the tests were highly correlated.

The Internet was selected as a mechanism for questionnaire distribution primarily because questionnaires distributed through the Internet have the advantage of allowing for anonymity of participants. Furthermore they allow the participants' time to reflect on their responses

with no disruption or influence from the researcher. See Appendix A for permission letters from Ross and Lease.

4.6.2 Questionnaire design

The main advantage in using surveys to gather data is that surveys are quick, cost effective and accurate in gathering, measuring and the analysis of data of a population (Zikmund, 2003). See Appendix B for a sample questionnaire. The questionnaire was divided into five sections as follows:

- Section A, comprised the introduction to the subject being studied, then the instruction on how to complete the survey, including the researcher and the supervisor's names and contact details. The survey also stated that participation was voluntary and participants could withdraw at any time in the process without any penalty
- Section B, included the demographic profile of the respondents, detailing information regarding the respondent's company size in term of users, job title and the industry type.
- Section C comprised questions relating to Cloud Computing, the primary aim was to test whether respondents knew what Cloud Computing is, if they implemented it in their organisation, for how many years they have implemented it, general knowledge of the network connectivity type used in their company.
- Section D was broken into five parts matching all the primary variables used for this study as outlined in chapter 4. All the questions in this section used a five point Likert scale (as cited by Lease, 2005),

    - Connectivity Pricing : Questions 11-15
    - Network reliability: Questions 16-19
    - Infrastructure availability: Questions 20-23
    - Security: Questions 24-27
    - General Attitude towards Cloud Computing: Questions 28-30

Although the Internet is most effective in distribution, the drawback proved to be the low response rate, which is as a result of mails sent to junk email boxes, destination servers identifying survey emails as spam or emails stuck on the respondents' to do list. To curb this effect, follow up emails and calls were made to respondents to ensure participation.

4.6.3 Pre-testing of the questionnaire

The main purpose of performing a Pre-test is to assist the researcher in ensuring that the questionnaire is reliable and fit for the intended study (Saunders & Lewis, 2012). Though care was taken to ensure minimum errors, the research might include some errors. For example, questions could be ambiguous after modification from previous studies. The new or adapted questionnaire was therefore subjected to a pre-test.

Following on validation conducted by Lease (2005) in his field/pilot trials, the seven experts were requested to validate the survey questionnaire. These tests were administered among the industry experts to ensure that constructs selected were valid and the questions were appropriate. A survey document was sent to the independent industry experts via email, containing a cover letter with instructions of what was requested. It should be noted that three of the expert work for the incumbent Telco in South Africa; while the other four were prominent IT conference speakers, CIOs in their respective companies, IT experts and industry commentators. See Appendix C for a mini profile of the experts involved.

The objective of the pre-test was for the expert to answer the following questions in relation to the survey questionnaire (Lease, 2005):

1. Were you able to retrieve the survey without any difficulty?
2. Were the contents of the survey questionnaire appropriate for IT leadership?
3. Are the survey items clear and easy to answer?
4. Do the instructions make clear sense
5. Were any of the questions intrusive, invasive and embarrassing or of a sensitive nature?
6. Would you recommend any thing to be added to the survey?
7. Any other comments?

Insights gained from the pre-test were incorporated into the final questionnaire, in particular security as an important construct, which was not part of the initial survey. In addition to the security suggestion, one of the experts recommended a question on time frames relating to adoption intention. Other suggestions were instrumental in further understanding of the cloud concept, including what the industry or conference attendees believe and concerns regarding cloud.

4.6.4 Possible Errors

Because Cloud Computing is a buzz word, the researcher anticipated some subject bias error. This was primarily because every IT person wants to think they are familiar with the trends and therefore might falsify some information to feel relevant. Furthermore, data gathered from surveys are self-reported, and therefore are susceptible to bias associated with acceptance, social desirability and non-response (Wu, 2012)

4.7 Data Analysis

After data was collected through the Survey Monkey website, it was translated to an IBM Statistical Package for the Social Sciences (SPSS) compatible file. SPSS version 20 was used for data analysis. Firstly, the data was evaluated to remove all the entries in which no data was captured, meaning entries where respondents abandoned the survey without entering much data. Entries with few missing data in some questions were left for SPSS to automatically correct during analysis.

SPSS has two built-in features for dealing with missing data namely, Listwise Deletion (LD) and Pairwise deletion (PD). Listwise Deletion (LD) reports on the missing observations for most tests, but will exclude the missing cases for analysis (Myrtveit, Stensrud, & Olsson, 2001). Pairwise deletion (PD) on the other hand, will exclude any variable with missing values, however it can still use the case when analysing other variables without missing variables (Graham, 2009). For this study, the researcher opted to leave all settings at default; Listwise Deletion (LD) is the default option.

The first test performed was to extract descriptive data from the collected sample, using frequency tables and cross tabulations of different survey items. According to Albright, Wiston and Zappe, (2009) frequency tables list the numbers of observations of some variables into various categories. Some frequency information was assessed using bar graphs.

The second test performed was the reliability test of the survey items. To perform the analysis, the Cronbach's Alpha co-efficient was used to calculate the internal consistency of the survey items. Internal consistency is used to measure the extent to which survey items measure the same concept or construct in a survey, thus the test analyses the inter-relatedness of survey items (Tavakol & Dennick, 2011).

In their article Tavakol and Dennick (2011), like many other studies, alluded to the fact that there is still no concensus among researchers on the accpetable value of alpha co-efficients.

That said alpha co-efficients ranges from a maximun of 0.90 for strong relations between items to 0.10 which indicates poor or no relation. Other studies provide the following rule of thumb, 0.9 = Excellent, ≥ 0.80 – Good, ≥ 0.70 – Acceptable, ≥ 0.60 – Questionable, ≥ .5 – Poor, and ≤ .5 – Unacceptable (Gliem & Gliem, 2003).

To compute the Cronbach's Alpha co-efficients, survey items were grouped into the four independent variables categories below:

- Network Bandwidth Pricing (current)
- Network infrastructure Availability
- Network infrastructure performance
- Network Security

The third test performed was the test of association and correlation. According to Labuschagne, (2011) a relationship between variables refers to a correlation between them. In these relationships of variables, there might be instances where one variable causes the other, which is called a causal relationship. On the other hand, there are simple relationships where there is no causality. Three main patterns that can be observed in relationship are, no relationship, negative relationship and positive relationship (Labuschagne, 2011).

A statistical test that is normally used in determining relationship between variables is called correlation co-efficient. The co-efficients range between -1.00 and +1.00, which indicates the degree of linear relationship between variables. A co-efficient of -1.00 or +1.00 indicates a strong relationship, while co-efficient of 0.00 indicates no relationship between variables as cited by Labuschagne, (2011).

Multicollinearity is normally indicated by correlations that are very close to 1.000. Though, a correlation of 0.80 is good, correlations over 0.90 are undesirable. They might be problematic or make estimation difficult. (Albright, Wiston, & Zappe, 2009). For this study, a Spearman correlation technique which is best suited for ordinal and ranked data was used.

To prepare the data for hypothesis testing, the fourth analysis performed was the factor analysis. The aim of factor analysis is to allow the researcher to describe a large number of variables using a smaller composite variable (Diamatopoulos & Schlegelmilch, 2000). The four independent variables above were represented by about three to five survey items, it was therefore necessary to group these items to make one or two items that can be used to represent each variable. Although large sample sizes are recommended for factor analysis, Ross (2010) argued that there was no agreement among researchers on the minimum

sample size. She further argued that a number of subjects must be at least five to ten times the number of variables. Clearly there is no consensus on a correct method.

There are two types of factor analysis, namely the common factor analysis (CFA) and the Principal Components Analysis (PCA). For this study PCA was selected. Diamatopoulos and Schlegelmilch, (2000) explain PCA as a factor analysis method which focuses on total variation of the data set and seeks to reduce the original set of variables into smaller manageable composite variables for further analysis.

Components with low correlation co-efficients were discarded from further analyses. The rotation method used for the PCA was Viramax. SPSS help function defines Viramax as “an orthogonal rotation method that minimizes the number of variables that have high loadings on each factor”. This method simplifies the interpretation of the factors. The components derived from the factor analysis were then re-tested for validity, using the Cronbach’s Alpha co-efficient analysis as done above.

The last section of the analysis was the inferential statistics. In cases where analysis is performed through estimation or hypothesis testing, a sample is used and analysed through different techniques to make inferences about the population. This phenomenon is called inferential statistics (Diamatopoulos & Schlegelmilch, 2000). The test performed in this section was the hypothesis testing using the subsets of the components derived from the factor analysis. The survey item with the highest correlation co-efficient was selected for hypothesis testing using the Chi-square Test of Independence.

In these tests the relationship between the items representing the dependent variable were evaluated against items representing the independent variables. Chi-squares were evaluated using the p-value or sig as presented by SPSS. The p-values range between 0.00 and +0.10, which indicates the degree of acceptability of the hypothesis. The following criteria was used as guidance to reject or accept the null hypothesis, ≤ 0.01 = convincing, ≤ 0.05 – Strong, $\geq 0.05 \leq 0.10$ – Moderate, ≥ 0.10 – weak or none (Albright, Wiston, & Zappe, 2009). Any p-value result over 0.10 would lead to the null hypothesis accepted.

4.8 Research Limitations

The following limitations have been identified given the time and budgetary constraints:

- The selected sample might exclude some of the major cloud adopters who could be of value to this study.
- Due to the unavailability nature of people in leadership positions, the study did not receive overwhelming response, to the researcher's dissatisfaction. That said, the study managed to attract at least a normal distribution of n>30.
- Given the statement above, the study is prone to non-repose biases
- The study only focused on large companies in South Africa
- This study was limited to cloud users not the providers
- The aim of the study was to assess Cloud Computing from a firm's point of view, although individuals (IT leadership) were assessed.
- Generalising of the results may not be extended to developed markets due to difference in context, which is why this study was conducted.

4.9 Conclusion

This chapter outlined the research methodology that was used for the study. The sub-topics covered in this chapter included the method and the design the study used. Subsequently the population, sampling, data collection method, the instrument used and comprehensive outline of data analysis were described in preparation for results interpretation in the next chapter. There were 56 usable responses captured for this study, covering a wide spectrum of IT leaders and industries across South Africa. In Chapter 5 the empirical results are illustrated to answer the research questions.

5 Chapter 5 Results

5.1 Introduction

This chapter presents the results of the data collected for the research. The data as indicated in chapter four was collected through a survey questionnaire administered to the respondents electronically via the Surveymonkey website. The results were gathered using the following statistical tests:

- Response Rate
- Frequency Statistics
- Test of association and correlation
- Factor Analysis
- Internal Consistency (Reliability)
- Chi-square

To fully comprehend the logic and the process of the statistical tests above, it would be ideal for the reader to frequently revisit section 4.7, wherein a thorough explanation is given.

5.2 Response rate

The quality indicator of any survey depends largely on the response rate and. Zikmund, (2003) indicated that, for any survey instrument to be judged fairly, the response rate must be determined. For this study, out of a hundred and twenty eight (128) invitations sent for participation, fifty five (55) participants responded, this translates to a total of 46% response rate. The following formula was used to calculate the response:

Figure 5.1: Response Rate

$$\text{Response Rate} = \frac{\text{Number of Respondents}}{\text{Sample population} - (\text{ineligible} + \text{unreachable})} \times 100$$

$$= \frac{55}{128 - 8} \times 100$$

$$= 46\%$$

Eight of the respondents abandoned the survey, having answered fewer than 10 questions, and therefore their incomplete observations were removed from the statistical analysis. The

majority of observations were answered fully; others had missing data in some questions. The relevant interventions were applied as outlined at the beginning of section 4.7 above.

5.3 Frequency Statistics

This section covers frequency statistics gathered from the respondents. The statistics information starts from section B of the questionnaire through to Section D. The results were displayed in frequency tables. These tables listed the number of observations of variables in various categories (Albright, Wiston, & Zappe, 2009).

5.3.1 Summary representation of the sample

Section B of the survey included the demographic profile of the respondents, detailing information regarding the respondent's company size in term of users, job title and the industry type. Below are the frequency results per question, including the cross-tabulation of three main questions from the communication network part of the survey (Section D). Effectively, all the Section A demographics questions were cross-tabulated with the following three questions:

- Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services
- I would feel comfortable recommending Cloud Computing to my organisation
- Bandwidth is a significant/important variable when considering putting services on the Cloud / Internet

The responses to the three questions were aggregated into Disagree, Neutral and Agree, as opposed to the original 5 point Likert scale response. This was simply done by adding agree and strongly agree responses together, the same applied to disagree and strongly disagree. These were done primarily for summarization purposes. Graphic representations of the demographic frequencies tables are available in Appendix D.

Size of the organisation

To determine the size of the organisation, respondents were asked to give information regarding the number of users they support. The results were as per table 5.1 below:

Table 5.1: Firm Size by number of users

Options	Frequency	Percent %	Valid Percent %	Cumulative Percent %
5000 or more users	18	32.7	32.7	32.7
1000 to less than 5000 users	15	27.3	27.3	60.0
50 to less than 500 users	9	16.4	16.4	76.4
500 to less than 1000 users	9	16.4	16.4	92.8
Less than 50 users	4	7.3	7.3	100.0
Total	55	100.0	100.0	

The survey respondents came from a diverse group of companies. Approximately 60% of the respondents were from large companies, supporting 1000 users and above. Conversely about 7.3% came from companies with a very small number of users. As stated earlier, the study was targeting mainly organisations with CIOs, which should be fairly large organisations. However, companies with a smaller user base could have CIOs for strategic reasons

Table 5.2 below is the cross-tabulation analysis of the size of the company, using the number of users versus some of the main questions of the communication network section of the survey. The results indicate that on average, the majority of the respondents agreed that bandwidth prices might increase the costs of Cloud Computing, except in organisations with between 500 and 1000 users.

The table further shows that the majority of respondents felt that bandwidth is a significant variable when considering Cloud Computing. Most respondents from different company sizes felt strongly about recommending Cloud Computing to their organisations

Table 5.2: Cross-tabulation: Number of Users, Price, cloud & bandwidth?

Cross Tab		Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services.			I would feel comfortable recommending Cloud Computing to my organisation.			Bandwidth is a significant/important variable when considering putting services on the Cloud / Internet.		
		Disagree	**Neutral**	**Agree**	**Disagree**	**Neutral**	**Agree**	**Disagree**	**Neutral**	**Agree**
How many years of experience do you have in IT leadership (Decision Making)	Less than 50 users	0.0%	25.0%	75.0%	**0.0%**	**0.0%**	**100.0%**	0%	-	100%
	50 to less than 500 users	11.1%	33.3%	55.6%	**11.1%**	**11.1%**	**77.8%**	0%	-	100%
	500 to less than 1000 users	11.1%	44.4%	44.4%	**11.1%**	**11.1%**	**77.8%**	0%	-	100%
	1000 to less than 5000 users	6.7%	26.7%	66.7%	**13.3%**	**13.3%**	**73.3%**	6.7%	-	93.3%
	5000 or more users	11.1%	11.1%	77.8%	**0.0%**	**16.7%**	**83.3%**	5.9%	-	94.1%

Experience in IT management

Respondents were asked how many years of IT leadership experience they had. Refer to Table 5.3 for leadership experience frequencies of the respondents.

Table 5.3: IT leadership (Decision Making) experience

Options	Frequency	Percent %	Valid Percent %	Cumulative Percent %
10 years +	29	52.7	52.7	100.0
5 to 9 years	19	32.7	32.7	47.3
1 to 4 years	5	9.1	9.1	14.5
None	3	5.5	5.5	5.5
Total	55	100.0	100.0	

More than three quarters of the respondents had experience in IT leadership. Approximately 10% of the respondents had limited IT decision making experience. 84% of the respondents had over five years of experience, whilst 6% of the respondents were surprisingly inexperienced in IT decision making. To compare the respondents' responses in relation to other questions, refer to Table 5.4 below

Table 5.4:Cross-tabulation: Experience, Price, cloud & bandwidth?

Cross Tab		Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services.			I would feel comfortable recommending Cloud Computing to my organisation.			Bandwidth is a significant/important variable when considering putting services on the Cloud / Internet.		
		Disagree	**Neutral**	**Agree**	**Disagree**	**Neutral**	**Agree**	**Disagree**	**Neutral**	**Agree**
How many years of experience do you have in IT leadership (Decision Making)	None	0.0%	33.3%	66.7%	**0.0%**	**33.3%**	**66.7%**	0%	-	100%
	1 - 4 yrs	0.0%	20.0%	80.0%	**0.0%**	**20.0%**	**80.0%**	0%	-	100%
	5 - 9 yrs	11.1%	27.8%	61.1%	**5.6%**	**11.1%**	**83.3%**	5.9%	-	94.1%
	10 + yrs	10.3%	24.1%	65.5%	**10.3%**	**10.3%**	**79.3%**	3.4%	-	96.6%

The results of the cross-tabulations above shows that, the majority of the respondents across different years of experience overwhelmingly agreed with a statement that said bandwidth pricing in SA might erode the cost effectiveness of Cloud Computing services. The respondents further agreed with the other two questions/ statements made. That said, there was a significant number of respondents who opted to be neutral, which might signify lack of understanding or limited knowledge in how Cloud Computing could benefit their organisations. The last question regarding bandwidth being a significant/important variable, there were no neutral respondents, with most respondents agreeing.

Job title of the respondents

The respondents were asked to indicate their job titles; the primary reason for this question was to ensure that respondents were IT decision makers. Furthermore, this question gives credibility to the study, with regards to the ordinance type. The Table 5.5 gives a summary of the job title profile as follows:

The results indicate that the study covered a majority of respondents in IT leadership as expected, with 42% of the respondents being CIOs. Over three quarters of the respondents were in IT leadership of some sort. From the experience gained from email responses from CIOs, some opted to delegate the response to the survey to other members of their team, for instance most CIOs forwarded the survey to their IT infrastructure or strategy directors.

Table 5.5: Job title?

Options	Frequency No#	Percent %	Valid Percent %	Cumulative Percent %
Chief Information Officer	23	42.0	42.0	42.0
IT Manager	14	25.0	25.0	67.0
IT Director	9	16.0	16.0	84.0
Chief IT Architect	3	5.0	5.0	89.0
Chief Technology Officer	2	4.0	4.0	93.0
Snr Specialists	3	5.0	5.0	98
IT Project Manager	1	2.0	2.0	100.0
Total	55	100.0	100.0	

From a cross-tabulation viewpoint in Table 5.6 below, 60% of the respondents comprising CIO and IT managers significantly felt that bandwidth cost might erode the cost effectiveness of Cloud Computing. They further would feel comfortable recommending Cloud Computing to their organisation. Lastly, less than one tenth of the respondents across all job title types felt that bandwidth is an insignificant variable to consider for Cloud Computing.

Table 5.6: Cross-tabulation: Job type, Price, cloud & bandwidth?

Cross Tab		Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services.			I would feel comfortable recommending Cloud Computing to my organisation.			Bandwidth is a significant/important variable when considering putting services on the Cloud / Internet.		
		Disagree	Neutral	Agree	Disagree	Neutral	Agree	Disagree	Neutral	Agree
What best describes your job title?	Chief Information Officer	9.1%	22.7%	68.2%	0.0%	9.1%	90.9%	4.5%	-	95.5%
	IT Manager	0.0%	44.4%	55.6%	11.0%	22.2%	66.7%	0.0%	-	100.0%
	IT Director	0.0%	20.0%	80.0%	20.0%	20.0%	60.0%	0.0%	-	100.0%
	Chief IT Architect	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%	0.0%	-	100.0%
	Chief Technology Officer	50.0%	0.0%	50.0%	0.0%	0.0%	100.0%	0.0%	-	100.0%
	Snr Specialist	33.3%	0.0%	66.7%	0.0%	0.0%	100.0%	0.0%	-	100.0%

Industry

Although the study targeted organisations across all industries, Table 5.7 below indicates that the majority of respondents were IT leaders from government departments or Financial services at 16.4%, followed by Wholesale & retail services at 13%. Comparing the response rate when cross-tabulated with other questions, Table 5.8 shows that most respondents felt that bandwidth cost might erode the cost effectiveness of Cloud Computing. Furthermore, an

overwhelming number of respondents would recommend Cloud Computing to their organisations and felt that bandwidth is a significant variable in Internet or cloud services.

Table 5.7: What is the primary industry or activity of your organisation?

Options	Frequency	Percent %	Valid Percent %	Cumulative Percentage %
Financial Services/Banking	**9**	**16.4**	**16.4**	**16.4**
Government	**9**	**16.4**	**16.4**	**32.8**
Wholesale and retail trade	7	12.7	12.7	45.5
IT Services	4	7.3	7.3	52.8
Manufacturing (Non-IT)	4	7.3	7.3	60.1
Mining and quarrying	3	5.5	5.5	65.6
Professional, technical, and Business Services (Non-IT)	2	3.6	3.6	69.2
Telecommunications	2	3.6	3.6	72.8
Travel/Leisure/Hospitality	2	3.6	3.6	76.4
Education	1	1.8	1.8	78.2
Health Care	1	1.8	1.8	80
IT Manufacturing	1	1.8	1.8	81.8
Real Estate	1	1.8	1.8	83.6
Other	9	16.4	16.4	100
Total	55	100.0	100.0	

Table 5.8: Cross-tabulation: Industry type, Price, cloud & bandwidth?

Cross Tab		Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services.			I would feel comfortable recommending Cloud Computing to my organisation.			Bandwidth is a significant/important variable when considering putting services on the Cloud / Internet.		
		Disagree	Neutral	Agree	Disagree	Neutral	Agree	Disagree	Neutral	Agree
What best describes your job title?	Other	22.2%	33.3%	44.4%	0.0%	0.0%	100.0%	11.9%	-	88.1%
	Education	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%	0.0%	-	100.0%
	Electricity, gas & water supply	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%	0.0%	-	100.0%
	Financial Services/Banking	0.0%	0.0%	100.0%	14.3%	0.0%	85.7%	0.0%	-	100.0%
	Government	0.0%	33.3%	66.7%	0.0%	22.2%	77.8%	11.1%	-	88.9%
	Health Care	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%	0.0%	-	100.0%
	IT Manufacturing	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%	0.0%	-	100.0%
	IT Services	0.0%	50.0%	50.0%	25.0%	0.0%	75.0%	0.0%	-	100.0%
	Manufacturing (Non-IT)	0.0%	25.0%	75.0%	0.0%	50.0%	50.0%	0.0%	-	100.0%
	Professional, technical, and Business Services (Non-IT)	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%	0.0%	-	100.0%
	Mining and quarrying	0.0%	0.0%	100.0%	50.0%	0.0%	50.0%	0.0%	-	100.0%
	Telecommunications	50.0%	0.0%	50.0%	0.0%	0.0%	100.0%	0.0%	-	100.0%
	Travel/Leisure/ Hospitality	0.0%	50.0%	50.0%	0.0%	25.0%	75.0%	0.0%	-	100.0%
	Wholesale and retail trade	28.6%	14.3%	57.1%	0.0%	12.5%	87.5%	0.0%	-	100.0%

5.3.2 Experience with Cloud Computing

The respondents were asked if their respective companies have implemented Cloud Computing. Table 5.9 below gives a summary of their responses, where 49% has already implemented Cloud Computing. On the hand, 26% of the respondents are planning to adopt the technology. Table 5.10 summarises the duration in which the respondents plan to adopt cloud. This is an indication that over 74% of the respondents have some knowledge or experience of Cloud Computing.

Table 5.9: Has your company implemented Cloud Computing

Options	Frequency	Percent %	Valid Percent %	Cumulative Percent %
Thinking about it, planning to adopt in the next _____ year/s	14	25.5	25.5	25.5
No	14	25.5	25.5	50.9
Yes	**27**	**49.1**	**49.1**	**100.0**
Total	55	100.0		

Table 5.10: Thinking about it, planning to adopt in the next _____ years (number of years)

Options	Frequency	Percent %	Valid Percent %	Cumulative Percent %
Yes/No/	41	74.0	74.0	74.0
1	5	10.0	10.0	84.0
2	3	6.0	6.0	90.0
3	3	6.0	6.0	96.0
4	1	2.0	2.0	98.0
Partially implemented - 6 months	2	2.0	2.0	100.0
Total	55	100.0	100.0	

The respondents were asked if they believed Cloud Computing will reduce their IT costs, Table 5.11 indicates that the majority of respondents at 74% felt that Cloud Computing will reduce their cost. This is consistent with the 74% respondents who are pro Cloud Computing deduced from the results given in Table 5.9 and 10 above.

Table 5.11: Do you generally believe Cloud Computing will reduce your overall IT costs?

Options	Frequency	Percent %	Valid Percent %	Cumulative Percent %
Yes	**39**	**70.9**	**70.9**	**70.9**
No	16	29.1	29.1	100.0
Total	55	100.0	100.1	

5.3.3 Cloud Communication Network Factors

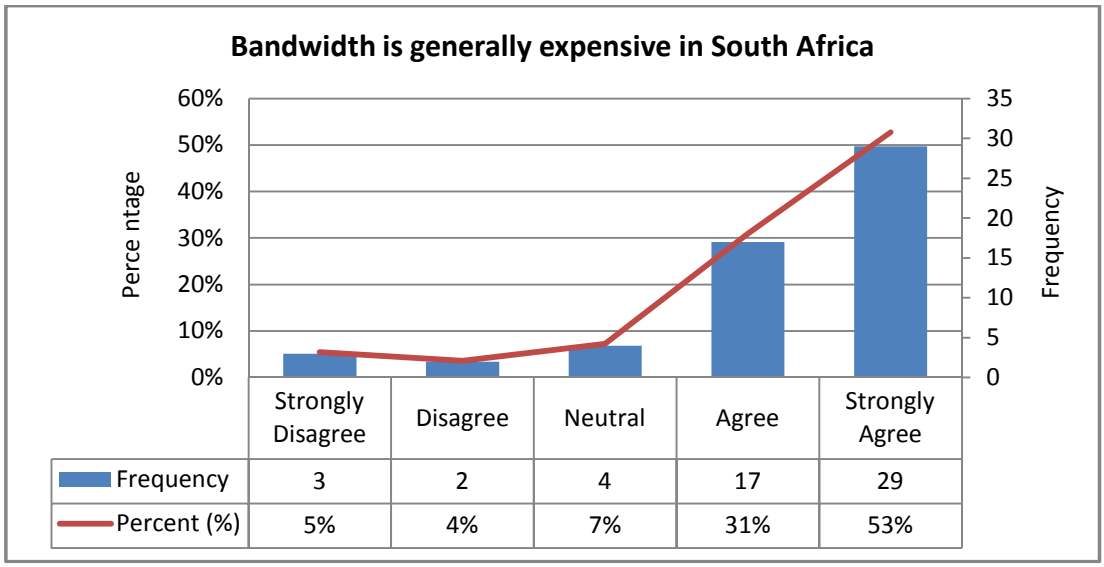
In this section, two questions were worded in a negative manner. Question 16 which asked the respondents if they normally experience network connectivity issues between their office branches and question 27 asking the if Cloud Computing communication networks were not secure three years ago. These two questions were re-coded to ensure that the results would be in reverse and the results would not yield negative correlations. The negative correlation was discovered in the original reliability test using Cronbach's Alpha analysis. More details will be discussed in the questionnaire reliability section below. The next section discusses the results of each network factor.

Price

Five questions were used to determine if communications networks prices had a significant influence on the decision of IT leaders to recommend Cloud Computing. The results were as follows:

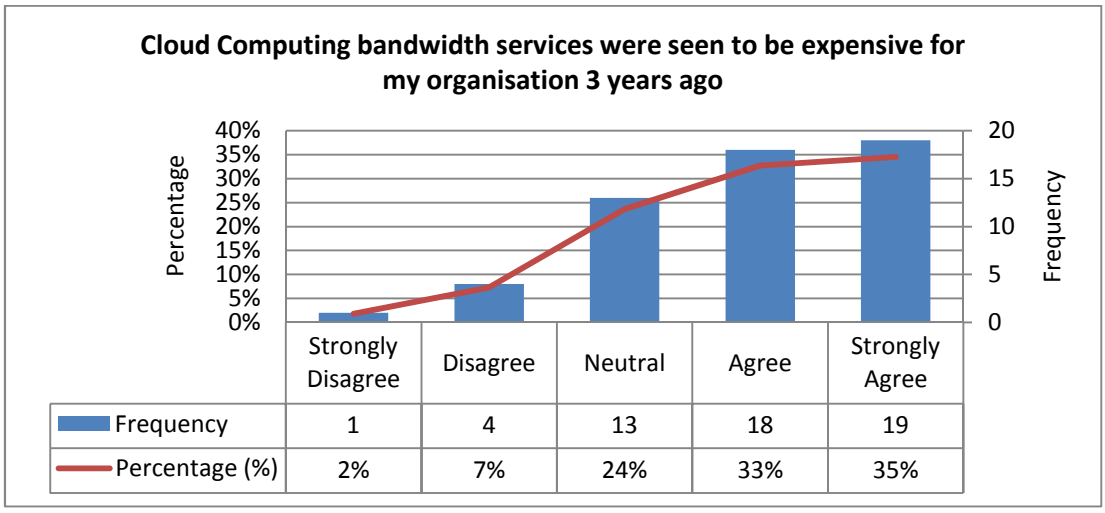
Firstly, the respondents were asked if they believed bandwidth or communication network prices were generally expensive in South Africa. Figure 5.2 below indicates that 84% of the respondents overwhelmingly believed that bandwidth is generally expensive in South Africa.

Figure 5.2 : Bandwidth Price



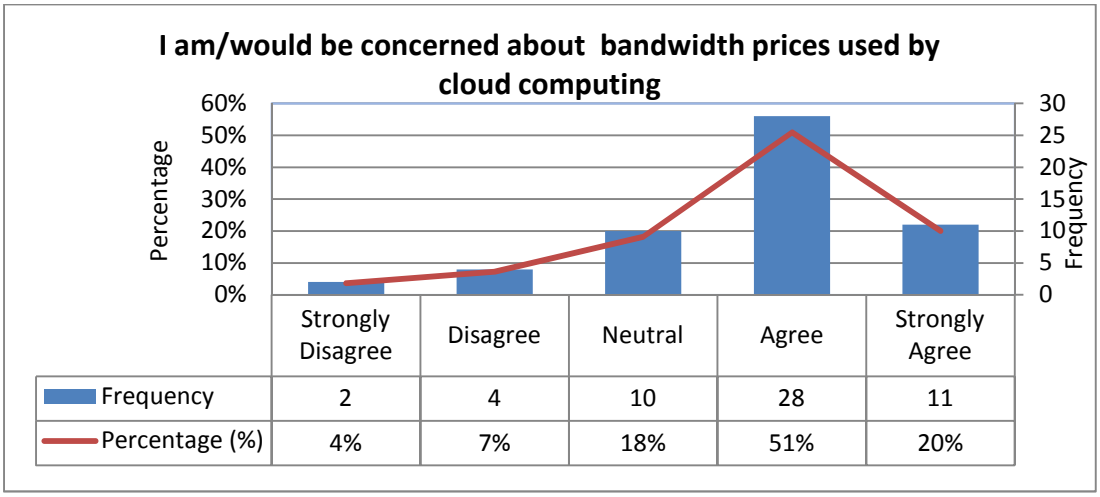
Secondly, the respondents were asked if they believed bandwidth or communication network prices were expensive three years ago. Figure 5.3 below indicates that 68% of the respondents believed that Cloud Computing bandwidth was expensive 3 years ago.

Figure 5.3 : Bandwidth Price 3 years ago



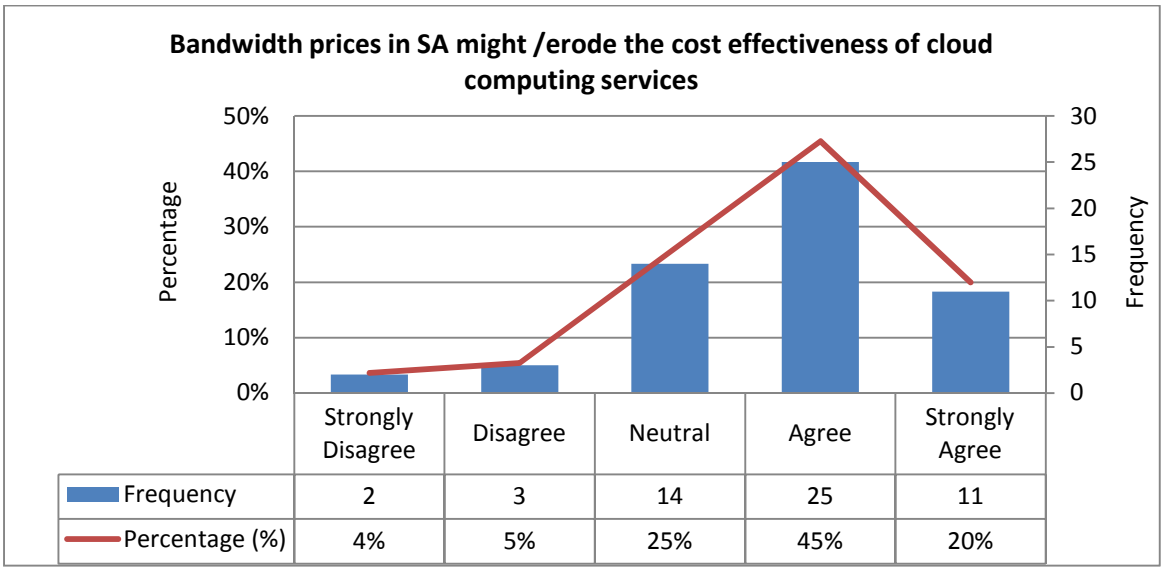
Thirdly, the respondents were asked if they would be concerned about bandwidth prices used by Cloud Computing technology. Figure 5.4 below indicates that 71% of the respondents would be concerned about Cloud Computing bandwidth prices.

Figure 5.4 : Concerns with bandwidth pricing



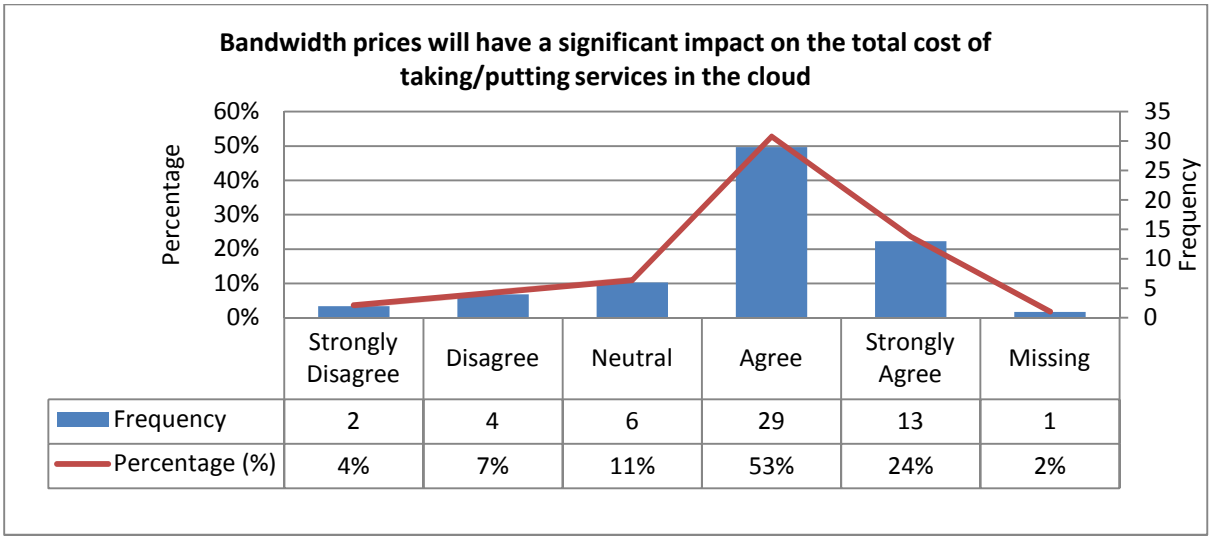
Fourthly, the respondents were asked if bandwidth prices might erode the cost effectiveness of Cloud Computing. Figure 5.5 below indicates that 65% of the respondents believed that communication network prices will or might erode the cost effectiveness of Cloud services.

Figure 5.5 : Bandwidth prices eroding cost effectiveness of Cloud services



Lastly, the respondents were asked if Bandwidth prices will have a significant impact on the total cost of taking/putting services in the cloud. Figure 5.6 below indicates that 77% of the respondents believed that communication network prices will have a significant impact in the total cost of deploying their services on the Cloud.

Figure 5.6 : Bandwidth prices impacting total cost of Cloud services



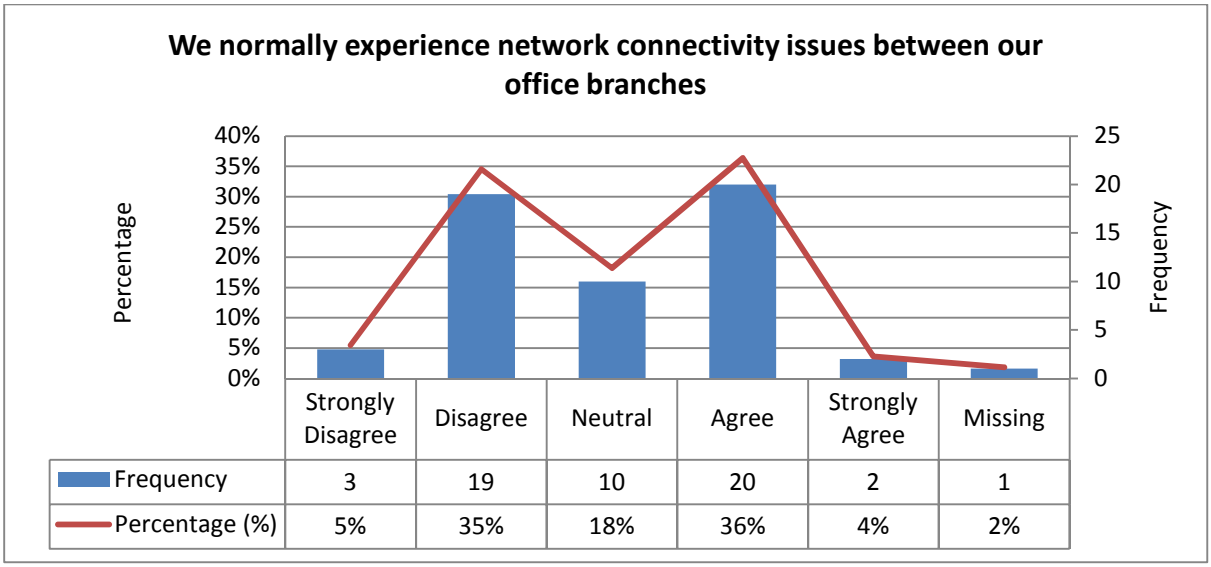
In Summary, bandwidth or the communication network seem to be a significant variable to consider judging from the responses of participants. In all questions the majority of the respondents consistently agreed or strongly agreed with each survey item.

Reliability

In this section of the questionnaire, four questions were asked to test if bandwidth or communication networks are reliable in South Africa. Below are the questions relating to this construct.

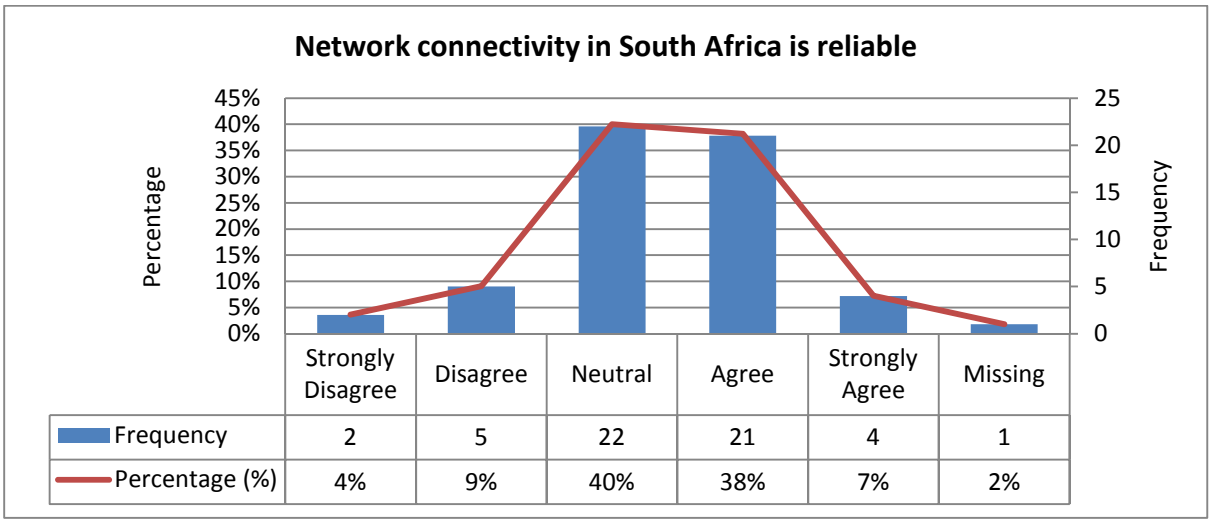
The respondents were asked if they normally experience connectivity issues between their branch offices. Figure 5.7 below indicates that only 40% of the respondents indicated having connectivity problems between their offices. Another 40% of the respondents were not experiencing connectivity problems between branches. Of the remainder of the respondents, 18% opted for neutrality on this question.

Figure 5.7 : Bandwidth or network connectivity issues



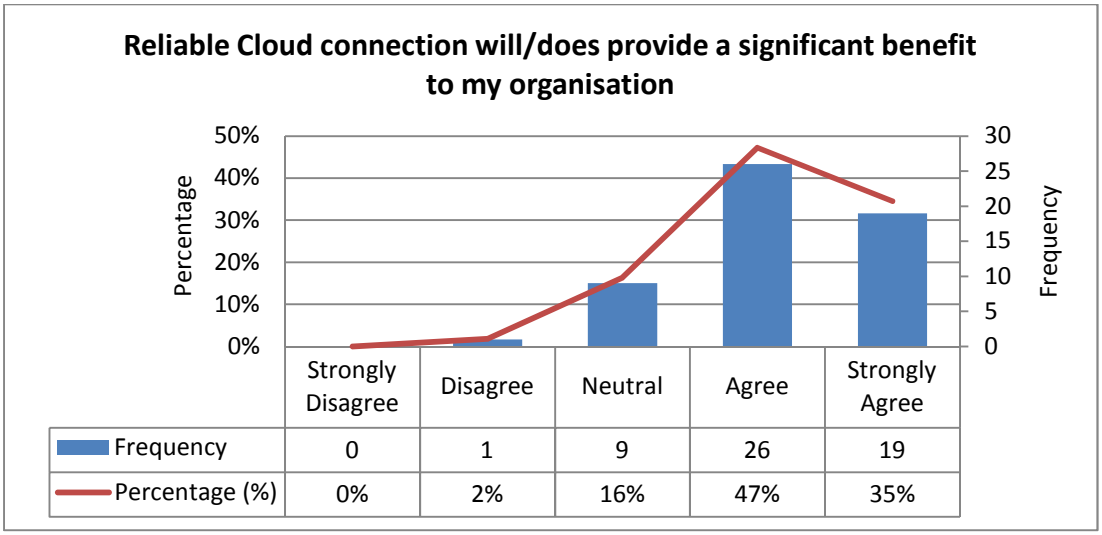
The next question on reliability, respondents were asked if network connectivity was reliable. Figure 5.8 below indicates that 45% of the respondents believed that communication networks were reliable. However, a worrying 40% of the respondents opted to be neutral and a mere 13% disagreed.

Figure 5.8 : Network connectivity in South Africa is reliable



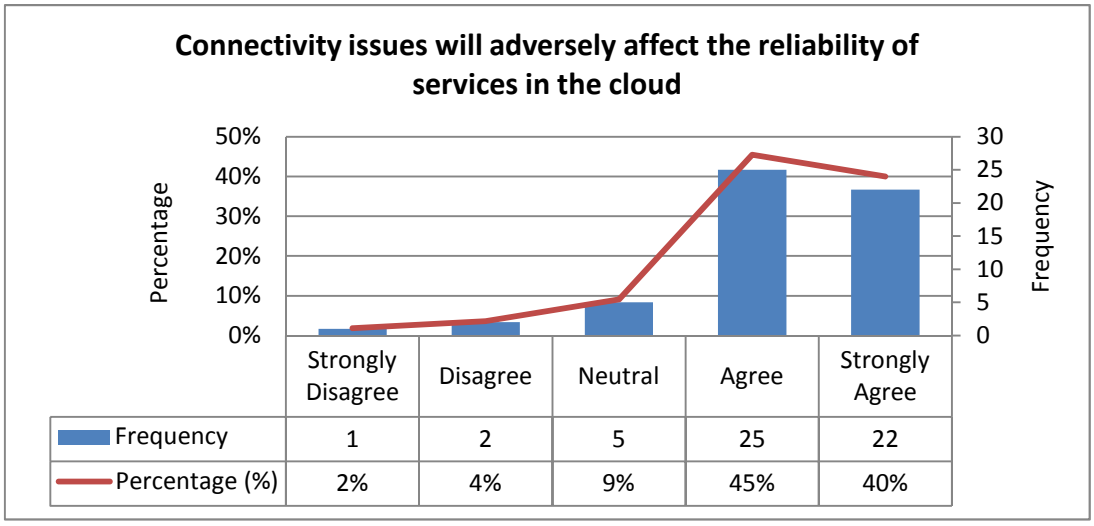
For the third question, respondents were asked if reliable Cloud connection provided a significant benefit to their organisations. Figure 5.9 below indicates that the majority of respondents at 82% believed reliable Cloud connections will provide a significant benefit to their organisation. None of the respondents were in disagreement. 16% of the respondents opted to be neutral.

Figure 5.9 Cloud connection provide significant benefit to organizations



Lastly in this section, respondents were asked if network connectivity issues will affect the reliability of Cloud services. An overwhelming 85% of the respondents agreed that connectivity issues will affect the reliability of Cloud services. About 15% of the respondents either disagreed or were neutral. Figure 5.10 below summarises the results.

Figure 5.10 Connectivity issues will adversely affect the reliability of services in the cloud



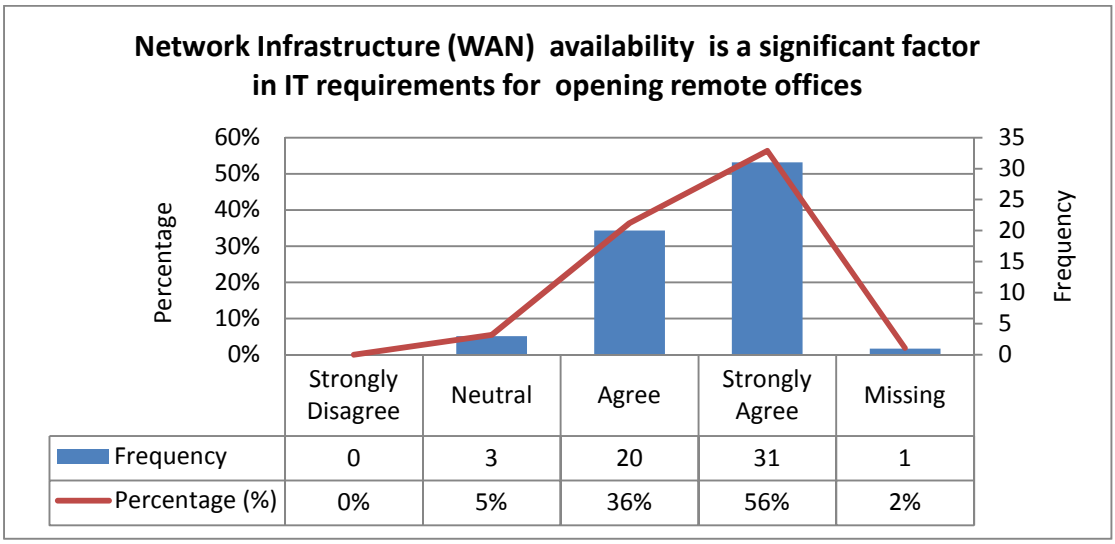
The four tables above Table 5.7, 5.8, 5.9 and 5.10 did not show consistent answering of questions. However, Tables 5.9 and 5.10 show similar trends in the way questions were answered. The results are generally skewed by participants opting to be neutral in most questions.

Availability

In this section, 4 questions were asked which assessed the availability of communications network infrastructure in areas where it is required by different businesses. The results follow below:

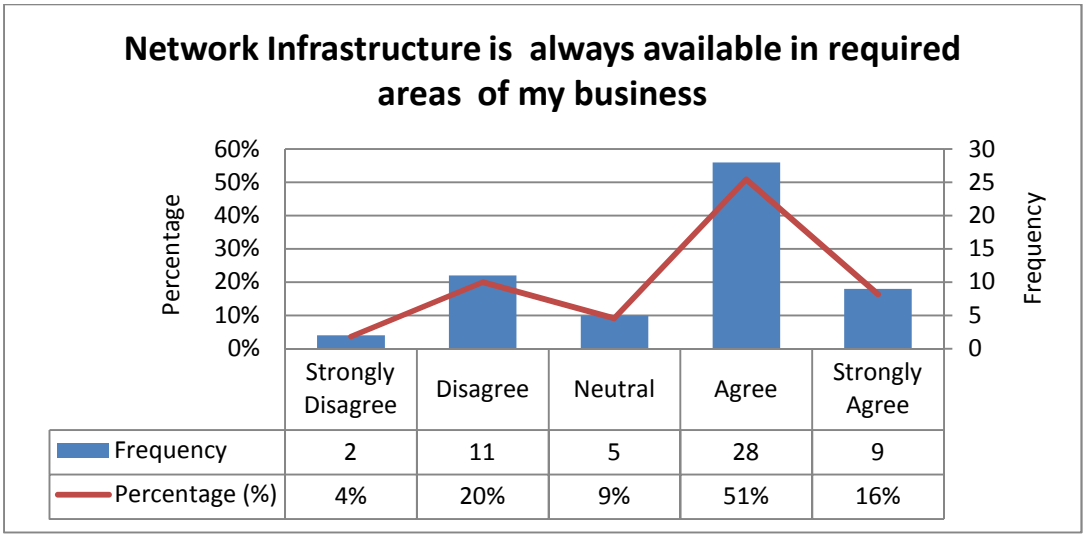
Respondents were asked if network infrastructure availability was a significant factor in IT's requirement to open new offices. Availability in this case does not refer to uptime, but it refers to infrastructure availability in different parts of the country. Figure 5.11 indicates that the majority of respondents at 92% felt that Network Infrastructure (WAN) availability is a significant factor in IT requirements for opening remote offices. None of the respondents disagreed.

Figure 5.11 : Significance of Network Infrastructure



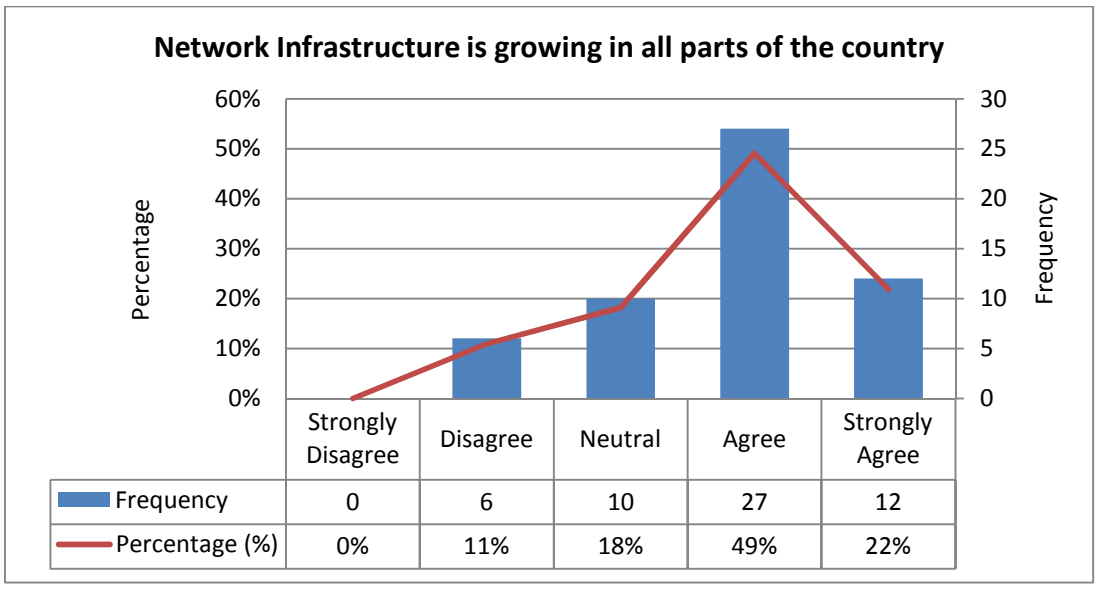
Respondents were asked if network infrastructure was always available in their required area of their businesses. Figure 5.12 indicates that the majority of respondents at 71% felt that Network Infrastructure coverage was adequate in most areas where it is required. However not all respondents were in agreement, 11% disagree and the rest were neutral.

Figure 5.12 : Network Infrastructure availability in all areas



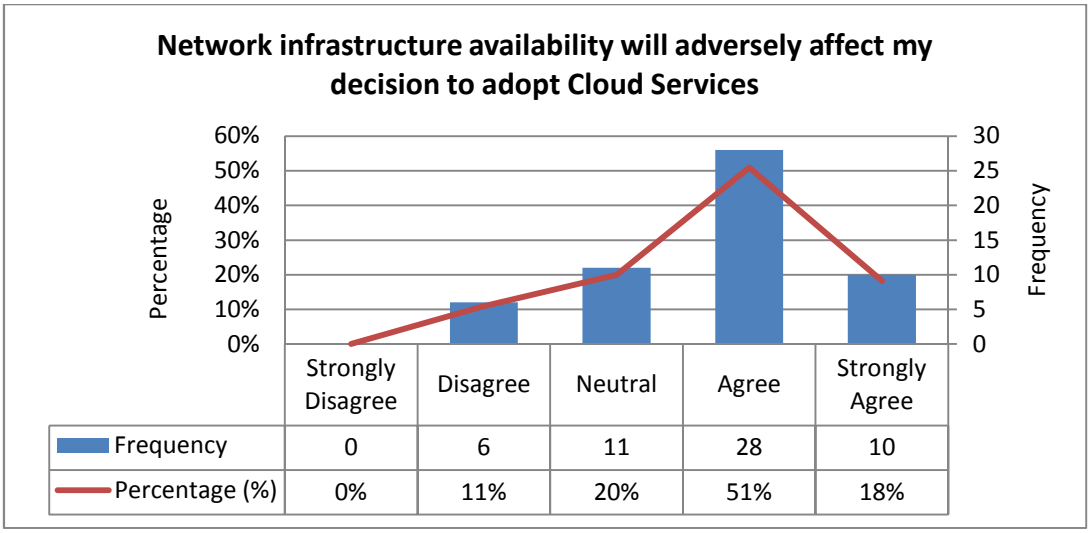
Respondents were asked if network infrastructure is growing in all parts of the country. Figure 5.13 indicates that the majority of respondents at 68% felt that Network Infrastructure coverage is growing country wide.

Figure 5.13 : Network Infrastructure growth country wide



Respondents were asked if network infrastructure availability will adversely affect their decision to adopt Cloud Services. Figure 5.14 indicates that 69% of respondent's decision to recommend Cloud Computing will be affected by infrastructure availability.

Figure 5.14 : Network Infrastructure availability effect on Cloud adoption



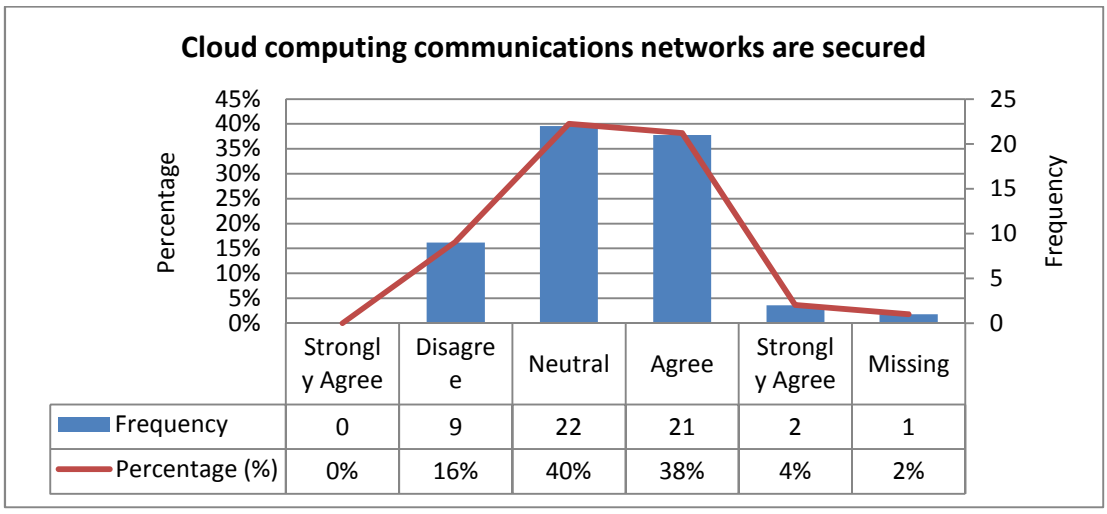
In summary, there seems to be clear consistency in the way the majority of respondents answered the questions. The majority in all questions either agreed or strongly agreed.

Security

The security section also comprised four questions, below are the results.

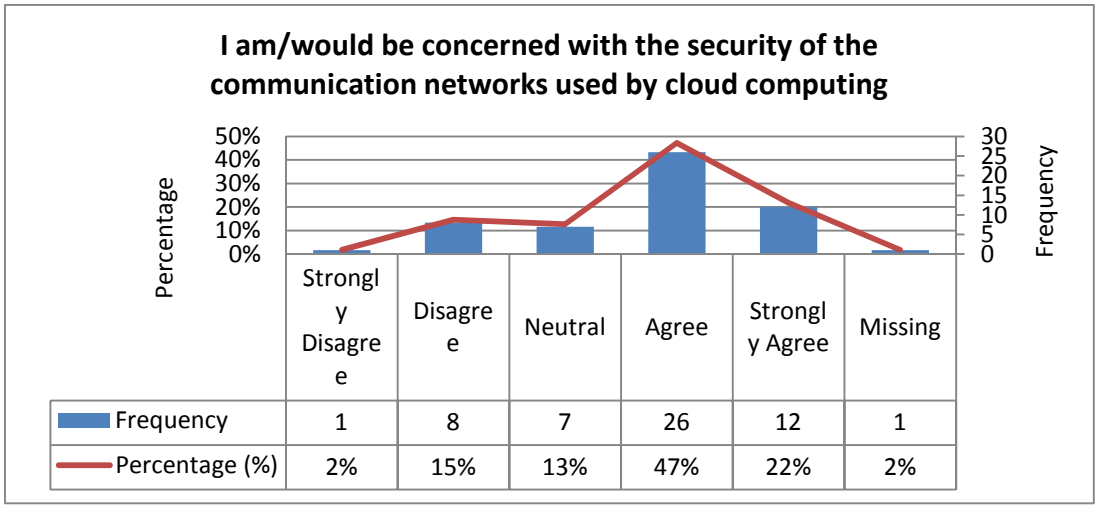
Respondents were asked if Cloud Computing networks were generally secured. Figure 5.15 indicates that a worrying 40% of respondents agreed that Cloud communication networks are secured. This is a clear indication of security being a serious concern for the respondents, with over half of them disagreeing or neutral.

Figure 5.15 : Security in the Cloud communication network



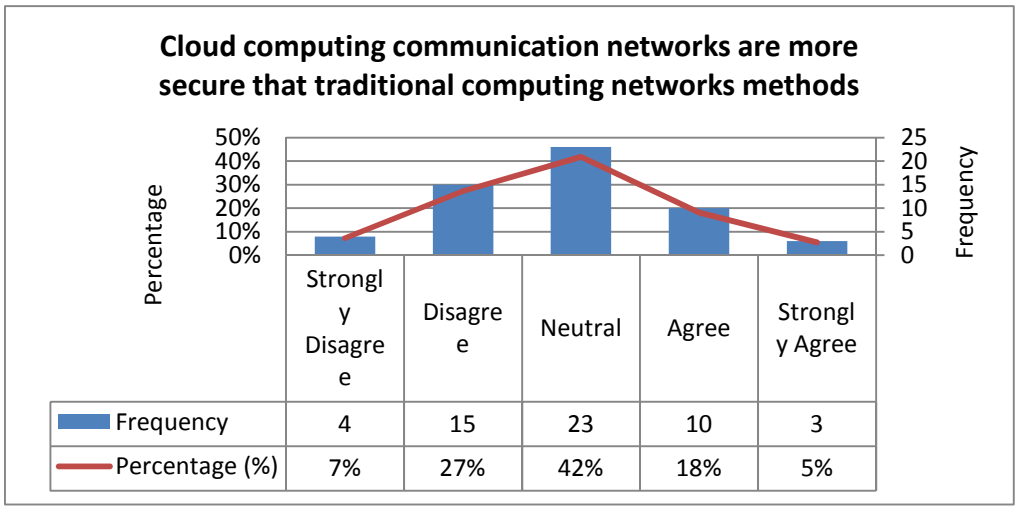
Similarly when the same question as above was asked differently, Figure 5.16 shows that the majority of the respondents at 70% were concerned with the security of the communication networks used by Cloud Computing.

Figure 5.16 : Concern with the security in the Cloud communication network



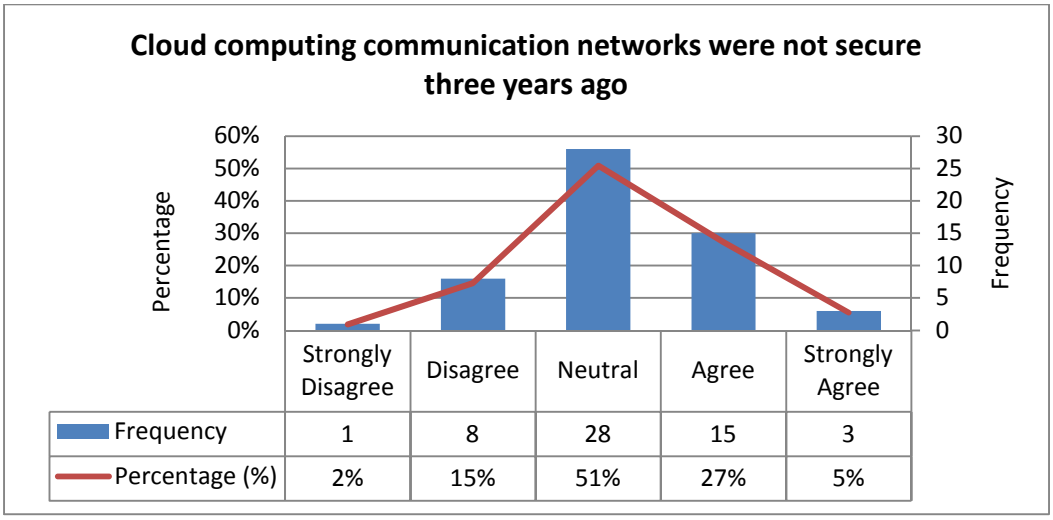
In the next question, the respondents were asked if Cloud Computing communication networks are more secure than traditional computing networks methods. Figure 5.17 indicates that most respondents were not certain whether security was more secured on the cloud compared to traditional networks, by opting to be neutral. Furthermore respondents who agreed with the notion were well in the minority.

Figure 5.17 : Cloud Computing Network Security vs. traditional computing security



Similarly, in the question about security improvements over the past three years, the majority of respondents at 46% opted to be neutral as depicted in Figure 5.18 below. This is an indication that security is almost a grey area in the view of most IT leaders. 34% of the respondents agreed that communication networks were not secured three years ago; therefore, there might have been some improvements over the years as the technology matures.

Figure 5.18 : Cloud Computing security three years ago



Cloud Attitude

This section comprised of three questions, the results follows below:

For the first question in this section of the questionnaire, respondents were asked if they would feel comfortable recommending Cloud Computing to their respective organisations. Figure 5.19 indicates that over three quarters (80%) of respondents would feel comfortable recommending Cloud Computing to their organisations.

Secondly, respondents were asked if they believed Cloud Computing uses proven technology. Figure 5.20 indicates that just over half at 60% of respondents feel that Cloud Computing uses proven technology. A worrying 38% of the respondents opted to be neutral.

Figure 5.19 : Comfort in recommending Cloud Computing

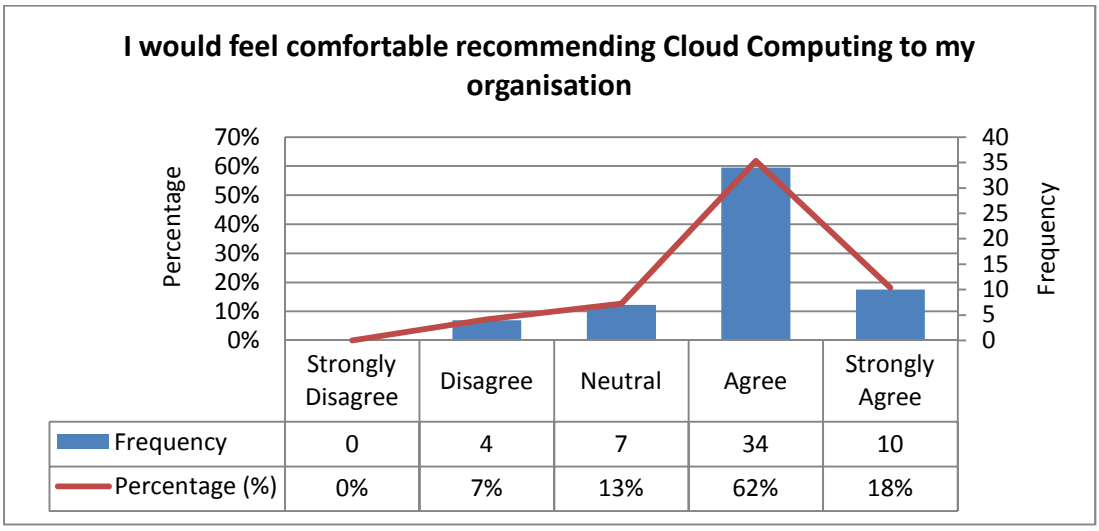
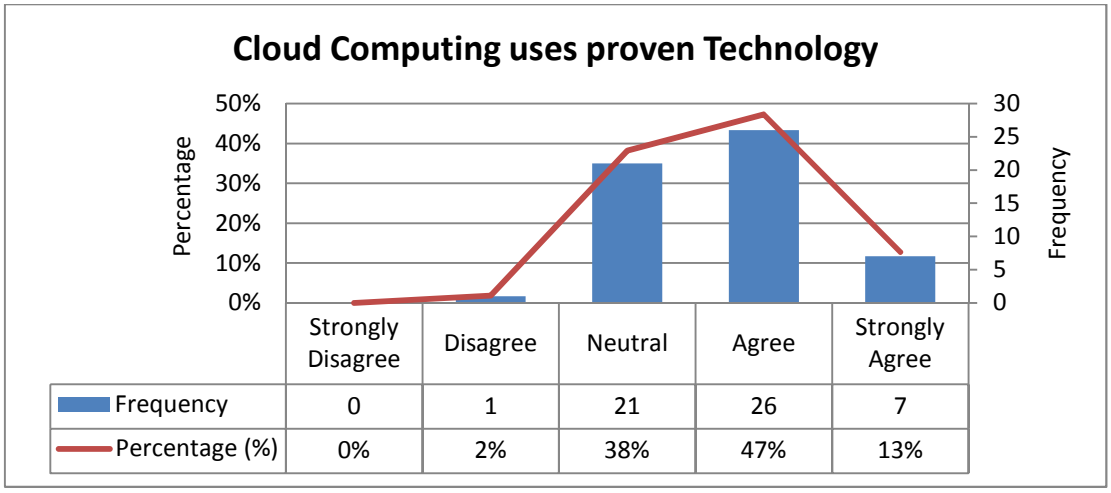
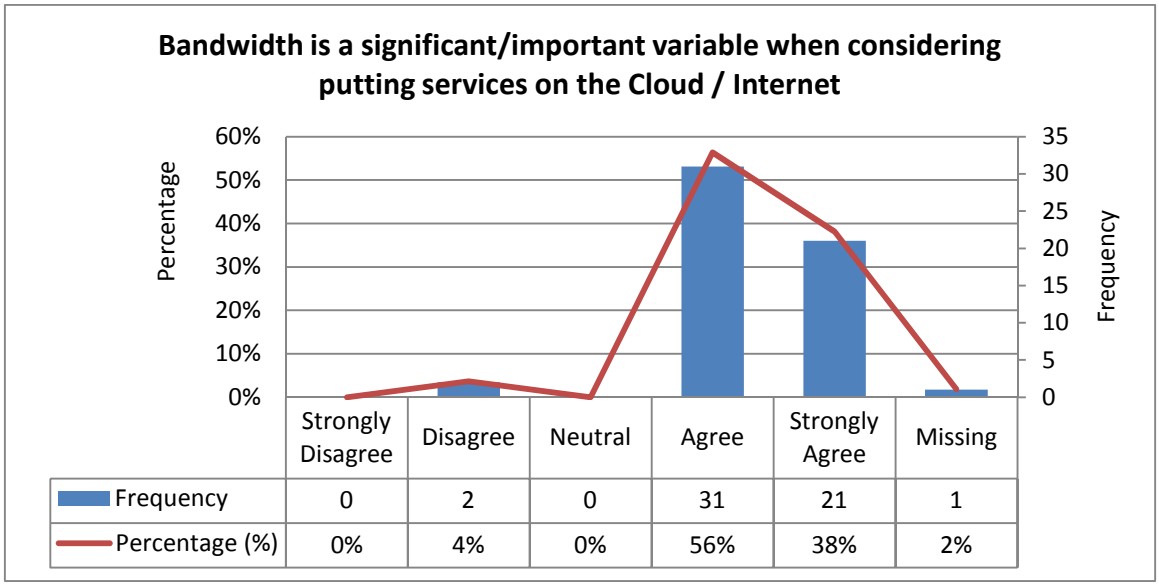


Figure 5.20 : Cloud Computing uses proven technology



On the last question of the questionnaire, the respondents were asked if they felt a Cloud Computing communication network was an important variable to consider when putting services on the Cloud. Figure 5.21 indicates that the majority of the respondents at 92% strongly agreed that a communication network was a significant variable to consider when putting services on the Cloud.

Figure 5.21 : Importance of communication network as an important variable



5.3.4 Correlation of all questions

Table 5.12 below gives an overview of all the main survey items correlated against each other. Examination of inter-correlation data indicates a mixed correlation between all items. That said, the matrix indicates that some items correlated ≥|0.40 with at least one other items in the table. The 0.40 plus correlations are highlighted on the figure. A general observation of the whole table shows that none of the survey items correlated highly.

None of the table items indicated any multicollinearity of items, particularly on survey items representing the independent variables. This therefore suggests that there might be reasonable factorability that could be applied to survey items. Furthermore the correlations result suggests that most survey items are relatively distinct conceptually and empirically.

Table 5.12: Correlation Matrix for all questions

	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
11	1.00																			
12	0.38	1.00																		
13	0.43	0.22	1.00																	
14	0.22	0.13	0.34	1.00																
15	0.26	0.44	0.461	0.51	1.00															
16	-0.02	0.17	0.12	0.24	0.23	1.00														
17	-0.08	-0.17	-0.19	-0.20	-0.10	-0.434	1.00													
18	-0.14	0.01	-0.08	0.12	0.32	0.11	0.05	1.00												
19	0.07	0.13	0.05	0.20	0.29	0.15	0.12	0.43	1.00											
20	-0.03	0.13	0.06	-0.01	0.14	0.07	-0.02	0.39	0.34	1.00										
21	-0.17	-0.06	-0.28	-0.07	-0.20	-0.22	0.33	0.12	-0.18	-0.15	1									
22	-0.37	-0.12	-0.06	0.12	-0.04	0.03	0.10	-0.05	-0.14	-0.04	0.37	1.00								
23	0.05	0.13	0.08	0.11	0.35	0.19	0.06	0.28	0.43	0.17	0.02	0.20	1.00							
24	-0.01	0.03	-0.10	-0.15	0.07	-0.32	0.29	0.45	0.15	0.28	0.45	-0.02	0.11	1.00						
25	-0.04	-0.03	0.15	0.09	0.02	0.45	-0.10	-0.13	0.02	0.06	-0.34	0.12	0.19	-0.41	1.00					
26	-0.17	-0.07	0.17	0.02	-0.07	-0.08	0.14	0.31	0.06	0.26	0.21	0.07	0.06	0.50	0.13	1.00				
27	0.04	0.03	-0.21	-0.02	-0.09	-0.03	0.08	0.14	-0.10	0.02	0.03	0.01	-0.25	-0.16	0.05	-0.31	1.00			
28	0.03	0.11	-0.05	0.01	0.03	0.04	-0.07	0.56	0.18	0.31	.31	0.16	0.21	0.50	-0.22	0.42	0.10	1.00		
29	0.02	-0.11	-0.19	0.08	0.18	0.03	0.12	0.54	-0.01	0.10	0.38	0.01	0.14	0.39	-0.20	0.14	0.27	0.42	1.00	
30	-0.03	0.28	0.16	0.11	0.19	0.21	-0.03	-0.09	0.06	0.01	-0.07	0.09	0.29	-0.05	0.15	0.1	-0.23	-0.01	-0.18	1.00

5.4 Factor Analysis

The study is structured into four independent variables namely, pricing, communication network availability, communication network reliability and network security. One variable represented the dependent variable of the study namely, adoption. Each of these variables is represented by three to four survey items or questions. The first test that was performed was the factor analysis commonalities. In this test, all survey items extractions were ≥ .3, which is a clear indication that each item shared some commonality with other items. This is in line with the inter-correlations test performed earlier where each item was at least ≥ 40. Table 5:13 outlines the commonalities. The reliability section below, gives further justification for factor analysis.

Table 5.13: Factor Analysis Communalities

Survey Item	Initial	Extraction
Bandwidth is generally expensive in South Africa	1.000	.614
Cloud Computing bandwidth services were seen to be expensive for my organisation 3 years ago	1.000	.767
I am/would be concerned about bandwidth prices used by Cloud Computing	1.000	.833
Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services	1.000	.822
Bandwidth prices will have a significant impact on the total cost of taking/putting services in the cloud	1.000	.796
We normally experience network connectivity issues between our office branches	1.000	.836
Network connectivity in South Africa is reliable	1.000	.801
Reliable Cloud connection will/does provide a significant benefit to my organisation	1.000	.804
Connectivity issues will adversely affect the reliability of services in the cloud	1.000	.744
Network Infrastructure (WAN) availability is a significant factor in IT requirements for opening remote offices	1.000	.717
Network Infrastructure is always available in required areas of my business	1.000	.813
Network Infrastructure is growing in all parts of the country	1.000	.820
Network infrastructure availability will adversely affect my decision to adopt Cloud Services	1.000	.827
Cloud Computing communications networks are secured	1.000	.727
I am/would be concerned with the security of the communication networks used by Cloud Computing	1.000	.866
Cloud Computing communication networks are more secure than traditional computing networks methods	1.000	.863
Cloud Computing communication networks were not secure three years ago	1.000	.894
I would feel comfortable recommending Cloud Computing to my organisation	1.000	.795
Cloud Computing uses proven Technology	1.000	.884
Bandwidth is a significant/important variable when considering putting services on the Cloud / Internet	1.000	.753

Factor analysis also allows researchers to be able to explain the total variance using the least number of components. It is therefore necessary to reduce these questions in preparation for hypothesis testing. According to Ross, (2010), factor analysis evaluates each reponse to the survey questions for a specific variable, to generate one or more composite resultant z-score values for each participant for input into the subsequesnt analysis. Given the reasons above, including the inter-correlation, factor analysis was conducted using the 20 survey items (Question 11 to 30).

Table 5:14 below gives a summary of the total variance explained by each factor. Only factors with an Eigenvalue of 1.0 and above were extracted. A factor of one and above indicates that a factor is good, relevant and therefore appropriate for analysis. The initial Eigenvalues indicates that components 1 to 9 explained 18%, 8%, 7% and 4 % of the variance respectively. After rotation, the variance per component changes to 14%, 8%, 8% and 7 % respectively. Although other components which were discarded had better variances explaining each factor even after rotation, they were discarded mainly because they had no theoretical base. All four components cumulatively explain a total 80% of the total variance.

Table 5.14: Total Variance Explained

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	3.568	17.840	17.840
4	1.569	7.846	50.196
5	1.469	7.346	57.542
9	.837	4.183	79.880

Component	Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.568	17.840	17.840	2.824	14.118	14.118
4	1.569	7.846	50.196	1.647	8.234	42.437
5	1.469	7.346	57.542	1.565	7.823	50.261
9	.837	4.183	79.880	1.392	6.961	79.880

Table 5:15 below gives a summary of the component matrix before rotation. For this study principal component analysis was used. Only components with correlations of .35 and above were captured, the rest were discarded. Although the table indicates sufficient factors loaded per component, the factors or survey items are not grouped into any pattern that reflects the variables or grouping of questions. To improve the relation between factors per component, rotation using a Varimax rotation process was performed. See Table 5:16. The rotation minimised the number of varibles which have high loadings on each factor.

Table 5.15: Component Matrix

	Component								
	1	2	3	4	5	6	7	8	9
Bandwidth prices will have a significant impact on the total cost of taking/putting services in the cloud	0.73	-0.45							
Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services	0.65	-0.52							
Bandwidth is a significant/important variable when considering putting services on the Cloud / Internet	0.57				0.41			-.40	
Network infrastructure availability will adversely affect my decision to adopt Cloud Services	.539				0.47				
Cloud Computing uses proven Technology	0.49	0.40		-0.44					
Connectivity issues will adversely affect the reliability of services in the cloud	0.47						-0.47		
Bandwidth is generally expensive in South Africa	0.44	-0.37			-0.42				
I would feel comfortable recommending Cloud Computing to my organisation	0.36	0.64							
Cloud Computing communications networks are secured	0.41	0.59							
I am/would be concerned about bandwidth prices used by Cloud Computing	0.48	-0.58							
Reliable Cloud connection will/does provide a significant benefit to my organisation	0.45	0.56	-0.38						
We normally experience network connectivity issues between our office branches			0.65			0.39			0.4
Network Infrastructure is always available in required areas of my business		0.39	0.59						
I am/would be concerned with the security of the communication networks used by Cloud Computing			-0.55			0.50	0.39		
Network connectivity in South Africa is reliable			0.51		0.37	0.51			
Cloud Computing communication networks were not secure three years ago				0.69		-0.42			
Network Infrastructure is growing in all parts of the country				-0.43	0.58		0.40		
Network Infrastructure (WAN) availability is a significant factor in IT requirements for opening remote offices	0.37	0.36				0.40			
Cloud Computing communication networks are more secure than traditional computing networks methods	0.36			0.53			0.54		
Cloud Computing bandwidth services were seen to be expensive for my organisation 3 years ago	0.53							-0.54	

Table 5.15: Component Matrix

	Component								
	1	2	3	4	5	6	7	8	9
Bandwidth prices will have a significant impact on the total cost of taking/putting services in the cloud	0.73	-0.45							
Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services	0.65	-0.52							
Bandwidth is a significant/important variable when considering putting services on the Cloud / Internet	0.57				0.41			-.40	
Network infrastructure availability will adversely affect my decision to adopt Cloud Services	.539				0.47				
Cloud Computing uses proven Technology	0.49	0.40		-0.44					
Connectivity issues will adversely affect the reliability of services in the cloud	0.47						-0.47		
Bandwidth is generally expensive in South Africa	0.44	-0.37			-0.42				
I would feel comfortable recommending Cloud Computing to my organisation	0.36	0.64							
Cloud Computing communications networks are secured	0.41	0.59							
I am/would be concerned about bandwidth prices used by Cloud Computing	0.48	-0.58							
Reliable Cloud connection will/does provide a significant benefit to my organisation	0.45	0.56	-0.38						
We normally experience network connectivity issues between our office branches			0.65			0.39			0.4
Network Infrastructure is always available in required areas of my business		0.39	0.59						
I am/would be concerned with the security of the communication networks used by Cloud Computing			-0.55			0.50	0.39		
Network connectivity in South Africa is reliable			0.51		0.37	0.51			
Cloud Computing communication networks were not secure three years ago				0.69		-0.42			
Network Infrastructure is growing in all parts of the country				-0.43	0.58		0.40		
Network Infrastructure (WAN) availability is a significant factor in IT requirements for opening remote offices	0.37	0.36				0.40			
Cloud Computing communication networks are more secure than traditional computing networks methods	0.36			0.53			0.54		
Cloud Computing bandwidth services were seen to be expensive for my organisation 3 years ago	0.53							-0.54	

Table 5.16: Rotated Component Matrix

	Component								
	1	2	3	4	5	6	7	8	9
Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services	0.88								
Bandwidth prices will have a significant impact on the total cost of taking/putting services in the cloud	0.84								
I am/would be concerned about bandwidth prices used by Cloud Computing	0.81								
Bandwidth is generally expensive in South Africa	0.60								-0.40
Reliable Cloud connection will/does provide a significant benefit to my organisation		0.85							
I would feel comfortable recommending Cloud Computing to my organisation		0.84							
Network infrastructure availability will adversely affect my decision to adopt Cloud Services			0.81						
Connectivity issues will adversely affect the reliability of services in the cloud			0.68						
We normally experience network connectivity issues between our office branches				0.83					
Network connectivity in South Africa is reliable				0.80					
Cloud Computing communication networks are more secure than traditional computing networks methods					0.83				
Cloud Computing communication networks were not secure three years ago		-0.37	0.35		0.68				
Cloud Computing communications networks are secured		0.48			0.52		-0.35		
Cloud Computing uses proven Technology		0.37				0.82			
Network Infrastructure is always available in required areas of my business						0.61	-0.38		0.49
I am/would be concerned with the security of the communication networks used by Cloud Computing							0.91		
Cloud Computing bandwidth services were seen to be expensive for my organisation 3 years ago	0.38							0.75	
Bandwidth is a significant/important variable when considering putting services on the Cloud / Internet			0.42					0.67	
Network Infrastructure (WAN) availability is a significant factor in IT requirements for opening remote offices							0.36	0.52	
Network Infrastructure is growing in all parts of the country									0.90

Table 5:17 below gives a summary of all questions per component extracted, indicating which questions were included in each component. To ensure validity or consistency with the theory, the components were labelled as follows in line with the independent variables of the study:

- Component 1 : Pricing
- Component 4 : Connectivity Reliability
- Component 5 : Network Security
- Component 9 : Infrastructure Availability

Other components such as components 2,3,6,7 and 8 were not considered for this study primarily because the results showed pairing of unrelated questions. Therefore only four components were adopted from the factor analysis.

Table 5.17: Summary of Extracted Components

Survey Questions: Pricing
Bandwidth is generally expensive in South Africa
Cloud Computing bandwidth services were seen to be expensive for my organisation 3 years ago
I am/would be concerned about bandwidth prices used by Cloud Computing
Bandwidth prices in SA might/erode the cost effectiveness of Cloud Computing services
Bandwidth prices will have a significant impact on the total cost of taking/putting services in the cloud
Survey Questions: Infrastructure Availability
Network Infrastructure is always available in required areas of my business
Network Infrastructure is growing in all parts of the country
Survey Questions: Connectivity Reliability
We normally experience network connectivity issues between our office branches
Network connectivity in South Africa is reliable
Survey Questions: Connectivity Security
Cloud Computing communication networks are more secure than traditional computing networks methods
Cloud Computing communication networks were not secure three years ago
Cloud Computing communications networks are secured

Table 5.18 shows the final loading using the new labels. This information was used to test the hypothesis for each variable. Questions with the highest correlation per component were used in the test. As indicated earlier, the four components cumulatively account for 80% of the total variance explained as outlined in Table 5.14 above.

Table 5.18: Final Component Loading

	Component			
	Pricing	Connectivity Reliability	Network Security	Infrastructure Availability
Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services	.881			
Bandwidth prices will have a significant impact on the total cost of taking/putting services in the cloud	.839			
I am/would be concerned about bandwidth prices used by Cloud Computing	.811			
Bandwidth is generally expensive in South Africa	.601			
We normally experience network connectivity issues between our office branches		.825		
Network connectivity in South Africa is reliable		.802		
Cloud Computing communication networks are more secure than traditional computing networks methods			.827	
Cloud Computing communication networks were not secure three years ago			.679	
Cloud Computing communications networks are secured			.516	
Network Infrastructure is always available in required areas of my business				.487
Network Infrastructure is growing in all parts of the country				.898

5.5 Reliability Testing of Components

Following a study conducted by Lease (2005), a test for reliability was achieved using the Cronbach's Alpha co-efficient. For this study, two reliability tests were conducted. Firstly, a reliability test was conducted using the original survey items. Appendix E gives the detailed view of the analysis, including each survey item analysed. Table 5:19 gives the summary of the results.

Table 5.19: Summary of Components the original Cronbach's Alphas

Component	Cronbach's Alpha	N of Items
Pricing	0.77	5
Network Infrastructure Availability	0.36	4
Network Connectivity Reliability	0.07	4
Network Security	0.03	4
Attitude towards Cloud	0.43	3

The results from the above table indicate that only price has a Cronbach's alpha with a co-efficient of over 0.70 (70%). This shows that price related questions on the questionnaire were very consistent. The other questions show extremely low co-efficients, which indicates that the questions were not consistent. This could also indicate that the respondents did not understand the questions clearly or did not understand the subject.

The co-efficient rose to 0.635 (64%) after deleting the last question (question 30) under the component attitude towards Cloud Computing, therefore results in question 30 of the survey were dropped from the study. The second attempt at reliability tests were performed using the new components as grouped by the factor analysis. Table 5:20 below shows the reliability results for the four new components extracted.

Table 5.20: Summary of Components Cronbach's Alphas

Component	Cronbach's Alpha	N of Items
Pricing	0.76	5
Network Infrastructure Availability	0.53	2
Network Connectivity Reliability	0.69	2
Network Security	0.57	3

This time around, the results show improved Cronbach's Alpha co-efficients for the three components; network connectivity reliability, network infrastructure availability and network security. However, there was a minimum drop in the pricing co-efficient relative to the original price co-efficient of .771. None of the components showed any Cronbach's Alpha improvement when the underlying items were deleted, therefore all survey items as outlined in Table 5.17 were included. Overall, the questionnaire item showed an improved reliability after the factor analysis, though not all components had a Cronbach's alpha co-efficient of more than .7.

5.6 Inferential Statistics

For the purpose of this study, as stated earlier, four highly correlated survey items per component were selected for hypothesis analysis. The correlation co-efficient was taken from Table 5.18 above outlining the final components loading. Table 5.21 below shows the survey items selected together with their applicable null hypothesis statement, including the correlation co-efficient. The survey item represented the whole component. Chi-square analysis was performed to test each hypothesis.

Table 5.21: Hypothesis Testing Correlation Analysis

Survey Item	Hypothesis	Correlation Coefficient
Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services	IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception of bandwidth pricing in South Africa (BWpr).	.881
Network Infrastructure is growing in all parts of the country	IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception on infrastructure availability (BWav).	.827
We normally experience network connectivity issues between our office branches	IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception on network performance (BWrel)	.825
Cloud Computing communication networks are more secure than traditional computing networks methods	IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception on communication network security effectiveness (BWsec)	.898

5.6.1 Hypothesis 1

The first null hypothesis stated, IT leaders' (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception of bandwidth pricing in South Africa (BWpr). To evaluate this hypothesis, the survey item 14 was compared to item 28. The items were as follows:

Item 14: Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services

Item 28: I would feel comfortable recommending Cloud Computing to my organisation

Table 5:22 represent a cross tabulation of these two items' responses compared to each other. The results indicate that most respondents who either agreed or strongly agreed with item 14 also agreed or strongly agreed with item 28 of the survey.

Table 5.22: Cross Tabulation for Hypothesis 1

		Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services					Total
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
I would feel comfortable recommending Cloud Computing to my organisation	Disagree	0	0	0	2	2	4
	Neutral	1	0	1	5	0	7
	Agree	0	3	12	15	4	34
	Strongly Agree	1	0	1	3	5	10
Total		2	3	14	25	11	55

In addition to the cross tabulation a Chi-square test was performed to assess the relationships between these two items. Table 5:23 outlines the Chi-Square results of hypothesis 1.

Table 5.23: Chi-Square for Hypothesis 1

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.573a	12	0.057
Likelihood Ratio	22.561	12	.032
Linear-by-Linear Association	.004	1	.948
N of Valid Cases	55		

The results indicate a p-value of 0.057, which indicates a significant relationship between the two survey items. This means that the data between communication network pricing and adoption is highly correlated. Due to the p-value being 0.057 which is a little more than 0.05 the null hypothesis was rejected. It could therefore be concluded that IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is dependent on their perception of bandwidth pricing in South Africa (BWpr).

5.6.2 Hypothesis 2

The null hypothesis for the third hypothesis stated, IT leaders' (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception on infrastructure availability (BWav). The evaluation for this hypothesis was conducted by comparing responses for survey item 28 and item 22. The items were as follows:

Item 22: Network Infrastructure is growing in all parts of the country.
Item 28: I would feel comfortable recommending Cloud Computing to my organisation.

Table 5:24 represent a cross tabulation of these two items responses compared to each other. The results indicate that most respondents who either agreed or strongly agreed with item 22 (70%) also agreed or strongly agreed with item 28 (80%) of the survey.

Table 5.24: Cross Tabulation for Hypothesis2

		Network Infrastructure is growing in all parts of the country				Total
		Disagree	Neutral	Agree	Strongly Agree	
I would feel comfortable recommending Cloud Computing to my organisation	Disagree	0	1	3	0	4
	Neutral	0	2	5	0	7
	Agree	5	6	15	8	34
	Strongly Agree	1	1	4	4	10
Total		6	10	27	12	55

Table 5.25: Chi-Square for Hypothesis 2

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.107a	9	0.523
Likelihood Ratio	11.211	9	.262
Linear-by-Linear Association	.628	1	.428
N of Valid Cases	55		

The results of Table 5:25 indicate a p-value of 0.523, which indicates an insignificant relationship between the two survey items. This means that the data between communication network availability and adoption is not highly correlated. Due to the p-value being 0.523, which is much more than 0.10, the null hypothesis was accepted. The p-value of more than 10% indicates that there is weak to no relationship between the two survey

items. The conclusion drawn in this hypothesis is that, IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception on infrastructure availability (BWav).

5.6.3 Hypothesis 3

The null hypothesis for the second hypothesis stated, IT leaders' (CIO/IT manager) decision to recommend Cloud Computing technology DTRCC) is independent of their perception on network performance (BWrel). The evaluation for this hypothesis was conducted by comparing responses for survey item 28 and item 16. The items were as follows:

Item 16: We normally experience network connectivity issues between our office branches.
Item 28: I would feel comfortable recommending Cloud Computing to my organisation.

Table 5:26 represent a cross tabulation of these two items responses compared to each other. The results indicate that most respondents who either agreed or strongly agreed with item 16 (54%) also agreed or strongly agree with item 28 (72%) of the survey.

Table 5.26: Cross Tabulation for Hypothesis 3

		We normally experience network connectivity issues between our office branches					Total
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
I would feel comfortable recommending Cloud Computing to my organisation	Disagree	0	3	1	0	0	4
	Neutral	0	2	1	4	0	7
	Agree	3	10	6	13	1	33
	Strongly Agree	0	4	2	3	1	10
Total		2	3	19	10	20	55

Table 5:27 below outlines the Chi-Square results of hypothesis 2.

Table 5.27: Chi-Square for Hypothesis 3

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.207a	12	0.769
Likelihood Ratio	10.264	12	.593
Linear-by-Linear Association	.665	1	.415
N of Valid Cases	54		

The results indicate a p-value of 0.769, which indicates a insignificant relationship between the two survey items. This means that the data between communication network reliability and adoption has low correlation. Due to the p-value being 0.769 which is much more than 0.10, the null hypothesis was accepted. The p-value of more than 10% indicates that there is weak to no relationship between the two survey items. Therefore, it can be concluded that IT leaders' (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception on network performance (BWrel)

5.6.4 Hypothesis 4

Lastly, null hypothesis representing the fourth construct stated, IT leaders' (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception on communication network security effectiveness (BWsec). Again, in this case the hypothesis was evaluated by comparing responses for survey item 28 and item 26. The items were as follows:

Item 26: Cloud Computing communication networks are more secure than traditional computing networks methods.
Item 28: I would feel comfortable recommending Cloud Computing to my organisation.

Table 5:28 represent a cross tabulation of these two items responses compared to each other. In this case however, results indicate that most respondents who either disagreed, neutral or strongly disagreed with item 26 (76%) also agreed or strongly agree with item 28 (80%) of the survey.

Table 5.28: Cross Tabulation for Hypothesis 4

		Cloud Computing communication networks are more secure than traditional computing networks methods					Total
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
I would feel comfortable recommending Cloud Computing to my organisation	Disagree	0	2	2	0	0	4
	Neutral	1	3	3	0	0	7
	Agree	3	8	16	7	0	34
	Strongly Agree	0	2	2	3	3	10
Total		4	15	23	10	3	55

Table 5.29: Chi-Square for Hypothesis 4

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.158a	12	0.048
Likelihood Ratio	20.707	12	.055
Linear-by-Linear Association	7.516	1	.006
N of Valid Cases	55		

The results as shown in Table: 5.29 indicate a p-value of 0.048, which indicates a significant relationship between the two survey items. This means that the data between communication network pricing and adoption is highly correlated. Due to the p-value being 0.048 which is less than 0.05, signifying a strong relationship between items, the null hypothesis was rejected. It could therefore be concluded that IT leaders' (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is dependent on their perception of communication network security effectiveness (BWsec).

5.7 Conclusion

The primary goal of this study was to provide IT leaders with new insights and knowledge into factors that must be considered in making decisions about Internet related technology adoption in a South African or in a developing country context. Bandwidth or communication network was the main factor analysed for this study. Four building blocks of communication networks, namely, the communication network pricing, communication network reliability, communication network infrastructure availability and communication network security were analysed.

Thus, the study measured the IT manager's perception on each of these building blocks using Cloud Computing as a test scenario. Four hypotheses representing this independent variable were tested in relation to the decision to adopt the technology. The findings indicated that two of the four hypotheses were accepted. The dependence found between survey items resulted in the rejection of hypothesis 1 and 4. On the other hand, the independence found in the survey items resulted in failure to reject hypothesis 2 and 3.

As a result, communication network pricing and communication network security were identified as being the factors that influences adoption of Cloud Computing. The next chapter outlines detailed interpretation and discussion of the results.

6 Discussion of Results

In this chapter, in-depth insights gained from the previous Chapter, wherein the data was analysed, will be presented. To effectively analyse the research hypothesis reference will be made to the hypothesis testing, along with other tests performed in previous chapters. Furthermore reference will be made to the theory covered in Chapter 2 and the hypothesis covered in Chapter 3.

In essence, the ultimate goal of this Chapter is to link the three pillars of this study; namely the data, the theory and the knowledge obtained; thereby answering the objectives of the study. The structure of this section will thus be anchored on the four hypotheses for this study. The results are mostly presented in tabular formats, starting with the descriptive data and thereafter the results from inferential statistics are depicted.

6.1 Descriptive Data

Although the core of the study is more on the inferential statistics, the descriptive statistics give an invaluable initial examination of the results (Labuschagne, 2011). The primary objective of the descriptive statistics is therefore to provide preliminary insights into the nature of responses gathered, reflected by the distribution of values in each variable of interest. The descriptive statistics further assist the researcher in detecting errors in the coding process and provides the means for presenting the data in a more palatable style, through the usage of tables and graphs (Diamatopoulos & Schlegelmilch, 2000).

6.1.1 Response Rate

The study managed to obtain 46% response rate as summarised in Figure 6.1. Figure 5.1 outlines how the rate was calculated.

Figure 6.1:Summary of the Response Rate

Total Sample	Targeted Sample	Actual Valid Reponses	Response Rate
300	128	55	46%

Although the study only managed to obtain 55 responses, the response rate of 25% (30 participants) would have satisfied the validity of the sample. Therefore, the central limit theorem as explained by Albright, Wiston, & Zappe, (2009) was satisfied with n = 55. Given n> 30, the non-response biases of the 73 participants who did not respond are seen to be insignificant. In view of the inherently busy nature of people working in leadership positions, the study managed to obtain a relatively high response rate.

6.1.2 Demographics Profiles

Most of respondents in this study (92%) were from organisations with a large user base, 50 plus users. Figure 5.1, outlining firm size through users' base, shows the study was dominated by respondents from firms with 5000 or more users, representing 33% of the total respondents. The figure also indicates that data was collected from various firm sizes represented by respondents. The information intuitively makes sense; primarily because the study targeted CIOs, who are mostly found in large firms.

Figure 6.2: Firm Size vs Recommending Cloud

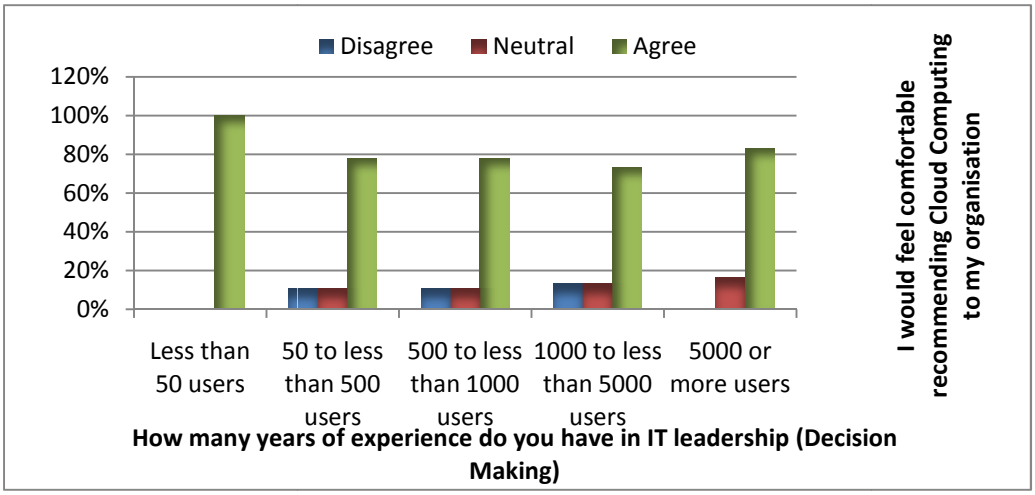


Figure 6.2 above is a depiction of the highlighted part of the cross tabulation, Table 5.2, which compared firm size to the decision to recommend Cloud Computing. Interestingly, the firm size seems not to have an impact on an individual's decision to recommend Cloud Computing. These sentiments are shared by Lease, (2005). However, in this study, it seems all participants from smaller firms agreed that they would recommend Cloud Computing to their organisations, though they are a very small number of the sample. This willingness by all firms, might be largely due to the cost effectiness of Cloud Computing and their small budgets. Contrary to these results, firm size was a significant determinant of adopotion in other studies (Low & Chen, 2011).

In Figure 5.2 assesing IT leader's experience in the field, it is evident that repondents with many years of experience command the highest percentage of responses. 85% of the repondests ranged from over five years experience to ten plus years. Although there are few new entrants into the IT leadership, the results indicate that most leaders in IT had vast experience in the field.

Figure 6.3: Leader Experience vs. Recommending Cloud

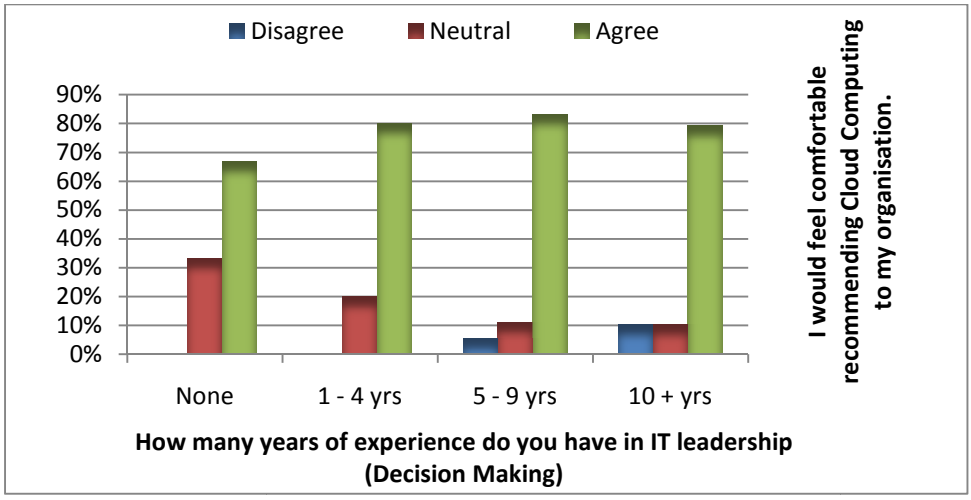


Figure 6.3 above is a depiction of the highlighted part of the cross tabulation, Table 5.4, which compared firm size to the decision to recommend Cloud Computing. Experience does not appear to have a significant influence on leaders' conformability to recommend Cloud Computing. This might be signalling a good understanding of the Cloud Computing benefits across different leaders' years of experience.

The respondents in this study were dominated by responses from CIOs' across industries. Table 5.5 indicates that 42% of the respondents occupied the highest rank in IT leadership. This is an indication that the study managed to capture responses from the most influential individuals in the IT fraternity. In smaller organisations, ranks like IT managers and IT directors are sometimes the highest officer in IT leaderships, particularly in smaller government departments. Again, in this case, job title or functions did not indicate any measurable influence in the leaders' comfort, authority and desire to recommend Cloud Computing to their respective organisations.

From an industry perspective, Table 5.7 indicates that the study covered a wide array of industries. Government and financial accounted for the majority at approximately 33% of responses. The cross tabulation Table 5.8 does not show any influence by industry type.

It can therefore be concluded that the study covered relevant people in its sample, responsible for their respective organisations IT decision making. Furthermore, the study covered a good number of industries. Given these suppositions, inferences can be made from these using this data to generalise to a wider IT population.

6.2 Statistical Inferences results

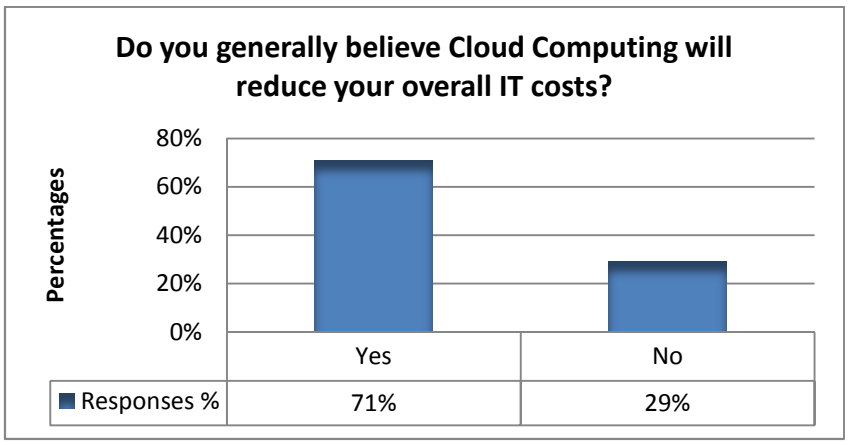
6.2.1 Communication network prices

$H_0$1: IT leaders' (CIO/IT manager) decision to recommend Cloud Computing technology (DTR_{CC}) is independent of their perception of bandwidth pricing in South Africa (BW_{pr}).

In this section, the results of the acceptance or rejection of the null hypothesis are assessed. First and foremost it is worth noting that the variable Communication Network Pricing always had high reliability results in the original and components based reliability test, this is summarised in Table 5.19 and Table 5.20. All pricing reliability questions had α=0.77 and α=0.76 respectively. This is an indication that most respondents are in agreement when responding to questions regarding bandwidth prices in South Africa.

From a Cloud Computing perspective, it was found that the majority of respondents strongly believed that Cloud Computing will generally reduce their overall IT costs. A summary of Table 5.11 results are depicted in Figure 6.4 below, where 71% of the respondents see Cloud Computing as a cost saver. This notion is supported in theory by a number of studies that defined the advantage of Cloud Computing (Armbrust *et al*., 2009; Buyya *et al*., 2009; Ross, 2010, Low & Chen, 2011). This indicates that most respondents know and understand benefits from a cost perspective.

Figure 6.4: Overall Cost Reduction by Cloud



Through factor analysis, all Communication Network Pricing sub-questions were consolidated into one variable that can be tested. A highly correlating question, which asked if Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services, was selected for this task. See Table 6.1 below.

Table 6.1: Hypothesis 1 Survey Item and Correlation

Survey Item	Hypothesis	Correlation Coefficient
Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services	IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception of bandwidth pricing in South Africa (BWpr).	.881

Two other questions in this category are examined before the selected question.

The results from Figure 5.2, 5.4 and 5.6, regarding general bandwidth pricing in South Africa indicates that the majority of respondents felt that the pricing for bandwidth is very high, with respondent percentages showing 84%, 71% and 74% respectively. Furthermore, for the main question representing the whole pricing contrasts, represented in Figure 5.5: Bandwidth prices eroding cost effectiveness of Cloud services, indicates that the 65% of the respondents were in agreement that the bandwidth cost will erode the cost effectiveness of Cloud Computing.

Another significant test performed was the cross tabulation between the respondents conformability to recommend Cloud Computing versus erosion of the cost effectiveness of Cloud Computing by cost. Table 5.22 indicates that the 27 respondents who agreed that they would feel comfortable recommending Cloud Computing, also felt that Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services. This is an indication that, although respondents will recommend Cloud Computing, bandwidth prices are a worrying factor.

A Chi-square Test of Independence between the two factors in Table 5.23 testing the hypothesis indicates that there is a significant relationship between the questions “I would feel comfortable recommending Cloud Computing to my organisation” and “Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services”. This is seen in the p-value of 0.05.

The finding above coincides with the findings in a study by Tobin and Bidoli (2005), where they found that high bandwidth costs were a key barrier to the adoption of technology. Brown *et al*., (2009) also attributed the slow uptake or adoption in Internet as an underlying technology, to prohibitive high cost of bandwidth. Gillwald (2007), also indicated that bandwidth prices are a most evident shortcoming of Internet based technology in developing countries. Similarly, Dillon, Wu and Chang (2010), highlighted that, whilst migrating services to the cloud can significantly reduce general computing infrastructure costs, it can on the other hand raise network communication costs. Lastly, Parikh, (2009) indicated in his study that high bandwidth cost might be a limiting factor to the overall Cloud Computing adoption.

The null hypothesis stated: H01: IT leaders' (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception of bandwidth pricing in South Africa (BWpr). At the p-value of 0.05, the research has proved the dependency between the dependent variable willingness to adopt Cloud Computing and the independent variable Communications Network Pricing. It can therefore be concluded that the null hypothesis can be rejected in favour of the alternative hypothesis:

H01: IT leaders' (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is dependent of their perception of bandwidth pricing in South Africa (BWpr).

6.2.2 Communications network infrastructure availability

$H_0$2: IT leaders' (CIO/IT manager) decision to recommend Cloud Computing technology (DTR_{CC}) is independent of their perception on infrastructure availability (BW_{av}).

Dealing with the second hypothesis, the factor analysis results extracted only two relevant questions. So it is acceptable for this study that instead of analysing the four questions asked, the results returned two. The question "we normally experience network connectivity issues between our office branches" was selected as the main question for analysis. This selection is based on the high correlation co-efficient extracted between the two remaining questions. See Table 6.2 below.

Table 6.2: Hypothesis 2 Survey Item and Correlation

Survey Item	Hypothesis	Correlation Coefficient
Network Infrastructure is growing in all parts of the country	IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception on infrastructure availability (BWav).	0.827

Figure 5.12 represents the question which asked if the network infrastructure was available in all areas where it is required by business. Surprisingly, the results showed that the 67% of the respondents agreed with the statement. This might indicate that businesses are expanding in areas where infrastructure is readily available only. This is in clear contradiction of what the theory indicated. According to Arinze & Anandarajan (2011), many developing countries do not have adequate network infrastructure coverage for personal computing and businesses. The results indicate that network Infrastructure is always available in required areas of the respondents' businesses.

The majority of respondents continued by indicating that infrastructure is growing in all parts of the country. Figure 5.13 results show that 71% of the respondents strongly agreed. These sentiments are shared by Fourie (2008), who argues that, although South Africa's telecommunication network is characterised by access problems and high costs, which might result in poor performance, the state of the physical infrastructure is of good standard. This result gives an indication that South Africa is a developmental state, and therefore, communication networks infrastructure is growing.

Cross tabulation between the respondents' conformability to recommend Cloud Computing versus bandwidth infrastructure is growing in all parts of the country, Table 5.25 indicates that the 31 respondents who agreed that they would feel comfortable recommending Cloud Computing, also felt that Bandwidth is growing in all parts of the country. This is an indication that the growth of infrastructure may lead to leaders recommending Cloud Computing to their organisations.

However, Chi-square Test of Independence between the two factors in Table 5.26, testing the hypothesis, indicates that there is an insignificant relationship between the questions "I would feel comfortable recommending Cloud Computing to my organisation" and "Network Infrastructure is growing in all parts of the country". This is seen in the p-value of 0.523, which is above 0.10.

Kim, Kim, Lee, and Lee (2009) identified seven types of cloud adoption issues. Included in the seven are three factors that are pertinent to this study; the availability, the performance and the cost. Rose (2011) maintains that by 2012, demand for bandwidth will exceed the capacity of the Internet. Therefore it can be inferred that communication network availability should influence the IT leaders' decision to recommend Cloud Computing. However the results indicate otherwise.

The null hypothesis stated: H02: IT leaders' (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception on infrastructure availability (BWav). At the p-value of 0.523, the research has failed to prove the dependency between the dependent variable willingness to adopt Cloud Computing and the independent variable Communications Network Availability. It can therefore be concluded that the null hypothesis can be accepted.

6.2.3 Communication network reliability

$H_0$3: IT leaders' (CIO/IT manager) decision to recommend Cloud Computing technology (DTR_{CC}) is independent of their perception on network performance (BW_{rel})

The factor analysis in questions relating to this hypothesis also returned two questions that can be used for further analysis. Using the same procedure used in hypothesis 2, the question that stated: We normally experience network connectivity issues between our office branches was the one with the highest correlation co-efficient at 0.825. Therefore it will be the one used for testing. See Table 6.3 below.

Table 6.3 : Hypothesis 3 Survey Item and Correlation

Survey Item	Hypothesis	Correlation Coefficient
We normally experience network connectivity issues between our office branches	IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception on network performance (BWrel)	0.825

According to the results of the test above it was not clear what the real verdict was, when it comes to the question about reliability of network connectivity in South Africa. Figure 5.8 indicated that 45% of the respondents agreed that infrastructure was reliable. What is blurring the results is the 40% of the respondents opting to be neutral resulting in a small percentage of respondents agreeing or disagreeing. The indication is that an unconvincing 45% of the respondents believe the network connectivity is reliable in the country and 40%

of the respondents cannot agree or disagree. According to theory articulated by Fourie, (2008) the networks in South Africa are of a good standard, which means they should be reliable; this theory can only be confirmed by 45% of this study's respondents.

The unconvincing results are exacerbated by the results from Figure 5.7, where there was a 50:50 split between the respondents who agree and those who did not agree with the statement that said, they normally experience network connectivity issues. The respondents who opted for neutrality are a problem in this case too. There is therefore inconclusive evidence with regards to reliability from the respondents' viewpoint.

That said, cross tabulation between the respondents' conformability to recommend Cloud Computing versus "we normally experience network connectivity issues between our office branches" (Table 5.26), indicates that the 18 respondents who agreed that they would feel comfortable recommending Cloud Computing, also felt that they experience network connectivity issues between their office branches. This is an indication that the respondents will still recommend Cloud Computing despite the reliability of communication network being questionable.

The Chi-square Test of Independence between the two factors in Table 5.27, testing the hypothesis, indicates that there is an insignificant relationship between the questions "I would feel comfortable recommending Cloud Computing to my organisation" and "We normally experience network connectivity issues between our office branches". This is seen in the p-value of 0.769, which is above the 0.10.

According to theory, major challenging areas faced by Cloud Computing are the performance, latency and reliability of the network (Leavitt, 2009). Reliability in the cloud refers to the ability of the network infrastructure to ensure reliable data communication between nodes in the cloud. Due to the flexibility of the cloud, network infrastructure should be responsive, i.e. adapt to changes in the cloud topology. This can negatively impact reliability of services (Idowu, Shi, Merabti, & Kifayat, 2012). Therefore Cloud Computing requires a reliable communication network (Arinze & Anandarajan, 2010). Consequently Communication Network Reliability should influence the IT leaders' decision to recommend Cloud Computing. However, the results indicate the opposite. As indicated by Low and Chen, (2011) increasing user awareness of the Cloud Computing benefits will positively affect the effecient use and diffusion of the technology.

The null hypothesis stated: H03: IT leaders' (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception on network performance (BWrel). At the p-value of 0.769, the research has failed to prove the

dependency between the dependent variable willingness to adopt Cloud Computing and the independent variable Communications Network Reliability. It can therefore be concluded that the null hypothesis can be accepted.

6.2.4 Communications network security

$H_0$4: IT leaders' (CIO/IT manager) decision to recommend Cloud Computing technology (DTR_{CC}) is independent of their perception on communication network security effectiveness (BW_{sec})

Three security questions were grouped together by the factor analysis test. Table 6.4 below gives the summary of the question selected for hypothesis testing.

Table 6.4 : Hypothesis 4 Survey Item and Correlation

Survey Item	Hypothesis	Correlation Coefficient
Cloud Computing communication networks are more secure than traditional computing networks methods	IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception on communication network security effectiveness (BWsec)	.898

The results obtained when testing if Cloud Computing was secure as depicted in Figure 5.15 above, show that respondents were not convinced of the security of Cloud Computing. 42% agreed that Cloud Computing is secure, while the 40% opted for neutrality and the rest disagreed. This is an indication that from a security perspective, there is still ground to cover. Moreover, the honours are with the service providers to demonstrate the security of their Cloud services (Ross, 2010).

Figure 8.18 also demonstrates an indecisive response from participants, as the percentage of respondents who believed Cloud security was not secure three years ago is 32%. A large number of respondents opted to be neutral. Generally, the expectation is that in time the security for Cloud has improved, however it takes respondents who have been tracking Cloud development to properly voice their opinion on the progress. However, most respondents believe the Cloud is secure, but the results indicate 51% of respondents being neutral. This still boils down to service providers' responsibility to educate their potential customers. According to theory, most organisations judge the security by control over the parameter, which Cloud Computing erodes (Zissis & Lekkas, 2012). This can prove to be a challenge to most organisations.

Security is seen as a serious issue of concern; this is evident again in the main security question tested. According to Figure 5.17, respondents continue to fall more on neutral grounds, while only 23% agreed that Cloud security is more secure than traditional security methods. There is still an indication that most respondents are not sure about Cloud security, and therefore are more inclined towards internally hosted security measures, where organisations retain parameter control (Zissis & Lekkas, 2012).

Cross tabulating between the respondents' conformability to recommend Cloud Computing versus Cloud Computing communication networks are more secure than traditional computing networks methods, Table 5.28, indicates that the 28 respondents who agreed that they would feel comfortable recommending Cloud Computing, also felt that Cloud Computing communication networks were not more secure than traditional computing networks methods. This is an indication that the respondents are comfortable to recommend Cloud Computing despite their being concerned with security issues.

A Chi-square Test of Independence, between the two factors in Table 5.29, testing the hypothesis, indicates that there is a significant relationship between the questions "I would feel comfortable recommending Cloud Computing to my organisation" and "Cloud Computing communication networks are more secure than traditional computing networks methods". This is seen in the p-value of 0.05.

According to theory, deploying Cloud Computing in any organisation brings significant security concerns (Bisong & Rahman, 2011). Another study by Ross (2010) indicated that Cloud Computing adoption depends largely on the perception of IT leaders of its security effectiveness. The increasing popularity of Cloud Computing goes along with growing security risks, which are becoming a greater concern and top issues for IT leaders and users (Qaisar & Khawaja, 2012). The larger part of theory coincides with the results from the statistical tests performed above. Communications Network Security is undoubtedly a serious concern for IT managers across industries and firm sizes.

In closing, the null hypothesis stated: H03: IT leaders' (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception on communication network security effectiveness (BW_{sec}). At the p-value of 0.05, the study has managed to prove the dependency between the dependent variable willingness to adopt Cloud Computing and the independent variable Communications Network Security. It can therefore be concluded that the null hypothesis can be rejected, in favour of the alternative hypothesis:

H_a4: IT leaders' (CIO/IT manager) decision to recommend Cloud Computing technology (DTR_{CC}) is dependent of their perception on communication network security effectiveness (BW_{sec})

6.3 Summary of findings

6.3.1 Bandwidth as a significant variable

The results of the factor analysis and the reliability tests required that Question 30, which asked whether the communications network is a significant variable when deploying services to the Cloud, be dropped. However, results on Figure 5.21 show that an overwhelming majority at 96% agreed that the communications network is a significant fact for consideration. The results of the study covered in the whole of section 6.3 of this study managed to prove that not all communications network factors are to be considered, but generally, a communications network is a vital variable, particularly its security and pricing. Table 6.5 below depicts the summary of the hypothesis tests performed.

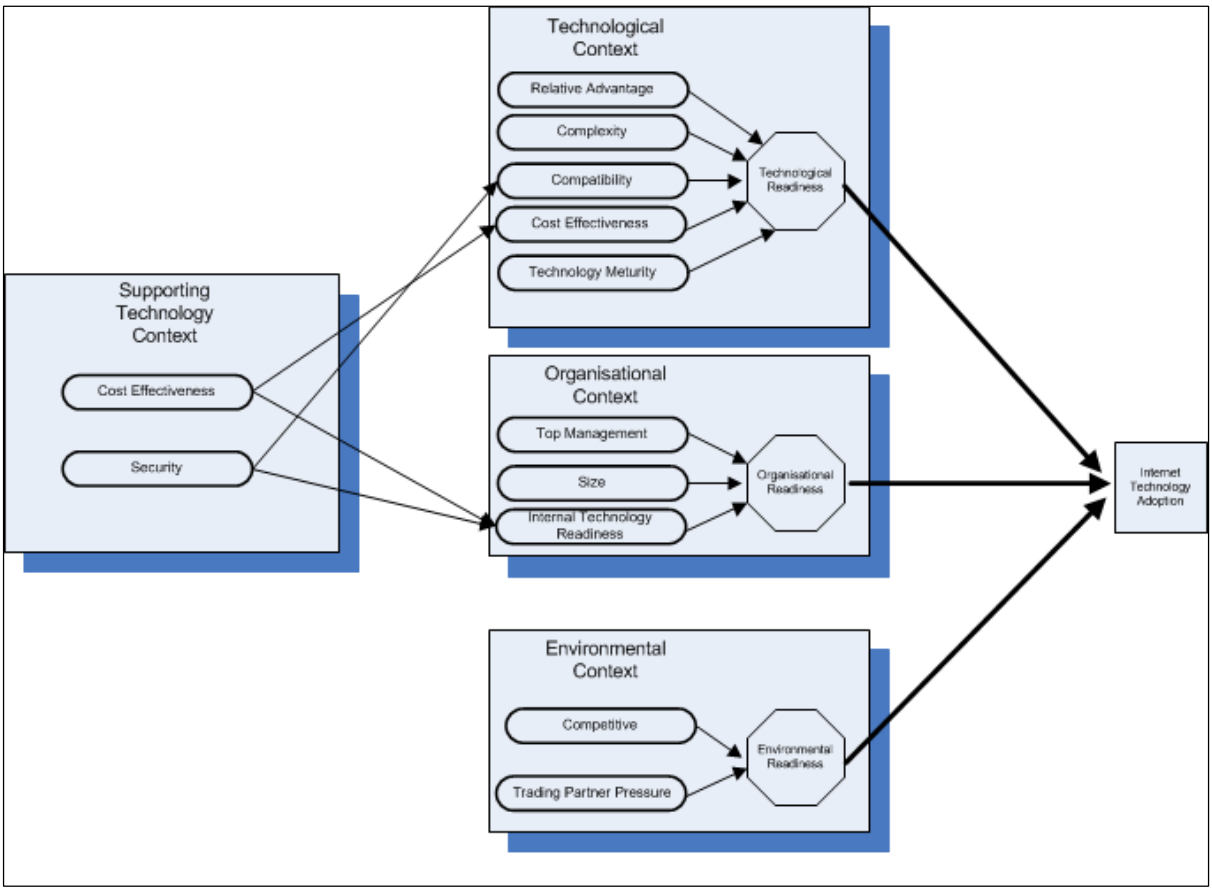
Table 6.5: Hypothesis Test Summary

Null Hypothesis	Test	Sig	Decision
IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception of bandwidth pricing in South Africa (BWpr).	Chi-square Test of Independence Chi-square Test of Independence	0.057	Reject the Null Hypothesis
IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception on infrastructure availability (BWav).	Chi-square Test of Independence	0.52	Accept the Null Hypothesis
IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception on network performance (BWrel)	Chi-square Test of Independence	0.77	Accept the Null Hypothesis
H04: IT leaders (CIO/IT manager) decision to recommend Cloud Computing technology (DTRCC) is independent of their perception on communication network security effectiveness (BWsec)	Chi-square Test of Independence	0.048	Reject the Null Hypothesis

6.3.2 TOE Adapted

As a result of these findings, the TOE framework or any adoption model can be adapted as depicted on the Figure: 6.5 below:

Figure 6.5: Adapted TOE Framework



To consistently adapt the model to different Internet technologies, a new construct namely, supporting technology context is introduced. Price is modified to give a generic name referred to as cost effectiveness. It should be noted that this sub construct; cost effectiveness, only refers to the cost effectiveness of the supporting technology and not the overall cost effectiveness of the technology to be adopted. The overall is covered in the technological context construct. The security sub constructs remains as is.

6.3.3 Unexpected results

It was absolutely surprising that the results did not indicate Communication Network Reliability and Communication Networks Infrastructure Availability as significant variables to consider when putting services on the Cloud. Intuitively the researcher felt that these factors were a given, however the results proved otherwise.

Although the results indicate that leaders are concerned more about pricing and security, and the big picture benefits thereof, Communication Network Reliability and Communication Networks Infrastructure Availability if not properly considered by organisations might lead to an unexpected rise in cost. The cost of down time of services due to unreliable communications networks can be a huge challenge or burden to businesses. Furthermore, more challenges can be experienced if businesses are not able to expand due to the unavailability of infrastructure.

6.3.4 Impact of the sample

The greatest limitation to this study proves to be a small sample size that the study obtained, consequently this calls for caution in the interpretation of results. Access to people in leadership positions is a most limiting factor that makes it difficult for the researcher to cover an adequate sample that would strongly suggest generalisation.

The exclusion of small firms as a target for this study might mean that the results for this study may not be generalised to smaller organisations, even though they stand to benefit more from Cloud Computing, as opposed to large organisations that can afford to build their own systems.

Lastly, it must be taken into consideration that what holds true in one country about technology adoption might not necessarily form a legitimate basis in other countries worldwide. It is therefore very important to understand that the results reveal very important factors, which are contextual.

6.4 Conclusion

Just over a decade ago, a study by Irwin (2001) revealed that the Communication network is a topic that is oftern discussed, however very little academic work has been done in this field. He futher highlighted that some work had been done, mostly in high end networks in the Western economies, rather than in countries like South Africa, where low bandwidth is commonly available and comes at a higher cost.

This study has managed to prove that the communications network, in particular its pricing and security factors, are important factors that must be considered for Internet based technology adoption. Pricing and Security of communication networks are the main factors proven by this study as important. These findings should contribute to literature and future studies.

The research objectives as outlined in chapter 1 has therefore being met. The next chapter concludes the research.

7 Conclusion & Recommendations

7.1 Introduction

This chapter covers the conclusion for this study, highlighting the main findings of this study and summarising them. Recommendations are made to IT leaders, Service providers and to academia based on these findings. Finally, suggestions for future research are discussed.

To kick off the discussion the researcher will first revisit the study's objectives:

The ultimate question that the research seeks to answer is as follows:
Is the communication network a key component to consider in the adoption models/frameworks when assessing adoption of Internet based innovation?

The following are the research steps:

- Assess models/frameworks used for adoption of different Internet based technologies
- Assess bandwidth related literature that focuses on adoption.
- Characterise Cloud Computing using Internet as an underlying platform of Cloud Computing in South Africa.
- Run the following tests:
    - Determine if the decision of IT leaders (CIO/IT manager) to recommend Cloud Computing technology is dependent of their perception of communication network **pricing** in South Africa.
    - Determine if the decision of IT leaders (CIO/IT manager) to recommend Cloud Computing technology is dependent of their perception of communication network **availability** in South Africa.
    - Determine if the decision of IT leaders (CIO/IT manager) to recommend Cloud Computing technology is dependent of their perception of communication network **reliability** in South Africa.
    - Determine if the decision of IT leaders (CIO/IT manager) to recommend Cloud Computing technology is dependent of their perception of cloud communication network **security** effectiveness.

Suggest or dismiss the communication network as a critical criterion to assess when conducting studies on Internet based innovation.

To give an overview, in Chapter 2 an extensive literature review was conducted, which covered an overview and details around the technology adoption models, including identifying bandwidth factors as a gap in the existing models. Secondly, literature review pertaining to bandwidth was covered. Lastly the literature covered Cloud Computing and Internet as an underlying technology driving Cloud Computing. Chapter 3 covered the hypotheses, testing of these hypotheses and demographics were performed in Chapter 5 and 6. The steps performed indicate that this study has achieved the aims outlined above which were set out in Chapter 1. The study therefore concludes with the key findings below.

7.2 Key Findings

In this study, the focus was on the communication Network factors contributing to the IT managers' decision to recommend or not to recommend Cloud Computing. The overall intention was to demonstrate the importance of the communication network as an important construct that must be included in the adoption evaluation. Except for reliability and availability, the findings of the research suggest two communications network factors influencing the decision by IT leaders to recommend the Cloud, namely price and security.

The demographic data like firm size, leader's experience and the industry type does not have any bearing on the leader's decision to recommend Cloud Computing. From these findings, it can be realised that adoption decisions are not primarily based on technical issues.

7.2.1 Communication Network Pricing

Communications network pricing also known as bandwidth pricing was indicated as a major factor to take into account when considering putting services on the Cloud. The implication given by these finding are that IT leaders are very cost conscious these days. The days where the IT organisation was seen as a glorified cost centre are slowly coming to an end. Organisations today are grappling with staying relevant to the market, this is evident mainly in their extended efforts taken to contain cost and deliver maximised returns.

IT organisations are therefore expected to contribute to these efforts by the overall organisation through cost savings and superior value adding systems. In the past, new innovations were adopted, because of the technical capability and benefits. Bandwidth upgrades were linked mainly to user demands. From this study, it can be realised that managers are not only falling for capabilities; they are more concerned with what it will cost despite the punting of benefits.

7.2.2 Security

As services are steadily moving to the Cloud, the concerns by managers for the security of their IT resources are increasing. This is largely exacerbated by their perceived loss of control or entrusting their data to outsiders. Although organisations have always outsourced management of their services to other companies, the security function has always been kept within the physical parameter of the company. Innovations that are Internet based, such as Cloud Computing, erode this parameter control and this worries or concerns most managers.

This study has, without a doubt, proved that security is on the radar for most IT leaders. Most organisations are vigilant considering the Internet security risks, which could come from the unknown and unmanageable situations in the manager's eyes. Furthermore the security measures, for instance tunnels with IP security (IPsec), might add overheads on bandwidth, necessitating upgrades, which might come at a cost. Thus, communications network security does not only cover risks, it comes at a cost and if not considered seriously or carefully might affect system availability and reliability.

7.3 Recommendations to stakeholders

The findings of this study cannot be ignored by IT managers, service providers nor is the academic community, if Internet based technology diffusion to be improved. In accordance with the results obtained from this study the following recommendations are in order.

7.3.1 Recommendations to IT leaders

This study has proved that communications network pricing and security are the main issues for consideration by managers. Managers should understand the implication of these two factors in order to strategically make beneficial decision for their organisations. These findings are not only applicable for Cloud Computing, however any Internet based Innovation or any Innovation that goes across a wide communications network will be affected by these two factors in one way or another. Some of the recommendations follow below:

- Cloud services are gradually becoming the new cost saving avenue for IT.
- To move services from the internal local area network might require an external wide area communication network, that is capable of performing as a local area network to maintain the same user experience. From a South African perspective, a wide area communications network like the one required for Internet is costly. Therefore

organisations must take careful consideration of their IT requirements relative to the organisational goals of managing costs.

- Communications network contention ratios must be fully assessed to maintain acceptable user experience before moving services to the Cloud.
- The old way of looking at security is gradually fading away; physical parameter security is not a major factor in the cyber space. Therefore, managers must start looking at security differently.
- Communication network pricing and security must be fully assessed by every organisation in order to compare benefits brought by Cloud Computing and to avoid unforeseen future upgrades that might escalate costs.

7.3.2 Recommendations to service providers

IT organisations have evolved, taking along its customers. It is almost obvious that service providers must also adapt to the changing environment. For an Internet innovation like Cloud Computing to grow, service providers cannot depend on selling technical capabilities only. Today customers are looking for value, services and solutions not new technology with non value adding gadgets. Points for service providers to consider:

- Non-technical factors are “key” in the adoption decision by most IT leaders as proven by this and other studies.
- Put value and cost savings ahead of all, in selling new technology.
- Give serious attention to price and security; ensuring that gaps are addressed as recommended by this study, particularly in Cloud Computing, to ensure quicker diffusion.
- Customer education is key to facilitating adoption of any technology. Most stumbling blocks on Cloud are addressed, but most customers are not informed about the improvements.
- Application builders should innovate in building applications that are suited for low bandwidth or communication network requirements as services move towards the Cloud.

7.3.3 Recommendations to academia

This study is unique in that it took a well-known topic that is lacking in literature and brought it to light. As stated in the literature, Internet in South African is mainly dominated by grey literature; it was therefore the aim of this study to contribute towards the building of literature

in a South African context. With respect to Internet based technology adoption theory the following proposals are recommended:

- Firstly, the communications network and its sub-factors are significant variables to consider when assessing the propensity for organisations or individuals to adopt an Internet based innovation. This study identified Communication Network pricing and Security as main factors.
- This study unearthed these two factors; there might be other factors that are communication network related that could add to the body of knowledge. The responsibility is with academia to unearth more constructs that can assist managers in making better future decisions in technology adoption.
- Adoption cannot be assessed for technology in isolation; the supporting building block across the technology value chain must form part of the assessment.
- Internet technology adoption models should be adjusted with the two factors found in this study to augment current adoption models.
- There is no one adoption model that can be generically used across all platforms and contexts, thus research must consider using mixed models to answer adoption issues.
- Internet Technology evolves daily, more studies are required in this field
- Demographic data such as firm size, leader's experience, leader's title or level and industry type do not have a significant impact on the decision to adopt technology.

7.4 Future research

- The findings of this study should be tested in other Internet based technologies; for instance hosted voice over IP (IP telephony) solutions, web hosted email, etc.
- The findings can be tested in other contexts similar to South Africa, like other African countries, to validate the factors.
- A longitudinal study will have to be conducted, for example in Cloud Computing, mainly to assess whether the factors still hold water as the technology matures in the long run.
- It is further expected that the communication network prices should drop as competition is introduced in the South African market. On the other hand, security measures should improve as the Cloud Computing technology gains ground. As technology evolves, it will be ideal for this study to be conducted under new conditions to validate the construct as outlined by this study
- A research that could be interesting could be for researchers to compare Adoption rates between different firm types.

- A Researcher can also focus on the influence of technical factors versus managerial factors in decision to adopt technology
- Today organisations are under pressure to manage their costs, an investigation into the changing role of price as the main adoption decider compared to other variables would be an interesting topic for future studies

7.5 Conclusion

The overarching question that the research sought to answer was:

Is the communication network a key component to consider in the adoption models/frameworks when assessing adoption of Internet based innovation?

From the results, it can be seen that the communications network cannot be ignored as a vital variable; it has serious implication to the future of Internet and its innovation. The study was very successful in delivering on its objectives, it is sincerely hoped that the results will contribute to IT leaders' future decision making, assist service providers in selling their product and become a stepping stone for future research in IT adoption decisions. It has added to the body of research by broadening existing Internet technology adoption models to cover a new construct called 'communications network'. Price and Security were identified as the main sub-constructs under communications network.

8 References

Alam, S. S. (2009). Adoption of internet in Malaysian SMEs. *Journal of Small Business and Enterprise Development, 16*(2), 240 - 255.

Albright, S. C., Wiston, W. L., & Zappe, C. J. (2009). *Data analysis decision making.* Mason, OH: South-Western Cengage Learning.

Anand, A., & Kulshreshtha, S. (2007). The B2C adoption in retail firms in India. *2007. ICONS '07. Second International Conference* (p. 46). Martinique: IEEE Conference Publications. doi:10.1109/ICONS.2007.55

Arinze, B., & Anandarajan, M. (2010). Factors that determine the adoption of cloud computing: A Global Perspective. *International Journal of Enterprise Information Systems (IJEIS), 6*(4), 55-68. doi:10.4018/jeis.2010100104

Armbrust, M., Fox, A., Griffith, R., Joseph, A D., Katz, R; Konwinski, A., Lee, G., Patterson, D., Rabkin, A., Stoica, I., & Zaharia, M. (2010). A View of Cloud Computing. *Communications of the ACM, 53*(4), 50-58. doi:10.1145/1721654.1721672

Baaren, E., Van der Winjngaert, L., & Huizer, E. (2011). Understanding technology adoption through individual and context characteristics: The case of HDTV. *Journal of Broadcasting & Electronic Media, 55*(1), 72-89.

Behrend, T. A., Wiebe, E. N., London, J. E., & Johnson, E. C. (2011). Cloud computing adoption and usage in community colleges. *Behaviour & Information Technology , 31*(2), 231-240. doi:10.1080/0144929X.2010.489118

Bhat, M. A., Bashir, A., Shah, R. M., & Bhat, I. R. (2010). Cloud computing a solution to information suppoer systems. *International Journal of Computer Appliation, 11*(5), 5-9.

Bisong, A., & Rahman, M. (2011). An overview of the security concerns in enterprise cloud computing. *International Journal of Network Security & Its Applictions, 3*(1), 30-45.

Brown, I. T., Letsididi, B. N., & Nazeer, M. N. (2009). Internet access in South African homes:A preliminary study of factors influencing consumer choice. *The Electronic Journal of Information Systems in Developing Countries (EJISDC), 38*(2), 1-13.

Buyya, R., Yeo, C. S., Venugopal, S., Broberg, J., & Brandic, I. (2009). Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering

computing as the 5th utility. *Future Generation Computer Systems, 25*(6), 599–616.

Chebrolu, S. B. (2010). *Assessing the relationships among cloud adoption, strategic alignment and information technology effectiveness* (Master's dessertation). Available from ProQuest® Dissertations & Theses database. (UMI No. 3426510)

Chong, A. Y., & Ooi, K. (2008). Adoption of interorganizational system standards in supply chains: an empirical analysis of RosettaNet standards. *Industrial Management & Data Systems, 108* (4), 529 - 547. doi:10.1108/02635570810868371

Comline, G. I. (2008). *An investigation into the effects that internet user experience, payment reliability and delivery reliability have on e-Commerce use in South Africa* (Master's dissertation), Retrieved from http://upetd.up.ac.za/thesis/available/etd-03102010-154135

Comptrib. (2012). *Telkom and Competition Commission*. Retrieved July 30, 2012, from Competition Tribunal, Republic of South Africa: http://www.comptrib.co.za/cases/procedure/retrieve_case/1233

Corrales, J., & Westhoff, F. (2006). Information technology adoption and political regimes. *International Studies Quarterly, 50*(4), 911-933. doi:10.1111/j.1468-2478.2006.00431.x

CSA (2012). Are enterprises really ready to move into the cloud. Retrieved July 30, 2012, from CSA: https://cloudsecurityalliance.org/wp-content/uploads/2012/02/Areenterprisesreallyreadytomoveintothecloud.pdf

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-340.

Di Giacomo, D., & Brunzel, T. (2010). *Cloud computing evaluation: How it differs to traditional IT outsourcing* (Master's Thesis). Jönköping University, Jönköping. Retrieved from http://urn.kb.se/resolve?urn=urn:nbn:se:hj:diva-12761

Diamatopoulos, A., & Schlegelmilch, B. B. (2000). *Taking the fear out of data analysis.* Andover, Hampshire, UK: Cengage Learning EMEA.

Dillon, T., Wu, C., & Chang, E. (2010). Cloud computing: issues and challenges. *2010 24th Ieee International conference on advanced Information Networking and Applications* (pp. 27-33). Perth: IEEE Conference Publications. doi:10.1109/AINA.2010.187

Dube, P. K. (2007). *Critical Evaluation of the Management of Pricing Policies in Telkom SA Ltd* (Masters dissertation). Retrieved from http://uir.unisa.ac.za/bitstream/handle/10500/90/2007%20MBL%20research%20report%20PK%20Dube%20Cover%20%26%20Contents.pdf?sequence=2

Erdogmus, H. (2009). Cloud computing: Does Nirvana hide behind the Nebula? *IEEE Journals & Magazines, 26*(2), 1-4.

Feuerlicht, G., Burkon, L., & Sebesta, M. (2011). *Cloud Computing Adoption: What are the Issues?* Retrieved from CISS.CZ: http://cloud-computing.vse.cz/wp/wp-content/uploads/IGA_2010_summary.pdf

Fourie, J. (2008). A note on infrastructure quality in South Africa. *Development Southern Africa, 25*(4), 481-494. doi:10.1080/03768350802318639

Gillwald, A. (2007). Between Two Stools: Broadband Policy in South Africa. *The Southern African Journal of Information and Communication (SAJIC)*(8), 53-77.

Gittlen, S. (2012). *Bandwidth bottlenecks loom large in the cloud*. Retrieved July 30, 2012, from Computerworld: http://www.computerworld.com/s/article/9223117/Bandwidth_bottlenecks_loom_large_in_the_cloud

Gliem, J. A., & Gliem, R. R. (2003). Calculating, Interpreting, and Reporting Cronbach's Alpha Reliability Coefficient for Likert-Type Scales. *2003 Midwest Research to Practice Conference in Adult, Continuing, and Community Education* (pp. 82-88). Columbus: Ohio State University.

Golden, B. (2009). *The Skinny Straw: Cloud Computing's Bottleneck and How to Address It*. Retrieved July 30, 2012, from CIO: http://www.cio.com/article/499137/The_Skinny_Straw_Cloud_Computing_s_Bottleneck_and_How_to_Address_It

Goscinski, A., & Brock, M. (2010). Toward dynamic and attribute based publication, discovery and selection for cloud computing. *Future Generation Computer Systems, 26*(7), 947-970.

Graham, J. W. (2009). Missing Data Analysis: making it work in the real world. *Annual Review of Psychology, 60*, 549-576. doi:10.1146/annurev.psych.58.110405.085530

Grobler, M., & Dlamini, Z. (2012). Global cyber trends a South African reality. *IST-Africa 2012*, (pp. 1-8). Dar es Salaam. Retrieved July 30, 2012, from http://researchspace.csir.co.za/dspace/handle/10204/5989

Hilgendorf, V., Reeves, D., & Blakley, B. (2012). *Defining Cloud Computing*. Retrieved July 30, 2012, from Gartner: http://www.gartner.com/DisplayDocument?id=1891414&ref=g_fromdoc

Idowu, I. b., Shi, Q., Merabti, M., & Kifayat, K. (2012). *Ad-Hoc cloud networks: A probabilistic model for vulnerability detection in critical infrastructure using bayesian networks.* Retrieved from Liverpool John Moores University: http://www.cms.livjm.ac.uk/pgnet2012/Proceedings/Papers/1569607177.pdf

InforWorls (2012). Apple iCloud breach proves Wozniak's point about cloud risks. Retrieved July 30, 2012, from InforWorld: http://www.infoworld.com/t/cloud-security/apple-icloud-breach-proves-wozniaks-point-about-cloud-risks-199450

Internetworldstats. (2012). *Africa*. Retrieved July 30, 2012, from Internet World stats: http://www.internetworldstats.com/africa.htm#za

Irwin, B. V. (2001). *Bandwidth management and monitoring for IP network traffic: An investigation* (Master dissertation). Retrieved from http://eprints.ru.ac.za/1969/1/barry_irwin_msc2001_thesis.pdf

Irwin, B., Siebörger, I., & Wells, D. (2010). Bandwidth management and monitoring for community networks. *Southern African Telecommunication Networks & Applications Conference.* Stellenbosch.

Jagun, A. (2007). Economic barriers to development: Cost of access to Internet infrastructure. *International Institute for Sustainable Development (IISD)*, 93-111.

Jianyuan, Y., & Zhaofang, Z. C. (2009). An empirical study on influence factors for organizations to adopt B2B e-marketplace in China. *Management and Service Science, 2009. MASS '09. International Conference on* , (pp. 1-6). Wuhan.

Julisch, K., & Hall, M. (2010). Security and control in the cloud. *Information Security Journal: A Global Perspective, 19*(6), 299-309.

Kim, W., Kim, S. D., Lee, E., & Lee, S. (2009). Adoption issues for cloud computing. *7th International Conference on Advances in Mobile Computing and Multimedia (MoMM '09)* (pp. 1-5). New York : ACM.

King, R. C., & Gribbins, M. L. (2002). Internet Technology Adoption as an Organizational Event:An Exploratory Study across Industries. *35th Hawaii International Conference on System Sciences*, (pp. 1-10). Hawaii.

Labuschagne, H. J. (2011). *The relationship between knowledge creation dimensions and the entrepreneurial performance of a local government institution in South Africa* (Doctoral thesis). Retrieved from http://upetd.up.ac.za/thesis/available/etd-05062012-094210/

Lease, D. R. (2005). *Factors influencing the adoption of biometric security technology by decision making information technology and security managers* (Doctoral Thesis). Available from ProQuest® Dissertations & Theses database. UMI No. 3185680).

Leavitt, N. (2009). Is Cloud Computing realy ready for prime time? *Computer, 42*(1), 15-20.

Leedy, P. D., & Ormrod, J. E. (2010). *Practical Research.* (I. Edition, Ed.) Upper Saddle River, New Jersey: Peaeson Education.

Lewis, C. (2005). Negotiating the net: The internet in South Africa (1990–2003). *Information Technologies and International Development, 2*(3), 1-28. doi:10.1162/1544752054782439

Lin, Y., & Chang, P. (2011). Maintenance reliability estimation for a cloud computing network with nodes failure . *Expert Systems with Applications, 38*(11), 14185-14189.

Low, C., & Chen, Y. (2011). Understanding the determinants of cloud computing adoption. *Industrial Management & Data, 111*(7), 1006-1023.

Mailonline (2012). Cloud safety: Internets storage service Dropbox admits security breach as fears grow over storing information online. Retrieved July 30, 2012, from Mailonline: http://www.dailymail.co.uk/sciencetech/article-2182229/Dropbox-Storage-service-admits-security-breach-fears-grow-storing-information-online.html

Motloutsi, V. M. (2009). *The state of IT governance in the top 20 IT spending companies in South Africa* (MBA dissertation). Retrieved from http://upetd.up.ac.za/thesis/available/etd-05062010-142632/

Myrtveit, I., Stensrud, E., & Olsson, U. H. (2001). Analyzing data sets with missing data: An empirical evaluation of imputation methods and likelihood-based methods. *IEEE Transactions on Software Engineering, 27*(11), 999-1013.

Nazari, G., & Karim, H. (2011). *Mission Possible: Becoming Green and Sustainable : An empirical study on Green IT Adoption and underlying factors influencing it* (Master's Dissertation) , Mälardalen University, Västerås. Retrieved from http://urn.kb.se/resolve?urn=urn:nbn:se:mdh:diva-14036

NIST. (2011). *Technical considerations for USG cloud computing deployment decisions.* Retrieved July 30, 2012, from National Institute of Standards and Technology: http://collaborate.nist.gov/twiki-cloud-computing/pub/CloudComputing/RoadmapVolumeIIIWorkingDraft/NIST_cloud_roadmap_VIII_draft_110311.pdf

Nortje, H. J. (2009). *Information environment of the teleworker* (Masters dissertation). Retrieved from https://ujdigispace.uj.ac.za/handle/10210/1852

Oliveira, T., & Martin, M. F. (2010). Understanding e-business adoption across industries in European countries. *Industrial Management & Data Systems, 110*(9), 1337- 1354.

Oliveira, T., & Martin, M. F. (2011). Literature Review of Information Technology Adoption Models at Firm Level. *The Electronic Journal Information Systems Evaluation, 14*(1), 110-121.

Optimus. (2012). *Bandwidth In South Africa Explained*. Retrieved July 30, 2012, Optimus01 : http://www.optimus01.co.za/bandwidth-south-africa-explained.html

Parikh, T. S. (2009). Engineering Rural Development. *Communications ACM,, 52*(1), 54-63.

Qaisar, S., & Khawaja, K. F. (2012). Cloud Computing: Network/Security threats and counter measures. *Interdisciplinary Jounal of Conteporary Research In Business, 3*(9), 1323-1329.

Rogers, E. M. (1995). *Diffusion of Innovation.* New York: The Free Press.

Rose, C. (2011). A break in the cloud? The reality of cloud computing. *International Journal of Management & Information Systems, 15*(4), 59-64.

Ross, V. W. (2010). *Factors influencing the adoption of cloud computing by decisions making managers* (Doctoral thesis). Avaialble from ProQuest® Dissertations & Theses database. (UMI No. 3391308).

Rubin, E. (2010). *After Security, Network Bandwidth is the Next Cloud Bottleneck*. Retrieved July 30, 2012, from CloudSwitch, Inc: http://www.cloudswitch.com/page/after-security-network-bandwidth-is-the-next-cloud-bottleneck

Saunders, M., & Lewis, P. (2012). *Doing research in business & management : An essesntial guide to planning your project.* Essex, , England: Prentice Hall.

Senatore, L. (2010). *A Critical Analysis of Factors Influencing Internet Diffusion in South Africa and its Implications on the Rollout of e-Government Services* (Masters dissertation). Retrieved from http://wiredspace.wits.ac.za/bitstream/handle/10539/8565/Dissertation.pdf?sequence=2

Subashini, S., & Kavitha, V. (2011). A survey on security issues in services delievery models of cloud computing. *Jounal of Network and Computer Applications, 34*(1), 1-11.

Sultan, N. A. (2010). Cloud computing for education: a new dawn. *International Journal of Information Management, 30*(2), 109-116.

Sultan, N. A. (2011). Reaching for the "cloud": How SMEs can manage. *International Journal of Information Management, 31*(3), 272–278.

Tan, J., Tyler, K., & Manica, A. (2007). Business-to-business adoption of e-commerce in China. *Journal of Information & Management, 44*(3), 332-352.

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education, 2*(1), 53-55.

Tobin, P. K., & Bidoli, M. (2006). Factors affecting the adoption of voice over internet protocol (VoIP) and other converged IP services in South Africa. *South African Journal of Business, 37*(1), 31-40.

Tornatzky, L., Fleischer, M., & Chakrabarti, A. k. (1990). *The process of technology Innovation.* Lexington: Books.

Tshaka, K. S. (2011). *Family influence factors and the propensity for nascent entreprenuership.* Masters Dissertation , University of Pretoria, Gibs, Pretoria.

Van Akkeren, J., & Cavaye, A. L. (1999). Factors Affecting Entry-level Internet Technology Adoption by Small Business in Australia – Evidence from Three CasesFactors Affecting Entry-level Internet technology adoption by small business in ustralia – Evidence from three cases. *Journal of Systems and Information Technology*, 33-48.

Venkatesh, V., & Bala, H. (2008). Technology Acceptance Model 3 and a research agenda on interventions. *Jounal of Decision Science, 39*(2), 273-315.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of Information Technology :Towards a unified view. *MIS Quarterly, 21(3)* , 425-478.

Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the Unified theory of acceptance and use of technology. *MIS Quarterly, 36*(1), 157-178. Retrieved July 30, 2012, from http://ssrn.com/abstract=2002388

Voas, J., & Zang, J. (2009). Cloud computing: new wine or just new bottle? *11*(2), 25-33.

Wang, W. Y., Rashid, A., & Chuang, H. (2011). Toward the trend of cloud computing. *Journal of Electronic Commerce, 12*(4), 238-242.

Wang, Y., Wang, Y., & Yang, Y. (2010). Understanding the determinants of RFID adoption in the manufacturing industry. *Technological Forecasting & Social Change, 77*, 803-815.

Wu, P. (2012). A mixed methods approach in technology acceptance research. *Journal of the Association for Information Systems, 13*(3), 172-187.

Wu, X., & Subramaniam, C. (2009). New Understanding of RFID Adoption and Infusion in Retail Supply Chain. *42nd Hawaii International Conference on System Sciences*, (pp. 1-10). Hawaii.

Youssef, A. E. (2012). Exploring cloud computing servicesand applications. *Journal of Emerging Trends in Computing and Information Services, 3*(6), 838-847.

Zikmund, W. G. (2003). *Business research methods 7th ed.* Ohio: Thomson South Western.

Zissis, D., & Lekkas, D. (2012). Addressing Cloud Computing Security Issues. *Future generation computer systems, 28*(3), 583-592.

9 Appendices

9.1 Appendix A: Permissions to use the Survey Instruments

Ross's Permission

On Apr 27, 2012 1:53 PM, "Virginia Ross" <rogart3@gmail.com> wrote:
Dear Madisa Ramagoffu,

Thank you for your interest in my dissertation. I would be glad to discuss my dissertation and potential ways to incorporate some of the concepts into your MBA research. I give you permission to use it as a reference, as long as you give proper credit.

Please be aware that my survey instrument is a modification of a survey instrument used by Dr. David Lease for his PhD research at Capella University, so it would be appropriate to also obtain his permission before using the survey instrument. You can contact him at DrDave@drdavidlease.com.

Best wishes on your graduate study.

Regards,

Dr. Virginia Ross

Lease's Permission

On Thu, May 10, 2012 at 3:08 PM, David R. Lease <dlease@verizon.net> wrote:

Hi Madisa:

Your topic sounds very interesting and quite timely. You have my permission to use my data collection iinstrument.

Best wishes for a successful research project!

Regards,
David

May 10, 2012 08:49:20 AM, madcap751@gmail.com wrote:

Hi Dr Dave

My name is Madisa Ramagoffu, I am a MBA student in University of Pretoria in South Africa. i was advised by Virginia Ross to request permission to use your survey instrument. I am doing a study in the following topic:

The impact of bandwidth related factors on Internet based technology in South Africa and other developing countries: A Cloud Computing perspective.

I therefore want to request to use a modified version of your survey, particularly due to its comprehensiveness and the vigorous validation and testing that it went through.

Your assistance in that regard will be appreciate

Regards
Madisa

9.2 Appendix B: Sample Questionnaire

The impact of network related factors on internet based technology in

Cover Note

Dear Respondent

I am a MBA student with the Gordon Institute of Business Science. I am conducting research on the impact of communication network related factors on internet based technology, especially Cloud Computing, in South Africa and other developing countries. The study will be anchored on cloud computing as a test technology.

As part of this research I would like to kindly invite you to complete a short survey on cloud communication network related factors. This will assist in understanding the factors that must be considered for internet based technology in the context of developing markets.

The survey will take approximately 15 minutes. Your participation is voluntary and you can withdraw at anytime without penalty. Please note that all data will be kept confidential. By completing the survey, you indicate that you voluntarily participate in this research.

For any questions please contact me or my supervisor. Our details are provided below:

Researcher Name: Madisa Ramagoffu
Email: ramagmm1@telkom.co.za
Phone : +27 81 355 3259

Research Supervisor Name: Roy Page-Shipp
Email: roy@pageshipp.co.za
Phone: +27 82 447 6289

Please continue by clicking the Next Button Below

The impact of network related factors on internet based technology in

About The Respondent

1. How many end users does your organisation support

- Less than 50 users
- 50 to less than 500 users
- 500 to less than 1000 users
- 1000 to less than 5000 users
- 5000 or more users

2. How many years of experience do you have in IT leadership (Decision Making)

- None
- 1 to 4 years
- 5 to 9 years
- 10 years +

*3. What best describes your job title?

- IT Assurance Manager
- Vice President of IT
- Director ICT/IT
- IT Director
- Chief Technology Officer (CTO)
- Deputy Director ICT/IT
- ICT Director
- Chief Information Officer (CIO)
- IT Project Manager
- IT Manager
- Chief Security Officer (CSO)
- Chief IT Architect
- Other (please specify)

4. What is the primary industry or activity of your organisation

- Construction
- Health Care
- Real Estate
- Education
- IT Manufacturing
- Mining and quarrying
- Electricity, gas & water supply
- IT Services
- Telecommunications
- Financial Services/Banking
- Manufacturing (Non-IT)
- Travel/Leisure/Hospitality
- Government
- Professional, technical, and Business Services (Non-IT)
- Wholesale and retail trade
- Other (please specify)

The impact of network related factors on internet based technology in

Section B: Experience with Cloud Computing

***5. Has your company implemented Cloud Computing**

- No
- Yes
- Thinking about it, planning to adopt in the next _____ years (number of years)

6. How many years of experience in implementing Cloud services technologies

- None
- Less than 2 yrs
- Two years to less than 5 years
- Five years or more

***7. Are you aware of the Cloud Computing Pricing components**

- Yes
- No

***8. Do you generally believe Cloud Computing will reduce your overall IT costs?**

- Yes
- No

9. Does your organisation have more that one office in South Africa/globally ?

- Yes
- No

10. What type of WAN connectivity do you have in your business?

- Business Dsl
- Metro Ethernet
- 3G
- Leased Lines
- Wireless
- Other (please specify)

The impact of network related factors on internet based technology in

Section C : Cloud Communication Network Factors

This page contains 10 questions, please answer all 10

***11. Bandwidth is generally expensive in South Africa**

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

12. Cloud Computing bandwidth services were seen to be expensive for my organisation 3 years ago

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

13. I am/would be concerned about bandwidth prices used by cloud computing

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

14. Bandwidth prices in SA might/erode the cost effectiveness of cloud computing services

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

15. Bandwidth prices will have a significant impact on the total cost of taking/putting services in the cloud

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

16. We normally experience network connectivity issues between our office branches

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

17. Network connectivity in South Africa is reliable

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

18. Reliable Cloud connection will/does provide a significant benefit to my organisation

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

***19. Connectivity issues will adversely affect the reliability of services in the cloud**

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

20. Network Infrastructure (WAN) availability is a significant factor in IT requirements for opening remote offices

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

21. Network Infrastructure is always available in required areas of my business

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

The impact of network related factors on internet based technology in

Section C:(Cont) Last Page

This page contains 9 questions, please answer all 9

22. Network Infrastructure is growing in all parts of the country

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

***23. Network infrastructure availability will adversely affect my decision to adopt Cloud Services**

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

24. Cloud computing communications networks are secured

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

25. I am/would be concerned with the security of the communication networks used by cloud computing

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

26. Cloud computing communication networks are more secure than traditional computing networks methods

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

27. Cloud computing communication networks were not secure three years ago

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

28. I would feel comfortable recommending Cloud Computing to my organisation

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

29. Cloud Computing uses proven Technology

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

30. Bandwidth is a significant/important variable when considering putting services on the Cloud / Internet

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

The impact of network related factors on internet based technology in

Thank you for your participation

Please email the researcher directly, if you required access to the results

----------Thank you for Participating ----------

9.3 Appendix C: Experts Profiles

Melody Fourie began her academic career studying Sports Science, prior to falling in love with IT. Fourie has worked in the IT industry for more than 17 years in various management and consulting roles. Career highlights have seen Fourie covering portfolios within training, business analysis, and from programming to business solutions architecture, prior to joining TWT as IT manager and later joining the board of executives. Fourie's key long-term responsibility is to focus on planning IT initiatives to ensure the organisation does not lose sight of the importance of IT. Her portfolio has recently expanded beyond IT, to include the management of strategic business projects with a key focus on aligning IT with business requirements.

Seaparo Phala is currently the Chief Information Officer for the Department of Arts and Culture. He is also the Chairperson for the Standing Committee on Knowledge and Information Management for the Government IT Officers Council (GITOC). He has held various positions in government including serving as Manager: Information Systems Development as well as a Deputy Director: Knowledge Management.

Thabo Ndela is the group CIO for the Sun International Group. He has more than 15 years of business and technology experience in banking, consulting and engineering. Ndela is a member of the Sun International Management Limited Board, Sun International Limited Risk Committee and IT Governance Committee. He has held positions of CIO at Absa Bank and SABC; executive director at Volition and Engineering Management at Nampak, among others. Ndela holds a BSc Electrical Engineering degree, Masters in IT and is studying towards a PhD in Commerce at the University of Cape Town. Ndela is a member of the South African Engineering Council, South African Institute of Electrical Engineer and Institute of Directors. He is a frequent speaker at technology and supply chain management conferences.

Abel Jordaan: currently oversees a group of high-level Internetworking specialists responsible for managed customer IP data networks in Telkom SA. Jordaan fulfilled many roles during his 20 years of supporting, designing and building enterprise, customer and subsidiary IP networks. He achieved the coveted Cisco Routing and Switching CCIE certification and became Telkom's first CCIE. Further highlights include the involvement in special investigation teams, establishing and being responsible for integrating the first MDNS customers and building a platform for one of Telkom's flagship managed products of today, namely VPNS. Other start-up initiatives include the build and support of the Internetworking portion of Intekom; the original Telkom Internet LAN and WAN networks.

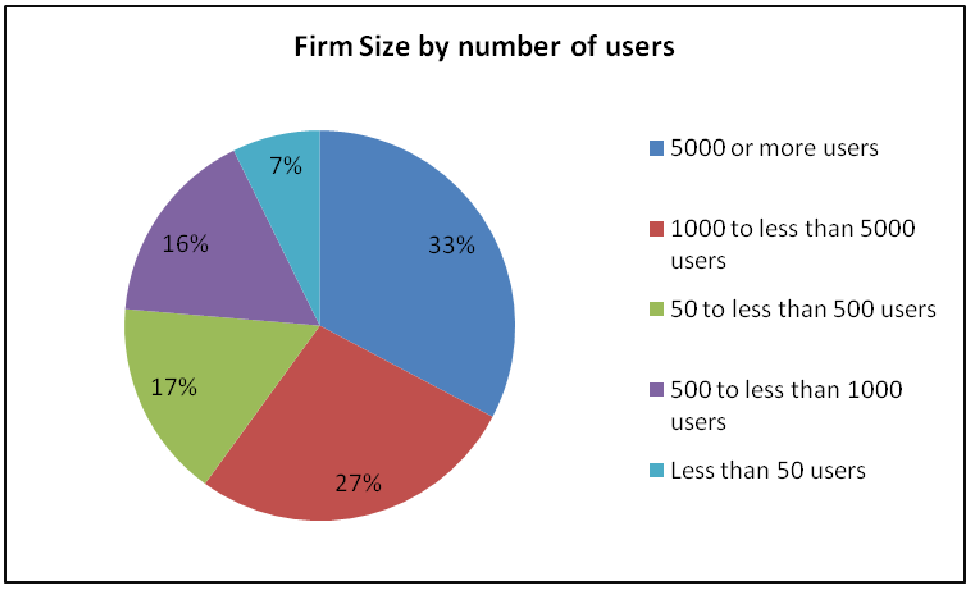
Len De Villiers: has 25 years experience in the IT industry and was educated at RAU, Wits, Insead (France) and Harvard (USA). He began his career in 1978 in IT management positions at BP, Metro Cash and Carry and Gencor. In 1986 he joined First National Bank as GM of IT, followed by 3 years as MD of Microdata and Executive Director at Datakor Holdings. In 1993 he joined the Nedbank Group as GM of Technology and Architecture and progressed to Managing Director of Central and Branch Operations for the entire Nedcor Group. He won several top achiever awards as well as the CEO award in 1998. He was appointed MD of Nedbank Group Operations in 2003 and as MD of Nedbank's Group Technology and Support Services from August 2004 until September 2008. He left as the Group CIO and joined Absa Bank in August 2008 as the Group CIO. He piloted a 5-year Strategic Technology Plan for the Absa Group articulating the technology plans and initiatives necessary to create and support the underlying technology required for the new "One Absa" Strategy. In 2009 he was voted The Most Admired CIO in South Africa by the CIO Council of SA consisting of the Top 200 CIO's in South Africa. He left the Absa Group as the Group CIO and joined Bayport Financial Services as the Group CIO during January 2012.

Gary Bradshaw: is a high level support specialist at Telkom's Network Operations Centre. He is responsible for the Operational Support Systems underpinning the IP/VPN based service offerings. He has over 20 years' experience in the Telecommunications Industry having started his career in the packet-switched data networks (X.25, frame relay, etc.) and quickly moved onto Internet Protocol technologies where he was instrumental in deploying Telkom's MPLS/VPN network and associated supporting management systems. He heads up the fault management team from an operational, technological, process and strategic perspective. In this role he is heavily involved in projects such as the FIFA Confederations Cup 2009 and the upcoming FIFA World Cup 2010." Qualifications: National Diploma Electrical Engineering. He is currently managing the core mobile networks team.

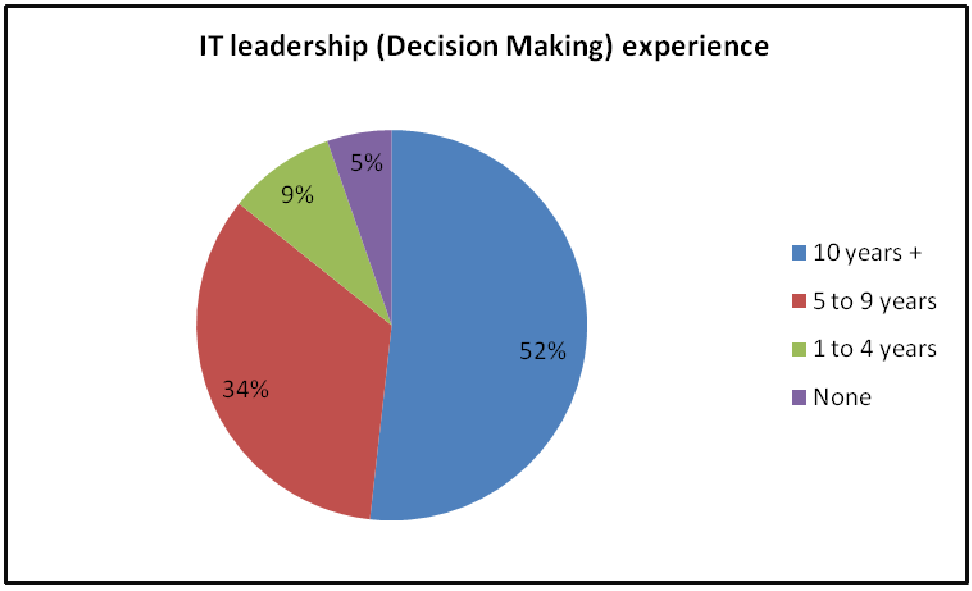
John Pimenta: Currently holds 25 years of experience in the telecommunications industry. He is responsible for the strategic leadership of high level support in areas of core telecommunications Network and Services specifically for Broadband, NGN products and IP services. Currently holds a master degree with in Management of Technology and Innovation specifically for Broadband, NGN products and IP services. Currently holds a Master Degree in Management of Technology and Innovation

9.4 Appendix D: Graphical Representation

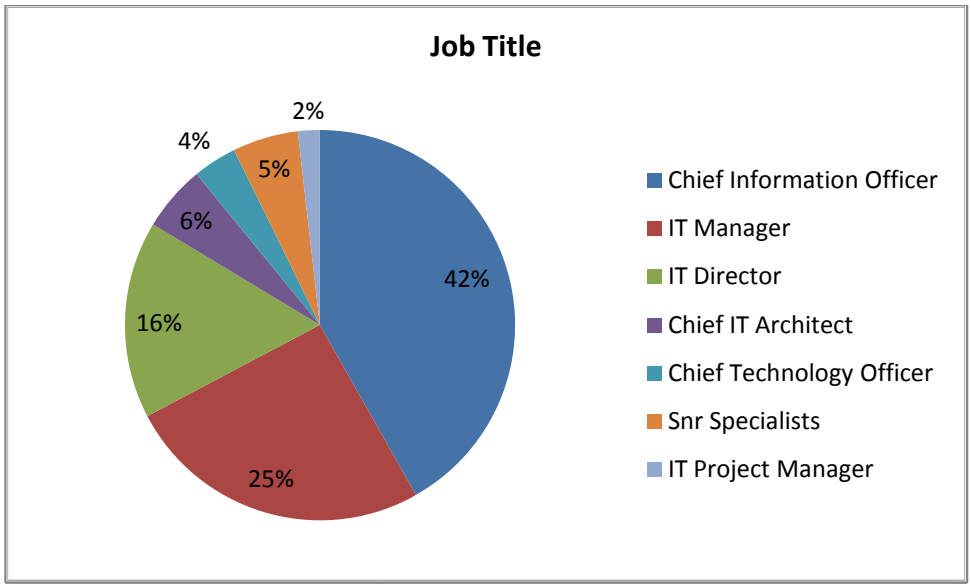
Graphic representation of Table 5.1



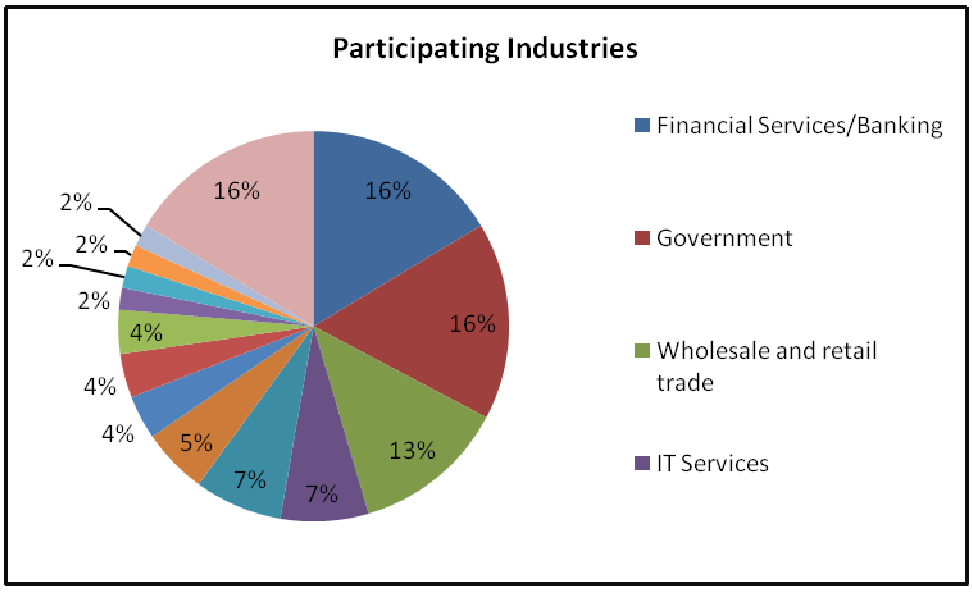
Graphic representation of Table 5.3



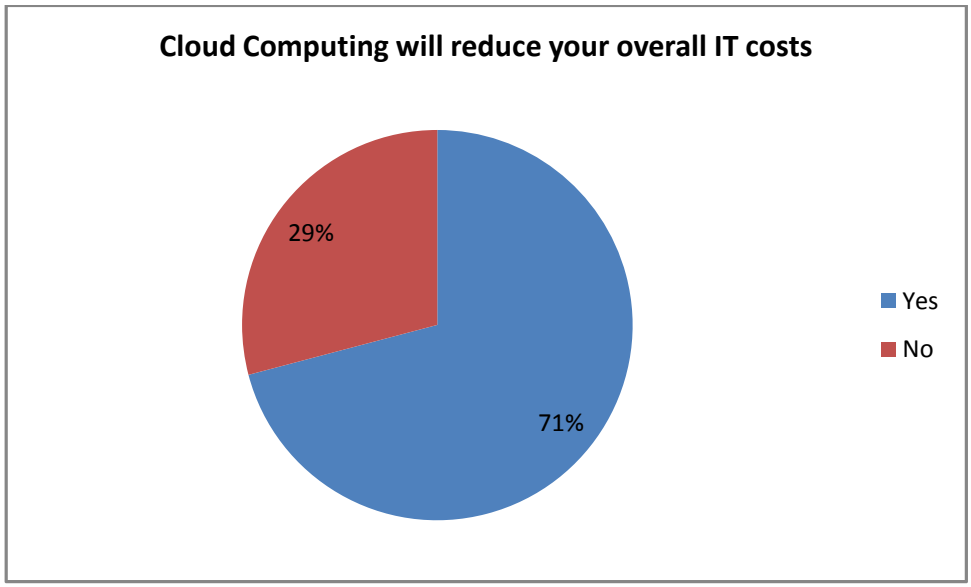
Graphic representation of Table 5.5



Graphic representation of Table 5.7



Graphic representation of Table 5.11



9.5 Appendix E: Reliability Test

Original Reliability Tests

Communications Network Pricing

TableD.1: Reliability Statistics for pricing

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.762	.767	5

Table D.2: Pricing Items Statistics

Survey Questions: Price	Mean	Std. Deviation	N
Bandwidth is generally expensive in South Africa	4.1667	1.15470	48
Cloud Computing bandwidth services were seen to be expensive for my organisation 3 years ago	3.8333	1.03827	48
I am/would be concerned about bandwidth prices used by Cloud Computing	3.7500	1.00000	48
Bandwidth prices in SA might erode the cost effectiveness of Cloud Computing services	3.7083	1.00970	48
Bandwidth prices will have a significant impact on the total cost of taking/putting services in the cloud	3.8333	1.01758	48

Table D.3: Pricing construct with one Item deleted

Survey Questions: Attitude towards cloud	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Bandwidth is generally expensive in South Africa	1.000	.343	.405	.243	.314
Cloud Computing bandwidth services were seen to be expensive for my organisation 3 years ago	.343	1.000	.205	.156	.436
I am/would be concerned about bandwidth prices used by Cloud Computing	.405	.205	1.000	.537	.606
Bandwidth prices in SA might/erode the cost effectiveness of Cloud Computing services	.243	.156	.537	1.000	.718
Bandwidth prices will have a significant impact on the total cost of taking/putting services in the cloud	.314	.436	.606	.718	1.000

Communications Network Reliability

Table D.3: Reliability Statistics for reliability construct

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.066	.128	4

Table D.4: Reliability Items Statistics

Survey Questions: Price	Mean	Std. Deviation	N
We normally experience network connectivity issues between our office branches	3.0213	1.05273	47
Network connectivity in South Africa is reliable	3.3191	.88726	47
Reliable Cloud connection will/does provide a significant benefit to my organisation	4.1702	.70152	47
Connectivity issues will adversely affect the reliability of services in the cloud	4.1702	.91649	47

Table5.5: Reliability with one Item deleted

Survey Questions: Pricing	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
We normally experience network connectivity issues between our office branches	11.6596	2.490	-.061	.281	.223
Network connectivity in South Africa is reliable	11.3617	3.540	-.279	.233	.466
Reliable Cloud connection will/does provide a significant benefit to my organisation	10.5106	2.255	.308	.115	-.319a
Connectivity issues will adversely affect the reliability of services in the cloud	10.5106	1.734	.341	.149	-.566a

Communications Network Infrastructure Availability

Table D.6 : Availability Statistics for availability

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.364	.332	4

Table D.7: Availability Items Statistics

Survey Questions: Availability	Mean	Std. Deviation	N
Network Infrastructure (WAN) availability is a significant factor in IT requirements for opening remote offices	4.5000	.61885	48
Network Infrastructure is always available in required areas of my business	3.4583	1.11008	48
Network Infrastructure is growing in all parts of the country	3.7708	.92804	48
Network infrastructure availability will adversely affect my decision to adopt Cloud Services	3.8125	.84189	48

Table D.8 : Availability with one Item deleted

Survey Questions: Pricing	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Network Infrastructure (WAN) availability is a significant factor in IT requirements for opening remote offices	11.0417	3.998	.000	.031	.449
Network Infrastructure is always available in required areas of my business	12.0833	2.376	.226	.146	.267
Network Infrastructure is growing in all parts of the country	11.7708	2.478	.356	.165	.093
Network infrastructure availability will adversely affect my decision to adopt Cloud Services	11.7292	3.095	.195	.057	.300

Communications Network Security

Table D.9: Security Statistics for security

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.031	.018	4

Table D.10: Security Items Statistics

Survey Questions: Security	Mean	Std. Deviation	N
Cloud Computing communications networks are secured	3.3191	.78315	47
I am/would be concerned with the security of the communication networks used by Cloud Computing	3.7660	1.04700	47
Cloud Computing communication networks are more secure than traditional computing networks methods	2.9149	.99629	47
Cloud Computing communication networks were not secure three years ago	3.1489	.83350	47
Cloud Computing communications networks are secured	3.3191	.78315	47

Table D.11: Security with one Item deleted

Survey Questions: Pricing	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Cloud Computing communications networks are secured	9.8298	2.666	.077	.469	-.066a
I am/would be concerned with the security of the communication networks used by Cloud Computing	9.3830	2.502	-.037	.270	.121
Cloud Computing communication networks are more secure that traditional computing networks methods	10.2340	1.966	.186	.479	-.335a
Cloud Computing communication networks were not secure three years ago	10.0000	3.217	-.145	.173	.240

Attitude towards Cloud Computing

Table D.12: Attitude Statistics for attitude towards cloud

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.426	.412	3

Table D.13: Attitude towards cloud **Items Statistics**

Survey Questions: Attitude towards cloud	Mean	Std. Deviation	N
I would feel comfortable recommending Cloud Computing to my organisation	3.9375	.75530	48
Cloud Computing uses proven Technology	3.6667	.72445	48
Bandwidth is a significant/important variable when considering putting services on the Cloud / Internet	4.2917	.68287	48

Table D.14: Attitude construct with one Item deleted

Survey Questions: Attitude towards cloud	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
I would feel comfortable recommending Cloud Computing to my organisation	7.9583	.892	.503	.280	-.223[a]
Cloud Computing uses proven Technology	8.2292	1.244	.255	.257	.333
Bandwidth is a significant/important variable when considering putting services on the Cloud / Internet	7.6042	1.606	.062	.089	.636

Components Reliability Test

Communications Network Pricing

Table D.15: Reliability Statistics for Pricing

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.771	0.771	5

Table D.16: Pricing Statistics

Survey Questions: Attitude towards cloud	Mean	Std. Deviation	N
Bandwidth is generally expensive in South Africa	3.74	.620	54
Cloud Computing bandwidth services were seen to be expensive for my organisation 3 years ago	3.59	.659	54
I am/would be concerned about bandwidth prices used by Cloud Computing	3.61	.685	54
Bandwidth prices in SA might/erode the cost effectiveness of Cloud Computing services	3.57	.662	54
Bandwidth prices will have a significant impact on the total cost of taking/putting services in the cloud	3.67	.673	54

Table D.17: Pricing with one Item deleted

Survey Questions: Pricing	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Bandwidth is generally expensive in South Africa	15.3148	9.390	.428	.772	15.3148
Cloud Computing bandwidth services were seen to be expensive for my organisation 3 years ago	15.6111	9.865	.407	.775	15.6111
I am/would be concerned about bandwidth prices used by Cloud Computing	15.7593	8.941	.616	.704	15.7593
Bandwidth prices in SA might/erode the cost effectiveness of Cloud Computing services	15.7963	9.260	.561	.723	15.7963
Bandwidth prices will have a significant impact on the total cost of taking/putting services in the cloud	15.6667	8.340	.736	.661	15.6667

Communications Network Security

Table D.18: Security Statistics for Pricing

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.570	0.570	5

Table D.19: Security Statistics

Survey Questions: Attitude towards cloud	Mean	Std. Deviation	N
Cloud Computing communication networks are more secure that traditional computing networks methods	3.74	.620	54
Cloud Computing communication networks were not secure three years ago	3.59	.659	54
Cloud Computing communications networks are secured	3.67	.673	54

Table D.20: Security with one Item deleted

Survey Questions: Pricing	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Cloud Computing communication networks are more secure that traditional computing networks methods	6.1111	1.497	.502	.250	6.1111
Cloud Computing communication networks were not secure three years ago	6.1481	2.242	.297	.585	6.1481
Cloud Computing communications networks are secured	5.6667	2.189	.360	.501	5.6667

Communications Network Availability

Table D.21: Avaialbility Statistics for Pricing

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.570	0.570	5

Communications Network Reliability

Table D.22: Reliability Statistics for Pricing

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.570	0.570	5