Cloud Adoption for Organisations in the eThekwini Area

By

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DECLARATION

With the signature below, I Thuthukani Mngomezulu, hereby declare that:

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Date: 04 November 2022

ACKNOWLEDGEMENTS

One of the greatest man innovators to have ever lived, Sir Issac Newton once said, for some individuals to see further than others, it is by standing upon the shoulders of giants, and this is exactly how I felt about this research project. Having an idea is one thing, but making that idea make sense and then developing the idea, processing the idea, testing the idea, and then presenting the idea is something completely different, and this could not have been possible if I had not been standing on the shoulders of giants.

I would like to express my deepest gratitude to Dr Karunagaran Naidoo, who helped transform the idea I had into a research project, it was not easy and there were many challenges we encountered along the way but he never gave up on me, he saw the bigger picture and he always made sure I keep my eyes on the ball and continue to work hard. Dr Naidoo has certainly been a great giant in this journey and was with me all the way, and I thank you.

To my wife, my hero, my cheerleader, we had great challenges along the way, even when I considered giving up, you were my rock, always reminding me I still need to finish what I started and make you proud one more time.

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Abstract

Cloud computing is a computing model that enables developing countries to open new business ventures without having to spend extensive amounts of money in upfront capital investment; "cloud computing is a practical approach to experience direct cost benefits, and it has the potential to transform a data centre from a capital-intensive set up to a variable priced environment. The main character of cloud computing is in the virtualization, distribution and dynamically extendibility" (Chauhan, 2012, p. 1). Of all the models that utilise the network as means for delivering computing resources, cloud computing is the best one yet; the cloud is more scalable and allows consumers to add and remove resources as their computational needs change without impacting business processes (Nuseibeh, 2011). There are other opportunities that organisations stand to benefit from cloud computing adoption, but in spite of all the opportunities, the rate at which organisations are adopting cloud Computing is increasing at a slower pace than expected in South Africa. From the statistics released in 2018 by the Business Software Alliance (BSA) and Global Cloud Computing Scorecard, it was highlighted that South Africa had fallen behind in its efforts to adopt Cloud Computing and different reasons were highlighted as a cause of this lag (BSA, 2018).

This research study aimed to investigate potential issues that impacted the organisation's desire to adopt the cloud resulting in the low adoption rate. The technology-organisation-environment (TOE) framework was the framework that was used in this research study. Four research questions were developed as part of achieving the objectives for this research study. A sample of organisations in the KwaZulu-Natal province was identified for this research study using the convenience sampling technique and an online survey hosted in Survey Monkey was sent out to the selected organisations. The collected data were analysed using SPSS tools. After analysis was performed on the data, it was found that most challenges that organisations faced were from external factors like infrastructure readiness, which organisations had no control over. Internal challenges also affected the organisation's adoption and usage of the cloud, but when data was grouped according to either belonging to the internal or external group, it was found that external issues affected organisations more than internal issues.

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ABBREVIATIONS

TAM	The Technology Acceptance Model is an information systems theory that is used to determine how users accept and use a technology.
SPSS	Statistical Package for the Social Sciences
BSA	Business Software Alliance.
IT	Information Technology.
ITC	Information and Communications Technology.
ICASA	Independent Communications Authority of South Africa.
PaaS	Platform as a Service.
SaaS	Software as a Service.
IaaS	Infrastructure as a Service.
SLA	Service Level Agreement.
CSP	Cloud Service Provider.

Chapter 1: Introduction

The overall structure of this research study is discussed in this chapter. This chapter introduces each chapter and gives a brief write-up of what was covered in the document. The background of the study is highlighted, including the short history of how technology was initially invented and the improvements that occurred overtime which laid a foundation for the cloud model. In addition, the problem statement will also be discussed, providing a comprehensive definition of the problems as well as the research questions and researcher objectives. Lastly, the theoretical framework adopted in this research study will be discussed. The chapter further explained the relevance of this research providing a brief review of the literature and highlighting identified gaps that were identified by this research. Moreover, a description of how the literature review was conducted will also be discussed, highlighting some of the key search terms that were used to find literature. This chapter will further provide a brief discussion of the research methodology. A brief description of the intended population for this study was provided and indicated how the population was identified and how the sample was selected. The tools used to analyse the data will also be discussed and the data analysis process that was utilised. Finally, the chapter will end with ethical considerations explaining the steps taken by the researcher on issues concerning research ethics.

1.1 Background

Cloud computing was introduced to further the role that IT played in organisations, the cloud was “by far” the most innovative model for delivering technology to organisations (Nuseibeh, 2011). Some factors acted as enablers for the adoption of the cloud that organisations required as prerequisites before moving to the cloud. These enablers included infrastructural and technology readiness requirements which some were not entirely in the control of the organisations. There were also policy and compliance considerations that governed the use of client personal information that organisations needed to adhere to; although these considerations had always been there but they were magnified due to the nature of the cloud model (Nicholas, 2013). With the adoption of the cloud model, organisations had multiple and unique challenges to deal with which included socio-economic issues, tax related issues, security concerns, trade agreements, protection of personal information policies, trade and competition implications, reliable power supply, cost of internet, broadband infrastructure requirements, and reliable network infrastructure (Peña-López, 2014). Given the challenges

that organisations were expected to deal with when adopting the clou, researchers such as BSA (2018), Mujinga (2013), and Allan, Loot, and Maxine (2016) conducted studies that evaluated the challenges that South African organisations faced when adopting and using cloud computing services. The BSA Software Alliance reported on some of the specific issues that affected South African organisations, how these organisations affected the organisation, and how that has contributed to the decrease in the adoption of the cloud. The focus for this research study was to take some of the factors that were highlighted by BSA (2018) as major contributors to the low cloud adoption rate in South Africa and investigate if these issues affected organisations in the eThekwini area.

1.2 Problem Statement

Cloud computing was believed to be a significant tool for developing countries in improving their access to first-world technology at reasonable costs. It was also suggested that the cloud would change how organisations conducted their day-to-day activities by reducing the cost of accessing first-world technology and improving the overall state of the economy since it enabled organisations to accomplish their goals at an affordable cost (Yeboah-Boatgeng & Essandoh, 2013). According to Nicholas (2013) and BSA (2018) there has been a lack of willingness to adopt cloud computing by many South African organisations and this has prompted the need for this research study. This research sought to understand why the rate of adopting cloud computing is decreasing among South African organisations, and this decrease was highlighted by the BSA when comparing findings on cloud computing adoption by different countries from 2013, 2016, and 2018. An article by Nicholas (2013) titled "SA falls behind on cloud computing", examined South Africa's current position in the BSA cloud computing adoption and cloud usage rankings. Nicholas (2013) stated that South Africa ranked 20th out of 24 leading IT economies in terms of cloud adoption and usage, this was a drop from the previous year's position of 18th. South Africa initially ranked higher in 2016, it was number 14 ^{out} of the 24 countries that were included in the study. But in 2018 the rate at which South African organisations adopted the cloud decreased and it ranked 15^{nth} out of 24 countries, a drop from its previously held position in 2016 (BSA, 2018). The BSA used benchmarks which were tracked over time to determine the rankings of each country as far as cloud computing adoption was concerned, and from the latest report from the BSA Software Alliance there was a drop in key benchmarks which was caused the lack of initiatives by organisations to adopt the cloud, and thus indicated a decrease in cloud adoption by South African organisations.

Literature that was reviewed which focused on the adoption of cloud computing by South African organisations, revealed that the majority of studies focused on small-medium sized enterprises and how they were managing the adoption of the cloud and how the cloud could improve their business models, with researchers such as Yeboah-Boatgeng and Essandoh (2013), Mujinga (2013), Mohlameane and Ruxwana (2014), and Matandela (2017) in their respective articles focusing on how cloud computing could be used by small and medium enterprises (SMEs). The other pattern that was discovered in reviewing the literature is that studies that focused on bigger organisations chose only one organisation in one business sector and did not diversify the targeted population, with researchers such as Van der Merwe (2013) choosing to focus on one organisation within one sector. In addition, some of the literature reviewed for this research focused primarily on the technology side of cloud computing and neglected the business side of the cloud.

The aim of the research study was to understand which factors affected organisation's intentions to adopt the cloud. This was done by focusing on four main areas that the BSA (2018) had stated that South Africa were struggling with the most and which contributed to the drop in the country's cloud adoption rankings; these were security concerns, compliance issues, IT readiness – broadband deployment, and even though not explicitly mentioned but some of the issues listed on the BSA benchmark card touched on the cloud vendor, and also the internal management steering of the organisation. The research sought to further establish how these issues were restricting organisations from adopting cloud computing, and what challenges relating to these issues did organisations face. Even though there were other challenges that organisations face when adopting the cloud, for this research study the focus was on the four listed since these have been noted by the BSA (2018) to have an influence on the state of the South Africa cloud market, and this research study sought to dig deeper and determine how these factors affected the adoption of the cloud from the consumer's perspective.

1.3 Research Questions

Main research question: How do the listed challenges affect the organisation's adoption and usage of the cloud?

1.3.1 How does bandwidth affect cloud computing adoption?

1.3.2 What role does executive management play in the adoption of cloud computing?

1.3.3 How does cloud provider conduct affect the organisation's decision to adopt cloud computing?

1.3.4 What role does security play in an organisation's decision to adopt cloud computing?

1.4 Research Objectives

Main research objectives: Finding out how the potential challenges that have been identified affect the organisation's adoption and usage of the cloud.

1.4.1 Assess the impact of bandwidth on the adoption of cloud computing.

1.4.2 Determine the role that executive management play in the adoption of cloud computing.

1.4.3 Determine what impact does cloud provider conduct have on an organisation's intention to adopt cloud computing.

1.4.4 Determine the impact that security concerns have on an organisation's intention to adopt cloud computing.

1.5 The Theoretical Framework

The technology-organisation-environment framework was the framework that was used for this research study. The model explained how the adoption of technology affected the different parts of the organisation, and to fully understand the overall impact of cloud computing to organisation, a framework that focused on not just only technology was needed for this research study. The model encompasses all the key elements of the technology, organisation,

and environment (TOE) framework. A detailed discussion of the framework and why it was chosen is presented in chapter 3.

1.6 Contribution of the Study

The identified patterns and gaps in the literature that was reviewed, which was highlighted in the problem statement section, for this research study justified the need for this type of study, even though not all the identified gaps will be addressed but the study was built upon some of the identified gaps. This research focused on organisations that were adopting or had already adopted the cloud and the challenges that these organisations encountered prior to, during, and after having adopted the cloud. Unlike literature that was reviewed, this research study focused more on the organisations instead of just the technology, and in this research study organisations of different sizes and economic sectors were targeted in order to diversify the findings, something that was lacking from the reviewed literature.

1.7 Research Methodology

1.7.1 Sample size

A sample was taken to find answers to the research questions that have been raised. Sample size calculation is the process of working out the number of respondents needed from the population in order to get research data that is representative of the entire population (Gogtay, 2010). In a non-probability study sample calculations are not an exact number that had to be selected but were instead an approximation of what could be used as a source of data. The size of the population in this research study consisted of organisations that were listed in the Durban Chamber of Commerce. The list of organisations in the Durban Chamber of Commerce consisted of company names, contact details, location, number of employees and the economic sector within which the organisation belonged (Durban-Chamber-Of-Commerce, 2017). Using convenience sampling, five organisations from the KwaZulu-Natal province were selected to participate in this research study. The selected organisations at the time of conducting this research study employed an estimated total number of 200 IT employees, which was the intended audience for data collection. The targeted audience for data collection were IT departments from the respective organisations, and in total 200 employees were available to participate in this research study, from which a sample of 132 employees was calculated for this research study, and this was achieved using Sekaran and Bougie's table, with a 95%

confidence interval and a 5% margin of error (Sekaran & Bougie, 2010).

1.7.2 Sampling strategy

Sampling strategy is a technique used to select an appropriate and correct sample from a population that is being studied (Alvi, 2016). In research, there are two sampling strategies that a researcher can use, and that is probability and non-probability sampling. A non-probability sampling method was used for this study; with non-probability sampling method "every unit of the population does not get an equal chance of participating in the investigation, this is because no random selections are made. The selection of the sample is made on the basis of subjective judgement of the investigator" (Alvi, 2016, p. 13). Non-probability sampling does not require that the population be very precisely defined, this makes it easy for the researcher to identify the population and sample. Probability sampling is a method that represents a case where all members in a population have an equal chance of being selected to take part in the study or sample (Alvi, 2016). There were different procedures that fall under the non-probability sampling method that were available for usage and these included incidental sampling, purposive sampling, snowball and quota sampling, and convenience sampling (Alvi, 2016). In this research study, convenience sampling was used. Convenience sampling technique "refers to the collection of information from members of the population who are conveniently available to provide it" (Kuma et al., 2014, p. 38). The "convenience" of the sample is determined by the criteria that the researcher uses such as accessibility, proximity, willingness to participate in the study, and the ability to provide the needed information for the research study. This method was chosen because organisations listed in the Durban Chamber of Commerce were widely spread and it was more convenient to select one specific area and focus on that area due to time and financial constraints for the researcher. The convenience sampling technique is quite useful where the target population is made up of unique and broad categories, just like in this study where organisations were of different sizes and formed part of different economic sectors.

1.7.3 Field work

The data was collected from organisations in the KwaZulu-Natal province which were chosen from a group of organisations listed in the Durban Chamber of Commerce website, and they were chosen based on the predefined criteria. The sampled organisations were selected using convenience sampling and an online questionnaire was sent to the sampled organisations. The researcher was assisted by department heads with the distribution of the questionnaire within

each organisation. Responses were captured and administered on the Survey Monkey website.

1.8 Ethical consideration

Ethical approval was obtained from the University of KwaZulu-Natal Ethics Committee. The researcher also secured a gatekeeper's letter from the organisations selected for the study. To ensure that organisational and human dignity is upheld, the intention of the research was discussed in detail. The organisations participating in the study signed an informed consent to show that they are voluntarily taking part and that they understand the purpose of the study. Maintaining confidentiality and privacy was a major priority, and the researcher ensured that all necessary issues related to ethics were observed.

1.9 Structure of dissertation

Chapter 1 introduced the study by discussing in detail the essential aspects of the study; which were the problem statement, the research questions, and the research objectives. The chapter also described the research design as well as the steps followed in conducting the study.

Chapter 2 discussed the different literature that was reviewed in conducting this research study. The chapter also discussed what cloud computing is, how the cloud works, and what are the important factors for the cloud to function correctly.

Chapter 3 discussed the theoretical frameworks that were considered for this research study, and also why some of these frameworks were not used in this research study. The chapter closed off by discussing why the framework that used was chosen.

Chapter 4 discussed the research methodology, the processes that were followed in order to conduct this research study.

Chapter 5 presented the results and the analysis of the data. The chapter also discussed how the research framework was key in analysing the findings for this study.

Chapter 6 explained the limitations, conclusion based on the findings, and recommendations for future studies.

1.10 Definition of key terms

TAM	The Technology Acceptance Model is an information systems theory that is used to determine how users accept and use a technology.
UTAUT	The unified theory of acceptance and use of technology is a technology acceptance model that aims to link user intentions and sub-sequent usage behaviour.
TOE	The technology-organisation-environment framework describes process by, which organisations adopt and implement innovations.

1.11 Conclusion

The overall structure of this research was highlighted in this chapter, with a brief description of each chapter giving an indication of what every chapter entails and how it aligned with the research strategy and objectives. The background of the cloud and research study was also highlighted. In addition, this chapter also explored the short history of how technology was invented and how improvements were made overtime which led to the introduction of a model such as the cloud model. The problem statement was defined, highlighting the steps to establish the problem. The problem statement highlighted the decrease in the adoption of the cloud, and the potential issues that may have directly affected the adoption of the cloud. It was further explained that this research study was going to do an investigation on some of the highlighted issues to measure the extent of the influence they had on the adoption of the cloud. The TOE framework was the chosen framework for this research study. The TOE framework was used as a guide in formulating the research questions for this research study and also designing the research instrument. Moreover, the steps taken in finding literature were explained. The research methodology was also discussed explaining the different steps that were followed in conducting this study. The targeted population was also indicated and how it was identified as well as how the correct sample was chosen for this research study. At the end of this study, the intention was to better understand some of the challenges that organisations faced in their use and adoption of the cloud. With the use of the TOE framework the study was able to determine if organisations struggled with technology, organisation, or environmental issues the most. The finding also highlighted if the issues came from inside or outside of the organisation and this

was done to determine if they were within the organisation's control. The next chapter touched on the literature that was reviewed as part of conducting this research study, and how some of the findings from this literature assisted in building a case for this research study.

2 Chapter 2: Literature Review

2.1 Introduction

In chapter one a brief discussion of the literature review was discussed focusing on how the literature review was conducted and what search terms were used to find the right literature for the research study. This chapter presents the literature that was reviewed and discusses how other researchers approached the cloud computing subject in their respective studies. This chapter discusses the theoretical background of the cloud; this section will go over the different definitions of cloud computing and will close off the section by discussing the definition that was chosen for this research study. The next section discusses the benefits and challenges of adopting the cloud. This section will look at past literature that has discussed the adoption process for the cloud and how these adoption initiatives in different sectors of economies benefited the adopting organisation, and also highlighting some of the challenges that these organisations faced when trying to adopt the cloud or using cloud services. The chapter also discusses the overview of the cloud. In this section the history of the cloud was covered, highlighting key moments in the growth of network based model, which eventually resulted in a stable cloud model. The building blocks for the cloud will be discussed in this section, while also highlighting the different characteristics that have built the cloud model and which act as pillars for the cloud.

The cloud service and deployment models will also be discussed in this chapter. This section highlights the most popular service and deployment models and why they are popular amongst organisations. The benefits and challenges of adopting the deployment models will also be discussed. The final section of the chapter looks at the areas of the cloud that this chapter research study focuses on. This section discusses the different challenges listed as part of the research question and what has been covered by past literature regarding these areas of cloud computing adoption. Moreover, the section discusses the reasons why this research study will focus on these areas by highlighting past literature and what areas were missed in that literature that this research study addresses.

2.2 The Theoretical Background of Cloud Computing

This section explores the different definitions of what cloud computing is and then highlights the definition of the cloud that was used in this research study. The benefits and challenges cloud computing are also discussed and the building block upon which the cloud model was built. The last section discusses the cloud adoption challenges and opportunities that this research study focused on.

2.2.1 Definition of the cloud

Since its inception, there were many definitions of the cloud and how it works, some technology researchers suggested that the cloud was no different from the technology that was already in existence and that the term "cloud" was just a fancy new marketing term that's meant to make the cloud "trendy" (Diaby & Rad, 2017). Other researchers suggested that cloud computing was another trend that will pass as it happened with the "dotcom bubble" which eventually popped, so too will the cloud phase (Low et al., 2011). In addition to the above statements about the cloud, some researchers suggested that cloud computing was not as original as it was being marketed and that everything the cloud model was had been remodelled from other models such as grid computing and mainframes (Hashemi & Bardsiri, 2012). The first academic definition of the cloud was suggested by Ramnath Chellapa in 1997, he defined the cloud "as a computing paradigm where the boundaries of computing determine the rationale rather than technical" (Shimba, 2010, p. 1); this was not accepted as the main definition of the cloud, but it contributed to the different definitions that had been formulated for the cloud.

Gorelik (2013) defined cloud computing as "a model consisting of both technological and business components which are aided by certain cloud-enabling technologies which have helped form the cloud and it is unlikely that cloud computing could have existed without them. Enablers such as open-source software, virtualisation, distributed storage, distributed databases, and monitoring systems are the cornerstones of cloud computing" (Gorelik, 2013, p. 13). While Gorelik's (2013) definition of the cloud focused on the principles upon which the cloud was build which were already in existence; Buyya et al., (2009) defined the cloud as "a parallel and distributed computing system consisting of a collection of inter-connected and virtualized computers that were dynamically provisioned and presented as one or more unified computing resources based on service-level agreements (SLA) established through negotiation between the service provider and consumers" (Buyya et al., 2009, p. 3). Hashemi and Bardsiri (2012) stated that other authors defined cloud computing as "a TCP/IP

based on high development and integration of computer technologies such as the first microprocessor, huge memory, high-speed network and reliable system architecture" (Hashemi & Bardsiri, 2012, p. 188).

With the different definitions of cloud computing that have been presented by various authors, this research study adopted the definition provided by the National Institution of Standard and Technology (NIST). The NIST suggested that, "cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service-provider interaction" (Mell & Grance, 2011, p. 2). This definition was chosen after a comprehensive literature review and it was found to the best fitting for this study. The NIST's definition of cloud computing touched on important cloud components that came together to build the cloud model such as deployment models, service models, and other essential cloud computing characteristics.

2.2.2 Benefits of adopting cloud computing

There was a genuine belief within the technology and business community that cloud computing was more beneficial for smaller organisations. Yeboah-Boatgeng and Essandoh (2013) published literature that examined the impact of cloud computing at macro and micro levels; with the literature Yeboah-Boatgeng and Essandoh (2013) targeted cloud opportunities such as increased SMEs revenue, significant job creation (Yeboah-Boatgeng & Essandoh, 2013). The successful adoption of a cloud model is dependent on the prerequisites, and once developing countries successfully meet the prerequisites for cloud computing adoption, these economies will benefit from cloud opportunities such as being aligned with how developed countries conduct their day-to-day business. Technology played a crucial role in how businesses processes were being executed, for instance, (1) goods and services in the world economy were becoming more ICT driven, the cloud acted as an enabler for emerging economies to have access to the economic gains from the move to the globalisation of the design, production, distribution, and support of good and services. (2) The cloud opened the way for lower and middle-income countries to participate more actively in the world's switch to an information-driven economy. (3) The cloud reduced the cost of initial or upfront investment and the operational complexities of using technology to help build smaller businesses into larger ones. (4) Cloud computing created significant benefits for both individual users and governments. (5) The cloud helped create infrastructure improvements for developing countries by initiating the need for these infrastructures to be in place, this led to

the economic case for creating broadband networks in lower-income countries (Cowhey & Kleeman, 2012).

Yeboah-Boateng and Essandoh (2013) looked at factors that affected small businesses' decision to adopt cloud computing, but the study focused on businesses in developing economies. With this study, the researchers were looking to highlight the importance of developing countries not missing out on the opportunities that were presented by the cloud. The researchers stated that the cloud gave developing economies access to technologies that were used by developed economies, this in turn created opportunities to innovate, and it also puts the organisations at an advantageous position relative to its competitors which were not yet on a cloud computing model (Yeboah-Boatgeng & Essandoh, 2013). A key advantage of the cloud was that it was unique to each organisation and catered to the needs of the specific organisation. With the cloud, there was no one generic solution for all organisations, and it didn't operate as a "one-size-fits-all" model (Barabas, 2018). Organisations needed to consider their needs for cloud computing services, the decision to move to the cloud had to be a business-driven decision, and organisations also needed to keep in mind the cost and benefit analysis, by comparing the total cost of moving to the cloud versus the benefits (Barabas, 2018). One of the popular features of the cloud was its ability to enable vendors to deliver applications and software to end-users via a subscription model, this meant that users had to pay a certain fee for the usage of the vendor's cloud services without the responsibility of having to own, manage, and maintain the services. Other benefits to the cloud model were the improvement in the organisation's security and redundancy as far as service availability was concerned. The cloud made it easy for users to be able to access the cloud services from any remote location, and this was achieved with the use of any device that had access to the internet (Barabas, 2018).

2.2.3 The challenges of adopting cloud computing

Even though the cloud model was a convenient model for accessing computing resources, there were challenges that made it difficult for organisations to adopt the cloud. The challenges included power outages, threats to security, performance, compliance, private cloud, integration, cost, and the environment within which the organisation operates (Kim et al., 2009). The authors examined these issues and having looked at the possible drawbacks that might have been caused by these issues the authors still believed that the cloud was a key element in the future of computing and in spite of the challenges organisations needed to make an effort to adopt the cloud. Motahari-Nezhad, Stephenson, and Singhal (2009) looked at the

outsourcing of businesses to the cloud and what unique opportunities and challenges it presented organisations with. The authors noted that "cloud computing offers a realisation of service-oriented architecture (SOA) in which IT resources are offered as services that are more affordable, flexible, and attractive to business" (Motahari-Nezhad et al., 2009, p. 3). However, there are potential risks that come with using cloud services, these included, foregoing control of company resources and software, and this might have resulted in an increase in the security threats to the organisation due to potential risks of data leaks when sharing external computing resources with other organisations. There was also the possibility that the cloud provider ran out of business and the adopting organisation loses access to its services (Motahari-Nezhad et al., 2009).

The challenges for organisations were not limited to those that were mentioned above, there were other potential risks that came with using cloud services that included, "(1) deciding which functions to move to the cloud and in what order, (2) how to ensure a smooth migration process given legacy applications in the environment, (3) how to find and select service offerings that met their requirements and established seamless interoperability between services" (Motahari-Nezhad et al., 2009, pp. 9-10). This highlighted some of the challenges that organisations could potentially face after having adopted the cloud, and this was in addition to the challenges that prevented the organisation from adopting the cloud. Nir Kshetri (2010) mentioned that the cloud model critics felt that the bandwidth used and requirements of the cloud made cloud computing adoption a difficult task for some parts of the world, especially in developing economies, which also included South Africa. The high costs of bandwidth lead to higher costs of running and managing the cloud services since the cloud model was essentially the internet. In one of this studies, Nir Kshetri (2010) looked at cloud computing in developing countries, and in his study, the author stated that developing countries needed to exploit the opportunities afforded by cloud computing, but also in doing that they must be wary of the risks associated with the cloud adoption (Kshetri, 2010). The author looked at the different developing countries, namely, China, East Africa, India, Qatar, Korea, South Africa, Turkey, Vietnam, and West Africa, to find out how developing economies were dealing with the adoption of the cloud. The author then looked at what these countries chose to use cloud computing for, and what cloud computing-based products they offered. The cloud computing model was applied to the developed countries with the use of broadband internet, and that acted as a barrier for some developing countries that the author had included as part of the study.

2.3 Overview of Cloud Computing

This section of the chapter discusses the overview of the cloud. This is done by highlighting the first time the idea of a network based model was captured and the progress that was made to develop the model overtime until we got the cloud model. The section also discusses the key elements that are needed for a cloud model to succeed, and as part of this the building blocks for the cloud are highlighted, deployment models, and service models.

2.3.1 The growth of the cloud model

The inception of the public cloud was closely linked with the establishment of the internet during the early 1900s. There was an increasing need for a large-scale public network, and the first documented call for this type of network was in the 1960s from J.C.R Licklider, who was one of the developers of ARPANET – this was the network that became the blueprint for the internet (Agarwal et al., 2016). J.C.R Licklider had a vision that involved multiple computers that were connected over the network and could communicate with each other and had access to each other's programs, applications, and data from anywhere. J.C.R Licklider was not the only researcher who had this vision, John McCarthy was another contributor to the idea of having a network-driven model to computing. McCarthy proposed that computing could be a public utility, this meant that computing would be viewed and treated the same way as water & electricity (Garfinkel, 2011). Figure 2-1 presents the timeline of the cloud and the milestones that have been achieved since the cloud model was first introduced. The first event highlighted in Figure 2-1 was the period between 2000 to 2005. A period better known as the "dotcom bubble"; during this period many businesses adopted technology and moved to an internet based business model and many of these failed due to a lack of understanding of how internet-based models worked (DeLong & Magin, 2006).

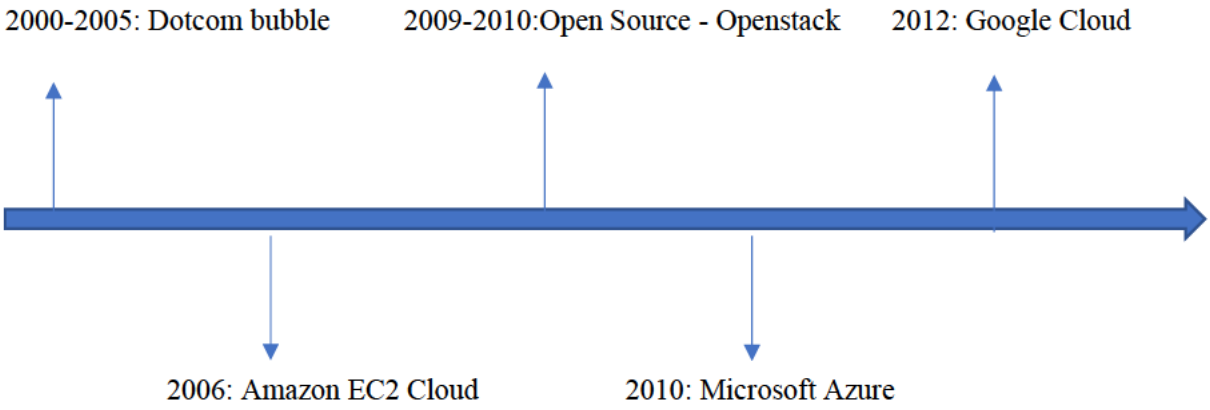


Figure 2-1: The growth of cloud computing (Liberman & Ari, 2015).

In 2006 Amazon introduced Amazon's EC2 service. With its EC2 service, Amazon allowed organisations to spin up, rent out, and manage virtual servers without owning the physical hardware (Amazon, 2014). The next key period was between 2009 to 2010. In this period, more cloud-based open-source technologies were introduced. The Openstack technology was introduced to further the study and exploration of the cloud model. Openstack was an open-source, free platform which had similar capabilities to Amazon's EC2 platform (Amazon, 2014). In 2010 Microsoft launched Microsoft Azure cloud service which was similar to Amazon's EC2 service, but better suited for users who were already using Microsoft products. Google launched Compute Engine in 2012, which was similar to what Amazon EC2 service, Openstack, and Microsoft had already launched (Amazon, 2014).

2.3.2 The building blocks for cloud computing

There are three core services that the cloud model was built upon, and these are computed services, networking services, and storage services (Liberman & Ari, 2015).

2.3.2.1 Computed services

Computed service is one of the core services provided by the cloud, and acts as an enabler for other cloud capabilities. It is offered as a processing capability powered by virtual machines that run on a physical host server (Liberman & Ari, 2015, pp. 17-19). The offerings that formed part of the compute services encompasses RAM, CPUs, disk, and bandwidth. A combination of these services was normally used to build different kinds of servers that addressed varying computational challenges (Liberman & Ari, 2015).

2.3.2.2 Storage services

Organisations consumed cloud services differently, and by default the way they consume its capabilities differ. Cloud storage services catered for both physical (which is a more traditional approach to computer architecture) and virtual storage (which is more modern and was utilised more), this type of storage was achieved through block storage or volumes (Liberman & Ari, 2015).

2.3.2.3 Network services

Networking in the cloud "consist of many products such as domain name systems (DNS), sharing of internet protocol addresses (IPs), Virtual Lan Area Networks (VLANs) and the bandwidth, which are necessary to connect the different pieces of the infrastructure, specifically virtual machines and storage solutions were found" (Liberman & Ari, 2015, pp. 19-22).

2.3.3 Cloud computing deployment models

According to Karnwal, Sivakumar, and Aghila (2011) "Cloud computing is a combination of distributed systems, utility computing, and grid computing. Cloud computing took advantage of these three computing models in a virtualised manner, the cloud model had capabilities like on-demand usage, pay per use, dynamically scalable and efficient provision resources" (Karnwal et al., 2011, p. 32). The cloud provided four types of services and was also made up of four deployment models, which include, the Public Cloud, Private Cloud, Hybrid Cloud, and the Community Cloud (Karnwal et al., 2011).

Table 2-1: Cloud computing deployment models

Deployment model	Scope of service	Owned by	Managed by	Security level	Location
Public	General public and large industry groups	CSP	CSP	Low	Off premise
Private	Single organisation	Single organisation	Single organisation or CSP	High	Off or on premise
Community	Organisations that share the same mission, policy, and security requirements	Several organisations	Several organisations or CSP	High	Off or on premise
Hybrid	Organisations and public	Organisations and CSP	Organisations and CSP	Medium	Off or on premise

2.3.3.1 The public cloud model

The public cloud model used the characteristics of the pay-as-you-go model to offer applications, data storages, and many other different services to its clients through a service provider. According to Diaby and Rad (2017) “this cloud model was built with a perspective to provide boundless memory storage and expand data transmission through the Internet to all organisations. It was also hosted, owned, and operated by a third-party service provider” (Diaby & Rad, 2017, p. 54). The public cloud was the easiest cloud model to set up since clients were unburdened from having to spend on equipment, applications, or even transfer speed costs. Organisations only had to pay for the services they consumed based on the agreed terms with the cloud provider. There are four basic characteristics which made the public cloud one of the more popular cloud models,

- Flexible and Elastic Environment: With the public cloud, customers gained access to cloud environments that were greatly adaptable and could be adjusted to fit the customer's needs based on the changes in demand (Diaby & Rad, 2017).
- Freedom of Self-Service: The public cloud gave organisations the opportunity to be fully in charge of their cloud model without taking assistance from the cloud provider. This was done by granting organisations access to pre-configured clouds, and these cloud services could run without any involvement from third-party organisations and thus giving the organisation full control over its environment (Diaby & Rad, 2017).
- Pay for what is used: The costing model in the cloud is highly adaptable and can be adjusted to match what has been utilised by the organisations.
- Availability and Reliability: The public cloud's reliability and dependability allowed organisations the freedom to schedule work for any time of the day (Diaby & Rad, 2017).

The public cloud services were off-premise multi-tenant solutions that organisations were granted access to using the "pay-as-you-use" model. While the public cloud is the most affordable and accessible of all the model, it is not the most secure when organisations adopt the public cloud they opened themselves to risk and challenges such as,

- Shared Hardware: By definition, the public cloud is structured as a multi-tenant environment, which meant that different organisations share the same hardware, storage, and network devices. This also means that the organisation's virtual server sits on a network that is chosen by the cloud provider (Singh & Jangwal, 2012).
- Third-Party Risk: Unfortunately, with the public cloud the performance of cloud services cannot be guaranteed to be safe and secure or to perform consistently, this was because the public cloud model exposed cloud services to third party suppliers and the performance and reliability of those third party providers could not be guaranteed.
- Security & Compliance: As mentioned previously that the public cloud had data security issues, this meant the organisation that deployed the public cloud will have a hard time adhering to the HIPAA compliance and PCI compliance since these were virtually impossible to achieve in the public cloud (Singh & Jangwal, 2012).
- Data Loss: No High Availability Fail-Over – In the public cloud, if a particular host were to crash, all of the virtual environments that were hosted on that host, along with the data stored in that host would be lost for good (Singh & Jangwal, 2012).

- Fraud & Spammers: One public cloud hosting provider can have fraud rates as high as 80%, and this was because the public cloud was the cheapest of all the deployment models and security validations for using public cloud services were not as strict as they were for the other deployment models (Singh & Jangwal, 2012).

The public cloud like any other technology model had its strengths and weaknesses, but the services offered by this model were still better and more affordable than any service organisations could pursue on their own data centres. For instance, security in the public cloud was still better than any form of security that organisations implemented on their own, with its offerings such as cybersecurity expertise, security innovation and more modern technology, regular penetration testing, and controlled access (Diaby & Rad, 2017).

2.3.3.2 The private cloud model

The private cloud deployment model functioned on behalf of the company, which meant this cloud model was not accessible to the public, it was owned and controlled by one company. Even though the private cloud services were dedicated solely to one organisation, the organisation did not always have to own the infrastructure that was used for the private cloud, but this responsibility could still be left to the cloud provider (Diaby & Rad, 2017). According to Diaby and Rad (2017) "the private cloud was known as the most secure cloud model as its data processes were controlled and managed in the organisation and exclusive of any limitations of bandwidth network, security disclosures, and exposure to ill-intentioned users that were usually found in the public cloud environment" (Diaby & Rad, 2017, p. 54). Organisations looking to adopt the private cloud chose from two variations of the cloud which are:

- The on premise private cloud: This type of private cloud was also known as the internal cloud since it resided within the organisation's personal data centre (Diaby & Rad, 2017).
- The externally-hosted private cloud: This type of private cloud model was hosted outside of the organisation's premises and it was usually controlled by the cloud provider (Diaby & Rad, 2017).

Some of the characteristics of the private cloud model that made it the most favoured cloud adoption model included the model's ability to enhance the security measures for the

organisations. The private cloud enhanced the organisation's security measures, and this was because this model arrived with pre-installed customisable firewall and other security features that protected the model against internal and external threats (Diaby & Rad, 2017). With the private cloud organisations also gained access to dedicated resources like a dedicated supporter of the private cloud from the cloud provider. Since the private cloud was owned and controlled by the adopting organisation the organisation had more control on how the model was set up and customised it to address specific needs and this in turn permitted the organisation to have more control over their information (Diaby & Rad, 2017). The private cloud service provider dedicated some of its resources to serve exclusively one organisation, and that organisation was sometimes responsible for the management and operation of their cloud unless it was otherwise stipulated in the service level agreement (SLA). Private clouds were considered the most secure form of deployment models since there is no sharing of resources between organisations, and this was a more expensive cloud deployment model. That exclusivity made it difficult for some organisations and individuals to deploy this type of model (Amor et al., 2015). Organisations interested in ensuring that user data is safe at all times and that they comply with government policies such as Sarbanes Oxley, PCI, or HIPAA compliance were advised to adopt the private cloud as with the private cloud complying with these policies was less challenging.

The private cloud had some of the best features of all the deployment models but it was not affordable for some organisations. With the private cloud organisations had to invest in new infrastructure and hardware, organisations also had to invest in skilled staff that could run, manage, and maintain the private cloud (Vikas et al., 2013). Some of the features of the private cloud model were not aligned to some of the cloud model selling points, if the organisation had to concern itself with managing its cloud environment then it will have to forego some of the cloud advantages like specialisation – which allowed the organisations to focus mainly on its core competencies. Private cloud adopters had an option of hiring third-party organisations to manage their cloud environment, but this resulted in increased costs, and also resulted in increased security risks (Vikas et al., 2013). Setting up a private cloud had a steep learning curve for the entire organisation, and this was challenging for both users and administrators. Although there were great opportunities to adopting the private cloud, the work that was needed to install and maintain large stage deployments was too big, and needed significant manpower, both in terms of time and skills (Pantić & Babar, 2012). The level of skill that is needed for

installing, managing, and using a private cloud needed to be an above average skill for a successful adoption of the private cloud.

2.3.3.3 The hybrid cloud model

Mohlameane & Ruxwana (2014) defined hybrid cloud as "a composition of two or more distinct cloud infrastructures - either the private, community, or public cloud - that remained unique entities, but were bound together by standardised or proprietary technology that enabled data and application portability" (Mohlameane & Ruxwana, 2014, p. 7). The hybrid cloud deployment model consisted of a combination of public and private clouds. This suggested that the hybrid cloud had some features of the public and private cloud. Therefore, organisations had an opportunity to choose what percentage of either the private or the public cloud were they adopting as part of their hybrid cloud. The organisations then put in place one standardised technology architecture upon which the hybrid model was deployed (Amor et al., 2015). The hybrid cloud model allowed organisations to organise their resources to best serve their needs. The private percentage of the hybrid cloud was used for critical functions of the organisation, while the public cloud was used for functions that were considered less critical to the functioning of the organisation (Amor et al., 2015). The discrete elements and building blocks of the private and public clouds individually were bound by standardised technology which made data and applications portable; nevertheless, the building blocks for these models remained unique to form the hybrid cloud.

The hybrid cloud provided organisations the ability to move workloads between the private and public clouds without reworking any key business functions or large capital expenditure. Scalability within the hybrid cloud led to more organisations turning to this form of deployment model in order to enable scalable business processes which had to be paid for once they were consumed (Telkom, 2016). The hybrid cloud continued to grow, more organisations preferred the this model over the other two models since it gave them more control over their environment. The rate at which the hybrid cloud was adopted compounded annually as time passed and as users became more comfortable with the idea of the hybrid cloud (Rao et al., 2015). There were many ways in which the hybrid cloud could be implemented, such as different cloud providers coming together and providing a combination of public and private services. There were individual hybrid cloud providers that organisations chose from should they not be comfortable with having multiple providers for their cloud services. This also gave organisations who already managed their own private cloud the opportunity to take services

from the public cloud and merge them into their current infrastructure (Rao et al., 2015). There were other hybrid cloud advantages that organisations took advantage of, such as moving away from the physical computing environment and into a cloud environment that offered flexibility, scalability, and virtualisation technology. Capital-intensive expenditure on storage and processing assets was also eliminated with the adoption of the hybrid cloud since the organisation used a combination of many different cloud services and cloud providers (Rao et al., 2015).

The hybrid cloud model combined the security and performance benefits of private environments with the cost and scale advantage of public cloud services, but there were challenges that organisations needed to be wary of, such as:

- Security: Security was the main challenge in the hybrid cloud. There were constant concerns of compliance, identity management, and data protection that organisations faced when planning out the hybrid cloud (Rao et al., 2015).
- Data and Application Integration: While the combination of the public and private cloud added great value to the cloud model, the integration of these public and private clouds was one of the most challenging tasks when setting up a hybrid cloud (Rao et al., 2015).
- System Management: Combining different cloud models and different service providers made it difficult for organisations to do effective configuration management. This in turn made it hard for organisations to monitor and configure their resources with the same tools and processes that were available for use in the private cloud, especially if the network integration was not done correctly (Rao et al., 2015).
- Compatibility: The public and private cloud ran on different infrastructures with different software stacks. The services and capabilities in a hybrid cloud varied greatly as the public cloud was built inherently more than any private cloud (Rao et al., 2015).

Given the challenges and opportunities that hybrid cloud exposed organisations to, it was important that organisations approached these opportunities and challenges in a well-thought-out manner. This is why the cloud council provided an insight into how organisations should approach the adoption of the hybrid cloud.

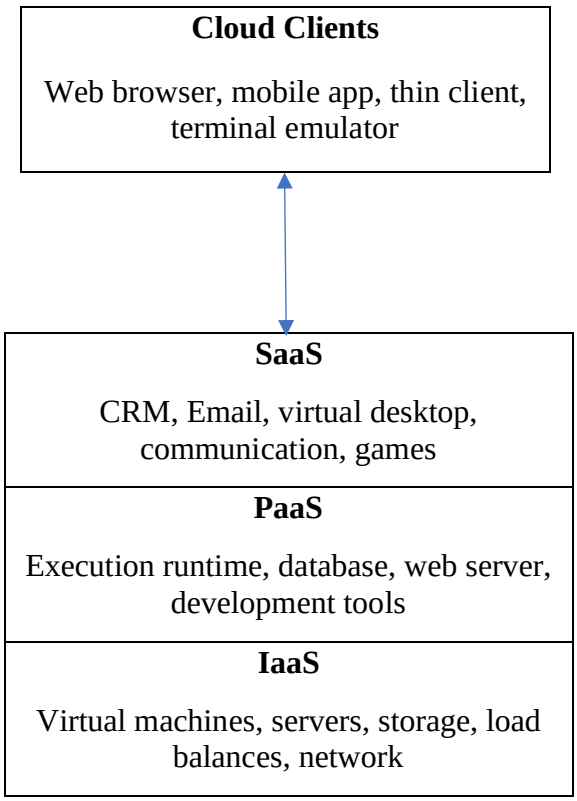
2.3.3.4 The community cloud model

Community clouds were similar to private clouds, in fact, some technology practitioners believed that community cloud was a private cloud for a community of organisations (Amor et al., 2015). While there were similarities between the private and the community clouds, the key difference between these models was that organisations that adopted the community cloud shared the cloud infrastructure amongst "the community" of organisations. In the private cloud the computing resources were dedicated to serving just one organisation. This community of organisations had the same mission, policy and security requirements and they strived towards the same goal. For example, educational clouds were used by universities, whereas with the private cloud it is mostly used by one organisation (Amor et al., 2015). The community cloud was set up to offer the capabilities of different technologies. The way in which the community cloud set up its infrastructure did not limit the model, and previously it had been known to combine the best capabilities of grid computing and distributed computing. This helped the technology model better contribute to the digital ecosystem and created a more sustainable form of green computing; this is achieved using cloud computing taking advantage of the computing self-management opportunities from the cloud (YASASWI et al., 2017). The community cloud was not owned or controlled by any single organisation, this made it more reliable as its availability was not dependent on the existence of just one organisation. This feature made the community cloud more robust, resilient to failure, and immune to the cloud failures that were usually associated with other cloud models (Marinos & Briscoe, 2009).

2.3.4 Cloud computing service models

Cloud computing had three different service models that organisations could adopt, which were infrastructure as a service (IaaS), software as a service (SaaS), and platform as a service (PaaS) (Gorelik, 2013).

Table 2-2: Cloud computing service models (Gorelik, 2013).



Cloud computing service models described what cloud services were available for organisations to choose from and what organisations needed in order to adopt one or all of these service models.

2.3.4.1 Infrastructure as a Service (IaaS) model

IaaS is a provision model whereby an organisation outsources all the physical hardware, and the hardware equipment it uses to support the operations of the business (Mohlameane & Ruxwana, 2014). IaaS presented opportunities such as cost reduction, automation, scalability, utility service, and flexibility. IaaS is a service model that provides infrastructure components to clients, like servers, networks, firewalls, and load-balancers. One of the reasons why organisations were encouraged to adopt the cloud was to avoid the extensive financial expenditure on infrastructure. Organisations were not required to have upfront capital expenditure, IaaS allowed organisations access to the lowest-level software in the stack, and that allowed them access to operating systems on virtual machines, the management dashboard of a firewall, or a load balancer (Gorelik, 2013).

With IaaS, hardware is delivered as a service that is accessible to users virtually via the cloud

courtesy of the cloud provider. “The components of IaaS include service level agreement (SLA), utility computing, cloud software, platform virtualisation, networks and connectivity, and computer hardware” (Mohlameane & Ruxwana, 2014, p. 7). Given that IaaS was a cloud computing product that offered users access to infrastructure computing resources, the organisations were not required to spend large upfront capital investments in setting up their infrastructure (Barabas, 2018).

2.3.4.2 Platform as a Service (IaaS) model

The cloud model is composed of different layers, and PaaS is a layer that typically sat on top of the hardware and operating system (Gorelik, 2013). The PaaS service model offered organisations the opportunity to simplify complexity of the maintenance of the infrastructure and applications, this afforded organisations more time to concentrate on developing suitable competencies for their core software. PaaS delivered applications that were already built for the client, and this took away the responsibility of spending resources to build applications for organisations. The cost of infrastructure software maintenance was usually higher than that of software development in large organisations. This has been one of the reasons why organisations preferred outsourcing a large portion of their infrastructure software, this helped organisations improve productivity and decrease their operational costs (Gorelik, 2013). One of the advantages of PaaS was its ability to scale up or down and provision the infrastructure that organisations used or decommission the infrastructure that organisations did not need anymore.

PaaS feature offerings allowed organisations to provision environments that developers used for design, build, and release of applications without having to own the platform (Mohlameane & Ruxwana, 2014). PaaS exposed users to an environment where they developed, managed, and delivered applications without setting up their own platforms. The service went beyond just offering storage and other computing resources, users also gained access to the tools that were already setup and existed in the PaaS environment (Barabas, 2018).

2.3.4.3 Software as a Service (SaaS) model

Software as a Service (SaaS) is the delivery of software as a service that organisations traditionally had to purchase and own, this includes software such as ERP, CRM, e-mail and collaboration Software (Mohlameane & Ruxwana, 2014). SaaS is a cloud computing service model that exposed users to a vendor’s cloud-based software products as a service. This model did not require users to purchase or own the software, but instead they accessed it through the

Web or an API. One of the popular features of SaaS is its ability to enable vendors to deliver applications and software to end-users via a subscription model, this meant that users paid a certain fee for the usage of the vendor's software without the responsibility of owning, managing, and installing upgrades of the software. Other benefits of this cloud service model included the improvements in the organisation's resistance and reliability, and in the event that there is equipment failure the organisation had assurances that its data was safe. To gain access to the SaaS services all that users needed was a device that had an internet connection, for example a mobile device (Barabas, 2018).

The SaaS service model allowed organisations to transfer some of the costs of owning software to the cloud provider while also ensuring that their staff members and intended users still had full access to the software (Gorelik, 2013). SaaS was the most widely used and popular cloud service model, and this was due to the fact that the SaaS market was the most open market to enter for software vendors, and as a result, there were SaaS offerings in every category of software products. In addition, the software that was being offered by cloud providers was a software that organisations were already using and the only change was with how they were now accessing it. The goal for SaaS providers was ensuring that organisations were motivated to outsource their software capabilities by always offering these services to organisations at an affordable cost (Gorelik, 2013).

2.4 Cloud Computing Adoption Research Studies

The position of South African organisations regarding technology adoption differed according to the respective business sector and organisation size, as a result, while some sectors were performing well in cloud adoption, some were underperforming (Van der Merwe, 2013). The banking sector in South Africa was among the leading in technology adoption and technology-based models in the world. South African banks were recognised internationally for the role that they play in continuously using technology to improve business models and business strategies (Van der Merwe, 2013). Given the banking sector's general positive response to technology adoption Van der Merwe (2013) conducted a study to investigate the banking sector's response to cloud computing adoption, moreover, the research examined cloud computing in one specific bank in South Africa. The intended audience for this research study were all IT employees in the IT department from the bank. This was done to determine how much knowledge did the IT employees have about the cloud, and to establish if they understood the benefits, risks, and challenges of using the cloud. From Van der Merwe's (2013) study, it

was found that cloud computing was still a new concept in South African banks, especially the public cloud. However, private clouds were already being utilised by organisations in the form of data centres and virtualised services. The overall findings of the researcher indicated that the benefits of adopting the cloud were far greater than the obstacles and risk, with cost savings being the main benefit of adopting the cloud (Van der Merwe, 2013).

While conducting a study that focused on the banking sector and particularly one bank would be useful in helping other organisations in the same sector to better understand the cloud, the study was not generalisable to other sectors and to organisations of smaller sizes. Likewise, Mohlameane and Ruxwana (2014) conducted a study that included more than one organisation, and this study focused on SMEs rather than well-established organisations. In their study Mohlameane & Ruxwana (2014) investigated the awareness of cloud computing within SMEs in SA. In addition, the paper identified SMEs perception on cloud computing as an alternative ICT solution. Mohlameane & Ruxwana (2014) used three organisations and nineteen participants. The findings concluded that there was a lack of understanding of cloud computing within the sampled participants, thus, Mohlameane and Ruxwana (2014) cited this as the main reason for the slow adoption rate within SMEs in South Africa (Mohlameane & Ruxwana, 2014). The findings from the study by Mohlameane and Ruxwana (2014) were more generalisable than those from the study by Van de Merwe (2013).

Matandela (2017) conducted a study that focused on South African SMEs. The study by the author was motivated by the fact that the rate at which SMEs adopted cloud computing remained low although the value associated with the cloud was widely researched especially in large enterprises. The study by Matandela (2017) used the Technology Organisation Environment (TOE) framework. Mohlameane and Ruxwana (2014) Matandela (2017) targeted organisations from different business sectors and also included a greater number of organisations. Even though the research study by Matandela (2017) was broader in scope it only targeted SMEs that were based in Johannesburg, and thus the findings were not generalisable to some of the organisations that operated outside of Johannesburg, but there were a lot of lessons in how the researchers conducted their research study, some of which were used in this research study, like to theoretical approach to use for these type of studies.

While other researchers focused on either one organisation or SMEs in South Africa; Allan et al., (2016) conducted a research study that investigated the business value of cloud computing in South Africa. Allan et al., (2016) indicated that at the time of conducting their research, there was not enough studies that helped in understanding the business value associated with cloud computing in South Africa and the context within which benefits and barriers were realised

(Allan et al., 2016). The authors indicated that some of the issues that acted as barriers to cloud adoption were concerns about security threats, and the reliability of the cloud. In their study, the researchers found that these issues were being referred to the most as being of concern by the research respondents.

Research studies that focused on the adoption of the cloud did not only look at issues that directly affected the organisation, some studies looked at issues that were outside of the organisation and had an indirect impact on how organisations adopted and used cloud computing. Xi (2014) assessed the readiness of a South African provincial government on the adoption of cloud computing; the author conducted an "extensive literature review on cloud-computing concepts, its characteristics and the possible non-technological readiness indicators for cloud-computing adoption. This led to the identification of three main groups of readiness indicators: (i) Infrastructural indicators; (ii) organisational indicators; and (iii) environmental indicators" (Xi, 2014, p. 26). The research by Xi (2014) gave an indication of South Africa's readiness for cloud adoption, and this was determined through the key pillars for cloud adoption. With this research study Xi (2014) was able to determine the readiness of the environments within which organisations operate for a cloud computing adoption, and this gave a different perspective to some of the issues and enablers organisations were faced with when adopting cloud computing. It had already been mentioned by authors such as Mujinga and Chipangura (2011) that in order for organisations from developing economies to start benefiting from the adoption of cloud computing there was a need to deal with infrastructural issues such as reliable power supply, network infrastructure, which acted as barriers for organisations wanting to adopt the cloud (Mujinga & Chipangura, 2011). The authors also believed that since bigger organisations already had their own data stores and server networks they had challenges migrating to the cloud, these organisations faced questions such as what to move to the cloud? Are the cloud services they are interested in compatible with the current environment? How much disruption might adopting cloud computing bring to the operations of the business? Organisations needed to have answers to the questions before moving to the cloud, or else the move to the cloud might not bring the success that it is expected to bring.
Given the challenges that developing economies faced with regards network readiness and infrastructure readiness, Yeboah-Boatgeng and Essandoh (2013) suggested that developing countries needed to focus more on mobile broadband and try to take advantage of the cloud with the use of mobile devices. Gillwald, Moyo, Odufuwa, and Kamoun (2014) also suggested that focusing on mobile broadband was the best option for developing countries. One of the

reasons for this was the limited availability of ADSL in some areas and poor quality of service, and with those issues, mobile devices were becoming the primary method of accessing the internet. Mobile broadband prices were comparatively lower than fixed broadband prices (Gillwald et al., 2014). The authors went further by looking at cloud computing in the different non-business sectors, the education sector and the government sectors in African countries and how accelerating cloud adoption within these sectors could positively influence the readiness of developing economies.

Researchers such as Mvelase, Dlamini, Sithole, and Dlodlo (2013) had conducted a similar study, but with focus on South Africa's readiness for cloud adoption. The study focused on the potential for a government public cloud in South Africa, the authors suggested that more government initiatives towards cloud adoption could help improve the state of the cloud in South Africa (Mvelase et al., 2013). Likewise, Lindeman (2012) conducted a similar study, which investigated the possibility of running and supporting a model such as cloud computing in South Africa (Lindeman, 2012). The author assessed the state of the infrastructure and environment to establish if in its state, organisations would be able to adopt cloud computing. The study concluded that there were issues such as infrastructural readiness, power outage issues which made it difficult for organisations to successfully adopt the cloud. In addition, examining the cloud on its own does not result in a lot of learning for organisations planning to adopt the cloud, but a corporate perspective on what cloud computing is and how it can be utilised is more effective.

2.5 Cloud Computing Adoption

This section of the chapter discusses the adoption of the cloud. As part of the discussion, opportunities and challenges that organisations expose themselves to when adopting the cloud will be discussed. The final part of the section will discuss the challenges that this research study focuses on, why those challenges were chosen, and the experiences of other organisations when faced with the same issues.

2.5.1 Opportunities for organisations adopting cloud computing

Cloud computing revolutionised how organisations addressed their technological requirements by enabling them to access infrastructure and application services without any upfront capital investment; instead organisations rented out these services for an agreed term through a service level agreement (SLA) (Garg et al., 2013). Cloud computing provided consumers access to

resources such as networks, servers, storage, applications, and other services that were rapidly provisioned as well as released with just a click of a button (Kumar & Charu, 2015). One of the cloud's notable features included its market-oriented architecture, which was self-regulated and gave the power back to the consumer. Organisations could easily scale their resources up or down based on their demand for computational resources, and this was achieved without incurring massive costs or downtime (Lin & Chen, 2012).

One of the cloud advantages was that it was unique to each organisation, and it could be tailored according to the needs of that specific organisation. There was no one generic solution for all organisations, and it did not operate as a "one-size-fits-all" model (Barabas, 2018). Organisations should consider their needs before adopting cloud computing services. The decision to adopt them should be business-driven. Organisations also need to consider cost and benefit analysis, compare the costs and benefits between moving to the cloud and keeping all their computing capabilities in-house.

Even though organisations needed to consider the cost-benefit of adopting cloud computing, the general cost savings that came with adopting the cloud were well documented. Avram (2014) stated that cloud computing "dramatically" lowers the cost of entry for smaller firms trying to benefit from compute-intensive business analytics that were commonly only available to larger organisations (Avram, 2014). The author went further to highlight some of the other opportunities that organisations stood to benefit from by adopting cloud computing. These included, immediate access to hardware resources with no upfront capital investment for organisations, which helps organisations cut down on time it takes to market. The cloud eliminated the time organisations would have taken to source the hardware, setting up the hardware, configuring the platform, and setting up the software; with cloud computing all this was achievable in a single day with a click of a button. These benefits were not only limited to first world countries, with the cloud model, even third-world countries were able to access some of the best technology that they previously weren't able to access (Avram, 2014).

The cloud had the ability to lower IT barriers to innovation, and evident to this was the rise in the number of start-ups whose business models were solely based on the cloud model, and these included companies such YouTube and Facebook. Cloud computing gave organisations a lot of flexibility on how they could manage their hardware and software. With cloud computing organisations were able to easily scale up or down their services instantly. Since computing resources were managed through software, they could be deployed very fast as new

requirements arise, and if there was a need to scale down due to a decrease in demand for computing services, organisations could scale down (Avram, 2014). This was one of the main reasons why the cloud model was developed, since models such as mainframe computing and grid computing were not as successful due to the lack of scalability; the cloud was able to achieve scalability through software APIs with minimal service provider interaction. In addition to the benefits of cloud computing adoption that have been listed, the cloud also makes possible new classes of applications and delivers services that were not possible before; examples include "(a) mobile interactive applications that were location, environment, and context-aware and that responded in real time to information; (b) parallel batch processing that allowed users to take advantage of huge amounts of processing power to analyse large amounts of information; (c) business analytics that could use the vast amount of computer resources to understand customer behaviour; (d) extensions of compute-intensive desktop applications that could offload the data crunching to the cloud leaving only the rendering of processed data at the front-end, with the availability of network bandwidth reducing latency involved" (Avram, 2014, p. 531).

2.5.2 Challenges for organisations adopting cloud computing

In a study by Kim et., (2009) the researchers conducted a study that examined the challenges related to the adoption of cloud computing. The researchers highlighted challenges that they believed made it difficult for organisations to adopt the cloud, which included concerns of power outages, threats to security, performance, compliance, private cloud, integration, cost, and the environment within which the organisation operated (Kim et al., 2009). These were some of the challenges that South African organisations were faced with, especially the issues of reliable power supply. BSA (2018) highlighted that the drop in the cloud adopting rankings for South Africa was due to the lack of clear ITC and compliance policies that protected the customer. Kim et., (2019) also note that security was one of the major hindrances for the adoption of the cloud, and researchers sought to understand how security hindered the process. The ease with which organisations in developed countries were able to adopt cloud services was enabled by the availability of a stable and reliable network infrastructure. Conversely, developing economies lacked reliable network infrastructure which acted as a barrier for their organisations when adopting the cloud (BusinessTech, 2016). The article posited that the network infrastructure in developing economies did not enable organisations to take advantage of the opportunities presented by the cloud model. The author highlighted the fibre roll-out challenges that hit the eThekwini area in South Africa where the fibre roll out project got halted

which made it difficult for organisations to access competitive fibre. This highlighted some of the challenges that organisations in developing economies had to deal with in their efforts to access cloud computing enablers (BusinessTech, 2016).

There are barriers that organisations faced prior to adopting the cloud and after having adopted the cloud. Organisations were faced with issues of security and privacy; since the cloud was a new computing model there were uncertainties about how security should be configured at the different levels of the model, i.e. network, host, application, and data levels (Avram, 2014). Along with security concerns there was also the challenge of organisations adequately addressing privacy and regulations risks. Other challenges that organisations faced included,

- Connectivity and Open Access: The potential of the cloud model depended on the availability of high-speed access to all. This in-turn required increased expenditure on more sophisticated consumer products that resulted in economies of scale for the organisations (Avram, 2014).
- Reliability: One of the advantages of adopting cloud computing was high-availability, which meant should a failure occur in site A, site B would keep the services up and running; but that feature required an additional cost and organisations that could not afford redundancy were constantly at risk of experiencing outages (Avram, 2014).
- Interoperability: The standard for interoperability is either as an enabler or a barrier to interoperability, and permits maintenance of the integrity and consistency of an organisation's information and processes. This is because the pace at which organisations changed outpaced the ability of IT organisations to respond to these changes, and as a result cloud services ended up being blockers to organisational goals (Avram, 2014).
- Economic value: The growth of cloud computing was predicted to result in great investment returns due to its cost saving offerings, but there were concerns that there are some hidden costs with the cloud that organisations were not always aware of. Adopting cloud computing had additional costs which included support, disaster recovery, application monitoring and notification, and data loss insurance; these costs were not always known to organisations when adopting the cloud (Avram, 2014).
- Changes in the IT organisation: Cloud adoption affected the IT organisation, and resulted in two dimension shifts in technology. The first one was the acquiring of a new skill set to deploy, manage cloud technology, and the ability to solve business problems.

The second one was how cloud adoption changed the IT role and what the new expectations were of the IT organisation (Avram, 2014).

Past research studies that have been highlighted in this research study by authors such Avram (2014) and Mujinga and Chipangura (2011) who emphasised the challenges that developing economies faced when adopting and using the cloud, but these challenges were not only limited to developing economies; organisations in developed economies also faced their own challenges from using the cloud model. According to Kshetri (2011) developed economies also faced challenges when adopting cloud computing. The cloud challenges were more noticeable in developing economies because some of these countries did not have the basic enablers that allowed them to adopt the cloud, yet they could potentially benefit from this technology (Kshetri, 2011). One of the challenges that developed economies faced when adopting the cloud was the problem of data security, it was stated that data security and intellectual protection remained the main barrier for cloud computing. Even though the organisations from developing countries were most likely to be affected by security threats, these threats were not limited to developing countries; for instance, 39% of European companies were concerned with the risk of a cloud computing security breach and sited this as one of the reasons why they were reluctant about moving their services to the cloud (Kshetri, 2011).

2.5.3 Cloud computing adoption challenges covered in this research study

The cloud computing challenges that this research study focused on have been listed below. The four research questions that this research study was built upon were based on these challenges.

2.5.3.1 Top management support

The reviewed literature for this research study had many authors and researchers emphasise the importance of considering all aspects of the organisations when adopting cloud computing, which meant involving all levels of management in the decision making process. This was also highlighted by Chetty, Sundaresan, Muckaden, Freamster, and Calandro (2013) with the researchers stating that lack of support from top managers was one of the issues that affected the adoption of the cloud. The authors in their study that focused on organisations in Taiwan concluded that the amount of knowledge that top management had about the cloud was the key when it came to the adoption of the cloud. In Taiwan, many managers rejected the idea of the cloud and this was due to the managers not being knowledgeable about the cloud(Chetty et al.,

2013). The authors stated that the success of cloud implementation was not only dependent on the availability of the right technology, but also the support from top management acting as an enabler. BSA (2018) mentioned that one of the issues South Africa was struggling with the adoption of cloud computing was the issue of governance, policies, and controls. Governance is a broad concept that involved the firm's responsibility to properly handle customer information. In addition, governance involved controlling and oversight by organisations over its policies, procedures and standards for IT service acquisition as well as the design, implementation, testing, use and monitoring of deployed services (IBM-Corporation, 2014). Compliance and risk management was always a critical process of governance on traditional IT systems and are now even more important with the model such as the cloud model. Cloud governance included the following:

- Organisations had to identify at which stages they needed to include stakeholders so they too could contribute to the decisions taken by the organisation and also determine what level of involvement was required from stakeholders.
- Developing a process that should be followed by an organisation when cloud-related decisions are taken.
- Organisations needed to have policies in place in addition to the service level agreement which both the organisation and the cloud provider adhered to.

The issues covered in this research study that top management could play a critical role in were not only limited to governance, there were other issues such as the employment of key staff members, finding the right cloud provider, and increased network expenditure. Other organisations might have had to increase expenditure due to needs for certain types of infrastructure and added internet costs (Alsanea, 2015). Other ways in which top management influenced the adoption of cloud computing within the respective organisations included how the cloud was going to be utilised once it was adopted. Konstantinos and Maria (2016) conducted a study where the researchers investigated how cloud computing was used in European organisations, and how that had a negative impact in the growth of the cloud model within European organisations. From the findings by Konstantinos and Maria (2016): "(1) 21% of European enterprises used cloud computing in 2016 mostly for hosting their email systems and storing files in electronic form, (2) 51% of those firms used advanced cloud services relating to financial and accounting software applications, customer relationship management or the use of computing power to run business applications, (3) In 2016 almost twice as many

firms used public cloud server (15%) as private cloud servers (8%), (4) Compared to 2014, the use of cloud computing increased particularly in large enterprises, an increase by 10+ points" (Konstantinos & Maria, 2016, p. 1). It was evident from the author's findings that some of the organisations adopted the cloud for their less critical business processes.

2.5.3.2 Security challenges

Security threats in the cloud were real, and it did not matter the size of the organisation or the region in which the organisation operated. A good example is the security breaches that occurred to Apple - when the iCloud was hacked in 2014 and client's confidential information was leaked on the internet (Lewis, 2014). Another example is when Sony was hacked and confidential financial information was released to the public (Peterson, 2014). A further example was when the adult website Ashley Madison was breached in 2015 and the website member's banking details and names were released to the public (Zetter, 2015).

Security was one of the significant concerns for organisations wanting to adopt the cloud, and security in the cloud was a complex matter. While the cloud provided organisations the opportunity to improve their security, organisations also got exposed to more threats due to cloud adoption (Agarwal et al., 2016). It was recommended that organisations considered security risks and opportunities associated with the cloud, and also take a closer look at governance, controls, design, and operational considerations prior to moving their services to the cloud. There were security and privacy standards in place that organisations and cloud providers had to adhere to, these included security standards that were covered in the ISO/IEC 27001 information security management standards guide – "ISO/IEC 27001 is widely known, providing requirements for information requirements for an information security management system (ISMS). Using these standards enabled various organisations to manage the security of assets such as financial information, intellectual property, employee details or information entrusted by third parties" (ISO, 2020).

One of the major challenges that organisations faced with security in the cloud was that threats were present at every level of the cloud paradigm. Singh and Malhotra (2014) listed the different levels of the cloud adoption paradigm and highlighted the security threats that organisations faced at each level.

- Network Security: When information from server to server over a network there was always a chance that that information could be intercepted, cloud service providers needed to ensure network security tools were put in place to protect against malicious

network interceptions. This is called man in the middle attack (Singh & Malhotra, 2015).

- Interface security: The quality of interface security was dependent on the operating system that the organisation chose to use, Linux systems were more secure than Windows systems. It was still the responsibility of the cloud provider to ensure that the interface they offered to organisations was secure.
- Virtual machine security: Users made use of virtual machines for processing their tasks, and since in the cloud different users accessed the same virtual machine, this increased the level of vulnerability for organisations.
- Compliance: Compliance focused on enforcing the terms of agreement that were listed on the SLA. The SLA was the only legal document between the cloud provider and the organisation and since there was no standardisation of the SLA there were always risks that the cloud provider could breach some of the terms of the agreement (Singh & Malhotra, 2015).
- Confidentiality: In a cloud model data was stored on geographically separated locations thus ensuring confidentiality, but in spite of these efforts to maintain confidentiality in the cloud, there was always the risk that the data could be compromised.

2.5.3.3 Choosing the right cloud provider

The ever-growing cloud vendor market presented both challenges and opportunities for organisations. The cloud vendors had different proposals and ideas for how organisations should be utilising cloud services, and this at times made it difficult for organisations to decide which cloud provider to work with since the margins separating the vendors in the eyes of the consumers were fine (Garg et al., 2013). The over saturation of providers can be seen as both positive and negative for organisations. The positive side of having many cloud service offerings was that this allowed cloud computing to act as a key enabler for an ever-present, convenient, on-demand network access to a shared pool of configurable computing resources.

Setting up a cloud environment was not an easy task, there were a lot of considerations that had to be made by organisations. The adoption of the cloud had the potential to change IT organisational set, IT models and IT strategies, and this is why it was critical that organisations follow the correct process when adopting the cloud, a process that won't disrupt business operation; that also entailed partnering with the right cloud provider. The relationship between the cloud provider and the organisation adopting the technology was fundamental and had the

potential to influence the organisation's decision to adopt the cloud, continue using cloud service. For instance, numerous organisations avoided using cloud providers whose data centres were located in the United States since government laws allowed the federal government to access any data centre for investigation purpose without the consent of the organisation, this resulted in organisation opting against cloud providers who hosted their services in data centres based in the United States (Advisen, 2012).

There were three critical issues that had the potential to affect the relationship between organisations and the cloud provider:

- Risk of security liability: With the risks of cloud technologies becoming more apparent, questions were raised about who should be responsible for security in the cloud between the cloud provider and the organisation. Organisations believed that along with the transfer of computing resources, the responsibility for the financial liabilities of data loss, and corruption should also be transferred to the cloud provider. This was never the case though, and if organisations wanted to transfer that responsibility over to the cloud provider, they had to negotiate a new contract with a new cost model and higher costs (Advisen, 2012). In a survey that was conducted by the Ponemon Institute, there were more cloud providers who expressed that they believed security in the cloud should be the responsibility of their customers, this was because many providers viewed the availability of their services at an affordable cost as their primary objective.
- The standard of cloud contracts: Organisations grew to realise that with the cloud model they were essentially outsourcing their data to a third-party vendor and entrusting them with the proper management of that data. Cloud computing agreements were based on the traditional outsourcing or technology licensing mode that limited vendor-liability, so in an event that the data got damaged, destroyed, or breached, there was not much that an organisation could from a legal standpoint (Advisen, 2012).
- Cloud insurance: Due to the risk exposure that organisations took by moving to the cloud, there were insurances that were formed to help organisations guard against potential financial loss. A caveat with these insurance policies though for the cloud provider was that they excluded any contractual liability assumed by the insured, and this exclusion eliminated coverage as most liability was assumed via contracts (Advisen, 2012).

2.5.3.4 Bandwidth challenges

Organisation in developing countries were usually faced with issues of bandwidth, which acted as a barrier for organisations in these regions when looking to adopt the cloud. Organisations had to deal with the cost of bandwidth, the lack of reliable network infrastructure, and the availability of bandwidth (Peña-López, 2014). Network readiness was one of the major challenges for South African organisations and the challenges were even more visible with organisations trying to move to the cloud (Nicholas, 2013). Nicholas (2013) found that there were many underlying factors that contributed to the network challenges. The problem of the lack of reliable network infrastructure, which in turn resulted in high internet costs in South Africa. According to Hippo (2016) "in 2015, the average cost of South Africa's broadband connectivity (ADSL) per month was ten times higher than that of the United Kingdom (UK), yet the UK's speed is five times higher than that of South Africa, and it reaches more people" (Hippo, 2016, p. 1). In 2017, the cost of data placed South Africa in the 97th most costly country when it comes to data out of the 196 countries that were considered for this study (BSA, 2016). According to the study, South Africans paid an average price of $55.91 per month in 2017, that is R794.48 ($55.91*(14.14 (17 November 2017))) in South African rand (Vermeulen, 2017). Although South African organisations faced these network challenges, there were fibre roll out projects taking place in major cities which improved the accessibility, quality, and cost of internet in some parts of the country (Hippo, 2016).

In 2019 most major cities in South Africa had fibre set up and the focus had shifted towards rolling out to smaller surrounding areas, and eventually the rural areas. This came as part of the government's plans that was drawn as part of the South Africa Connect broadband policy in 2013; "the bigger plan is to have 100% penetration of affordable, high-quality broadband (at a minimum speed of 10Mbps) across the country by 2030" (Chatz, 2019, p. 1). Although this was an ideal situation, it was slow and had proven to be very costly. Replacing all the old lines that were set up in cities – which were used for ADSL internet access – with fibre-optic cables required an estimated amount of R60 billion (Chatz, 2019).

2.6 Conclusion

This chapter presented the literature that was reviewed and discussed how other researchers approached the cloud computing subject in their respective studies. This chapter discussed the theoretical background of the cloud; this section went over the different definitions of cloud computing and will close off the section by discussing the definition that was chosen for this

research study. Thereafter the benefits and challenges of adopting the cloud were discussed. This was done by looking at past literature that discussed the adoption process for the cloud and how these adoption initiatives benefited organisations in the different sectors of the economy. Challenges that these organisations faced were also highlighted. As part of this process, gaps were also identified from past literature, especially the literature that focused on South African organisation's cloud adoption journey. Past studies tended to focus on either one particular sector or organisations of one particular size, this research study included organisations of all sizes in order to get variation in the data collected. The chapter also discussed the overview of the cloud; the history of the cloud was covered by highlighting key moments and years in the growth of network based models, which eventually resulted in a stable cloud model. The building blocks for the cloud were discussed in this section, while also highlighting the different characteristics that built the cloud model and which act as pillars for the cloud. This chapter also discussed cloud service and deployment models, and as part of that process the most popular service and deployment models were highlighted including reasons for why they were the most popular amongst the different organisations. The benefits and challenges of adopting the deployment models were also discussed. The final section of the chapter looked at the areas of the cloud that this research study focused on. This chapter discussed the different challenges listed as part of the research questions and was covered by past literature regarding the highlighted challenges. Chapter 3 of this research study discussed the research framework and how the chosen framework was used to address some of the gaps identified from past literature.

3 Chapter 3: Theoretical Framework

3.1 Introduction

Chapter 2 discussed the literature that was reviewed for this research study, the gaps that were identified from that literature, and how the framework that was used for this study assisted in addressing some of those gaps. This chapter defines a theoretical framework and how it was used in cloud computing research. The chapter lists four technology acceptance frameworks that were under consideration for this research study. Each framework is then discussed further, highlighting its strengths and the reasons for not utilising some of these frameworks for this study. The four frameworks that will be discussed are technology acceptance model 2 (TAM2), theory of reasoned action (TRA), theory of planned behaviour (TBP), and the theory of technology-organisation-environment framework (TOE). The further examines the fundamental constructs of the TOE framework, and presents the TOE model that will be used in this research study. The TOE framework model is broken down even further in order to discuss each element of the TOE framework (i.e. technology, organisation, environment). The role that each element of the TOE framework plays in making a case for this research study is discussed. The chapter goes further by discussing how the different elements of the TOE framework assisted with the formation of the research question, and with this subsets of the TOE framework model will be presented, along with the relevant research questions. Lastly, the chapter discusses why the TOE framework was chosen for this research study, what the benefits of the framework are, and how the framework assisted in addressing some of the gaps that were identified from past literature.

3.2 Overview of Conceptual Models used for Cloud Adoption Studies

Different technology adoption frameworks were explored before in this study before choosing the appropriate one; the framework was used to support the theory that was presented for this research study. The criteria for choosing a suitable framework for this study primarily focused on technology acceptance and usage, and how widely the framework was used in technology acceptance studies. There was a number of theoretical frameworks that could have potentially been used, below are a few that were discussed:

- Technology Acceptance Models 2 (TAM2)
- Theory of Reasoned Action (TRA)

- Theory of Planned Behaviour (TBP)
- Technology Organisation Environment Framework (TOE)

The listed theories were discussed in past literature that focused on the adoption of the cloud and helped researchers to explain how organisations adopt cloud computing. Only one theory from the above listed was used in this research study. The decision was taken after examining all the theories listed above.

3.2.1 Technology Acceptance Model 2 (TAM2)

TAM specified the key factors that played a role in the user's decision to accept a particular technology, this model was used to explain and predict user's behaviour in varying situations and environments where factors affecting the user's behaviour may not have been necessarily constant over time (Samaradiwakara & Gunawardena, 2014). The goal of TAM2 was to cover the shortcomings found in TAM. TAM2 included additional key determinants of technology acceptance that were not addressed in TAM. These determinants discussed in TAM2 "explain perceived usefulness and usage intentions in terms of social influence and cognitive instrumental processes" (Mohammad & Suleiman, 2014, p. 1647). TAM2 aimed to understand how the effects of these determinants changed as users get more exposure to the technology system (Mohammad & Suleiman, 2014). When TAM2 was introduced based on the TAM framework, two processes, the social influence process and the cognitive instrumental process were integrated into the TAM2 framework (Low et al., 2011). TAM was introduced to explain why users rejected or accepted innovative technology, whereas TAM2 was introduced to improve on the explanatory powers of TAM.

The technology acceptance models (TAM2) was not used in this research study because this model examined user behaviour towards a specific technology, and the decision whether to adopt the technology or to not was taken based on the user's feelings about that particular technology (Samaradiwakara & Gunawardena, 2014). For this research study, while understanding user feelings would have been useful, but understanding the issues that impacted the adoption of the technology, the use of the technology, and the conditions under which the technology was being used was more important. In order to study the adoption of technology, this research study needed a framework that could help investigate issues that were outside of user behaviour. The technology acceptance model has two determinants, these are perceived ease of use and perceived usefulness. Perceived usefulness is based on the belief that a user

had a particular system and only that system should be improved in order to improve the user's current performance. The second key construct is perceived ease of use, this is the user's perception on how much effort it takes the user to use a particular system (Oladepo, 2014). Measuring the usefulness of the cloud depended on many factors, some of which were outside of the organisation and had no direct link to the user, and as a result it would have not been easy for this research study to fully explore some of those issues with this framework.

3.2.2 The Theory of Reasoned Action (TRA)

According to Ami-Narh, Aziale, and Akanferi (2014) TAM was based on the theory of reasoned action (TRA) (Ami-Narh et al., 2014). TRA stated that "individual behaviour is driven by behavioural intention where the behavioural intention is a function of an individual's attitude towards the behaviour and subjective norms surrounding the performance of the behaviour" (Ami-Narh et al., 2014, p. 7). In other words, "one's behaviour and the intent to behave is a function of one's attitude towards the behaviour and their perception about the behaviour" (Ami-Narh et al., 2014, p. 34). Normative behaviour referred to beliefs of an individual that are accepted by specific people or groups and dictated whether behaving in a particular manner was appropriate. Attitude on the other hand is defined as "a favourable cognitive evaluation, emotional experience, or behavioural tendencies that people constantly held for a certain situation or ideas" (Fang et al., 2017, p. 13). Samaradiwakara and Gunawardena (2014) conducted a research study looking at the application of the different technology acceptance models and their effectiveness under varying conditions. The researchers highlighted the different strengths and weaknesses of each model, and one of the weaknesses that played a role in the TRA framework not being used in this research study was that, TRA assumed that once an individual has formed an intention to act, they will have the freedom to act in the intended manner. This was not the case though, individual behaviour was at times limited by ability, time, environment, or organisations (Samaradiwakara & Gunawardena, 2014). The main objective of conducting this research study was finding out why certain organisations were potentially limited to act as expected when it came to the adoption of the cloud, and what factors influenced their behaviour. The research questions and questionnaire were constructed to determine what environmental and organisational limits affected the organisation's intentions to adopt the cloud. Since the TRA model assumed that users had the freedom to act as they intended to act and failed to account for the different factors that might affect the user's intentions, this model could not be used in this research study.

3.2.3 The Theory of Planned Behaviour (TPB)

The Theory of Planned Behaviour (TPB) attempted to resolve the shortcomings of the Theory of Reasoned Action (TRA). TPB started as a Theory of Reasoned Action in the 1980s to predict and anticipate the user's intentions to act in a certain way at a particular place and time (Mmadu & Egbule, 2014). The theory was introduced to explain all user behaviour. The behavioural intent of this theory distinguishes it from all the other theories, this theory measured the person's intention to do or to not to do something, and it stated that a person's intention to behave in a particular way was influenced by their attitude that the behaviour will lead to expected results and the risks and benefits will be within the expected scope (LaMorte, 2016). TPB stated that for an individual to behave in a certain way, it is dependent on their level of motivation (intention), and their ability (behavioural control) to perform that particular task. While the TPB framework included some factors that were not considered previously when studying other technology adoption frameworks, TPB was still not suitable for this research study. TPB did not factor in issues that were outside of the organisation and how these may impact technology acceptance, and user experience with using the technology (LaMorte, 2016). This research was not only interested in the framework that studied the behaviour of the end-user, but also a framework that studied the factors that might have not been directly linked with user behaviour but still affected the adoption of the technology. With the use of the TPB, only half of the research questions would be answered for this research study since the questionnaire was set to address even factors that were outside of user behaviour, which meant that the decision to adopt or not adopt the technology did not rely heavily on how the user felt about the technology, but could have also been determined by other factors other than user perception and attitude.

3.2.4 The Technology Organisation Environment Framework (TOE)

The technology organisation and environment (TOE) framework "is a classic framework that proposed a generic set of factors that explained and predicted the likelihood of innovation/technology adoption. The framework proposed three bits of enterprise elements that influence the adoption and/or implementation of innovations. The contexts of the TOE are technology development, organisational conditions, and industry environment" (Awa et al., 2016, p. 17). The technology context of the TOE framework assessed the technology that the organisation was already using and the technology the organisation intended on adopting. The technologies varied in terms of their perceived usefulness, technical and organisational

compatibility, complexity and the learning curve of that technology (Tornatzky et al., 1990). The authors described the organisational context as the organisation's decision making process, it involved descriptive measures - meaning that the organisation interrogated its "business scope, top management support, organisational culture, business model and strategy, the complexity of managerial structures measured by centralisation, formalisation, and vertical differentiation, the quality of human capital, and size and size-related issues such as internal slack resources and specialisation – prior to the adoption of the technology" (Tornatzky et al., 1990, p. 305). The environmental context "related to the operational facilitators and inhibitors, but more importantly competitive pressure, trading partners' readiness, sociocultural issues, government encouragement, and technology support infrastructures such as access to quality ICT consultants" (Awa et al., 2016, p. 5). These inhibitors had the power to influence how an organisation viewed a particular technology and ultimately played a significant role in the organisation's decision to adopt or not to adopt the technology.

The three contexts of the TOE framework were crucial in formulating research questions for this research study. The advantage of using the TOE framework for any research is that it focuses on both external and internal environments. The TOE framework focuses on the technology, organisational , and environment context; each context of the TOE framework was used as a guide when formulating the research questions for this research study, which are listed below,

- How does bandwidth affect cloud computing adoption?
- What role do executive management play in the adoption of cloud computing?
- How does cloud provider affect the decision to adopt cloud computing?
- What role does security play in an organisation's decision to adopt cloud computing?

The question that examined the impact of bandwidth focused on the environmental context of the TOE framework; the question about top management support focused on organisational contexts; and the question about security focused on all three contexts of the TOE framework; and cloud providers question focused on both technology and organisational contexts of the TOE framework. Grouping issues according to either internal or external was important to the investigation of this research study to help understand where the challenges that organisations face originated from. The TOE framework included both human and non-human factors when studying technology acceptance, which gave a better understanding to why some technology innovations get adopted, while other innovations get rejected. When studying how users viewed technology adoption, it was important to understand that strategies were shaped by an

individual's mode of behaviour; this is why it was believed that ICT adoption reflected an owner's ambitions, top management support and managerial productivity, and CEO's knowledge and characteristics (Awa et al., 2016). The TRA and TPB frameworks were generally used on studies that focused on individual adoption of technology, while TAM and TOE frameworks were used on studies that studied technology adoption at an organisational level. The differentiating factor between TAM and TOE frameworks for this research study and why the TOE framework was chosen over the TAM framework was the fact that the TOE framework was more suitable when studying the adoption from larger organisations which operated in an unpredictable environment. Durodolu (2016) stated that the TAM framework was commonly used successfully in academic atmospheres, where the environment was already known and was unlikely to change for the foreseeable future (Durodolu, 2016). The author stated that the TAM framework was not easy to use in business environments, where users have to deal with different technologies while trying to perform at the best possible levels. Durodolu (2016) stated that most studies that supported the use of TAM frameworks focused mostly on office software or development applications rather than business application and thus this framework had limitations when studying technology acceptance in a normal business environment (Durodolu, 2016).

The TOE framework was considered the most suitable theory for this study where the focus was on technology acceptance in a business environment. The main elements (technology-environment-organisation) of this framework proved to be broader in scope when testing technology acceptance in a business environment where there were many potential factors that affected how users interact with technology. The three TOE framework contexts has been used in the past to study the adoption of other technologies such as "EDI, KM, e-business, RFID, e-commerce, enterprise systems, and e-procurement" within a business environment and this was further evidence that this framework was more suitable for this research study (Awa et al., 2016). Unlike the other frameworks, it has been stated that the TOE framework provides a more holistic insight into "adoption challenges and adoption factors, value-chain activities, adoption processes and implementation, post-adoption, and development of capabilities using the technology" (Awa et al., 2016, p. 16), and this was one of the main reasons why it was used for this study. To further emphasise the effectiveness of the TOE framework when studying the adoption of technology by organisations, Lian, Yen, and Wang (2014) highlighted the four dimensions that can potentially affect the organisation's decision to adopt cloud computing, which were human dimension, organisation dimensions, technology dimension, and

environmental dimensions (Lian et al., 2014). The findings of the study indicated that the five most critical factors drawn from these four dimensions, include data security, perceived technical competence, cost, top management support, and the complexity of the technology. Moreover, internal and external organisational factors were believed to cause problems in the adoption of the cloud. The approach by Lian et al., (2014) to use the TOE framework to study the different dimensions that could affect the adoption of the cloud was one of the reasons why the TOE framework was used in this research study. Lian et., (2014) indicated that the TOE framework has the potential to help identify whether the issues affecting the usage of the cloud were came from internal or external dimensions, and this was one of the objectives of this research study, to determine whether the challenges that organisations faced came from inside or outside the organisation (Lian et al., 2014).

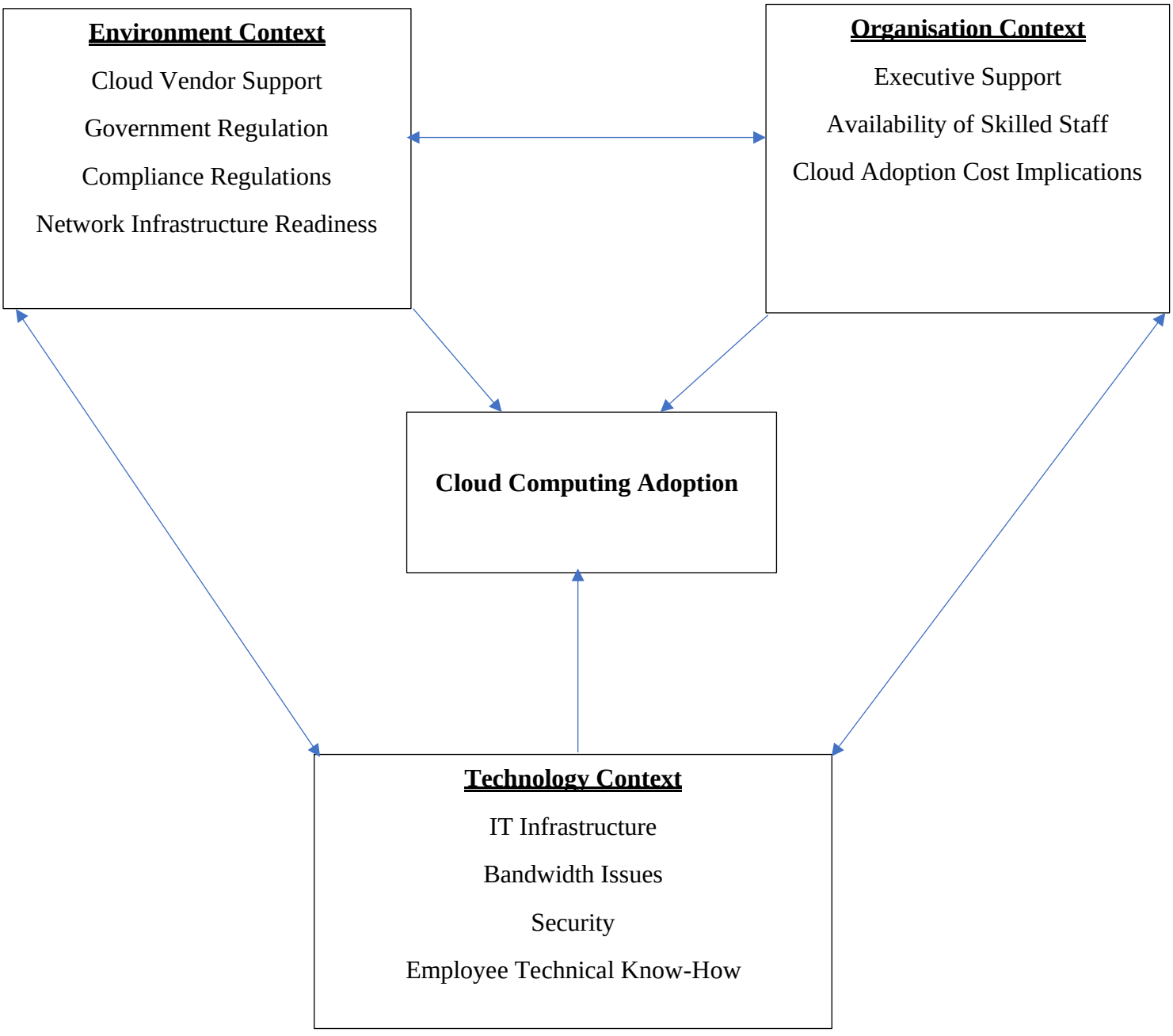


Figure 3-1: Proposed framework explaining cloud adoption within TOE (Karahanna et al., 2006)

The model that was adopted for this research was originally from Karahann (2016), and was modified to suit the objectives of this research study (Karahanna et al., 2006). This model was used to explain how organisations adopted technology, and with this model the researchers explained how the different contexts might affect the technology adoption process for organisations. The model in Figure 3-1 encompassed all the key elements of the TOE framework, and it suggested possible factors within the TOE elements that might affect the organisation's technology adoption journey. The possible issues that might influence an organisation's adoption of the cloud were not limited to the ones discussed in this model, but the ones listed more aligned with the research objectives.

3.2.4.1 Technology context

The image below on Figure 3-2 broke down the TOE model introduced in Figure 3-1. The model on Figure 3-2 examined the technology context and how it was used in this research study. Figure 3-2 also listed the research questions that were formulated based on the issues commonly found in the technology element. When introducing the framework adopted in this research study, it was mentioned that the chosen framework was broad in scope and more issues that potentially affected the technology acceptance process; Figure 3-1 further illustrated how the TOE framework achieved that. Using the technology element, it was possible to identify technology issues that organisations face in the adoption of technology, and the issues identified enabled this study to formulate research questions based on the identified issues.

Table 3-1: Relationship between TOE framework and research questions

TOE Context	Technology Related Concerns	Research Questions for This Research Study
Technology Context	IT Infrastructure	• How does bandwidth affect the adoption of cloud computing? • What impact does security have in the organisation's decision to adopt cloud computing?
	Bandwidth Issues	
	Security Concerns	
	Employee Technical Know-How	

According to Ramey (2013), "technology is a body of knowledge devoted to creating tools, processing actions, and the extraction of materials. Technology is used to accomplish various tasks even in people's lives, it is also described as products and processes used to simplify people's daily lives" (Ramey, 2013, p. 1). Literature reviewed showed that factors such as "the availability of internal and external technology resources (e.g. ICT infrastructures, internet), relative advantage, security, reliability, capability, cost, quality of software in the market, vendor support, type of IT solution within the firm and their compatibility, IT objectives and

assumptions, and evaluation of benefits influence adoption" affected how technology was perceived and received by users (Awa et al., 2016, pp. 4-5). The issues highlighted by Awa et al. (2016) affected how an organisation and end-user perceived technology and this played a crucial role in the adoption of that technology. The issues that were covered by the technology context in this research study were highlighted in Figure 3-2 above, along with the research questions that were raised for this research study based on the technology context.

- IT Infrastructure: Using the technology context of the TOE framework, this research study had questionnaire questions that investigated how cloud computing infrastructural requirements could affect organisation's adoption of the cloud.
- Bandwidth issues: This research study targeted organisations of different sizes, with different spending power. Running a network based model could potentially lead to an increase in the organisation's bandwidth expenditure. Bandwidth issues were not only limited to increased cost but also the availability of internet providers in the area, fibre roll-out initiatives, and the quality of the internet in the area.
- Security concerns: Security had been one of the hindrances for cloud providers when promoting the cloud model to organisations. For security measures to be effective, they needed to reduce the risks of internal and external attacks to the organisation. The organisation should also be protected from unauthorised exploitation of systems, networks, and technologies (ITGovernance, 2018). The aim was to find out how much effort had been put in place to ensure that organisational data was safe at all times.
- Employee technical know-how: It was essential to understand how the shortage of cloud skilled staff members affected the organisation's adoption and usage of the cloud. With this issue it was also important to try and understand the cost implications of upskilling current staff members to the level that they could run and manage the cloud (Garg et al., 2013).

3.2.4.2 Organisation context

The image below in Figure 3-3 showed a further breakdown of the TOE framework model in Figure 3-1 that was used in this research. This model was further broken down in order to show the specific link between the framework, research objectives, and research questions. The TOE frameworks in Figure 3-1 illustrated some of the issues organisations faced when adopting technology, and in Figure 3-3 these issues were broken down even further to show the link between what was listed in the TOE framework model (Figure 3-1) and the research questions

for this research study. From the organisational context, the focus for this research was on executive management support, availability of skilled staff, and the cost of adopting the cloud.

Table 3-2: Relationship between TOE framework and research questions

TOE Context	Organisational Context Points of Interest	Research Question for This Research Study
Organisation Context	Top Management Support	• What role did top management play in the adoption of cloud computing?
	Availability of Skilled Staff	
	Cloud Adoption Cost Implications	

The organisational context was descriptive and directly related to the availability and use of internal resources. The proposed organisational issues in this study that may have affected the organisation's adoption of the cloud, including the size of the organisation, social influences, individual difference factors, organisation mission, top management support, availability of expertise, types of products offered, corporate culture and ownership structure (Awa et al., 2016). The issues that were covered by the organisation context in this research study have been highlighted in the Figure 3-3 above, and the research question that was raised in this research study based on these issues was also listed.

- Top management support: Top management support was essential to the approval of any IT-related project, not only from a financial perspective but also from a compliance, business strategy, business continuity, governance, and policy perspective. When IT managers considered adopting any technology, they had to sell the idea to the organisation's top management until that project was eventually approved.
- Availability of skilled staff: A literature that was reviewed for this research study by Garg et al., (2013) highlighted that there was a lack of knowledge form organisations about what cloud computing was and this was due to the shortage in people who were

"cloud-savvy". This shortage in cloud skill had the potential to affect the organisation's adoption and use of the cloud.

- Cloud adoption cost implications: Organisations also had to take into consideration the issue of cost. The cloud adoption costs were not only monetary costs but there were also non-monetary costs such as potential business disruption, time lost while sourcing for a cloud provider (Garg et al., 2013).

3.2.4.3 Environment context

The diagram below in Figure 3-4 was a further breakdown of the TOE framework model in Figure 3-1 to show the link between the TOE framework, research objectives, and research questions for this research study. In Figure 3-1, the different environmental issues that can affect the adoption of technology were listed. Based on the depicted environmental issues research questions were developed around these issues as one of the main focus areas for this study.

Table 3-3: Relationship between TOE framework and research questions

TOE Context	Environment Context Points of Interest	Research Question for This Research Study
Environment Context	Cloud Vendor Support	• How does cloud provider conduct affect the organisation's decision to adopt the cloud?
	Government Regulations	
	Compliance Regulations	
	Network Infrastructure Readiness	

The environmental context of the TOE framework related to issues such as "operational facilitators and inhibitors, and more importantly the competitive pressure, trading partner readiness, sociocultural issues, government regulations, and technology support infrastructures such as access to quality ICT consultants" (Awa et al., 2016, p. 5). The issues mentioned above

were external to the organisation and were not fully within the organisation's control; however, they affected the organisation's daily operations and played a significant role in the organisation's adoption and usage of the cloud. The environmental context in the TOE framework represented the place within which the organisation operated, and the different occurrences that happened as a result of operating in that area. It suggested that the decisions taken by the organisation regarding the cloud were affected by certain environmental factors that either enabled or made it difficult for organisations to adopt the cloud (Awa et al., 2016). The issues that were covered by the environment context in this research study have been highlighted in the Figure 3-4 above, and the questions that were raised in the questionnaire looked to find out how the listed environment context issues might have affected the adoption of the cloud.

- Cloud vendor support: Finding the suitable cloud provider for the organisations was a critical process that had major consequences on the outcome of the cloud adoption process. Cloud provider conduct had the potential to negatively impact the organisation's cloud adoption process and cloud usage.
- Government policies: One of the findings from the BSA (2018) was that South Africa was still lagging behind with its ICT policies, the BSA believed that the communication policies did not protect the customer's as much as they needed to (BSA, 2018) This is why there were questions in this research study to investigate this matter and how it potentially affected the adoption and use of the cloud.
- Compliance regulations: Compliance and risk management had always been critical processes of governance in traditional IT systems and were now even more important with the model such as the cloud model (IBM-Corporation, 2014). Cloud computing exposed organisations to greater risk than the traditional technology models since it was a network model, and added to that, organisations dealt with different cloud providers so it was important that customer protection policies were adhered to at all times.
- Network infrastructure readiness: At the time of conducting this research study, there was a lack of network infrastructure in some parts of the eThekwini city as projects to roll-out fibre had been halted in certain areas and this had the potential to affect the availability of reliable network and internet (Chatz, 2019). The lack of proper network infrastructure in place has the potential to affect access to fibre, and it may cause a negative impact in the reliability of the network, and ultimately the adoption of the cloud (Nicholas, 2013).

3.3 Conclusion

This chapter defined a theoretical framework and how it was used in cloud computing adoption research studies. The chapter listed four technology acceptance frameworks that were under consideration for this research study. Each framework was then discussed further, highlighting its strengths and the reasons for not utilising some of these frameworks for this study. The four frameworks that were discussed were technology acceptance model 2 (TAM2), theory of reasoned action (TRA), theory of planned behaviour (TBP), and the theory of technology-organisation-environment framework (TOE). The chapter further examined the fundamental constructs of the TOE framework, and presented the TOE framework model that was used in this research study. The TOE framework model is broken down even further in order to discuss each element of the TOE framework (i.e. technology, organisation, environment). The role that each element of the TOE framework played in making a case for this research study was also discussed. The chapter went further by discussing how the different elements of the TOE framework assisted with the formation of the research question; this was achieved by presenting each subsets of the TOE framework model along with the relevant research questions. Lastly, the chapter discussed why the TOE framework was chosen for this research study, what the benefits of the framework were, and how the framework assisted in addressing some of the gaps that were identified from past literature. Chapter 4 of this research study discussed how the research study went about in addressing some of the gaps that were identified from past literature. This was achieved by detailing how this research study was carried out, and this has been described in the research methodology section below.

4 Chapter 4: Research Design and Methodology

4.1 Introduction

Chapter 3 of this research study discussed how the TOE framework was used to broaden the scope of areas that needed to be investigated when adopting cloud computing. In chapter 3, it was also highlighted how the different contexts of the TOE framework were used to help formulate the research questions and focus areas for this research study. This chapter will detail how the research questions that have been raised by this research study will be answered, and how the objectives of the study will also be achieved. This chapter defines research methodology and what role it plays in a research study. In this chapter, the research methodology is defined and discussed in relation to this research study. The first section gives in detail the steps that were followed in constructing this research study. The research design section of this chapter presents the research onion and the layers of the model that will be used in this research study. The reasons for using the layers that have been listed are given in the discussion of each layer. The chapter also discusses the research approach that will be used in this research study. There are three potential approaches that can be chosen from; the quantitative approach, qualitative approach, and mixed methods approach. For this research study the quantitative approach will be used, but the qualitative and mixed methods approach will also be discussed. In addition, the chapter highlights tools that were used to identify the population of interest, tools used to identify the correct sample and the techniques used to collect and analyse data. The chapter further highlights the importance and credibility of the research study. This chapter also discusses the approach and tools that were used to analyse data for this research study and the benefits of approaching the data analysis in that manner. Lastly, the measures that were put in place to ensure that the study maintained its credibility throughout the entire study.

4.2 Research Methodology

The research methodology explained how the research study was conducted and how answers to the research questions were obtained. A method is a way of achieving something or an approach that is taken to solve a particular problem. Research methodology, in essence, described the way of doing something; it also described the manner and approach that was used to answer the research questions and fulfil the objectives of the research study (Vilakati, 2015). For this research study the processes and techniques of the descriptive research design were

used, and this design was chosen because it aligned with how the researcher intended to conduct this research study, and as Vilakati (2015) had mentioned that the descriptive approach was used to describe variables rather than to test a predicted relationship between variables, which is how this research study was conducted (Vilakati, 2015). Even though no comparisons were made between variables this research study used the quantitative approach to research, and the reason for this was that with the quantitative approach statistical tools could be used to analyse the data; and as Creswell (2014) mentioned, "it is very hard to argue against statistical data" (Creswell, 2014, p. 2). The data was collected using a survey and this data was then analysed using tools in SPSS. Given that no comparisons were being made between variables the researcher focused on tools that presented the exact findings from the participants. Bar charts and measures of central tendency were the main tools of analysis being used in this research study. The population for this research study was identified as being organisations in the Durban Chamber of Commerce, and five organisations were identified from the overall list of organisations and these organisations were selected using convenience sampling.

4.3 Research Design

Research design played a crucial role as a link between proposed theories and arguments that added to the research topic and the collected data. This research study followed the techniques and processes of a descriptive research design. A descriptive research design referred to a study that had as its main objective the accurate portrayal of the characteristics of persons, situations or groups; "this approach was used to describe variables rather than to test a predicted relationship between variables" (Vilakati, 2015, p. 27). The researcher chose descriptive research because the research design coincided with the tools that were used in this research study. One of the methods of descriptive research is the surveys for data collection, which was utilised in this study. Descriptive research also supported the use of tools such as graphs and bar charts to analyse data, and these were some of the tools that were used in this research study. One of the limitations of the descriptive research design was that the generalisability of the study depended on the type of sample, and sample size. For this research study it would be difficult the generalise the findings since the intended minimum number of individual participants was not reached. This research study is still relevant though since one of the advantages of descriptive research design is that descriptive studies can lay a foundation for future studies, and this research study will act as a foundation for other future studies (Vilakati, 2015).

One of the traditional ways in which a research methodology could be formulated was with the use of the research onion. The research onion provided a layered and exhaustive description of how an effective research methodology was formulated (Melnikovas, 2018). A visual description of the research onion was provided in Figure 4-1, along with the layers of the onion that were used for this research study.

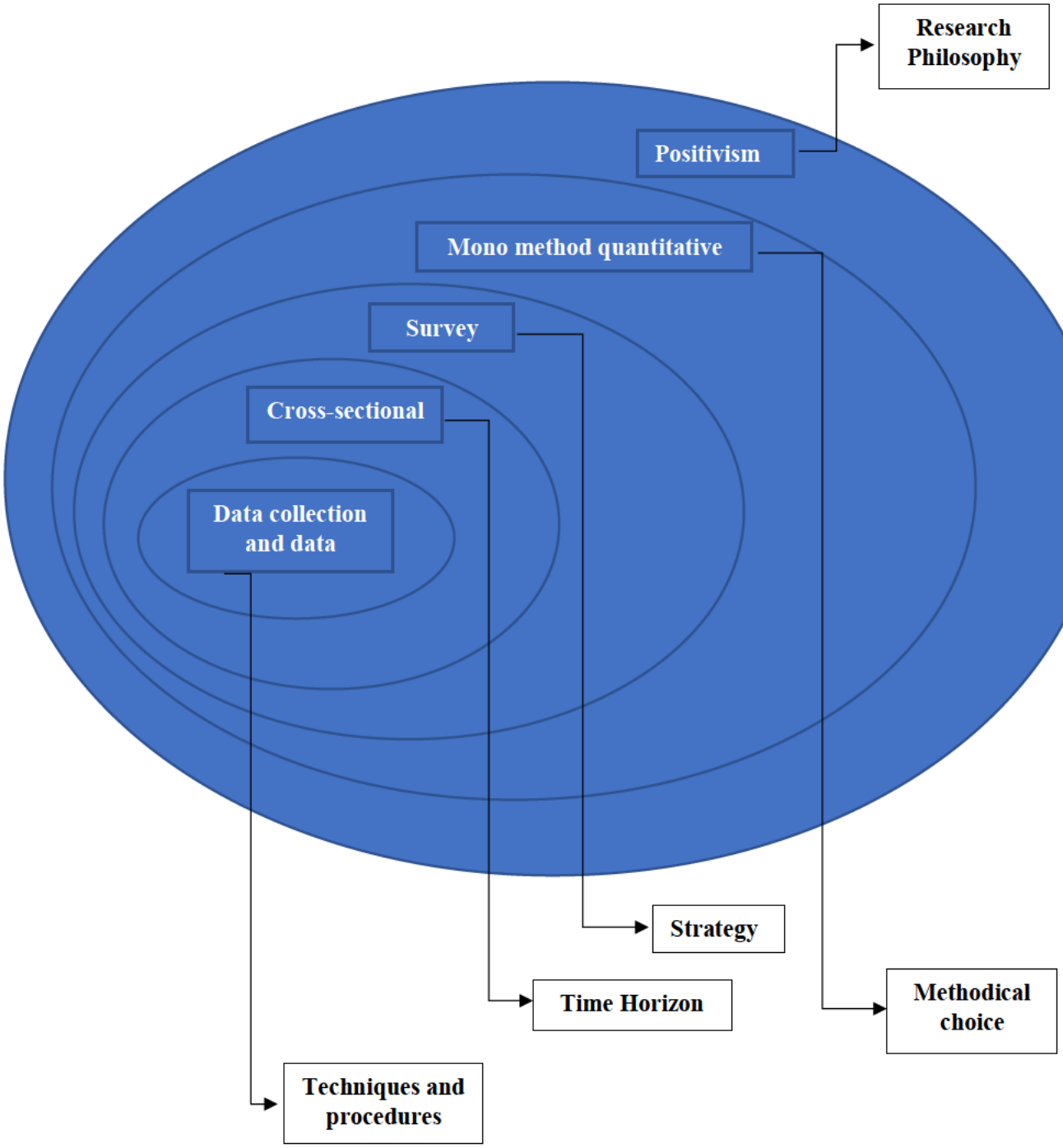


Figure 4-1: The research onion. Sources: (Melnikovas, 2018)

Figure 4-1 above illustrated a clear image of how the research onion was used as a guide in approaching and designing this research study. The diagram used in this research above, Figure 4-1, was adopted from a study "The Layers of Research Design" by Mark Saunders and Tosey (2013). The aim of the study was to describe each layer of the research onion and how it contributed to the designing and shaping of research. Using some of the layers of the research onion, a clear research design for this research study was formulated. The components of the research onion used to develop the research design for this research study are explained below:

- **Research philosophy**: The philosophy that was used for this research study was the positivism philosophy. The reason for using this philosophy was that this research collected and analysed quantitative data and positivism appropriately aligned with this research approach (Melnikovas, 2018).

- **Methodological choice:** Methodological choice determines the use of quantitative and qualitative methods or various mixtures of both. The research approach that was used in this research is quantitative research. In this research study, data was collected using questionnaires and SPSS tools were used to analyse it. Different statistical applications (approaches to analysing statistical data) (Melnikovas, 2018).

- **Strategies:** The research strategy that was used for this research study was the survey strategy. A survey was used as a means of data collection and the data was later analysed using SPSS tools.

- **Time horizon:** This research used cross-sectional, which was an observational approach that analysed data collected from the population or from a sample at a specific point in time (Melnikovas, 2018).

- **Techniques and procedures:** Questionnaires were used to collect data. The questions in the questionnaire were based on the research questions for this study. The questionnaire was hosted on the Survey Monkey website and SPSS tools were used to analyse that data.

The main purpose of a descriptive research technique was to examine a phenomenon happening at a specific place and time, and it interpreted the conditions of the present (Issah, 2017). Descriptive research design was concerned with "conditions, practices, structures, differences or relationships that existed, opinions held, processes that are going on or trends that were evident" (Creswell & Creswell, 2017, p. 113). Gathering data was key to finding answers to

research questions when using this type of research technique since one of its strengths was reporting on the current state of any phenomena (Alceso, 2011). The descriptive approach was suitable for this research study because it focused on establishing practices, structures, and trends about a particular topic and this was the work being done with cloud computing, especially in developing countries (Kshetri, 2010). The other reasons this approach was chosen was that the tools that were mostly used for analysing data in this type of approach were easily accessible and were easy to use. Descriptive technique tools such as frequencies, mean, median, mode standard deviation, correlation, scatter plot, graphs, tables, charts, and histograms are the main tools that are used to analyse the data. Not all of the listed tools were utilised in this research study, instead, the frequency diagrams, histogram, and correlation diagram were used to depict the data collected.

4.3.1 Research approach

The first step in conducting this research study was to develop a research title which was followed by reviewing the literature in line with the research topic. Gaps were identified in the reviewed literature which the study sought to address. The research questions of this study were formulated using the TOE framework as the guiding framework. The TOE framework was crucial in formulating the sub-question that were used as part of the data collection. The intended participants for this study were identified and selected using convenience sampling. As part of that process, ethical clearance was obtained, and the participants signed the consent forms agreeing to participate in the study. The research instrument was tested to ensure it was fit for purpose. The research instrument used was an online survey hosted in Survey Monkey. The e-mails containing the link to the survey were sent to the selected participants and the results were captured and stored in Survey Monkey. Survey Monkey was the choose platform over other platforms such as Google Forms because there are organisation that block access to some Google platform, and as a result a platform that most organisation were already familiar with, and had fewer security concerns over was chosen. On the deadline set for the completion of the surveys data from the respondents was downloaded and analysed using SPSS tools.

4.3.2 Qualitative Research

Qualitative research is an approach for exploring and understanding how individuals or a group define a social or human problem (Creswell, 2014). Qualitative approach did not align with the goals of this research which intended on using statistical data, hence this approach to research was not chosen. Qualitative research findings cannot be presented statistically, and this

research used statistical tools to present data (Creswell & Creswell, 2017).

4.3.3 Quantitative Research

This research employed a quantitative research approach. This research approach used surveys and experiments, it employed statistical procedures, tests, verified theories or explanations, measured information numerically, and employed statistical procedures (Rahayu, 2018).
The quantitative approach was chosen because data collected needed to be tested using an instrument and approach that is less prone to bias and this required less interaction between the research and the respondent. The goal of this research was to present findings based on numbers and facts rather than opinion and interpretation of those opinions. Quantitative research was also chosen because one of the objectives of this research was to present results that could be tested for reliability. The characteristics of quantitative research assumed that collecting, measuring, and analysing the results using quantitative techniques led to more accurate results. Quantitative research enabled the researcher to use sampling methods that reached larger and dispersed populations, which made the findings of the study unique and ensured the data collection process maintained its integrity.

4.3.4 Mixed methods research

Mixed methods approach is a research approach that uses both quantitative and qualitative approaches when collecting and analysing data (Creswell, 2014). The main reason for using mixed methods was that they were believed to provide a more complete understanding of a research problem than when they were using one of them. For this research study only the qualities of the quantitative approach were needed and this is why the mixed method approach was not used.

4.4 Population and Sample

According to Sekaran (2002) “a population refers to the entire group of people, events, or things of interest that the researcher wishes to investigate” (Sekaran, 2002, p. 266). A sample, on the other hand is a fraction of the entire population, it consisted of members elected from the population. Sekaran (2002) stated that “sampling is the process of selecting enough elements from the population so that data collected from the can correctly represent the entire population” (Sekaran, 2002, p. 266). For this research, the population was composed of organisations in the eThekwini business area found from the Durban Chamber of Commerce

website. There were many organisations that operated in the eThekwini business area that were listed in the Durban Chamber of Commerce, but it was not possible to get to all of them to participate in the study, and as a result only a sample of organisations were selected, and these organisations were selected using convenience sampling and on the criteria that made it easy for the researcher to reach the intended organisations and gather the necessary data.

4.5 Data collection

The ever-increasing use of the World Wide Web (www) and electronic mail (e-mail) exposed researchers to easier and more accurate methods of collecting research data. Online surveys were perceived to be easier to administer than paper surveys, the response rates were higher and there was less effort required in terms of posting out and data entry (Harlow, 2010). Many possible methods can be used to collect data. There were more conventional modes of collecting data such as using the telephone, mail, and face-to-face interviews, but internet-based surveys offered unique capabilities and convenience. Questionnaires were used in this study because they were the most reliable and quick tool for receiving results without compromising the integrity of the study. Given that this was a quantitative study, a questionnaire made it easier to collect, measure, analyse and interpret the data. Online questionnaires provided a lot of convenience to the data collection process but there were limitations to using online surveys. When using online surveys there was a risk of accessibility, the researcher needed to know beforehand if the identified respondents were able to access the online survey; this could have potentially affected the response rate (Harlow, 2010). Accessibility was not a major concern for this research study since the sampled organisations were picked based on pre-set conditions, as a result the chosen respondents were those that had access to all the right resources to access the online survey.

4.6 The Design and Standardisation of the Research Instrument

Steps were taken in preparation of the research instrument to ensure that the research meets the required standards and achieve its intended objectives. The four research questions were broken down further to formulate sub-questions that were used for the research instrument to collect data through an online survey. The pilot studies were conducted to test the research instrument, and improvements and adjustments were made based on the feedback. The research instrument was also tested for construct validity through face validity and content validity. Face validity referred to whether an indicator seemed to be a reasonable measure of its underlying construct

on its face. The instrument was also taken through a content validation process, which is a process of assessing how well a set of indicators match with the relevant content domain of the construct that was measured (Hoseini, 2013). Prior to sending online surveys to participants, ethical clearance was obtained. Once ethical clearance was obtained, the next step was to get consent from the participants to participate in the research study. The participants signed the consent forms and were emailed links to the online survey hosted in the SurveyMonkey website. A statistical package for the social sciences (SPSS) tool was used to analyse data for this study. SPSS "was a software package that was used for logical batched and non-batched statistical analysis" (Vrontis et al., 2018, p. 86). SPSS was utilised to build predictive models and conduct other analytic tasks. The tools that were used for data analysis and measurement in this research include, bar chart, descriptive statistics, mean, standard deviation, and the Kruskal-Wallis test.

4.7 Data analysis and Measurement

In a quantitative study, "the researcher is expected to turn raw numbers into meaningful data through the application of rational and critical thinking" (Suresh et al., 2011, p. 288). The collected data was interpreted in many ways; therefore, it is important to apply fair and careful judgement. A statistical package for the social sciences (SPSS) tool was used to analyse the data in this research study. SPSS "is a software package that is used for logical batched and non-batched statistical analysis" (Vrontis et al., 2018, p. 86). SPSS was used to build predictive models and conduct other analytic tasks. The tool was convenient to use as it has a visual interface which made it easier to leverage statistical and data mining algorithms (Vrontis et al., 2018). The tools that were used for data analysis and measurement in this study include bar chart, histogram, and descriptive statistics.

4.7.1 Approach to data analysis

In setting up the questionnaire, Likert Scale was used to measure responses from the respondents; "Likert Scale is composed of a series of four or more Likert-type items that are combined into a single composite score/variable during the data analysis process. Combined, Likert Scale items are used to provide a quantitative measure of a character or personality trait" (Joshi et al., 2015, p. 398). The type of data that was collected using this tool was ordinal data, and in statistics "ordinal data is data where observations are ranked in some measure of magnitude". Numbers assigned to groups express a "greater than" relationship; however, how

much greater is not implied, the numbers indicate the order (Joshi et al., 2015). Ordinal data were commonly employed in various surveys and questionnaires. The Likert Scale listed the categories of psychometric scale such as “strongly agree” or “strongly disagree”. For this research study bar charts and central measure of tendency were used to analyse and present ordinal data; “central tendency is the value that described the entire set of data as a single measurement, and the three primary measures of central tendency are the mean, median, and mode” (Kaur et al., 2018, p. 61). Since this research used ordinal data, the median and mean were the measures of central tendency which were the main focus for this research study. According to Yellapu (2018) the median is the middle value in distribution when the data are ranked in order from highest to lowest (or vice versa). If there are an odd number of values, the median is the exact middle value. However, if there is an even number of values, the median is the average of the two middle values. The median was the better choice for analysing ordinal data of all the central tendency tools as the median “is the point of the 50^{th} percentile of the distribution”, which meant it was the value that divided the distribution to two equal parts (Kaur et al., 2018).

4.7.1.1 Measures of Variation

The measure of central tendency provided critical and useful information when the researcher wanted to analyse the data collected. But there were some challenges when using measures of central tendency, and one of them was their failure to capture variation within a dataset. The advantage to capturing measures of dispersion was that these measures described the degree to which variable’s values were similar or differed, but these types of measures were more suitable to ordinal data, interval, and ratio; and from that data using the measures of variation it is possible to determine the range of the data, variance, and standard deviation (Kaur et al., 2018).

Using Kruskal-Wallis to measure variation

It was a norm for researchers when analysing data to use tools that inferred, which meant for the quantitative response, variables were normally distributed from the population from which they were drawn (Creswell, 2014). In practice though, this was hardly the case; and for researchers there were methods available and could be used to make inferences about the population means (e.g. the one-sample and two-sample procedures and analysis of variance) are quite robust (Creswell, 2014). For this research study the non-parametric Kruskal-Wallis test was used. According to Ostertagova, Ostertag, and Kovac (2014), “nonparametric methods

required less stringent assumptions than their parametric counterparts, and they used less information from the data. This made the nonparametric tests somewhat less powerful than the corresponding parametric tests for the same situations when the assumptions of the parametric tests were met" (Ostertagova et al., 2014, p. 118). Nonparametric tests were used when conditions for the usage of parametric tests were not met. The Kruskal-Wallis test was used when conditions for the usage of parametric tests were not met, and when used in those circumstances, the Kruskal-Wallis was used for testing whether samples are taken from the same distribution. The Kruskal-Wallis test is usually performed when, "the continuous distributions for the test variables are exactly the same (except the medians) for the population; and when the cases represent random sample from the population, and the scores on the test variables are independent of each other" (Ostertagova et al., 2014, p. 119). When using the Kruskal-Wallis test, a good indicator that at least one sample varied from other samples was deduced from the significance of the Kruskal-Wallis test results. However, the test did not tell where the variations occurred and the number of those variations. Since for this research study an online survey was used to collect the data, the survey had Likert Scale response options for the respondents. In order to get meaningful analysis from Likert Scale responses, the collected data had to be treated as ordinal (Ostertagova et al., 2014).

In order to analyse Likert Scale data some steps needed to be taken to ensure that the data was ready for analysis;

- Before analysing the data in SPSS, firstly the data needed to have values assigned to the responses that the respondents provided. For this research study the coding was organised as (strongly disagree = 1, disagree = 2, neither agree nor disagree = 3, agree = 4, and strongly agree = 5).
- The responses that disagreed (1 and 2) with the statement in the research questionnaire were grouped and assigned to the value 1, and the responses that agreed (4 and 5) with the statement were grouped and assigned to the value 2.
- Two groupings were created for the Kruskal-Wallis analysis in this research study. The TOE framework was used as a guide in creating these groups. The first group grouped questionnaire responses according to whether they were addressing internal or external issues.
- The second grouping grouped questionnaire responses according to whether they were addressing technology, organisation, or environment context issues of the TOE framework.

- The aim of creating groups was to determine where the challenges that organisations face originated from. This was done to determine whether organisations faced challenges that were within their control and was it issues that organisation could not control.

4.8 Data Quality Control

The quality of this research study was maintained using the reliability and validity measures; "data validation is a process that follows prescribed rules about the value of data elements, including data type, range of values, missing values, consistency, and total cross-referencing". Content validity was also one of the important steps in maintaining the quality of the data that was collected. This step ensured that the content that was used to gather data was both adequate and representative enough that it could be relied upon to gather data that was relevant for the study (Sawalqa & Hamdan, 2011). To test the content of the survey for this research study, the researcher conducted a pilot study where respondents were asked to test the survey and make suggestions at the end. When conducting the pilot study there was a combination of individuals that were selected; the research study targeted individuals who had no prior knowledge of what cloud computing was or how IT systems worked, and individuals who had characteristics similar to those of the ones that have been selected to participate in this research study. The reason behind doing the pilot in this manner was to try and determine how understandable the questions were to individuals who had no idea what the cloud was or how IT systems worked, and with the selection of the second group the aim was to try and determine if the questions were understandable and relevant enough to gather informative data. Based on the feedback received from the pilot study adjustments were made to the questionnaire and with the guidance approval of the research supervisor the final questionnaire for this research study was finalised and sent to the targeted organisations.

4.9 Conclusion

This chapter detailed how the research questions that were raised by this research study were answered, and how the objectives were achieved. This chapter defined what a research methodology was and the role it played in a research study. The first section gave detailed steps that were followed in constructing this research study. The research design section of this chapter presented the research onion and the layers of the onion that were used in this research study. The reasons for using the chosen layers were also discussed. The chapter also discussed

the research approach that was used in this research study. There were three potential approaches that could have been used; the quantitative approach, qualitative approach, and mixed methods approach. For this research study the quantitative approach was used; but the qualitative and mixed methods approach were also discussed. In addition, the chapter highlighted tools that were used to identify the population of interest, tools used to identify the correct sample and the techniques used to collect and analyse data. This chapter discussed the approach and tools that were used to analyse data for this research study and the benefits of approaching the data analysis in that manner. Lastly, the chapter further highlighted the importance and credibility of the research study, the measures that were put in place to ensure that the study maintained its credibility throughout the entire study. After having detailed in this chapter how the research study was conducted, chapter 5 presented the data that was collected using the methodology that was described in this chapter.

5 Chapter 5: Data Presentation and Analysis

5.1 Introduction

Chapter 4 introduced the research methodology for this research study and in this chapter, the process that was followed in conducting the study was discussed in great detail. The research design and approach that were used were discussed, the population and sample were also highlighted, and the data collection process. This chapter presents the analyses of the data that was collected using the methodology discussed in chapter 4. It was mentioned in the previous chapter that online questionnaires were sent out to the sampled organisations, this chapter will present the responses for each question in the questionnaire, and present the results in a bar graph. The final section of this chapter will group the results according to the different elements of the TOE framework to determine if organisations struggle with technology, organisational, or environmental issues the most.

5.2 Demographic

The respondents for this study were organisations from the KwaZulu-Natal province. A sample of five organisations were chosen for this research study and the organisations selected varied in size between small and large organisations. The organisations selected had been in business for number of different years, some had been in business for over 30 years, some 15 years, and the other had only been in business for 5 years. The number of employees that these organisations employed in their IT department was also different, with some organisation having large IT departments, and some only having “key resources” in their IT departments.

5.3 Research Questions, Results, and Analysis

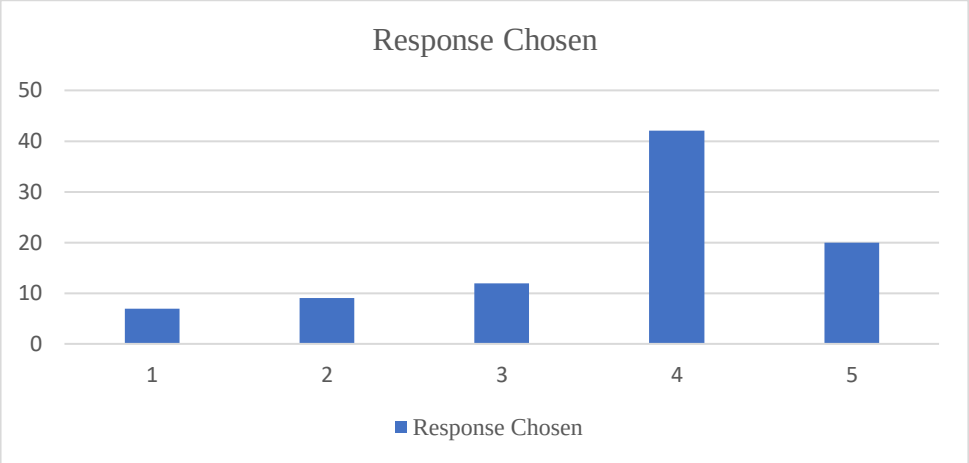
This section presented each research question, the results, and the analysis of the results.

5.3.1 How does bandwidth affect cloud computing adoption?

Below is a list of sub-questions related to bandwidth issues that formed part of the questionnaire.

5.3.1.1 The internet connection in the organisation can be relied upon to support the use of cloud computing.

Table 5-1: The internet connection in the organisation can be relied upon to support the use of cloud computing



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. As can be seen from the diagram in Table 5-1 responses 4 and 5 had the highest number of responses which was an indication that respondents believed that the internet connection set up within their respective organisations was good enough to sustain their needs.

Table 5-2: The internet connection in the organisation can be relied upon to support the use of cloud computing

Response Scoring

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	90	2.19	2.00	2	1.080	197
Missing	2					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.1.2 The current network infrastructure in the eThekwini area can be relied on to support organisations.

Table 5-3: The current network infrastructure in the eThekwini area can be relied on to support organisations

The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. From the findings presented in Table 5-3, response number 4 (agree) was the response that was chosen the most with the second highest option being response 3 (neither agree nor disagree). Looking at the overall results, there is a greater

number of responses that agree with the question (4 and 5) than those that disagree (1 and 2), which was an indication that a great number of respondents believed that the current network infrastructure in the eThekwini area could be relied upon to support the needs of the organisations.

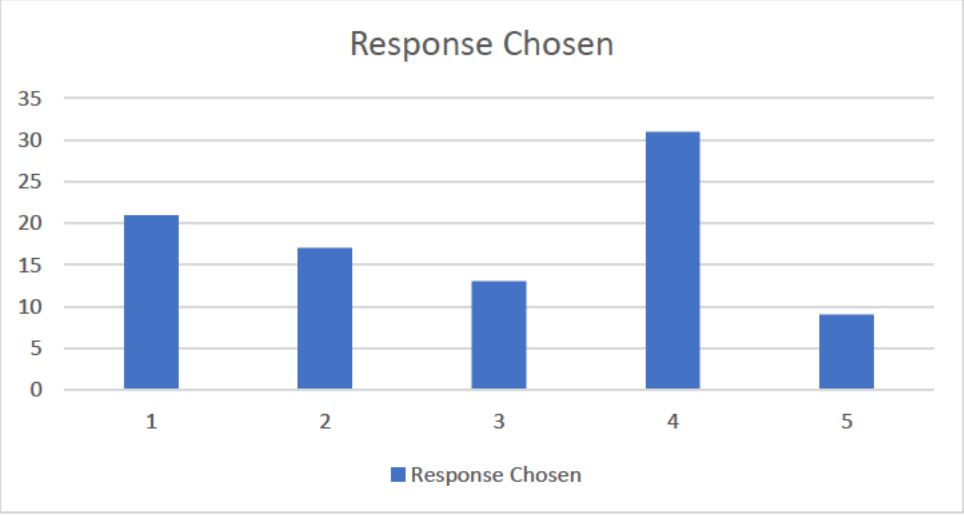
Table 5-4: The current network infrastructure in the eThekwini area can be relied on to support

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	91	2.57	2.00	2	1.097	234
Missing	1					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.1.3 The current cost of internet connectivity in the eThekwini area is affordable.

Table 5-5: The current cost of internet connectivity in the eThekwini area is affordable.



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. On the question of cost most respondents chose

response 4 (agree), but there was also a significant number of respondents who chose response 1 and 2 (strongly disagree and disagree). The results were broken down even further, and that revealed that the number of responses that agreed with the statement (response 4 and 5) accounted for 40 (31 + 9) of the results; the results that disagreed with the statement accounted for 38 (21 + 17), which meant there was only a difference of 2 between those that agreed and those that disagreed. While there were more respondents who agreed with the statement, the results indicated that there was cause for concern as far as the cost of internet connection in the eThekwini area was concerned.

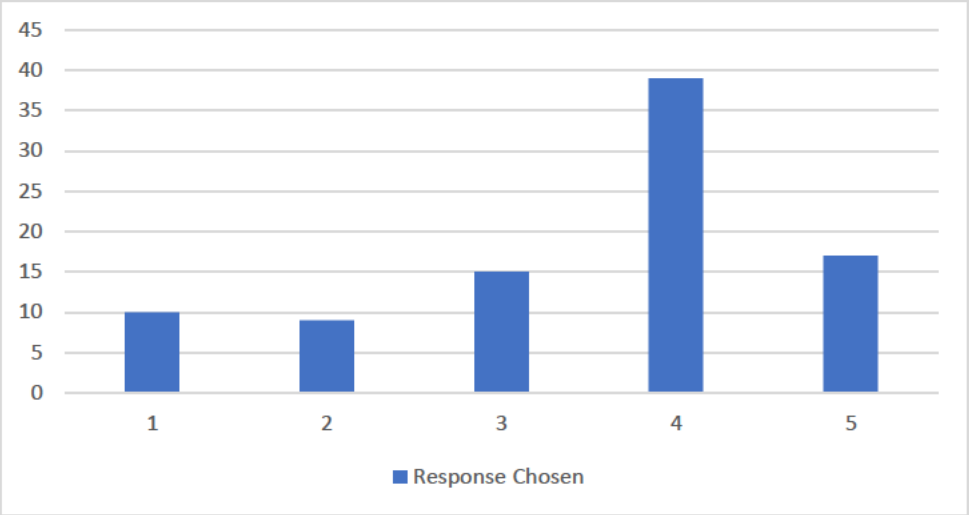
Table 5-6: The current cost of internet connectivity in the eThekwini area is affordable.

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	91	3.15	3.00	2	1.357	287
Missing	1					

Measures of central tendency were generated for this questions to show how the data was distributed.

5.3.1.4 The organisation has a network capacity plan to help manage the performance of the network.

Table 5-7: The organisation has a network capacity plan to help manage the performance of the network



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-7 indicated that response 4 (agree), was the response that was chosen the most, with option 5 (strongly agree) being the second highest option that was chosen. This indicated that the majority of respondents believed that their respective organisations had a network capacity plan to help manage the performance of the network.

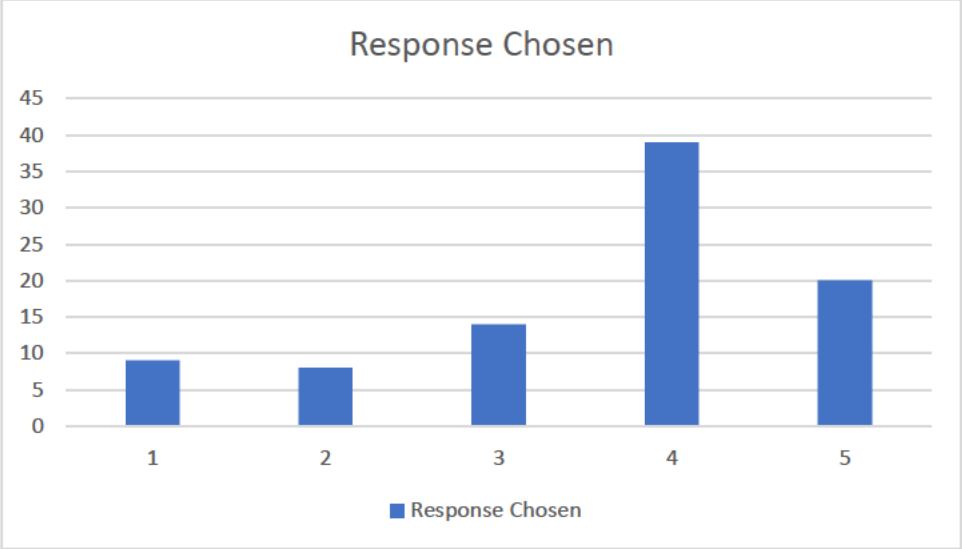
Table 5-8: The organisation has a network capacity plan to help manage the performance of the network

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	90	2.50	2.00	2	1.238	225
Missing	2					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.1.5 The speed of the internet connection in the organisation supports the use of cloud computing services.

Table 5-9: The speed of the internet connection in the organisation supports the use of cloud computing services



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-9 indicated that response 4 (agree), was the response that was chosen the most, with option 5 (strongly agree) being the second highest option that was chosen. This indicated that there was a greater number of respondents that agreed with the statement (4 and 5) than those that disagreed (1 and 2).

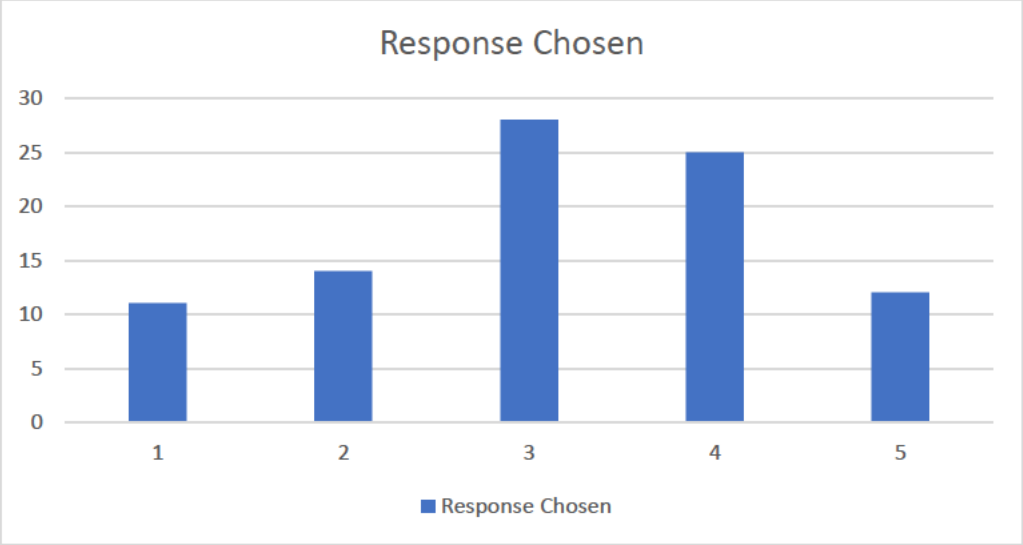
Table 5-10: The speed of the internet connection in the organisation supports the use of cloud computing services

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	90	2.37	2.00	2	1.194	213
Missing	2					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.1.6 The organisation uses tools such as Google Transfer Application, GSUtil, or any other similar tool to help minimise data traffic costs.

Table 5-11: The organisation uses tools such as Google Transfer Application, GSUtil, or any other similar tool to help minimise data traffic costs



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. From the results presented in Table 5-11, response 3 (neither agree nor disagree) was chosen more than any other response. The overall results indicated that there was also a good number of respondents that agreed (4 and 5) with the statement.

Table 5-12: Question 5.3.1.7 test summary

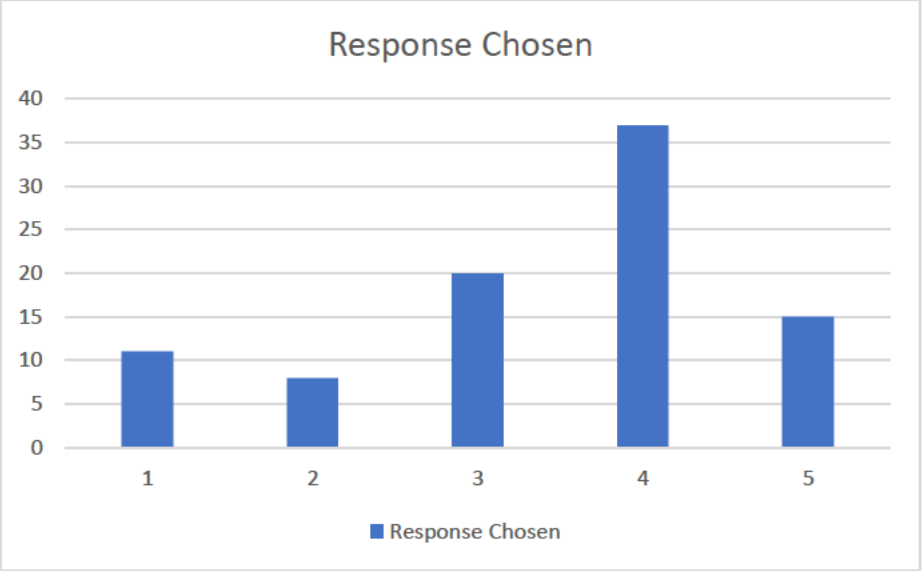
N		Mean	Median	Mode	Std. Deviation	Sum
Valid	90	2.86	2.00	3	1.204	257
Missing	2					

Measures of central tendency were generated for this question to show how the data was

distributed.

5.3.1.7 The organisation has network analysers to evaluate network traffic.

Table 5-13: The organisation has network analysers to evaluate network traffic



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-13 indicated that response 4 (agree), was the response that was chosen the most, with option 5 (strongly agree) being the second highest option that was chosen. This indicated that there was a greater number of responses that agreed with the question (4 and 5) than those that disagreed (1 and 2).

Table 5-14: The organisation has network analysers to evaluate network traffic

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	91	2.60	2.00	2	1.228	237
Missing	1					

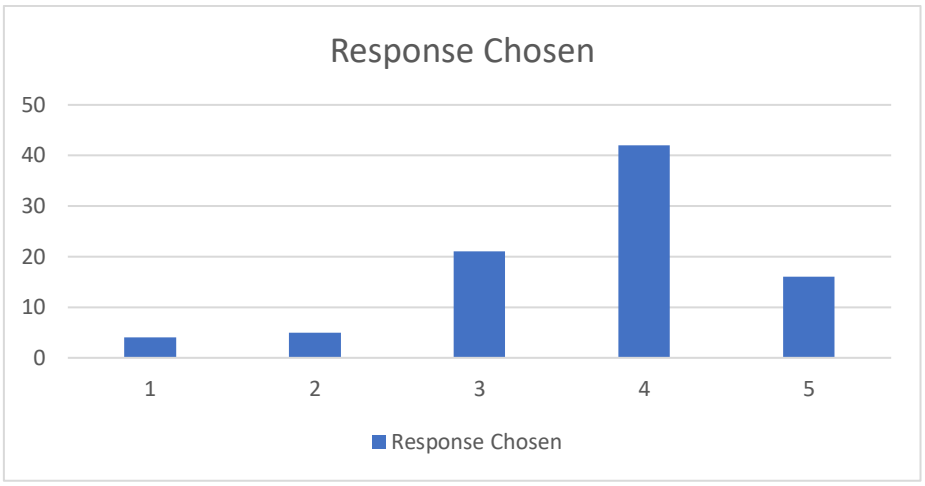
Measures of central tendency were generated for this question to show how the data was distributed.

5.3.2 How does cloud provider conduct affect the decision to adopt cloud computing?

The sub-questions that formed part of the questionnaire have been listed below

5.3.2.1 The issues of potential vendor lock-in are addressed by the service level agreement between the organisation and the provider.

Table 5-15: The issues of potential vendor lock-in are addressed by the service level agreement between the organisation and the provider.



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-15 indicated that response 4 (agree), was the response that was chosen the most. This indicates that there is a greater number of responses that agreed with the statement (4 and 5) than those that disagreed (1 and 2).

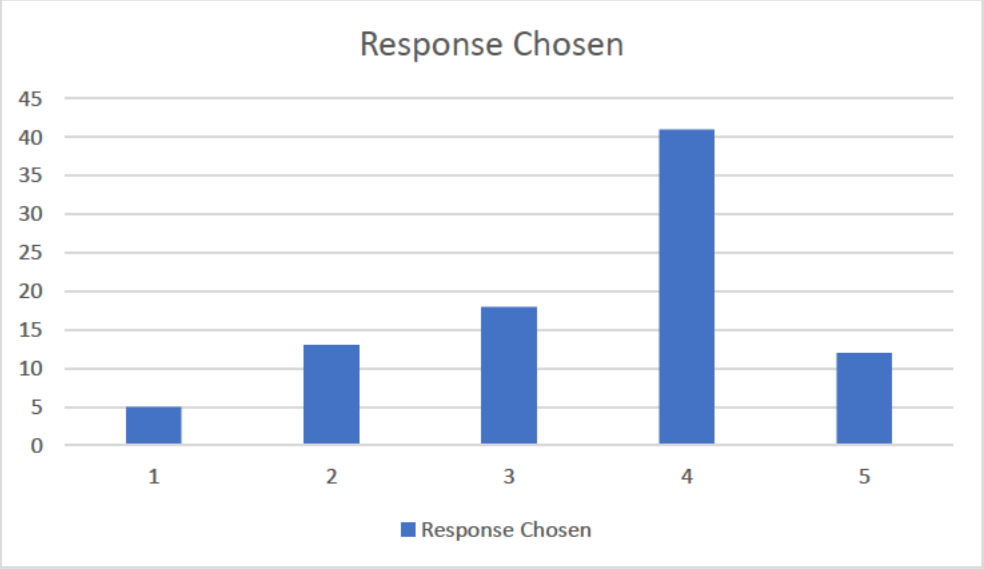
Table 5-16: The issues of potential vendor lock-in are addressed by the service level agreement between the organisation and the provider.

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	87	3.11	4.00	4	1.205	271
Missing	5					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.2.2 Cloud vendors are responsible for the development of the security measures that will be put in place.

Table 5-17: Cloud vendors are responsible for the development of the security measures that will be put in place.



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a

particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-17 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated that there was a greater number of responses that agreed with the statement (4 and 5) than those that disagreed (1 and 2).

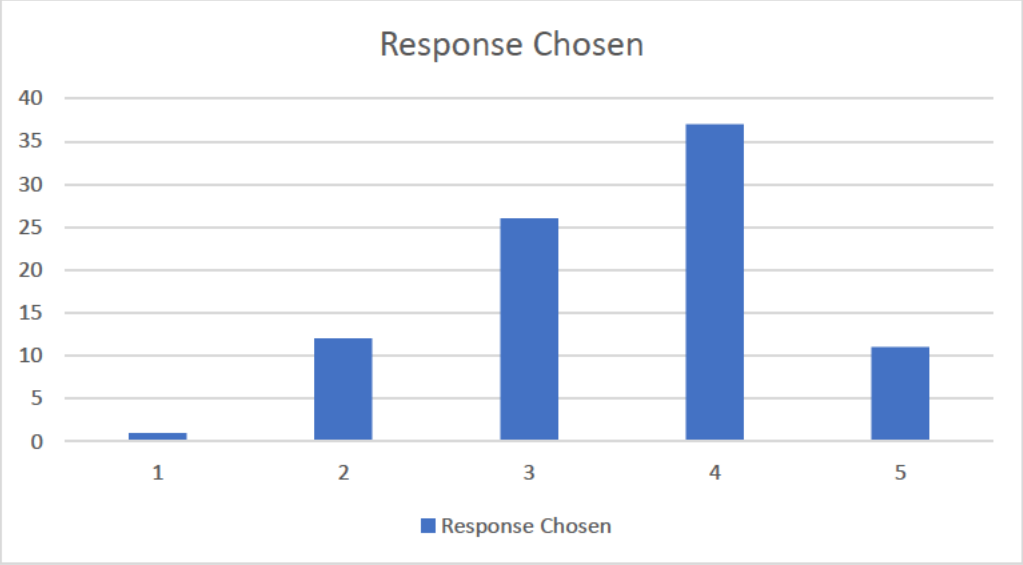
Table 5-18: Cloud vendors are responsible for the development of the security measures that will be put in place.

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	89	3.18	4.00	4	1.163	283
Missing	3					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.2.3 The cloud provider conducts cloud services demonstrations to help the organisation choose a suitable cloud service.

Table 5-19: The cloud provider conducts cloud services demonstrations to help the organisation choose a suitable cloud service



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-19 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated that the number of respondents that agreed (a and 5) with the statement was higher than that of respondents who disagreed with the statement (1 and 2).

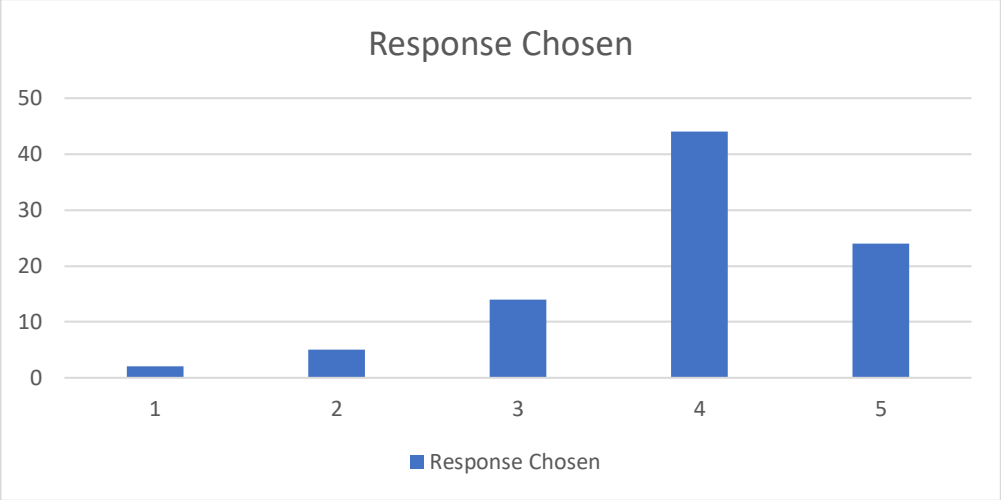
Table 5-20: The cloud provider conducts cloud services demonstrations to help the organisation choose a suitable cloud service

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	89	3.03	3.00	4	1.061	264
Missing	5					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.2.4 The organisation can rely on the cloud provider to provide support after the cloud has been adopted.

Table 5-21: The organisation can rely on the cloud provider to provide support after the cloud has been adopted.



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-21 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated that the number of respondents that agreed with the statement (4 and 5) was higher than that of respondents who disagreed with the statement (1 and 2).

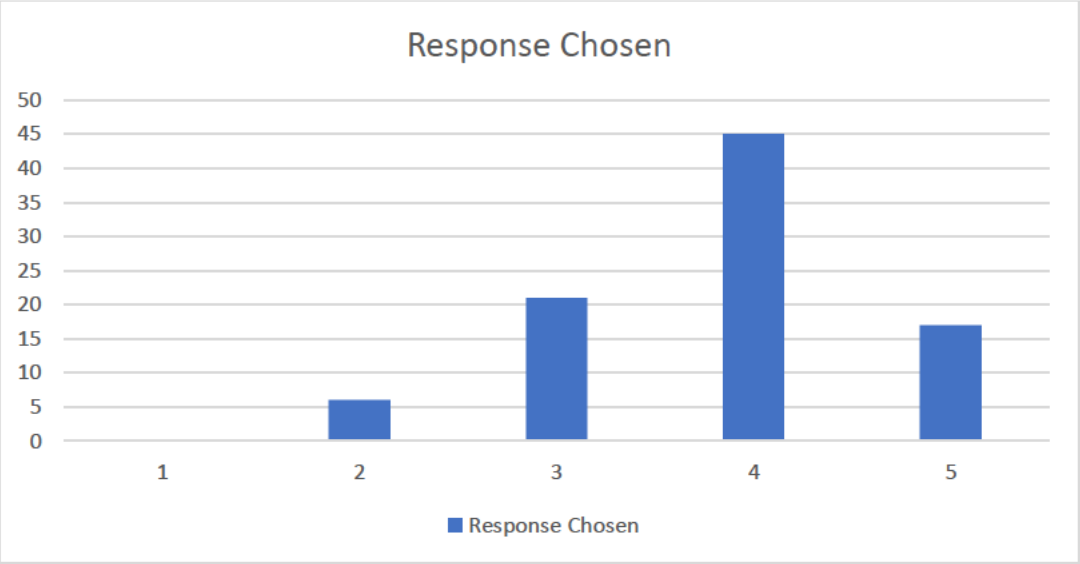
Table 5-22: The organisation can rely on the cloud provider to provide support after the cloud has been adopted.

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	89	3.21	4.00	4	1.301	286
Missing	3					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.2.5 The SLA stipulates that reasonable and required access is granted to the cloud provider to allow the provider to perform their duties.

Table 5-23: The SLA stipulates that reasonable and required access is granted to the cloud provider to allow the provider to perform their duties.



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-23 indicated that

response 4 (agree), was the response that was chosen the most. The overall results indicated that the number of respondents that agreed with the statement (4 and 5) was higher than that of respondents who disagree with the statement (1 and 2).

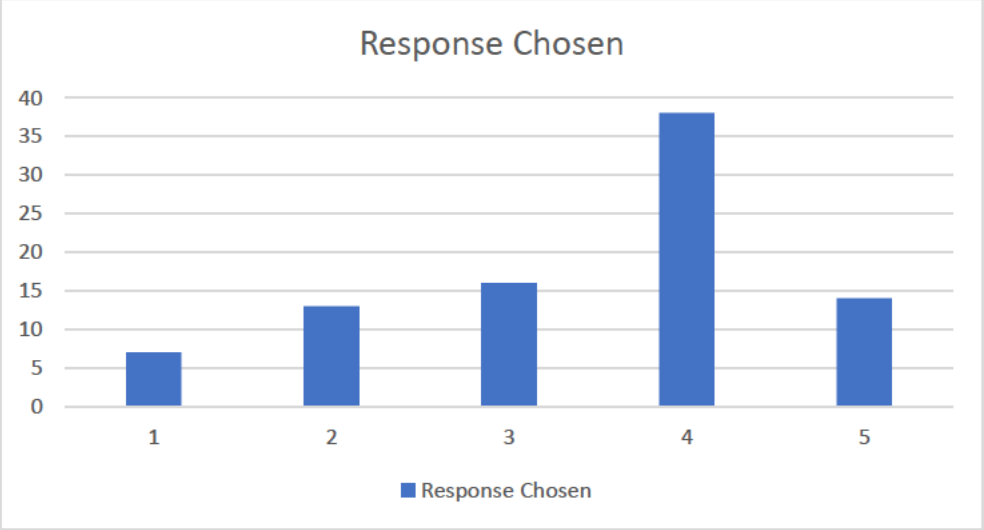
Table 5-24: The SLA stipulates that reasonable and required access is granted to the cloud provider to allow the provider to perform their duties.

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	89	3.17	4.00	4	1.150	282
Missing	3					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.2.6 Organisations experience difficulties finding the right cloud provider.

Table 5-25: Organisations experience difficulties finding the right cloud provider



The following bar graph showed the Likert Scale responses that respondents chose when

responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-25 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated that the number of respondents that agreed with the statement (4 and 5) was higher than that of respondents who disagree with the statement (1 and 2).

Table 5-26: Organisations experience difficulties finding the right cloud provider

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	88	3.17	4.00	4	1.234	279
Missing	4					

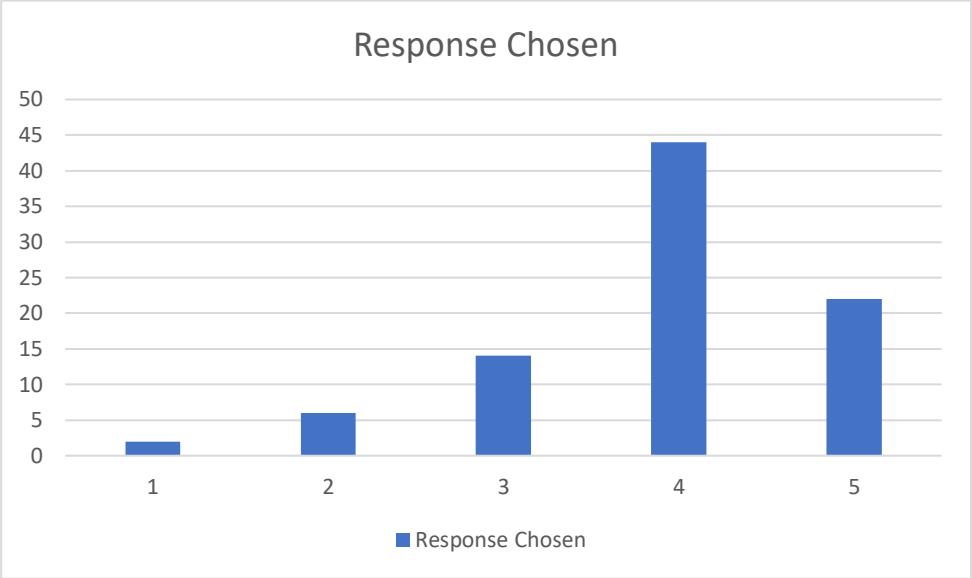
Measures of central tendency were generated for this question to show how the data was distributed.

5.3.3 What role does security play in an organisation's decision to adopt cloud computing?

The sub-questions that formed part of the questionnaire have been listed below

5.3.3.1 The organisation is aware of the security risks associated with storing its data in the cloud.

Table 5-27: The organisation is aware of the security risks associated with storing its data in the cloud



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-27 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated that the number of respondents that agreed with the statement (4 and 5) was higher than that of respondents who disagree with the statement (1 and 2).

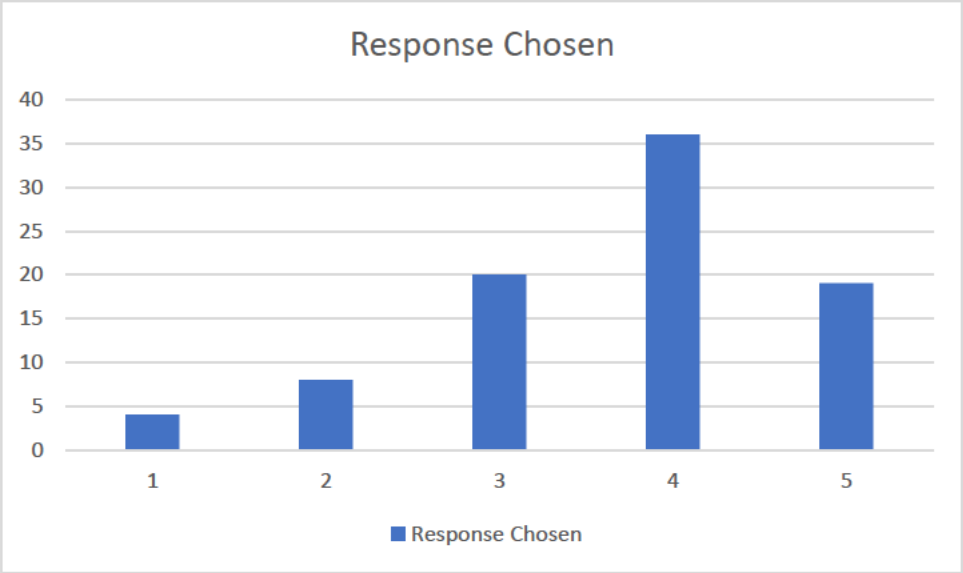
Table 5-28: The organisation is aware of the security risks associated with storing its data in the cloud

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	88	3.00	4.00	4	1.295	264
Missing	4					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.3.2 There are data encryption tools in place to protect data while being transmitted to and from storage centres.

Table 5-29: There are data encryption tools in place to protect data while being transmitted to and from storage centres.



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-29 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated that the number of respondents that agreed with the statement (4 and 5) was higher than that of

respondents who disagree with the statement (1 and 2).

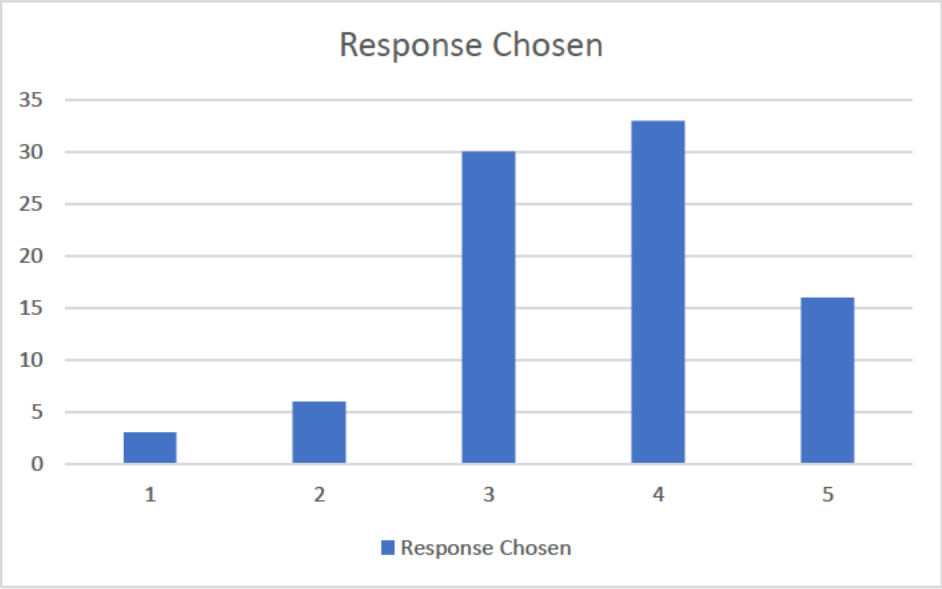
Table 5-30: There are data encryption tools in place to protect data while being transmitted to and from storage centres.

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	87	2.95	3.00	4	1.257	257
Missing	5					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.3.3 The SLA addresses possible threats of malicious insider attackers within the cloud provider's organisation.

Table 5-31: The SLA addresses possible threats of malicious insider attackers within the cloud provider's organisation.



The following bar graph showed the Likert Scale responses that respondents chose when

responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-31 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated that the number of respondents that agreed with the statement (4 and 5) was higher than that of respondents who disagreed with the statement (1 and 2). There was also a significant number of respondents who chose option 3 (neither agree nor disagree), but no meaningful conclusions can be drawn from this since data was collected using a questionnaire and there were no follow up interviews.

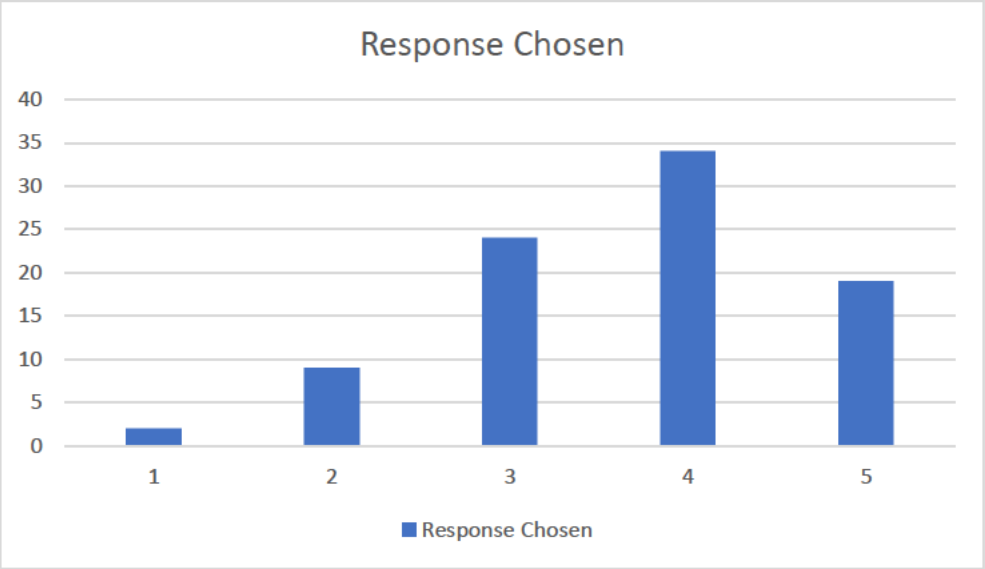
Table 5-32: The SLA addresses possible threats of malicious insider attackers within the cloud provider's organisation.

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	88	3.10	3.00	4	1.145	273
Missing	4					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.3.4 The cloud provider can be relied upon to maintain the integrity of the organisation's data.

Table 5-33: The cloud provider can be relied upon to maintain the integrity of the organisation's data.



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-33 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated that the number of respondents that agreed with the statement (4 and 5) was higher than that of respondents who disagree with the statement (1 and 2).

Table 5-34: The cloud provider can be relied upon to maintain the integrity of the organisation's data.

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	88	2.88	3.00	4	1.202	253
Missing	4					

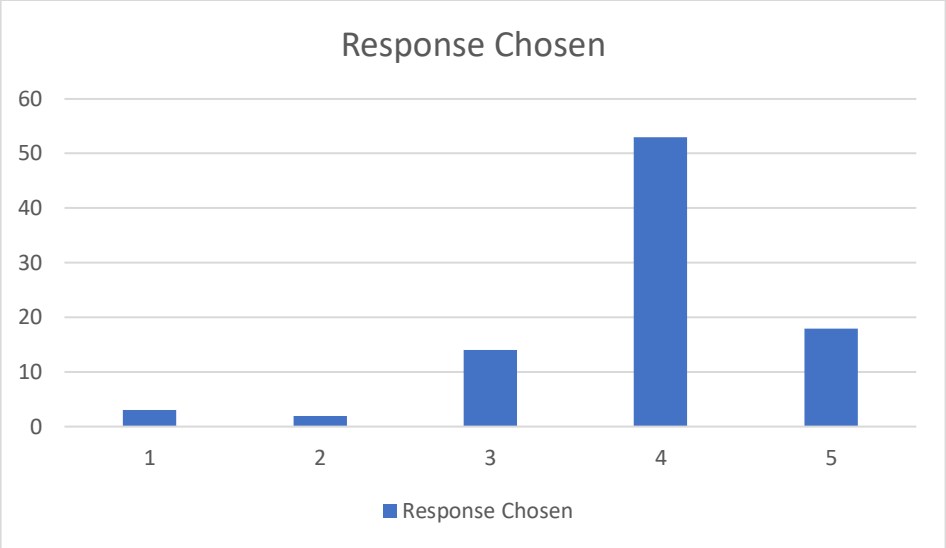
Measures of central tendency were generated for this question to show how the data was distributed.

5.3.4 What role does executive management play in the adoption of cloud computing?

The sub-questions that formed part of the questionnaire have been listed below,

5.3.4.1 The organisation's management supports the adoption of the cloud.

Table 5-35: The organisation's management supports the adoption of the cloud



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-35 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated that the number of respondents that agreed with the statement (4 and 5) was higher than that of respondents who disagree with the statement (1 and 2).

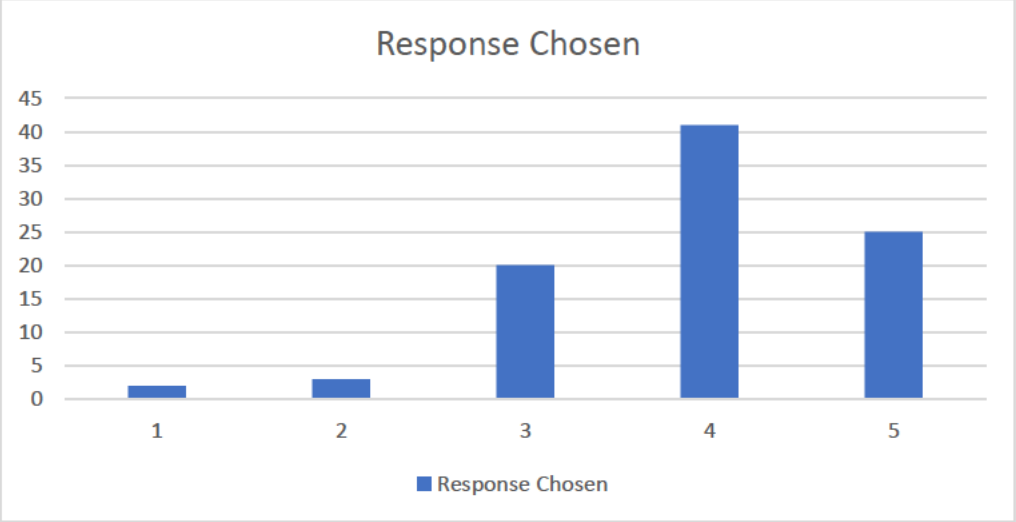
Table 5-36: The organisation's management supports the adoption of the cloud

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	90	3.21	4.00	4	1.232	289
Missing	2					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.4.2 IT managers within the organisation fully support the adoption of the cloud.

Table 5-37: IT managers within the organisation fully support the adoption of the cloud



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-37 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated that the number of respondents that agreed with the statement (4 and 5) was higher than that of respondents who disagree with the statement (1 and 2).

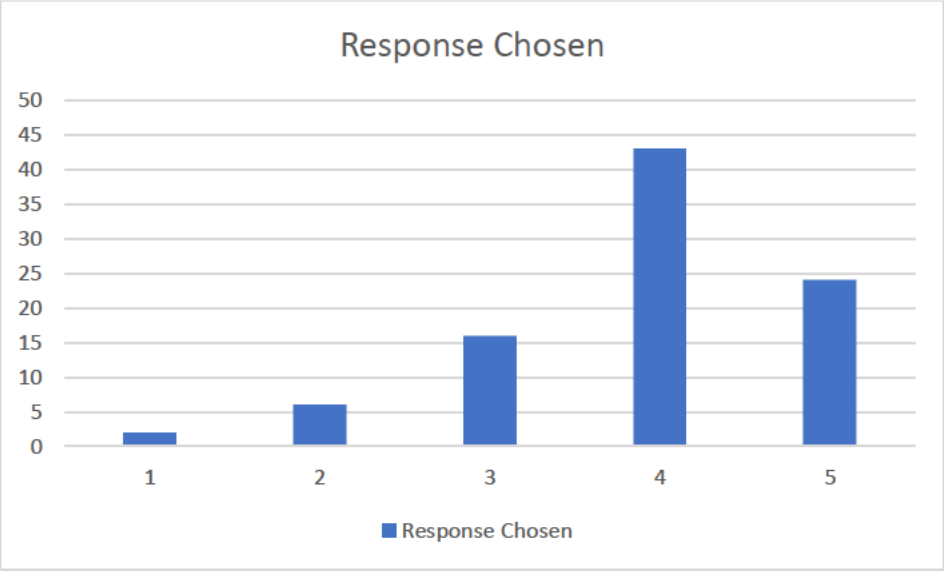
Table 5-38: IT managers within the organisation fully support the adoption of the cloud

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	91	2.91	3.00	4	1.297	265
Missing	1					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.4.3 Systems requirements needed for cloud adoption are accepted by the organisation's management.

Table 5-39: Systems requirements needed for cloud adoption are accepted by the organisation's management



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-39 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated

that the number of respondents that agreed with the statement (4 and 5) was higher than that of respondents who disagree with the statement (1 and 2).

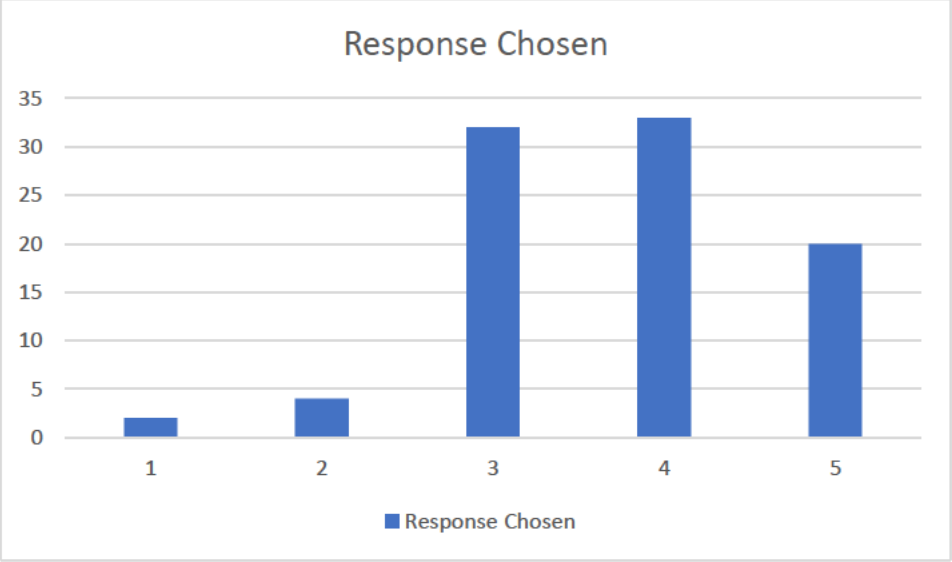
Table 5-40: Systems requirements needed for cloud adoption are accepted by the organisation's management

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	91	2.95	4.00	4	1.303	268
Missing	1					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.4.4 The monetary needs to adopt the cloud are understood by the organisation's management.

Table 5-41: The monetary needs to adopt the cloud are understood by the organisation's management



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of

respondents that chose that response option. There was a significant number of respondents who chose response 3 (neither agree nor disagree) on this question which could be because of many different reasons which could not be explored due to the nature of the research study. It was encouraging though that even though there was a large number of respondents who chose response 3, there were still a lot more respondents who chose responses 4 and 5, which agreed with the statement.

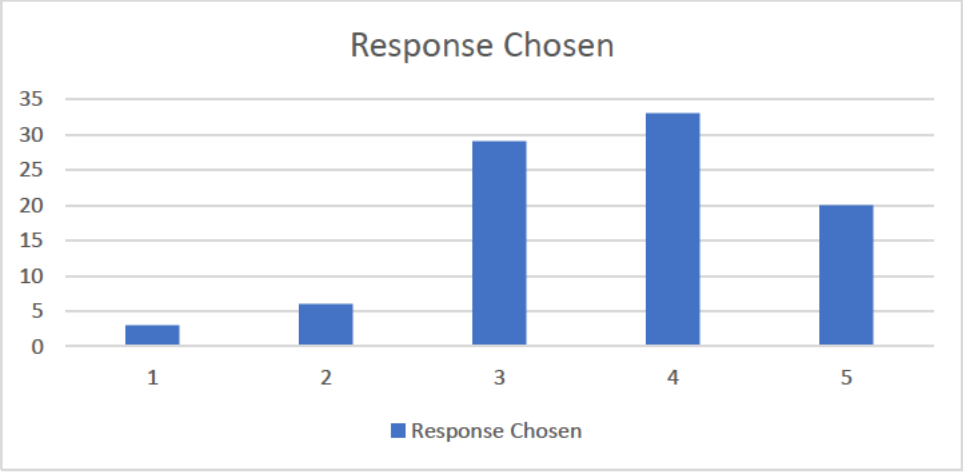
Table 5-42: The monetary needs to adopt the cloud are understood by the organisation's management

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	91	2.90	3.00	3	1.202	264
Missing	1					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.4.5 Compliance implications for cloud computing adoption are understood and accepted by management.

Table 5-43: Compliance implications for cloud computing adoption are understood and accepted by management



The following bar graph showed the Likert Scale responses that respondents chose when

responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-43 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated that the number of respondents that agreed with the statement (4 and 5) was higher than that of respondents who disagree with the statement (1 and 2).

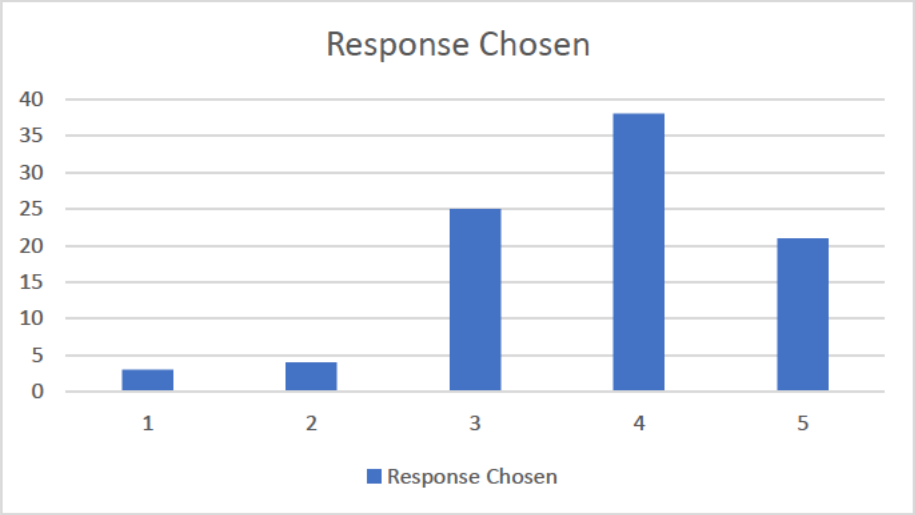
Table 5-44: Compliance implications for cloud computing adoption are understood and accepted by management

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	91	2.92	3.00	4	1.204	266
Missing	1					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.4.6 Legal considerations for cloud adoption are presented to and accepted by management.

Table 5-45: Legal considerations for cloud adoption are presented to and accepted by management.



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-45 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated that the number of respondents that agreed with the statement (4 and 5) was higher than that of respondents who disagree with the statement (1 and 2).

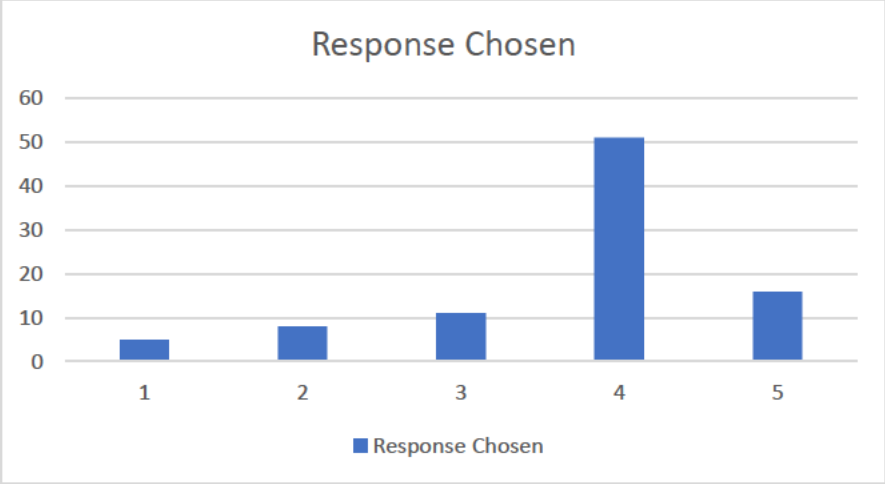
Table 5-46: Legal considerations for cloud adoption are presented to and accepted by management

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	90	2.99	3.00	4	1.241	269
Missing	2					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.4.7 IT managers ensure there are cloud skilled staff members to support and use cloud computing services.

Table 5-47: IT managers ensure there are cloud skilled staff members to support and use cloud computing services



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-47 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated that the number of respondents that agreed with the statement (4 and 5) was higher than that of respondents who disagree with the statement (1 and 2).

Table 5-48: IT managers ensure there are cloud skilled staff members to support and use cloud computing services.

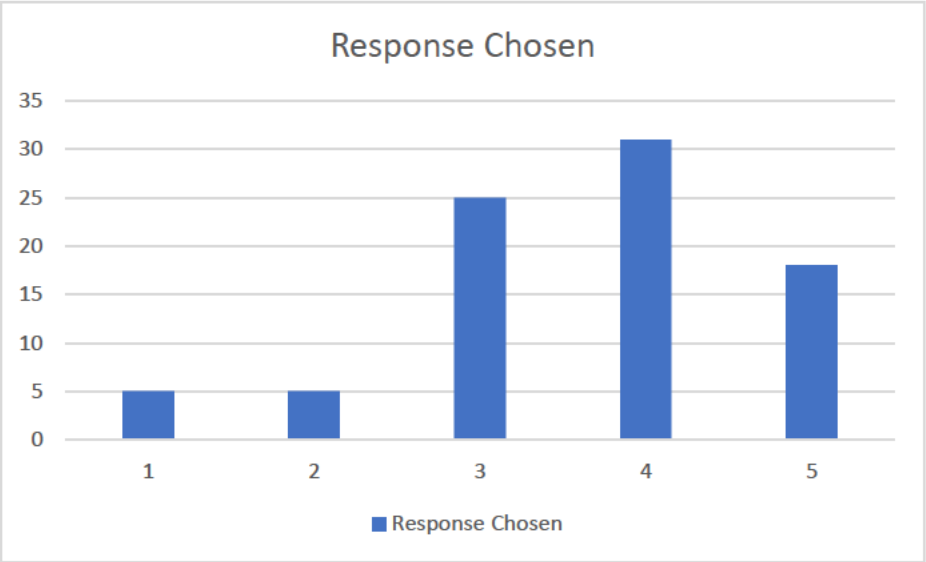
N		Mean	Median	Mode	Std. Deviation	Sum
Valid	91	3.18	4.00	4	1.279	289
Missing	1					

Measures of central tendency were generated for this question to show how the data was

distributed.

5.3.4.8 There are clear plans to upskill employees with cloud related skills.

Table 5-49: There are clear plans to upskill employees with cloud related skills



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-49 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated that the number of respondents that agreed with the statement (4 and 5) was higher than that of respondents who disagree with the statement (1 and 2). From the findings presented in Table 5-49 it can be concluded that in addition to ensuring that organisations hired skilled staff members, they also ensured that they upskilled the ones that had already employed.

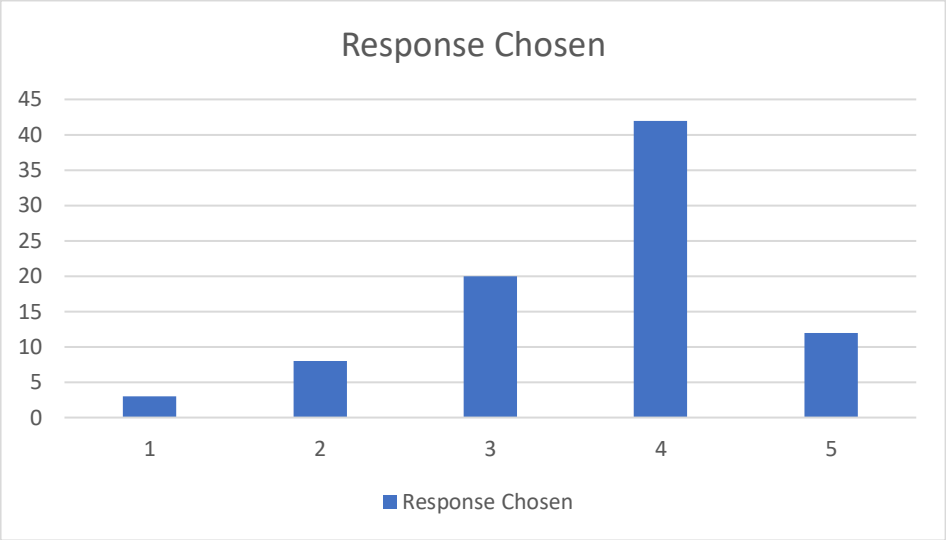
Table 5-50: There are clear plans to upskill employees with cloud related skills

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	84	2.98	3.00	4	1.251	250
Missing	8					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.4.9 The risks associated with cloud computing are understood by the organisation's management.

Table 5-51: The risks associated with cloud computing are understood by the organisation's management



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-51 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated that the number of respondents that agreed with the statement (4 and 5) was higher than that of respondents who disagree with the statement (1 and 2). The results indicated that organisations understood the risks associated with adopting cloud computing, which was important for organisations wanting to adopt cloud computing.

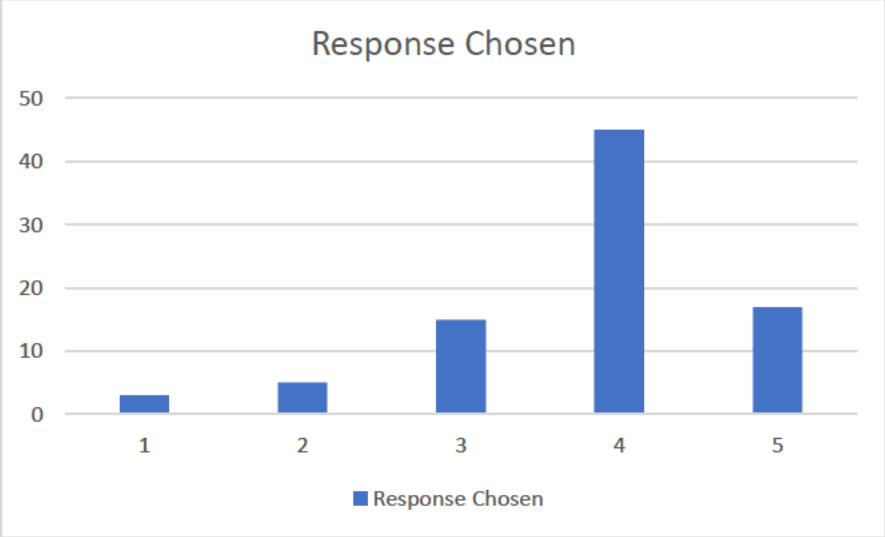
Table 5-52: The risks associated with cloud computing are understood by the organisation's management

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	85	3.16	4.00	4	1.132	269
Missing	7					

Measures of central tendency were generated for this question to show how the data was distributed.

5.3.4.10 The business needs of the business are considered prior to the adoption of the cloud.

Table 5-53: The business needs of the business are considered prior to the adoption of the cloud



The following bar graph showed the Likert Scale responses that respondents chose when responding to this question. The vertical axis showed the number of respondents that chose a particular response option, ranging from 1 to 5, and the horizontal axis showed the number of respondents that chose that response option. The bar graph in Table 5-53 indicated that response 4 (agree), was the response that was chosen the most. The overall results indicated that the number of respondents that agreed with the statement (4 and 5) was higher than that of respondents who disagree with the statement (1 and 2). These findings were encouraging since

the main objective of any technology adoption should always be to address the needs of the organisations.

Table 5-54: The business needs of the business are considered prior to the adoption of the cloud

N		Mean	Median	Mode	Std. Deviation	Sum
Valid	85	3.09	4.00	4	1.240	263
Missing	7					

Measures of central tendency were generated for this question to show how the data was distributed.

5.4 Using the TOE Framework to Interpret the Results

Chapter 3 of the research study covered the research framework that was used in this study, which was the TOE framework. In this chapter it was highlighted how the different contexts of the TOE framework were used to help formulate the research questions. The research questions were set up to focus on both internal and external issues of the TOE framework that organisations could be subjected to while adopting or utilising cloud computing. As part of analysing results for this research study, the findings that were negative (strongly disagree and disagree) were presented into two different forms of groups for further analysis in Table 5-55 below. Firstly, the findings were grouped based on whether the statements that respondents responded to were categorised as internal or external; and then a comparison was performed on the internal and external groups to determine which group impacted the organisations the most. The reason for this grouping was to determine where the most challenges that organisations faced originated from. The second grouping that was formed on the results was based on the three elements of the TOE framework (technology, organisations, environment). The responses were analysed according to whether the statement focused on either the technology, organisation, or environment element of the TOE framework. The aim of performing this analysis was to determine if the issues that negatively impacted the organisation were due to the technology, the environment within which the organisation operated, or the decisions taken by organisational structures.

5.4.1 Grouping challenges according to determine whether they are internal or external

Table 5-55: Categorical field information score

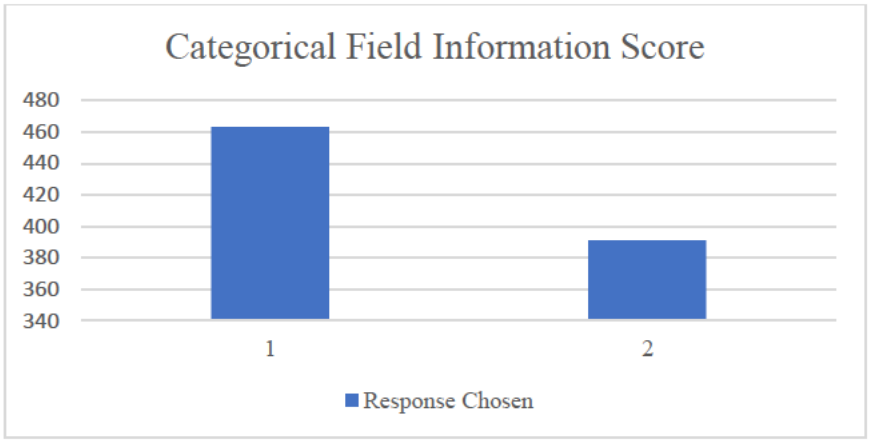
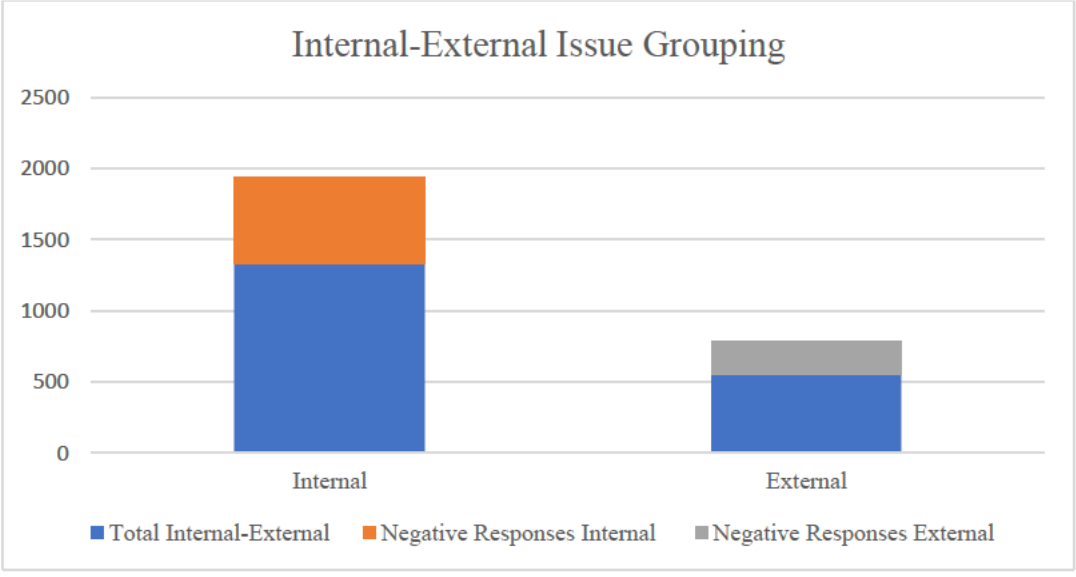


Table 5-55 above presented the results that were found after grouping the negative responses, strongly disagree (1) and disagree (2). After having grouped the findings according to responses of 1 and 2, the results were analysed further by grouping them according to whether the questions addressed an internal or external concern, and the findings were presented in Table 5-56 below.

Table 5-56: Grouping of internal and external adoption challenges



The responses were grouped further according to whether the question focused on the issues that were considered to originate from internal or external processes. In generating this grouping, the 27 questions that formed part of the questionnaire were taken for each respondent, and for each response. Once the results were grouped according to the responses chosen, it was found that it was issues that were categorised as internal that had the most number of negative responses. The total number of questions on internal and external issues in this research study was not equally divided, and to get a better understanding of what issues had the greatest impact, the percentage of each group (internal and external) was calculated. For internal issues the percentage contribution was 611/1326 * 100 = 46%; and for internal issues the percentage impact based on the findings was 243/548 * 100 = 44%. The representation of the responses indicated that the majority of the negative was as a result of internal issues even though the difference was 2%.

Table 5-57: Hypothesis test summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Score is the same across categories of Owning Group	Independent-Samples Kruskal-Wallis Test	.138	Retain the null hypothesis

a. The significance level is .050

b. Asymptotic significance is displayed

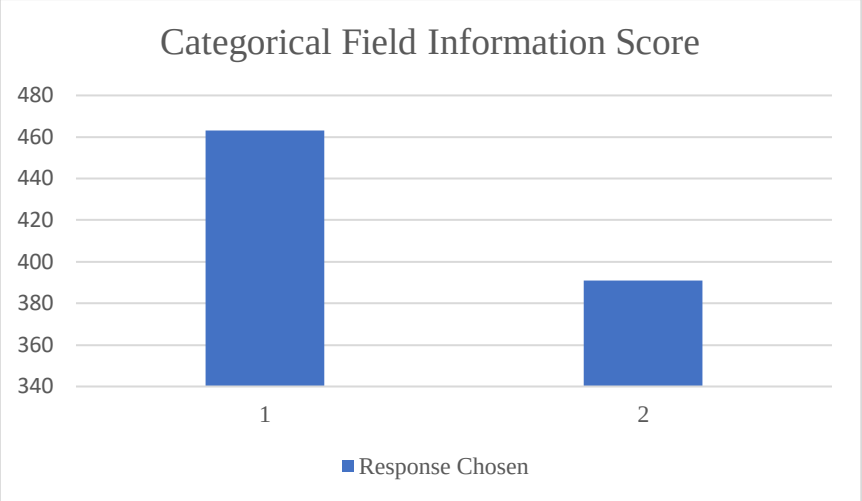
Score across Owning Group

Total N	**854**
Test Statistic	2.197
Degree Of Freedom	1
Asymptotic Sig. (2-side test)	.138

Table 5-57 gives the value of p after running the analysis on the data. Since $p < 0.001$, this indicated that there were significant findings that suggested the null hypothesis should be rejected as the differences between the groups were not due to chance.

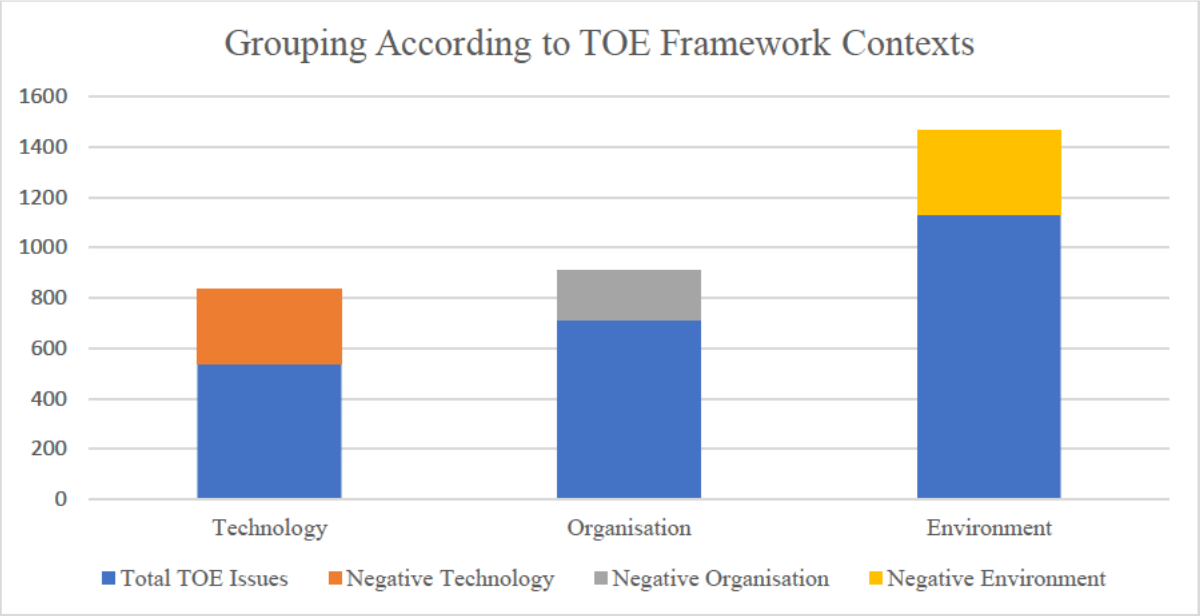
5.4.2 Grouping challenges according to technology, organisation, and environment

Table 5-58: Categorical field information score



The second part of group analysis for this research study was to group the responses according to each context of the TOE framework. In Table 5-58 above the negative responses are presented with 1 representing strongly disagree and 2 representing disagree. The results were grouped and analysed further in the Table 5-59 below to present the grouping of results according to each context of the TOE framework.

Table 5-59: Results grouping according to TOE framework contexts



In Table 5-59 above the total number of responses for each context of the TOE framework are presented in the blue part of the bar graph. From each blue block of the TOE element in Table 5-59, the total number of negative responses is calculated for each element to determine which element contributed the most to the total number of negative responses. From the findings, the technology context contributed 340 negative responses, organisation context contributed 199 negative responses, and environmental context contributed 340 negative responses. Based on these findings it was concluded that the biggest challenges that organisations faced came from technology and environmental issues.

Table 5-60: Hypothesis test summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of the score is the same across categories of Owning Group	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis

a. The significance level is .050

b. Asymptotic significance is displayed

Score across Owning Group	
Total N	**854**

Test Statistic	79.824
Degree Of Freedom	2
Asymptotic Sig. (2-side test)	.000

Table 5-60 gives the value of p after running the analysis on the data. Since $p < 0.001$, this indicated that there were significant findings that suggested the null hypothesis should be rejected as the differences between the groups were not due to chance.

5.5 Conclusion

This chapter presented the analyses of the data that was collected using the methodology discussed in chapter 4. It was mentioned in chapter 4 that online questionnaires were sent out to the sampled organisations, this chapter presented the responses for each question in the questionnaire, and the results were displayed in a bar graph. The final section of this chapter will grouped the results according to the different elements of the TOE framework in order to determine the element that organisations struggled with the most between technology issues, organisational issues, and environmental issues. After having analysed the results, chapter 6 will discuss the conclusion, limitations, and recommendations of the research study based on the findings and the entire experience of conducting the research study.

6 Chapter 6: Conclusion, Limitations and Recommendations

6.1 Introduction

This chapter draws conclusions about the research study based on the findings that were presented in chapter 5. This was done by discussing each research question that was raised for this research study and discussing what the objective of the research question was and comparing that to the findings that were discovered after having analysed the research data. The limitations of this research study will also be discussed, highlighting missed opportunities and areas that could have been better explored. Recommendations for future studies will also be discussed based on the findings and short-comings of this research study. This chapter presents recommendations for each research question from the research questions that were raised for this research study. The final section of the chapter discusses recommendations for future studies, what this research study did well, and what future studies could improve on.

6.2 Conclusion based on the findings

Chapter 2 of this research study focused on the literature review of the study. Key findings and patterns were highlighted in this chapter on how researchers approached the topic of cloud computing within South African and other countries around the world, but more focus was given to developing economies. In chapter 2 gaps were identified while reviewing the literature. This study sought to address the identified gaps, as the research questions and objectives were informed by literature gaps. Chapter 3 focused on the theoretical framework, the study. The technology-organisation-environment (TOE) framework was chosen as the main framework for this research study, and the research questions, sub-questions, and objectives were developed with the use of the TOE framework.

The reason that the TOE framework was chosen for this research study was because this model broadened the scope of factors that should be considered when studying the acceptance of technology. With the use of the TOE framework the scope of potential issues that affected the adoption of the cloud was not only limited to technology-related issues, but the scope was broadened to include issues that were not directly linked to the use of the cloud but played a role in the usage of the technology. The use of the TOE framework in this research study could be seen in how the research questions were formed. The first question focused on bandwidth issues, the second question focused on executive management influence, and the third question focused on cloud vendor conduct; only the fourth question was directly linked to the usage of

the cloud, which focused on the cloud's exposure to security threats. With the use of the TOE framework the scope of the research questions was broadened to focus on environmental issues, organisational issues, and technology issues; the research questions and sub-questions were also developed with this broadened view of the technology adoption process.

The organisations that were selected for this research study were purposely selected based on criteria that was predefined. The chosen instrument for the collection of data was an online survey which was composed of the four main research questions and their respective sub-questions.

- How does bandwidth affect cloud computing?

This research question focused on issues that were both internal and external to the organisation. In the TOE framework, bandwidth challenges were categorised as external to the organisation, whereby the availability and cost of bandwidth were not in the hands of the organisations but were controlled and set by internet service providers. Another concern was the availability of the internet in the different business areas, which was affected by issues such as infrastructural readiness, and availability of competitors in the supply of bandwidth. The internal aspect of this question focused on the organisation's willingness and the affordability of the costs associated with bandwidth. The research question also touched on the area of security and ensuring that the organisation had internet security that could be trusted to protect the organisations once it moved to a network-based model like cloud computing. The sub-questions respondents were asked focused on both internal and external issues, and the findings were presented in chapter 5 of this research study. Eight sub-questions relating to this research question formed part of the questionnaire and these questions looked at addressing potential internal and external issues. In some of the literature that was reviewed for this research study, it was highlighted that bandwidth as some of the issues affecting cloud computing adoption in African countries and developing nations in general (Mujinga & Chipangura, 2011). With the bandwidth research question, the aim was to try and gauge how much of an issue bandwidth was for the organisations that were adopting and using the cloud.

The results for this research question were presented in chapter 5, and having gone over the results from each sub-question, the responses provided to the questionnaire indicated that respondents believed that their respective organisations had no significant bandwidth performance issues for their internal processes. On the questions that focused on external issues, like infrastructure readiness and cost of bandwidth, the results indicated that respondents believed that organisations faced challenges.

- How does the cloud provider affect the decision to adopt cloud computing?

With this research question the aim was to investigate how cloud provider conduct affected the relationship between the cloud provider and the adopting organisation. There were six research sub-questions which formed part of the questionnaire about cloud providers which looked at cloud provider related issues that could potentially negatively impact organisations looking to adopt cloud computing or those that were already using cloud services. Having reviewed past literature on cloud computing adoption and noted some of the issues that past researchers had highlighted, this research study focused on issues surrounding cost, security, support, and the process of finding the right cloud provider for the organisations. From the findings that were presented in chapter 5, the responses indicated that organisations were not being significantly affected by cloud provider conduct. It was only when respondents were asked if cloud providers conduct demonstrations prior to the adoption of the cloud where respondents did not answer as positively as they did in the other questions.

- What role does security play in the organisation's decision to adopt cloud computing?

Security was highlighted as one of the contributors to the decline in South Africa's cloud adoption rankings by the BSA (2018). Incidents of security related challenges that organisations faced due to using network based technology models were highlighted in chapter 2 of this research study. In literature that was reviewed for this research study looking at cloud adoption by developed nations, security concerns were highlighted as being one of the main concerns for organisations wanting to adopt the cloud (Kshetri, 2011). Given that failure to protect customer information was highlighted as being a challenge even for South African organisations, the questionnaire for this research study included five questions that looked at possible ways that security might have affected the adoption and usage of the cloud.

From the findings, the questions about security had the most number of responses where respondents chose "neither agree nor disagree"; and for questions relating to the security tools that organisations could use to protect themselves respondents answered with either "strongly agree" or "agree", this indicated that organisations had tools in place to protect themselves against security threats. In questions that focused on security policies and clauses to protect organisations against threats, respondents chose to "neither agree nor disagree". This could have been an indication that not all respondents were aware of their organisation's policies as far as cloud computing was concerned, or that some of these organisations did not have policies in place to protect themselves and their clients. While the overall results indicated that organisations were managing the issue of security, it was concerning that on the questions

relating to policy and contracts respondents chose to be neutral.

- What role does executive management play in the adoption of cloud computing?

In organisations, the decision to adopt any form of technology goes through the different managerial structures until it is eventually approved, which emphasised the importance of the role that top management played in technology adoption. There were ten research sub-questions in the questionnaire that looked at possible ways that executive management might negatively influence the adoption of cloud computing. The questions were put to investigate the management's position when it came to supporting cloud adoption, making the necessary funds available, ensuring that policy and compliance considerations were adhered to, and ensuring that the organisation had enough human and technology resources to support the adoption and usage of the cloud. The responses that respondents gave to this indicated that top management was in support of the adoption of the cloud. It was only on the question of compliance implications, and the question of legal considerations where respondents did not answer in support of top management, with the majority of respondents choosing "neither agree nor disagree". In the previous question which looked at security concerns, respondents exhibited the same behaviour when asked about policies and compliance issues, this could have been an indication that respondents were not well informed on these issues.

The motivation for conducting this research study was to investigate the cause for the low adoption rate of cloud computing. This research study was built around the issues that were highlighted as main contributors by the BSA, along with some other issues that were identified from past literature. The research instrument for this research study consisted of sub-questions that were based on the four main research questions for this research study. Having collected and analysed the collected data, the concluding remarks were that from the organisations selected, they were not significantly hindered by issues that were listed in the questionnaire. There were however changes in response trends when issues pertaining to the operational environment were brought to respondents. The findings indicated that organisations were being negatively impacted by issues pertaining to the readiness of the environment within which they operated.

6.3 Limitations of the study

While the aim of this research study was not to find information that could be generalised on to the entire population, but the study did have a goal of laying a solid foundation for future studies. Using the TOE framework for this research study improved the diversity of the data that was collected. The TOE framework also helped when the data was being analysed, especially with the different groups that were created to help understand the impact of the issues that were raised with the questionnaire. While the groups that were created when analysing the data were useful, there was one more grouping that could have made the findings even better and laid a solid foundation for future studies. In collecting the data for this research study, the data was not grouped according to organisation or economic sector, all the organisations were using the same link to capture their responses. Given that organisations of different sizes and economic sectors were purposely selected for this research study, not grouping the data according to organisation and economic sector was a missed opportunity because it could have been easier to compare the difference in behaviour by organisations depending on their size and economic sector.

6.4 Recommendations

When examining studies that focus on issues that can potentially have an impact on the organisation's decision about adopting technology there were many factors of potential concern to consider that were raised. For this research study, the issues that were identified have been listed below and the relevant research questions;

- Bandwidth - How did bandwidth affect cloud computing adoption?
- Executive management influence - What role did executive management play in the adoption of cloud computing?
- Cloud provider relationship - How did cloud provider conduct affect organisation's decision to adopt cloud computing?
- Security concerns - What role did security play in an organisation's decision to adopt cloud computing?

The issues that could have had impact in the organisation's intention to adopt the cloud and also the usage of cloud computing were not limited to the ones that were listed as part of research questions for this research study. The decision to focus on the mentioned issues was

informed by past literature and also findings by the BSA which highlighted the biggest blockers for South African organisations when adopting cloud computing. The other issues that were listed as part of the research questions were selected after having studied past literature which highlighted some challenges that organisations in developing and developed countries were struggling with. Using the TOE framework, the researcher managed to develop research questions for this study. The approach of using the TOE framework for this research study was beneficial since based on response it was easier to track which issues were environmental, technological, and organisational.

Using the TOE framework to group questionnaire questions as either internal or external assisted with analysing the data that was collected. As it had already been stated that many issues affected an organisation's attitude towards the cloud, and some of these issues were internal and some external to the organisation. That is why the TOE framework was used for this research study as it was the best framework to study the adoption of a technology whose usability and acceptance depended on more than just user experience, but the usage was also affected by the environment and other organisational factors. During the data analysis process certain patterns were picked up in how respondents responded to the questions; for instance, in the questions about internal issues – which were issues within the organisation's control – respondents were more assertive in their responses with the majority of the questions getting the agree or strongly agree responses. Opposite behaviour was observed for external questions – issues not within the organisation's control – there was more disparity in the results as there was a greater number of respondents who chose the either "disagree" or "strongly disagree" response. The findings indicated that organisations were still impacted by security concerns, and network infrastructure issues, which are issues that were not entirely in the control of the organisation.

Highlighting the external issues that the findings found to be potential causes for challenges to organisations does not mean there were no internal issues that were potentially affecting organisations in their use and adoption of the cloud. Having analysed the data, it was picked up that on the questions concerning top management support, and especially questions on compliance and legal issues respondents did not answer with clarity as they did with the other questions. On the questions concerning compliance and legal readiness the majority of the respondents chose the "neither agree nor disagree" response. This was a change in behaviour compared to the behaviour that respondents had shown in other questions. It could have been

because respondents did not have access to this information, or it could have been that organisations were struggling with ensuring they are compliant at all levels of their cloud adoption and usage, or it could have been that organisations were struggling with finding a cloud provider that's compliant with South African laws. The second grouping of the results that was done was on either the issues that organisation were technology, environment, or organisation issues. From this grouping the results indicated that most challenges that organisations experienced came from environmental issues, which were not entirely in the control of the organisations.

The grouping of the results in this manner revealed where most challenges organisations faced originated from, which was good for the overall presentation of the results, but there were more questions that were raised after having analysed and grouped the results. This was especially the case for the research questions that had many responses of "neither agree nor disagree", it would have been useful to go back to the organisations to ask follow up questions so as to help better understand the reasons for choosing "neither agree nor disagree". While targeting organisations of different sizes and from different sectors helped with getting diverse responses, it was difficult to determine which factors affected which organisation the most. For example the technology adoption process and usage for an organisation in the financial sector is not the same for an organisation in the manufacturing sector. Organisations in the financial sector tend to be more cautious in how they approach technology adoption and usage than those in the manufacturing sector.

In addition to grouping the results according to either internal or external, or according to the TOE framework element, future studies can also group the results according to each organisation and also the sector that those organisations belonged to. With the results captured in one file and not grouped according to organisation and group there were some findings that were missed. As already mentioned, after having analysed the results many potential "follow-up" questions were raised but the researcher could not ask the respondents those questions due to the type of research approach that was used and the tool that was used to collect the data. Due to this short-coming, it is suggested that for future studies sampled organisations should be given their own dedicated research instrument, results be captured individually for each organisation so better comparisons can be made on the results. In addition to that, it is also suggested that in designing the research instrument the respondents must be given the option to add comments on questions where they "neither agree nor disagree", this would help better understand why they chose those responses, and this can also help answer the questions that

come up after having analysed the results.

6.5 Conclusion

This chapter drew conclusions about the research study based on the findings that were presented in chapter 5. This was done by discussing each research question that was raised for this research study and discussing what the objective of the research question was and comparing that to the findings that were discovered after having analysed the research data. The limitations of this research study were also discussed, highlighting missed opportunities and areas that could have been better explored. Recommendations for future studies were discussed based on the findings and short-comings of this research study. This chapter presented recommendations for each research question from the research questions that were raised for this research study. The final section of the chapter discussed recommendations for future studies, what this research study did well, and what future studies could improve on.

Reference List

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Cloud computing adoption by companies in the eThekwini area

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School of Management, Information Systems & Technology and Governance

Discipline Information Systems & Technology

University of KwaZulu-Natal, South Africa

- Please complete this voluntary questionnaire on cloud computing adoption for organisations in the eThekwini area. This research seeks to investigate the current state of cloud computing adoption by organisations in the eThekwini area. Please be forthright in your answers.
- Please select the preferred option where given options to choose from.
- Please complete all sections of the questionnaire.
- Please check the checkbox to the statement of informed consent, giving the researcher permission to use the responses for this research project.
- Please note if you have not checked the checkbox, you cannot go any further with the questionnaire.
- Please mark only ONE option per question.

Please check the checkbox to the statement of informed consent, giving the researcher permission to use the responses for this research project.

Section two: ***Do internet issues (availability, cost, and speed) affect the adoption of cloud computing?***

1. The internet connection in the organisation can be relied upon to support the use of cloud computing?

- ☐ Strongly agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree

2. The current network infrastructure in the eThekwini area can be relied on to support organisations?

- ☐ Strongly agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree

3. The current cost of internet connectivity in the eThekwini area is affordable?

- ☐ Strongly agree
- ☐ Agree
- ☐ Neutral

- [ ] Disagree
- [ ] Strongly Disagree

4. The organisation has a network capacity plan to help manage the performance of the network?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

5. The speed of the internet connection in the organisation supports the use of cloud computing services?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

6. The organisation uses tools such as Google Transfer Application, GSUtil, or any other similar tool to help minimise data traffic costs?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree

☐ Strongly Disagree

7. The organisation has network analysers to evaluate network traffic?

☐ Strongly agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly Disagree

Section three: ***What role does management play in the adoption of cloud computing?***

1. The organisation's management supports the adoption of the cloud?

☐ Strongly agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly Disagree

2. IT managers within the organisation fully support the adoption of the cloud?

☐ Strongly agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly Disagree

3. Systems requirements needed for cloud adoption are accepted by the organisation's management?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

4. The monetary needs to adopt the cloud are understood by the organisation's management?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

5. Compliance implications for cloud computing adoption are understood and accepted by management?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

6. Legal considerations for cloud adoption are presented to and accepted by management?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

7. IT managers ensure there are cloud skilled staff members to support and use cloud computing services?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

8. There are clear plans to upskill employees with cloud related skills?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

9. The risks associated with cloud computing are understood by the organisation's management?

- [ ] Strongly agree

- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

10. The business needs of the business are considered prior to the adoption of the cloud?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

Section four: *How does cloud provider affect the decision to adopt cloud computing?*

1. The issues of potential vendor lock-in are addressed by the service level agreement between the organisation and the provider?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

2. Cloud vendors are responsible for the development of the security measures that will be put in place?

- [ ] Strongly agree
- [ ] Agree

- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

3. The cloud provider conducts cloud services demonstrations to help the organisation choose a suitable cloud service?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

4. The organisation can rely on the cloud provider to provide support after the cloud has been adopted?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

5. The SLA stipulates that reasonable and required access is granted to the cloud provider to allow the provider to perform their duties?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

6. Organisations experience difficulties finding the right cloud provider.

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

4. Section five: *What role does security play on the organisation's decision to adopt cloud computing?*

1. The organisation is aware of the security risks associated with storing its data in the cloud?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

2. There are data encryption tools in place to protect data while being transmitted to and from storage centres?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

3. The SLA addresses possible threats of malicious insider attackers within the cloud provider’s organisation?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

4. The cloud provider can be relied upon to maintain the integrity of the organisation's data?

- [ ] Strongly agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

Addendum 1: Ethical Clearance

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

25 October 2018

Mr Thuthukani Mngomezulu (210517872)
School of Management, IT & Governance
Westville Campus

Dear Mr Mngomezulu,

Protocol reference number: HSS/0740/018M
Project title: Cloud adoption for organisation's in the eThekwini area

Approval Notification – Expedited / Amendment Application

In response to your application received on 14 June 2018 and amendment on 16 October 2018, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

AMENDMENT:

- Removal of one Research Site

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

[redacted]
Dr Shamila Naidoo (Deputy Chair)

/ms

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