



University of Fort Hare
Together in Excellence

A cloud computing adoption framework for financial service institutions in South Africa

By

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**A cloud computing adoption framework for financial service
institutions in South Africa**

by

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Abstract

Financial service providers in South Africa are failing to leverage the benefits that cloud computing could contribute to their business and clients. The primary objectives of cloud computing include reducing overall Information Technology (IT) service costs and processing time whilst increasing process throughput, reliability, availability and flexibility. However, despite these advantages, both strategically and operationally, there is still a relatively slow adoption rate. This can be attributed to the potential pitfalls of the technology such as security concerns, failure downtime resulting from server maintenance or unforeseen outages, implementation complexity and compatibility issues.

Very few migration readiness assessment strategies exist, and those that do exist are focused at a much higher level of abstraction. No framework exists within which financial service providers can assess the feasibility or readiness of their unique financial services for cloud computing. The development and demand for cloud industry standards (including the assessment of service readiness) is the foremost concern of IT decision makers.

This research project examines ways in which South African financial service providers are able to increase the rate of adoption of cloud computing services. To achieve this financial service providers require a means to increase adoption level of cloud computing. The contribution of this research project is a framework based on the Technology Organisation Environment Framework (TOE) that medium-sized financial organisations can make use of in order to assess the feasibility of their financial services for the adoption of cloud computing.

The research project applies design science to produce an extensive framework which financial services organisations can use to evaluate their readiness for the adoption of cloud computing. The findings of the research suggest that there is strong interest from employees within financial services organisations to explore cloud computing as a means to improve the value they are already able to offer clients.

Keywords: Adoption, cloud computing, financial services, readiness

Declaration

I, Nicolette Introna (200703752), hereby declare that:

- The work in this dissertation is my own work.
- All sources used or referred to have been documented and recognised.
- This dissertation has not previously been submitted in full or partial fulfilment of the requirements for an equivalent or higher qualification at any other recognised educational institution.
- I am fully aware of the University of Fort Hare's policy on plagiarism and I have taken every precaution to comply with the regulations.
- I am fully aware of the University of Fort Hare's policy on research ethics and I have taken every precaution to comply with the regulations. I have obtained an ethical clearance certificate from the University of Fort Hare's Research Committee and my reference number is the following: **PID0215INT01** (attached as Appendix A).

Ms. Nicolette Introna

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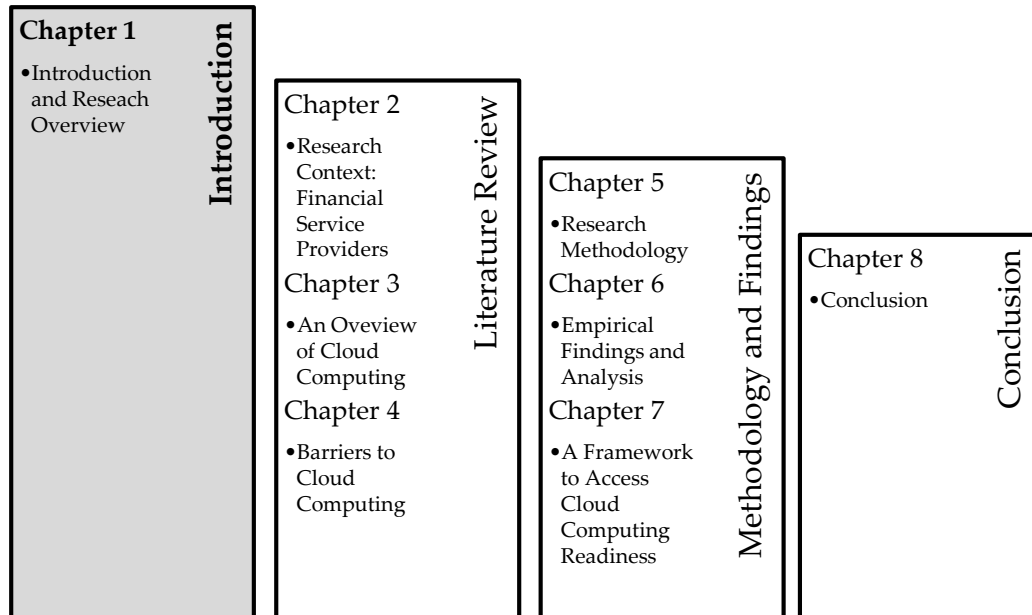
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Chapter 1

Introduction and Research Overview



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1 Introduction and Research Overview

1.1 Introduction

Columbus (2015) reveals that the estimated spend on public cloud computing in 2016 will reach \$106 billion. Cloud computing has been growing exponentially for a number of years, in 2011 a study by Gantz, Toncheva, & Minton (2012) pointed out that in that year alone, “Information Technology cloud services helped organisations of all sizes and all vertical sectors around the world to generate more than \$400 billion in revenue and created around 1.5 million new jobs” (Gantz, *et al.*, 2012, p.1).

Gantz, *et al* (2012) estimate that by 2015 more than 14 million jobs will be created worldwide as a result of spending on public and private cloud computing services. Of this, Gantz, *et al* (2012) believe that more than 50% will be amongst small and medium-sized businesses and more than one million jobs will be within the banking, communications and discrete manufacturing industries. The industry this research project focuses on is the financial services industry specifically the financial service offerings of that industry.

Mochiko (2012) points out that of the 14 million jobs expected to be created globally, nearly 145 000 will be in South Africa. Thus, the role of cloud computing in organisations is set to increase into the future. Cloud computing is set to positively contribute towards economic growth and job creation, in turn increasing the overall economic potential of South Africa (Schüssler & Urbach, 2012).

It is stated by Low, Chen and Wu (2011) that cloud computing has become the new ‘buzzword’ within the Information Technology (IT) industry. Due to this recognition, cloud computing is fast becoming a focal area within organisations who aim to attain IT innovation, investment and overall a competitive edge. As more organisations begin to invest interest in moving towards cloud computing they will require structured processes in assessment and adoption of these technologies.

Gantz, *et al* (2012) believe that the majority of organisations look at migration to cloud computing as a way to free up existing resources, thus giving them the ability to focus on innovation and key objectives. Therefore, the primary objectives of cloud computing highlighted by Gantz, *et al* (2012) include reducing overall IT service costs and processing time whilst increasing process throughput, reliability, availability and flexibility. However, Low, *et al* (2011), point out that even with the advantages offered by cloud computing, both strategically and operationally, there is still a relatively slow adoption rate.

Slow adoption of cloud computing may be as a result of some of the potential pitfalls of the technology such as security concerns, failure downtime resulting from server maintenance or unforeseen outages, implementation complexity and compatibility issues (Low, *et al.*, 2011). Therefore, Low, *et al* (2011) recommend that organisations choosing to adopt cloud computing consider a gradual implementation approach and follow a slow migration process that steadily increases the number of processes or functions being hosted by the cloud. Scott (2015) states that the financial industry is still in the early stages of cloud adoption. Further to this Scott (2015, p. 1) reiterates that a recent study conducted in March 2015 by the Cloud Security Alliance found that, “A majority, 61 percent of financial institutions, are developing a cloud strategy within their organisation.” This highlights an urgent need for research which assists financial organisations to assess their cloud adoption maturity position.

Research into the limitations, risks and best practices around this technology are becoming essential. Marston, Li, Bandyopadhyay, Zhang, and Ghalsasi (2011) provide the following five main categories as potential areas for information systems (IS) researchers to focus on concerning cloud computing:

1. Cloud computing economics;
2. Cloud computing and IT strategy/policy issues (including security);
- 3. Technology adoption and implementation issues;**
4. Cloud computing and green IT; and
5. Regulatory issues.

This study focuses specifically on point three above namely: technology adoption and implementation issues. The adoption of such technologies is dependent on the ability for an objective assessment of the readiness of each individual service and the components thereof. Marston, *et al* (2011, p. 187) elaborate on areas for consideration with regards to cloud computing adoption and implementation and highlight a few issues:

“Organisations are also looking for guidance in developing technology roadmaps, in order to decide (a) which applications are best positioned for moving to the cloud (i.e. how are applications to be divided between in-house and on the cloud) and (b) how to implement the changes in the least disruptive manner.”

This highlights the core contribution of this research project.

This research project examined ways in which South African financial service providers are able to increase the rate of adoption of cloud computing services. To achieve this, financial service providers require a means to assess the readiness of their services for the adoption of cloud computing. The contribution of this research project is a framework that medium-sized financial organisations can make use of in order to assess the feasibility and readiness of their financial services for migration to cloud computing. Through this contribution, the uncertainty associated with the assessment of the readiness of their services for migration to cloud computing will become clearer. In order to develop the framework, the problem statement needs to be explained and understood – which section 1.2 below addresses.

1.2 Statement of the Problem

Financial service providers in South Africa are failing to leverage the benefits that cloud computing could contribute to their business and clients. This is due to a number of issues influencing the relative ease at which business managers and executives are able to assess the readiness of their financial services for such a technology. Additionally, Schüssler and Urbach (2012) attribute factors ranging from slow broadband connections to the technology (as a whole) being unknown by business users. Marcos, Leichter, Losa, Medina, Reyes, Rodriguez and Wang (2015, p. 13) claim that, “*most of the financial industry has yet to build a solidified, concerted approach to cloud adoption.*” Therefore, the problem that currently exists is that financial service providers are not capable of assessing the readiness of their own services for cloud computing. This results in increased risk of loss of revenue through competitor adoption of similar services.

The risk of moving highly confidential financial services to the public cloud can be enormous if not properly controlled (Howarth, 2009). Babar and Chauhan (2011) concur pointing out that cloud computing, as a concept, is still relatively new and misunderstood. They add that this presents several research challenges that require solving before the understanding of cloud computing improves (Babar & Chauhan, 2011).

Business managers and executives face numerous technical decisions when deciding which route to take when migrating their portfolios to the cloud. This can often result in timely delays or the complete abandonment of such ambitions. Babar and Chauhan (2011) point out that very few adoption assessment strategies exist, and those that do exist are focused at a much higher level of abstraction. No framework exists within which financial service providers can assess the feasibility or readiness of their unique financial services for cloud computing. This is supported by Foddering (2011) who notes that the development and demand for cloud industry standards

(including the assessment of service readiness) is the foremost concern of IT decision makers. The findings of this research project, in chapter 6, address the lack of concise direction financial organisations experience towards migration of services to public cloud computing.

In order to establish a cloud computing readiness framework for financial service providers, the following research questions were established. This research project focused on the resolution of both the primary and secondary research questions as a means to address the research problem described in this section.

1.2.1 Primary Research Question

The primary research question reads as follows:

How can a South African financial service provider determine the readiness of financial services for the adoption of public cloud computing?

The primary research question sought to find a means to improve the readiness assessment of financial services for cloud computing by financial service providers in South Africa. Urquhart (2008) warns that even the most established organisations find it challenging to move to the public cloud. Foddering (2011) and Marcos, *et al* (2015) argue that a contributing factor towards this challenge is that there are very few clear guidelines that outline how organisations can go about migrating various services to the public cloud with minimal risk. The next section discusses the three secondary research questions.

1.2.2 Secondary Research Questions

Sub Question 1: How can cloud computing be used to improve the financial services of a medium-sized South African financial service provider?

The implementation of cloud computing technologies is a relatively new paradigm within the IT industry. Due to the uncertainty of cloud computing, few organisations fully understand cloud computing and the associated benefits (Babar & Chauhan, 2011). Sriram (2011) therefore lists a number of ways in which cloud computing can add value to financial organisations. Some of these benefits include cost savings, usage-based billing, business continuity, business agility and focus and lastly green IT (Sriram, 2011). For financial organisations Scott (2015) cites being “digital” and the ability to quickly bring new products and services to the market as an important benefit. The benefits in the context of this research project are discussed further in Chapter Three.

Sub-Question 2: What are the factors which impede the adoption of cloud computing at South African financial service providers?

Financial service providers need to be aware of all challenges they may face in implementing cloud computing. Garg (2011) highlights the fact that the challenges to financial institutions are heightened because of their security-sensitive environment. It is therefore crucial that financial organisations understand these challenges before they implement cloud computing. Garg (2011) provides a list of challenges, which include security, data privacy, availability, absence of standards, vendor lock-in and compliance. In the opinion of Sultan (2011) organisations are fearful and uncertain when it comes to implementing cloud computing as cloud computing is an emerging computing service paradigm. The hesitation towards cloud computing adoption is especially heightened as a result of the prevalent data breaches and hacks in recent years (Bailey, 2015). The barriers in the context of this research project are discussed further in Chapter Four

Sub-Question 3: What attributes of a financial service are required before cloud adoption can be achieved?

This sub-question establishes the attributes specifically required from a financial service before that service is ready for migration to cloud computing. Assessing the common attributes of all financial services and mapping these to the requirements for cloud computing establishes a list of required attributes. Organisations that wish to utilise the outcome of this research project have access to a definitive list of attributes from which an assessment of their services becomes possible. An assessment of minimum values for each attribute can be identified in order for organisations to improve specific components of their financial services. The attributes required for cloud computing migration are discussed further in Chapter Four. Introna and Piderit (2013) provide the attributes for assessment in order to migrate financial services to cloud computing.

1.3 Objectives of the Study

The objective of this research project is to produce a framework which will assist business managers and executives in assessing the readiness of their financial service offerings for delivery using cloud computing. Using this framework managers and executives should be better informed of the major impediments and key requirements of preparing their services for cloud computing.

The framework from this research project should be applicable to any financial service offering. All financial service offerings should be capable of being individually assessed and rated at a level of readiness for migration to cloud computing. This allows key managers and executives to make

informed decisions about which services to prepare for migration to public cloud computing services.

1.4 Significance of the Study

Business executives and decision makers are not familiar with the technical complexity of cloud computing, its dependencies and limitations. These stakeholders need a simple framework to assess the readiness of these services in such a way that they can make a decision without needing to understand Information and Communication Technology (ICT) related topics. This research project is important as it provides a framework which is aligned to both IT and business needs.

Organisations are increasingly moving towards cloud computing models to take advantage of the benefits of this operating model (CA Technologies, 2012). As stated previously, Mochiko (2012) points out that of the 14 million jobs expected to be created globally in cloud computing by 2015, nearly 145 000 will be in South Africa. The provision of services through cloud computing provides numerous benefits to both consumers and service providers alike. Financial service providers who are slow to respond to the adoption of cloud computing are likely to find themselves in a disadvantaged position to respond rapidly to changes in market conditions (CA Technologies, 2012).

This research project is unique in its approach to resolving the problem of a specific technology adoption within South African financial service providers, namely cloud computing. The provision of a framework from which organisations in this market can assess the adoption and readiness of their services for cloud computing is highly valuable. Alter, Peng, Runhua and Harris (2010) point out that managers and executives become lost in technical details of cloud computing and ultimately stall or abandon these efforts due to this. The proposed framework presents an opportunity for the practical advancement of this process without detailed technical expertise required. The next section provides an overview of the literature and underlying theory as discussed in detail in Chapter Two to Chapter Four.

1.5 Literature Review

This section provides an overview of the literature review conducted as part of this research project, which can be found in chapters two, three and four. Information was gathered from numerous books, journals, articles, conference proceedings and other studies. A foundation was established from the literature reviewed, providing secondary data for this research project. Insight

into the problem area is expanded upon, synthesising what is known, and what is unknown. Through critical analysis the primary theoretical foundation for this research project is detailed.

1.5.1 Underlying Theory

The underlying theory of this research project is the Technology Organisation Environment Framework (TOE), as depicted in figure 1.1 below. The TOE was chosen as a result of emphasis being placed upon adoption at an organisational level as opposed to an individual level, which the Diffusion of Innovation, Technology Acceptance Model and Unified Theory of Acceptance and Use of Technology are more focused on (Oliveira & Martins, 2011). The innovative decision making process for adoption provides a maturity path for measuring the readiness progress within the framework (Rogers, 2003).

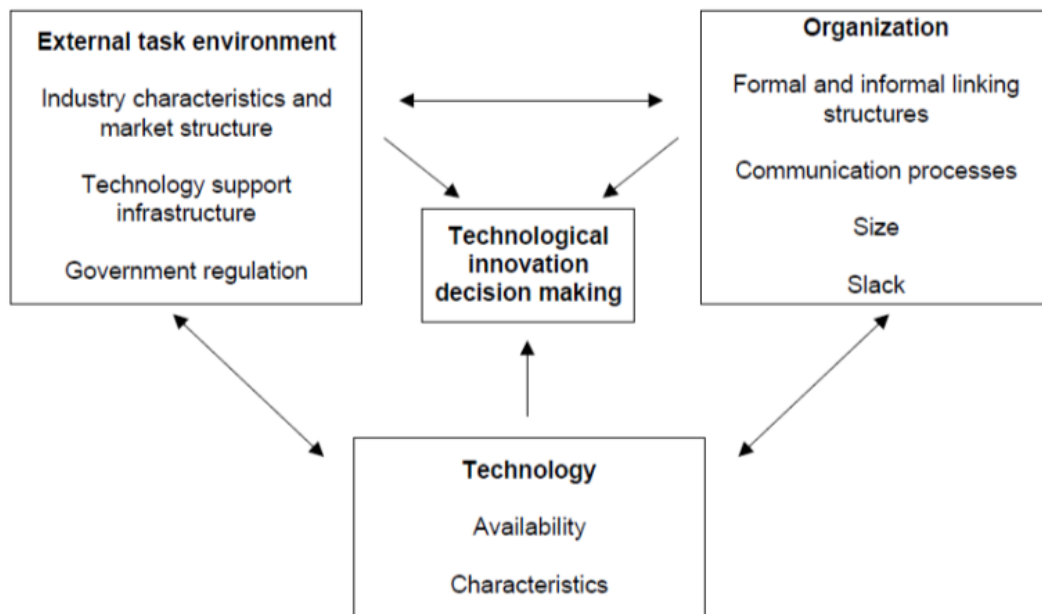


Figure 1.1: TOE Framework (Oliveira & Martins, 2011)

The TOE framework can be described as a framework, which examines the process of how an organisation goes about adopting and implementing technological innovations. The adoption and implementation process is believed to be largely influenced by the various contexts namely: technology, organisation and environment (Tornatzky & Fleischer, 1990). The three contexts aim to represent not only the constraints but also the opportunities faced when considering technological innovation. Thus when assessing the technology innovation of cloud computing and more specifically the adoption of cloud computing organisations can factor in all possible strengths and weaknesses. Further to this, Tornatzky and Fleischer (1990) state that these three elements

influence the way in which organisations: view the need, search for and adopt new technology (which is relevant to this research project).

1.5.2 Assessing the Readiness and Feasibility of Cloud Computing

Sriram (2011, p. 5) and Cisco Systems Incorporated (2010) highlight the importance of establishing the correct cloud computing strategy by noting that, cloud service models offer institutions the option to move from a capital intensive approach to an operational expenses approach. They both highlight the importance in choosing the correct service model.

1.5.3 The Benefits of Cloud Computing

Cloud computing, in the opinion of Foddering (2011), is currently viewed as being one of the most topical and exciting developments in the IT and business spheres. Mashandudze and Dwolatzky (2015, p. 1) refer to cloud computing as being a “*buzzword that has seismically revolutionised the ICT industry.*” This new and exciting development as a result has brought about much discussion and debate within the IT and business communities. With any topical technology the benefits as well as the weaknesses need to be considered prior to the adoption of cloud computing. Tao, Marten, Kramer and Karl (2011) are of the opinion that cloud computing offers numerous benefits (which have been listed in figure 1.2). These benefits are supported by Marston, *et al* (2011) who include energy savings in addition to elasticity, economy, reliability and on-demand environments.

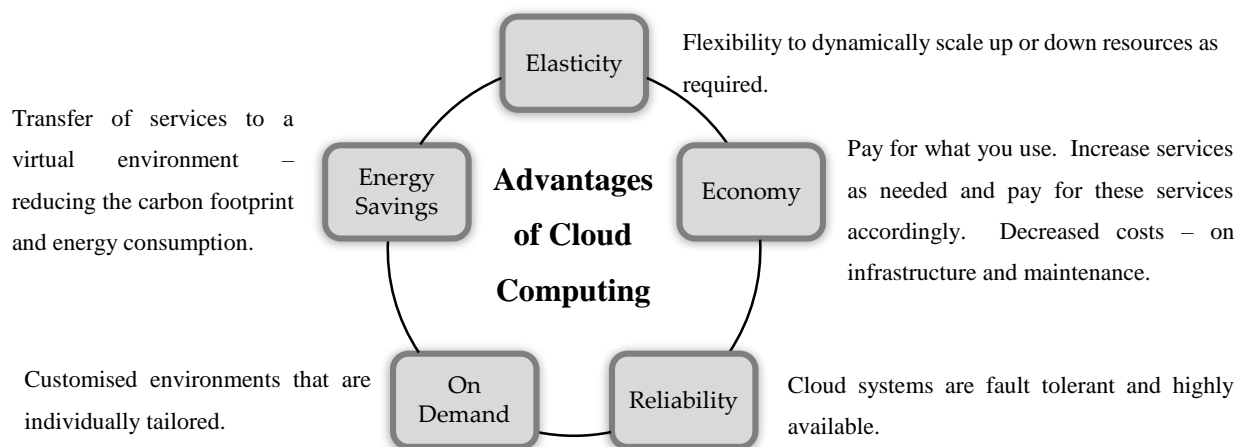


Figure 1.2: Cloud Computing Benefits [adapted from Marston, et al (2011)]

Further to the above benefits, Foddering (2011) states that the main contributor to cloud computing adoption is cost savings. Scott (2015) conveys but further adds that financial service companies have the same interest in cloud adoption as any other organisation with the main reasons being cost savings, scalability and quick deployment of new products and offerings to the market. Other

benefits include easier maintenance, automatic updates, and improved collaboration and communication (Foddering, 2011).

1.5.4 Factors which Impede the Adoption of Cloud Computing

Cloud computing is fast becoming the future and, because of this, change is inevitable (Babar & Chauhan, 2011). The adoption of cloud computing, as previously discussed, offers organisations a variety of benefits, but with any new technology there are various challenges, issues and risks which exist (Alter *et al*, 2010). These issues may impede the rate of cloud computing adoption but Kim, Kim, Lee and Lee (2009) are of the opinion that most of these adoption issues can be solved.

In South Africa, adoption of cloud computing, amongst South African organisations has been dramatically slower when compared to other countries (Moyo, 2015). The slow rate of cloud adoption could be due attributed to multiple reasons. Kim, *et al* (2009) however acknowledge six main types of adoption issues: outage or availability, security and performance (which can be grouped together as quality of service issues) followed by compliance, integration, cost and environment.

In light of the above issues, Foddering (2011) provides statistics from a Cisco commissioned study, where 250 IT decision makers in large United Kingdom (UK) companies across five sectors were telephonically interviewed. The findings were as follows: 75% of respondents acknowledge security and privacy, 64% recognised data location, 62% integration issues with in-house IT and 60% recognised hosted services as their main concern and barrier to cloud computing adoption.

Alter, *et al* (2010) concur with Kim, *et al* (2009) but further add that factors impeding the rate of cloud computing adoption may include:

- Insufficient knowledge or understanding of what cloud computing is, therefore:
 - Take a more cautious approach towards the new technology.
 - Have a limited understanding of the possible benefits.
- Viewed as a temporary fad (unconvinced of the need to adopt cloud computing).
- Low confidence in the ability of cloud computing to solve complex problems.
- Inability to provide a long lasting competitive advantage.

In addition to the above Heyink (2012) highlights the complications organisations should consider surrounding the geographical locations of cloud services providers. Cloud service providers that

are situated in a different geographical location (outside of South Africa) may be exposed to different legal jurisdictions and consequences, business practices and government oversight (Heyink, 2012).

1.6 Research Methodology

Hofstee (2006) argues the importance of paying attention to the method before commencing research or writing. By detailing the method, the overall academic work and writing will be strengthened. In light of this argument, table 1.1 below provides the reader with a clear overview of the detailed research plan, from which the solution to the problem was pursued.

The research design and methodology becomes clearer thus developing the necessary insight to better understand the overall context and direction. Further to this the research design and methodology creates a linkage between the theory and argument of the research project, reflecting the range of dimensions within the research process (Limpanitgul, 2009).

Table 1.1: Research Design and Methodology

Area	Approach	Reason Why Selected
Paradigm	Interpretivist Paradigm	Interpreting subjective values and using the subjectivity of people. Credibility will be added by applying critical thought.
Methodology	Design Science Methodology	Developing a framework that aims to solve an organisational problem.
	▪ Hevner's IS Research Framework	Provides rigor and relevance therefore adding credibility to the research framework.
	▪ Table 1.2: Seven Guidelines	The seven guidelines will form a checklist that will strengthen the credibility of the framework.
	▪ Evaluate (Expert Review)	Expert evaluation of research framework
Data Collection	Questionnaires	A pilot study was conducted. Multiple open and close-ended questions with a Likert scale – ensuring questions remain subjective (convenience sample).
	Interviews	In depth analysis (for clarification and context)
Data Analysis	Expert Review	Make use of expert review and critical thought will be applied therefore adding credibility.
	Qualitative and Quantitative	Triangulation will be applied in the analysis of the research findings.

Area	Approach	Reason Why Selected
	<ul style="list-style-type: none"> ▪ Pattern Matching 	To establish frequently occurring phenomena and strengthen the internal validity of the research project outcomes.
	<ul style="list-style-type: none"> ▪ Microsoft Excel ▪ Microsoft SQL Server ▪ Power BI 	For the processing of quantitative data from the primary research findings.

1.6.1 Research Paradigm

The paradigm that was used within this research project was that of interpretivism, which in the opinion of Williams (2000), is strongly associated with a qualitative approach. Myers (1997) states that interpretive studies are generally aimed towards understanding the phenomena, through the meanings that people assign to them. Qualitative research focuses on understanding the setting of phenomena and not the measurement of the phenomena. This leads to a greater understanding of the social world and the behaviour of humans (Eldsbi, Irani, Paul, & Love, 2002).

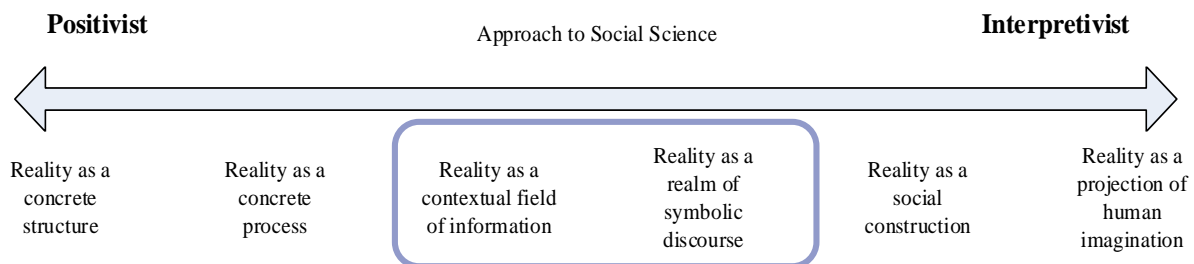


Figure 1.3 - Continuum of Core Ontological Assumptions (Collis & Hussey, 2009) As shown in

As shown in figure 1.3, this research project is positioned towards the centre of the extremes of Positivist and Interpretivist research. A balance of both ontological assumptions was used.

1.6.2 Research Method

The research design is Design Science which was applied using the Design Science research guidelines in table 1.2 below. The output of this research project is a tangible assessment framework. Design Science is well suited to research that ends in an artefact such as the framework proposed through this research project.

Table 1.2: Design Science Research Guidelines (Hevner, March, Park, & Ram, Design Science in Information Systems Research, 2004)

Guideline	Description	Application
1. Design as an Artefact	Design Science research must produce a viable artefact in the form of a construct, a model, a method, or an instantiation.	This research project produces a framework for assessing the readiness of financial services for cloud computing.
2. Problem Relevance	The objective of Design Science research is to develop technology-based solutions to important and relevant business problems.	The technical complexity of cloud computing creates a level of confusion in which business decision makers are unable to assess the feasibility of their services.
3. Design Evaluation	The utility, quality and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods.	Numerous techniques are utilised to evaluate the effectiveness of the framework towards providing a means of assessing readiness.
4. Research Contributions	Effective Design Science research must provide clear and verifiable contributions in the areas of the design artefact, design foundation, and/or design methodologies.	The contribution of this research is a framework which business managers and executives from financial service organisations are able to assess their unique products for cloud computing.
5. Research Rigor	Design Science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact.	Using techniques and methods incorporating expert reviews and questionnaires, the research project seeks intensive rigor towards ensuring a credible output.
6. Design as a Search Process	The search for an effective artefact requires utilising available means to reach desired ends while satisfying laws in the problem environment.	Experts will be essential in establishing the relevance and practicality of the output towards seeking a solution to the problem area.
7. Communication of Research	Design Science research must be presented effectively both to technology-oriented as well as management-oriented audiences.	By presenting findings from this research project at relevant conferences and publishing findings in academic journals relating to this problem area, exposure to the research project will be maximised. One conference paper based on the findings of this research has already been published (See Appendix C)

1.6.3 Data Collection Methods

Data collection was from both primary and secondary resources. As shown in figure 1.4 questionnaires were used as the primary data collection method within the research project. The reason questionnaires were chosen is because information can be effectively gathered from a large number of employees at a relatively low cost (Whitten & Bentley, 2008).

The questionnaire (see Appendix B) included a combination of questions relating to the key attributes of cloud computing services as defined from multiple sources in the literature review section. The questionnaires used within this research project were web-based and anonymous, in the hope of encouraging employees to be more honest pertaining to their answers. Within the questionnaire, open-ended, close-ended and a Likert scale were used so that responses could be evaluated using mixed methods (qualitative and quantitative means).

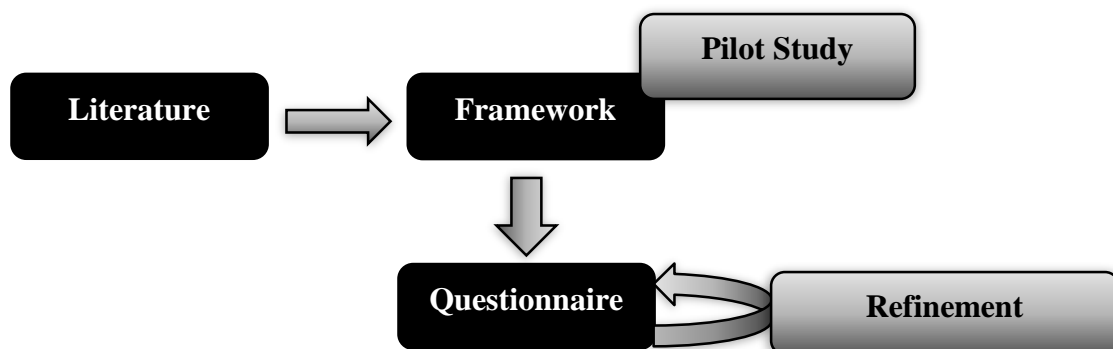


Figure 1.4: Empirical Process to Refine Framework

Firstly, a pilot study of the questionnaire was conducted – in order to ensure the questions were appropriate for the study and unambiguous. After the participants completed the web-based questionnaire, interviews were set up with two industry experts, in order to gain further in depth responses to key questions. The results from the questionnaires and interviews, in addition to the secondary data sources, helped to contribute towards establishing the research output framework.

1.6.4 Sample and Population

Questionnaire Population and Sample: The questionnaire was conducted at a South African financial services organisation which wishes to remain anonymous. The organisation will be referred to as Company A to protect its identity. All IT staff, senior finance staff, managers, and executives have a direct involvement with the information strategy of Company A. These staff members form the entire population relevant for this research project. A convenience sample of

170 members were selected as the population for the primary data collection component of the research project. The selected members of the population were known to have the relevant knowledge, experience, and time to participate.

The questionnaire population consisted of 57 respondents over both the pilot and questionnaire process. Responses to each question refined the framework further based on the findings. The sample was selected by using a convenience sampling method. Respondents were selected based on their relevant knowledge of the problem domain. The 57 respondents represent over 30% response rate, of which the majority of senior managers responded. The researcher deems this response rate as acceptable.

Interview Population and Sample: Two industry experts were selected using convenience sampling for a final evaluation of the research findings. The following section describes the methods used to analyse the responses.

1.6.5 Data Analysis Methods

Yin (2003) advocates pattern matching logic as one of the most desirable techniques when analysing qualitative data. He further explains that in order to do so, an empirically based pattern must be compared with a predicted pattern(s). Should the patterns coincide, these results will assist with the strengthening of the case studies internal validity within the research project.

In order to analyse the quantitative data from the interviews and questionnaires, excel spreadsheets and graphs were used, thus establishing and identifying visible patterns or trends within the full data set. Other analysis instruments used include a relational database and data analysis tool called PowerBI. The analysis performed for each of the data collection methods was performed independently, then analysed for similar trends and patterns. The results were compared with the literature review results to perform the pattern matching.

1.7 Delimitation of the Study

Hofstee (2006) explains that delineation provides a protection from criticism levied by individuals questioning the omission of specific topics. The following factors provide the delimitation for this study:

- The research project is limited to the assessment of only the financial services offered commercially to clients.

- The framework is intended for the assessment of either an entire financial service or a part thereof.
- The research project is limited to only the technological aspects of a financial service.
- Only financial service providers under regulation within South Africa are considered.
- The research project is not tailored for any specific cloud vendor or cloud service provider.

1.8 Ethical Considerations

Research can involve different people in different disciplines, therefore standards to promote values that are essential to collaborative work are essential. Ethics such as trust, accountability and mutual respect are included in these standards. Ethical lapses in research can significantly harm human and animal subjects, students and the public (Hofstee, 2006). Ethical considerations specific to this research are as follows:

- All data collected will remain anonymous.
- There will be a non-disclosure procedure strictly adhered to regarding the intellectual property of the organisation used within the case study.
- The company was afforded the opportunity to review all information prior to it being made publically available.

Whereby an ethical concern was encountered during the course of this research project, the researcher agreed to confirm any resolution with the assistance of the university ethics committee where necessary.

1.9 Chapter Outline

This section provides the chapter outline for the research project. The outline is illustrated in figure 1.5 below.

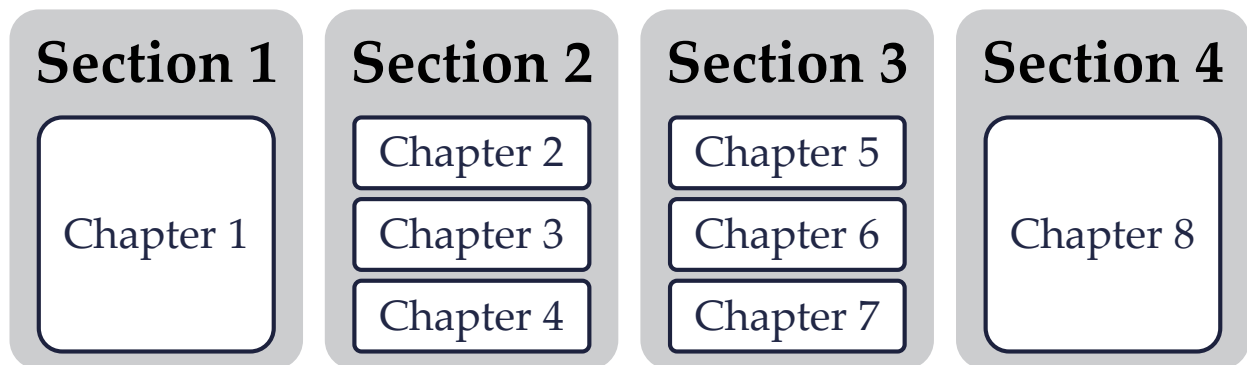


Figure 1.5: Chapter Outline

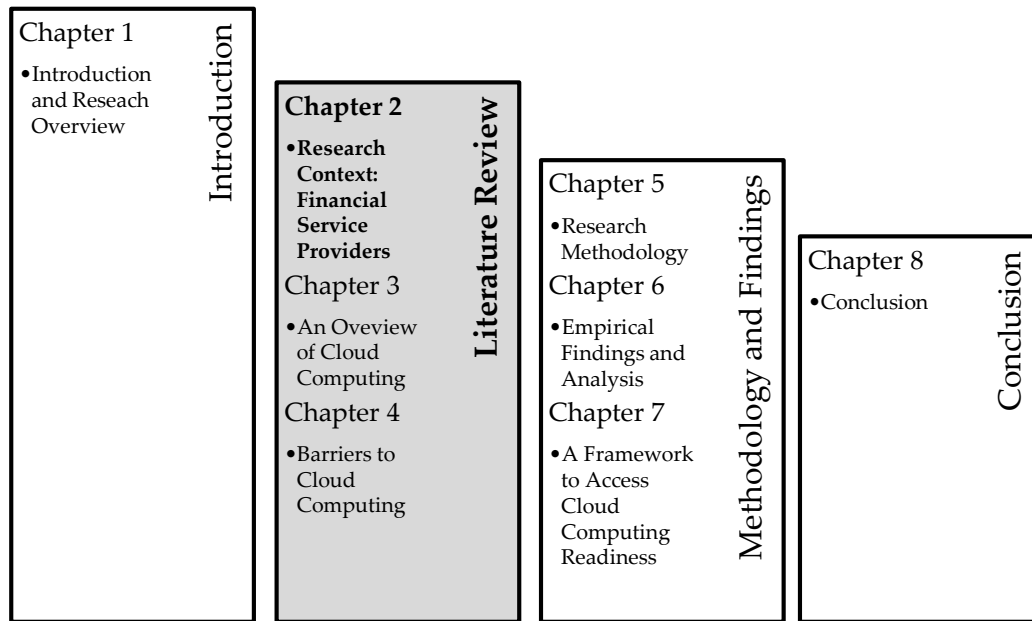
Chapter one, the first section of this research project, provides an introduction and sets the background. This chapter is responsible for introducing the problem and defining the methodology undertaken to resolve that problem.

The second section comprises of a literature review component. This section includes three chapters (two, three and four) each detailing the primary literature topics in detail, including the research context.

Section three is made up of three chapters (five, six and seven) which discuss the methodology and empirical findings; followed by the research framework. Chapter eight in section four provides the research project conclusion and recommendations for future research.

Chapter 2

Research Context: Financial Service Providers



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2 Research Context: Financial Service Providers

2.1 Introduction

The purpose of this research project is to establish a framework for financial services organisations from which they can assess the readiness for cloud computing. The research project was conducted within a financial organisation located in South Africa, specifically the Eastern Cape. The financial organisations' operations are not however limited to the Eastern Cape, as there are various business units across South Africa and Africa, specifically East Africa. The organisation falls within the scope of the South African Financial Sector. According to Tshinu, Botha and Herselman (2008) such financial institutions are not adequately addressing their Information and Communication Technology (ICT) risk through proper application of regulatory frameworks and guidelines.

The company agreed to participate in this research project, but due to the nature of their operational environment requested that they remain anonymous. This research will therefore refer to the financial organisation as Company A. The reason as to why Company A was chosen for this research project includes the following:

- One of the largest independent financial service providers within South Africa.
- Cater for a large target market but focus on lower income earning individuals.
- Offers products which are highly innovative.
- Over the years has shown rapid growth and development.
- Continuously seeking ways in which to optimise their products, market share and income.

Further to the above, Company A is a South African based financial service provider. Being a non-banking financial service provider within South Africa, Company A is therefore governed by the Financial Service Board (FSB) (2013). In relation to this the credit industry is regulated by the National Credit Regulator (NCR) (2013). Company A, being a financial service provider which provides credit, is thus regulated and governed by both the FSB and the NCR.

This chapter describes the context within which this research project was undertaken. The context of this research project was a medium-sized financial organisation. This chapter begins by introducing the organisation, its corporate overview, profile and strategic direction. The organisation operates within the financial services sector and provides various financial services which are described further in section 2.3. Finally, the chapter details the Information Technology (IT) landscape and customers of the organisation before providing a brief conclusion to the chapter.

2.2 Corporation Overview

2.2.1 Company Profile

Company A was established in 2001 as a specialist financial services credit provider and is based in South Africa and the East African Region. To date around 1 900 people are employed by Company A.

The group Chief Executive Officer (CEO) noted that as the years have passed Company A has grown its collections expertise and diversified substantially (Chief Executive Officer, 2014). Due to this growth Company A has a diverse portfolio of businesses, which offers primarily unsecured credit to South African consumers through the following channels or divisions:

- *Personal Finance*
- *Home Improvement Finance*
- *Affordable Educational Solutions* – with affordable payment terms for students
- *Debt Collection Services* of non-performing and partially-performing unsecured debts
- *Cellular and Assurance Products*
- *Micro Enterprise Finance*

At the time of this research project the products described above were only made available to consumers via various telesales, branches and third party building merchants located around South Africa.

1.1.1.1 Current Focus

The current primary focus of Company A's South African operations is to provide unsecured credit in South Africa. In addition to providing unsecured credit, debt collection services are also offered to customers. Unsecured credit or financing is provided through two main channels: third parties and via various point-of-sale branches countrywide. Financing includes that of home improvement, education and general purpose personal credit. The company Chief Information Officer (CIO) pointed out that at present the home improvement product is the largest contributing product to Company A, accounting for almost 80% of new monthly business intake (Chief Information Officer, 2014). This product is made available to the customers through approximately 650 walk-in points-of-sale countrywide.

2.2.1.1 Financial Performance

The empirical component of this research project was performed during the 2012 and 2013 financial years for the organisation. At the time the empirical component was performed the most

recent published financial results were for the financial year ending 31 March 2012 and comprised of the following highlights:

- Total assets amounted to R3.558 million, which is an increase from the 2011 financial year end of R2.881 million.
- Profit before tax for 2012 amounted to R207 million which is up by 34% from the previous year's financials.
- Shareholders' Equity of R1.027 million.
- Capital Adequacy Ratio of 39% (determined in accordance with Basel II).

The tables that follow provide a view of the financial performance of company A in the years preceding this research project.

Table 2.1: Key Performance Indicators (Company A, 2012)

Key performance indicators		2012	2011	2010	2009	2008	2007
Profit before tax	R'000	203,807	184,021	142,090	189,580	159,941	143,610
Taxation		(82,833)	(62,649)	(43,795)	(54,179)	(41,304)	(31,772)
Profit after tax	R'000	120,974	121,372	98,295	135,401	118,637	111,838
Non-controlling interest		3,392	1,096	(419)	(9,588)	(3,339)	(1,825)
Attributable earnings	R'000	124,366	122,468	97,876	125,813	115,298	110,013

Table 2.2: Condensed Statement of Financial Position (Company A, 2012)

Condensed statement of financial position						
as at 31 March 2012						
	R'000	2012 €'000	US\$'000	R'000	2011 €'000	US\$'000
Assets						
Net advances	2,726,738	266,106	354,444	1,844,053	191,845	269,377
Cash and cash equivalents	657,254	64,142	85,435	849,680	88,395	124,120
Other assets	173,901	16,971	22,605	187,473	19,503	27,385
Assets of disposal group - Housing division	720,836	70,347	93,700	730,564	76,003	106,720
Total assets	4,278,729	417,566	556,184	3,611,770	375,746	527,602

Table 2.3: Statement of Financial Performance (Company A, 2012)

Statement of financial performance						
for the year ended 31 March 2012						
	R'000	2012 €'000	US\$'000	R'000	2011 €'000	US\$'000
Net yield	825,364	80,655	110,712	669,015	70,415	92,956
Finance costs	(227,296)	(22,212)	(30,489)	(140,552)	(14,794)	(19,530)
Net margin	598,068	58,443	80,223	528,463	55,621	73,426
Non-interest income	198,276	19,375	26,596	186,857	19,667	25,962
Net operating income	796,344	77,818	106,819	715,320	75,288	99,388
Operating expenses	(589,642)	(57,621)	(79,094)	(561,776)	(59,128)	(78,057)
(Loss)/gain from Housing division	(2,895)	(283)	(389)	30,477	3,207	4,234
Profit before taxation	203,807	19,914	27,336	184,021	19,369	25,565
Taxation	(82,833)	(8,095)	(11,112)	(62,649)	(6,594)	(8,705)
Profit for the year	120,974	11,819	16,224	121,372	12,773	16,860
Average rate used for currency conversion	1.00	10.23	7.46	1.00	9.50	7.20

The following points describe the summarise financials for Company A for the period which proceeded the interview process.

- Growth in profit before tax of 35%.
- Growth in net advances of 48% (2011: 23%).
- Acquired Debt and Outsourced Collections division acquired over R2 billion (face value) of distressed portfolios (2011: R1.3 billion).
- Retail Financial Services – South African division delivered strong year on year growth in credit sales volumes:
 - Home Improvement Finance – 91%
 - Branch Retail – 51%
 - Funding raised in the year R1.1 billion (2011: R1.2 billion)
 - Average capital adequacy rate 42% (2011: 52%)
 - Return on equity 12% (2011: 14%)

2.2.1.2 Human capital

The group Human Resource (HR) manager (2014) notes that in 2012 around 1 900 employees were employed by Company A, in South Africa and East Africa, which was a 10% increase on the previous year's number of employees. The increase of employees resulted due to the expansion within the Retail Financial Services and Educational divisions. In East Africa specifically, 206 people are employed, with the staff growing by 70% in the past financial year.

Company A’s organisational chart is depicted in figure 2.1 below, as described by the HR manager (2014), specifically depicting the managerial layers. Company A has a relatively flat managerial structure and can therefore be grouped in the three main managerial levels, namely: executive, senior and middle management. All other employees fall into the “normal” or “non-managerial” category.

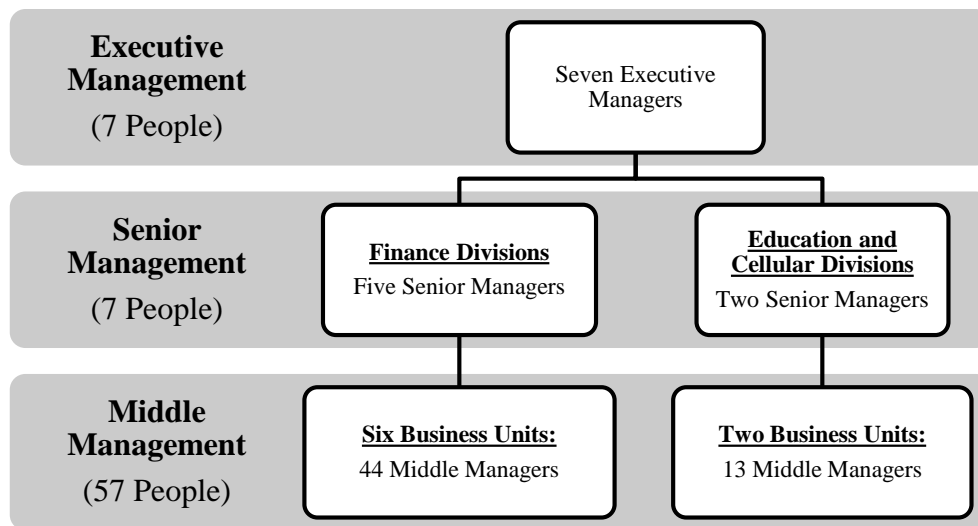


Figure 2.1: Company A Management Organogram

2.2.1.3 Governance

Company A (2012) has taken cognisance of the guidance provided by King III, and incorporated improvements into the group’s governance and management systems to the extent that they are practical and relevant to the group and its stakeholders. The organisation does not currently employ any individuals to focus specifically on governance, however the board and IT department takes responsibility for all governance related requirements.

2.2.1.4 Divisional Information

This section describes each of the divisions of the organisation which were included in the research project.

2.2.1.4.1 Retail Financial Services – South Africa

The integrated report shows that this is the largest division within the group, offering individual unsecured credit to the South African market (Company A, 2012). The Retail Financial Services division is broken down further into four business units, namely: home improvement finance, branch retail, assurance and cellular. Company A’s Financial Integrated Report for 2012 highlighted the following: “The vision of this division is to provide financial assistance to

employed people who currently find it difficult to access these services to improve the quality of their lives.” (Company A, 2012, p. 4)

2.2.1.4.2 Acquired Debt and Outsourced Collections – South Africa

This is the oldest division within Company A, with over 10 years experience in:

- Collecting unsecured distressed debt from the South African market.
- Offering outsourced collection services for third party credit providers.
- Providing in-house collection services to the divisions within the organisation.

The CEO (2014) explains that the financial organisation has developed a vintage-based valuation model, which assists in determining an appropriate purchase price for a given debt portfolio on sale. Collections performance is said to be consistently predictable and thus Company A is able to make accurate cash flow predictions.

2.2.1.4.3 Micro Enterprise Finance – East Africa

Operations within East Africa are still relatively immature when compared to the other divisions within Company A (Chief Executive Officer, 2014). This division focuses on three primary territories with most branches opening between 2006 and 2010. The operations within these regions focus on the following:

- *Payroll lending to government staff* – whereby loans are collected by means of salary deductions authorised by the relevant government departments.
- *Micro-enterprise finance* – providing loans to small businesses for productive purposes.

The company integrated report indicates that the purpose of the East Africa division is to enable customers to increase their financial income through the financing of their businesses (Company A, 2012).

2.2.2 Strategic Direction

The group CEO (2014) notes that recently Company A has refined the focus of their South African operations. Over the last few years emphasis has been placed on increasing exposure to purpose-specific home improvement and education finance, thus reducing the overall exposure to general-purpose credit.

The CEO (2014) explains that due to numerous reasons, Company A has recently taken a decision to cease the origination of general-purpose unsecured credit, freeing more resources to focus on

the development of the home-improvement and education-finance business. As a result various business units (branches network, cellular and educational divisions) will be sold or closed. Company A will however continue to centrally manage and collect the receivables portfolio previously originated by the branch network. In light of the above refocus, once concluded, Company A will consist of three main divisions:

- **Finance (South Africa):** Home improvement and educational finance.
- **Finance (East Africa):** Micro enterprise finance and home improvement finance.
- **Portfolio Recovery:** Acquisitions, outsourced collections and debt management.

2.3 Financial Services Overview

Company A operates in the South African financial services sector, which is both large and sophisticated for an emerging market (International Monetary Fund, 2014). Company A provides various financial services adhering to the regulatory frameworks as instituted by the Financial Services Board (FSB) and the National Credit Act (NCA). The FSA (2015) indicates that it exists to ensure financial service providers provide a safe investment environment. More information about the financial services provided by Company A follows in this section.

The average loan size is R10 000 with a term of either 36 months or 48 months. Customers are categorised into risk groups, using proprietary credit scoring methodologies (Company A, 2012). The risk group determines what a customer may qualify for and includes the loan pricing, maximum amount and term. Table 2.4 presents a unified view of the financial services provided by Company A.

Table 2.4: Financial Services Overview (Company A, 2012)

Financial Service	Product Type	Product Details
Personal Finance	Short Term Unsecured Personal Loan	Up to R5 000 for new customers and R6 000 for repeat customers Repayment term of one, three or six months
	Long Term Unsecured Personal Loan	Ranges from R15 000 to R90 000 Repayment term of six months to 48 months
	Top Up Unsecured Personal Loan	No initiation fees
Home Improvement Finance	Merchants which are mainly Home Improvement Retailers offering Customers Unsecured Home Improvement Loans	Loans up to R100 000 Repayment term up to 48 months

Financial Service	Product Type	Product Details
Affordable Educational Services	Private Education Products and Services with Financing Options	School, Further Education Training (FET), Higher Education and Corporate Training Products Various financing options
Debt Collection Services	Portfolio Recovery Solutions	Accurate pricing, purchase and rehabilitation of debt portfolios
	Debt Portfolio Acquisitions	Purchase non-performing consumer debt portfolios from the original credit providers (retailers and banks).
	Outsourced Collections	Specialised outsourced collections services
Cellular Services	Mobile Devices	Choose handset to suit lifestyle and budget Contract over 24 months
	Top-up Airtime	Vodacom, MTN and Cell C Contract over 24 months
	Data Contracts	Vodacom, MTN and Cell C Contract over 24 months
Insurance Services	Credit Life Assurance	E.g. Unemployment, Deceased, Medically Boarded, Retrenched
	Funeral Assistance Plan	Cover for main member only
	Cancer Plan	R100 000 cover upon positive cancer diagnosis
Micro Enterprise Finance	Payroll Lending	Payroll lending to government staff
	Individual Lending: Business Improvement	Business Loan (minimum of two years in operations) for productive purposes
	Individual Lending: Working Capital	Business Loan for small businesses for productive purposes
	Group Lending	Business Loan typically for large businesses
	Educational Loan	Instalments spread over a period of time instead of paying upfront

2.4 Information Technology Department and Information Services

The Company A CIO (2014) explains that the internal IT Department can be broken down into three main divisions, namely infrastructure, development and business analysts. The HR manager (2014) explains that this department employs around 100 individuals. The infrastructure department can be further divided into four business units, namely: support, hardware, software release management and database administration. Table 2.5 below provides further detail into how these divisions and business units are structured in terms of positions and numbers of employees as provided by the HR manager.

Table 2.5: IT Department Employee Information as at December 2013 (Human Resource Manager, 2014)

Division	Business Unit	Role	Employees	Management Level
Infrastructure	Support		10	Non-managerial
	Hardware		8	Non-managerial

Division	Business Unit	Role	Employees	Management Level
	Software Release Managers		5	Non-managerial
	Database Administrators		3	Non-managerial
Development		Chief Information Officer	1	Senior Management
		Information Systems (IS) Manager	1	Middle Management
		Architect	2	Senior Management
		(IS) Project Manager	8	Middle Management
		Senior Developers	10	Non-managerial
		Developers	15	Non-managerial
		Junior Developers	20	Non-managerial
Business Analysts		Business Analyst Manager	2	Middle Management
		Senior Business Analyst	5	Non-managerial
		Business Analyst	4	Non-managerial
		Junior Business Analyst	2	Non-managerial
Total			96	

2.4.1 Current IT Environment

The IT operations of Company A are currently co-located in three separate sites (Chief Information Officer, 2014). Two sites are located in the same province; with the main site located in another province. All routine IT services are provided by an in-house IT department, including server and infrastructure maintenance. The CIO (2014) notes that where resources are unavailable, outsourced resources may be used from time to time. All main line business systems are hosted on virtual servers, running on physical servers within the main data centre. Data is centralised, however there is constant replication of limited data to the other locations.

The CIO (2014) adds that backups are performed twice outside of office hours, and are stored securely on-site. Physical security is adequately applied to prevent malicious individuals from accessing the server room equipment. Information security measures are applied through active directory, multiple firewalls, and password protected forms of authentication for custom applications. Finally, the CIO (2014) explains that databases are configured with strict user roles defining which users are able to read and update data.

2.4.2 IT Challenges

Company A has historically done well to prevent security breaches however potential threats remain (Chief Information Officer, 2014). Fire resistant systems are installed; however extreme disaster such as natural disaster, bombing or sabotage would render services severely compromised. In the event of major infrastructure failure, replication of information to other locations does not provide sufficient services to operate entirely as a failover location. As critical IT resources are located at the main office, disaster recovery is restricted to this location. The CIO (2014) points out that the operational databases are very large in size with some in excess of 500GB. While many services are provided from on premises virtual server infrastructure, some services remain on physical machines, making upgrades and maintenance more difficult.

2.4.3 Strategic Initiatives

Company A has increased its footprint to include other African countries. This has resulted in efforts to re-engineer some of the main systems for hosting at a location other than the main server infrastructure. The CIO (2014) notes that efforts are also being increased in virtualisation of the existing infrastructure to maximise the hardware investment that has already been made. The enterprise system architect explains that development of new systems is undertaken with special attention to service oriented development architectures and principles. This is in order to ensure that future services may be considered for off-site hosting.

2.5 Customers

Currently Company A is on a drive to develop a better understanding of their target market's needs (Business Analyst Manager, 2014). Through developing a better understanding, the customer value proposition can be re-evaluated. According to the BA manager (2014) an internal research programme was recently undertaken at Company A to help develop a better understanding into the lives, aspirations and circumstances of customers. This type of research assists in targeting the correct segments in which Company A operates. Table 2.6 provides the target market for each of the products which are available from Company A.

Table 2.6: Product Types and Target Market (Company A, 2012)

Financial Service	Product Type	Target market
Personal Finance	Short Term Unsecured Personal Loan	Lower income earning group
	Long Term Unsecured Personal Loan	Lower income earning group

Financial Service	Product Type	Target market
	Top Up Unsecured Personal Loan	Repeat Customers
Home Improvement Finance	Merchants which are mainly Home Improvement Retailers offering Customers Unsecured Home Improvement Loans	Lower income earning group who seek to make improvements to their existing homes
Affordable Educational Services	Private education products and services with financing options	School learners, school leavers, people entering the job market and people in the job market
Debt Collection Services	Portfolio Recovery Solutions	Primary Customer: Credit Providers Secondary Customer: End user rehabilitation
	Debt Portfolio Acquisitions	Customers with non-performing consumer debt
	Outsourced Collections	Other credit providers
Cellular Services	Mobile Devices	Customers unable to take out contracts through traditional channels
	Top-up Airtime	Customers unable to take out contracts through traditional channels
	Data Contracts	Customers unable to take out contracts through traditional channels
Insurance Services	Credit Life Assurance	All customers with existing credit from Company A
	Funeral Assistance Plan	Company A customers who have been approved for any credit products
	Cancer Plan	Existing customers of Company A
Micro Enterprise Finance	Payroll Lending	Government Staff
	Individual Lending: Business Improvement	Micro and small enterprises that find it difficult to access conventional finance
	Individual Lending: Working Capital	Micro and small enterprises that find it difficult to access conventional finance
	Group Lending	Small groups of between 3-7 individuals that borrow collectively
	Educational Loan	Customers seeking to expand their educational knowledge but are unable to finance this.

The BA manager (2014) explains that personal finance, insurance, home improvement and cellular interact and provide services to customers via four main channels (figures as at December 2013):

- **Branches:** Total of 54 located around South Africa, allowing customers to experience face-to-face service.
- **Merchants:** 942 Points of sale which currently offer home improvement financial products (loans) to the public.

- **Telesales:** Call centre which processes cellular and life assurance applications telephonically. These are both company-owned and managed and in some instances externally owned.
- **Broker Network:** Brokers which sell a variety of assurance products.

Customers from across financial service areas communicate with inbound as well as outbound call centres. The BA manager (2014) explains that documented communication is sent back and forth via facsimile, electronic mail, postal mail and short message service (SMS). The various target markets generally prefer communication via postage or SMS, and generally seem to be immature when it comes to technology (Business Analyst Manager, 2014). However, he adds that email correspondence is encouraged as the preferred means of communication by Company A. Recently Unstructured Supplementary Service Data (USSD) has been implemented, encouraging self-help and thus reducing some of the inbound call queries relating to financial service products.

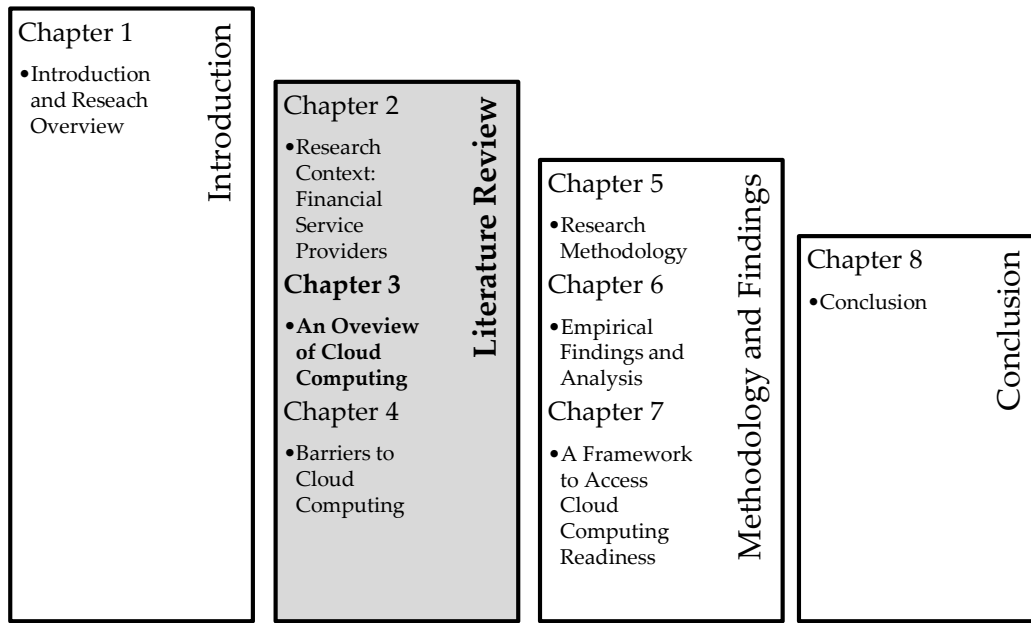
2.6 Conclusion

This chapter provided insight into the research context, namely a medium-sized financial services organisation operating within South Africa. The corporate overview provided the focus, profile and strategic direction the organisation has undertaken. The chapter concluded by exploring the financial services provided by the organisation and the IT infrastructure and resources currently deployed to ensure the operations are able to continue. The objective of the research is to provide a framework for application in financial service providers for assessing cloud computing readiness. This chapter has provided that context from which the empirical research can be completed.

The context was found to be a good candidate for the purposes outlined within the objectives set out in the first chapter of this research project. As one of the largest independent financial services organisations operating within South Africa access to experts in the IT and finance sectors is made possible. The on-premises IT operational environment indicates that there is strong opportunity at this organisation for a cloud migration framework to be developed and assessed. The next chapter introduces the cloud computing model and its benefits and establishes the foundation from which the empirical component of the research project is formulated.

Chapter 3

An Overview of Cloud Computing



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3 An Overview of Cloud Computing

3.1 Introduction

This chapter introduces cloud computing and details the benefits which exist for organisations looking to improve their adoption rate of cloud computing. Interest in cloud computing has grown significantly within the information technology (IT) industry (Low, Chen, & Wu, 2011). Jones (2013) expects the total worldwide market for cloud computing to reach \$158.8 billion in 2014, an increase of 126.5 percent from 2011. By 2015, end-user spending on cloud services could be more than \$180 billion (IT and Technology, 2015). Additionally, IT and Technology (2015) state that it is predicted that the global market for cloud equipment will reach \$79.1 billion by 2018.

As a result of this rapid growth and investment, cloud computing is fast becoming a focal area within organisations who aim to attain IT innovation, investment and a competitive edge. This is supported by Jones (2013) who highlights that cloud adoption continued to rise in 2013, with 75 percent of those surveyed, reporting the use of some sort of cloud platform. Further to this IT and Technology (2015) reports that 82 percent of companies reportedly saved money by moving to the cloud in 2015. While 80 percent of cloud adopters saw improvements within six months of moving to the cloud (IT and Technology, 2015).

With this being said, Lin and Chen (2012) are of the opinion that as with any topical technology, the benefits, weaknesses and compatibilities of cloud computing need to be considered prior to adoption. For financial service providers in South Africa, the context for this research project, it is important to leverage the benefits that cloud computing can contribute to their business and clients. Unfortunately, a simple framework for assessing the readiness of a financial services organisation for cloud computing does not exist. In order to establish such a framework a foundational understanding of cloud computing is required. Therefore, this chapter aims to do the following: briefly discuss the history and evolution of cloud computing followed by a standard definition on which this research project is based.

The definition will take into account the characteristics followed by an analysis of the service and deployment models. Next, the cloud enablers will be investigated; the prerequisites to adopting cloud computing and what considerations (from a business and IT perspective) should be taken into account prior the migration of services to the cloud are described. Lastly, the drivers that encourage the adoption of cloud computing will be discussed followed by the significant benefits.

3.2 Understanding Cloud Computing

3.2.1 Background and History

Cloud computing, as a concept, is not completely new and for this reason Kim, Kim, Lee and Lee (2009, p. 1) refer to the concept as “reincarnation”. Cloud computing’s basis is apparent in other earlier computing methods and for this reason they use the term “reincarnation”. Figure 3.1 depicts the historic evolution of cloud computing which was said to originate in the 1960’s as time-sharing systems. This then evolved in the 1990’s and was known as network computing and grid computing. These terms are defined by BusinessDictionary.com (2013) as follows:

- **Time-sharing:** Use of a computer's resources in a manner that several users access the system (or a central computer through remote terminals) in a sequence but seem to be working simultaneously.
- **Network computing:** A group of two or more computing devices connected via a form of communications technology. For example, a business might use a computer network connected via cables or the internet in order to gain access to a common server or to share programs, files and other information.
- **Grid computing:** Interconnected computer systems where the machines utilise the same resources collectively. Grid computing usually consists of one main computer that distributes information and tasks to a group of networked computers to accomplish a common goal.

What becomes apparent from the above definitions is that they all focus on multiple people or users being able to access the same information over a network. This, in essence, is what cloud computing represents: multiple people accessing information over the internet. Kim, *et al* (2009) further state that the growth in interest of cloud computing can be attributed to new technology offerings such as virtualization technologies, web technologies, scale-out technologies and infrastructure hardware and software technologies.

The views of Kim, *et al* (2009) are shared by Ross (2010, p. 16) who states that, “Cloud computing can be considered a natural evolution from grid computing in its approach to providing computing resources to remote users.” In addition to this Ross (2010, p. 16) explains that, “the adoption of cloud computing has been a fairly recent phenomenon” and thus only surfaced in research publications around 2006, and since then has received extensive research interest.

Dell (2013) concurs with the views of Kim, *et al* (2009) and Ross (2010) about the evolution or history of cloud computing but highlight the more recent progression which includes:

- **In 2008:** Computing resources becoming a metered service called utility computing and the increase in organisations switching from company owned hardware to cloud services
- **In 2009:** Various funding initiatives and research grants towards cloud computing research
- **Present:** Sedani and Doshi (2015) argue that cloud computing in general is accelerating but has yet to distinguish itself from the internet. Bond (2015) adds that history is repeating itself, as we have gone from a centralised approach to highly distributed and now back to centralised.

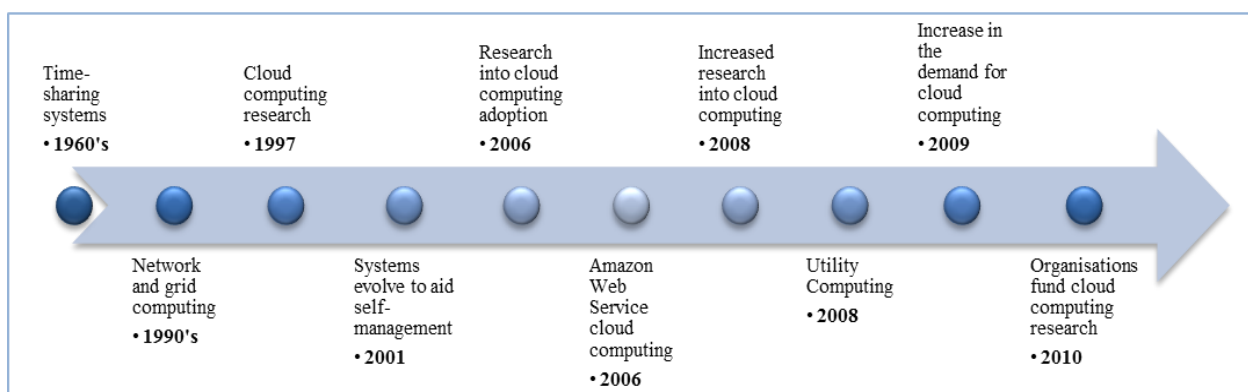


Figure 3.1: A Summary of Cloud Computing's History to Date [compiled from Dell (2013), Kim, *et al* (2009) and Ross (2010)]

The combined views of Dell (2013), Kim, *et al* (2009) and Ross (2010) have been consolidated into figure 3.1 above, giving the reader a very high-level overview of the history of cloud computing to date.

The following section aims to define cloud computing thus assisting to establish a clear understanding of the technology central to this research project. Additionally, the factors which positively or negatively influence the rate of adoption, such as the overall benefits and weaknesses will be discussed. These need to be fully understood by an organisation in order to successfully migrate to a cloud platform.

3.2.2 Standard Definition

Numerous definitions exist for cloud computing but to date there is no universally agreed industry definition. The most commonly cited definition seems to be that by the US National Institute of Standards and Technology (NIST) which reads as follows, “a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (as an example, 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. 1).

In addition to the definition NIST explains other aspects from which cloud computing is comprised, namely:

- **Five characteristics** which include on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service.
- **Four deployment models** being private clouds, community clouds, public clouds, and hybrid clouds.
- **Three service models** which are Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) (Khajeh-Hosseini, Sommerville, & Sriram, 2010).

Figure 3.2 illustrates the various elements from multiple definitions to show a single view of the combinations of characteristics available to produce a cloud computing solution.

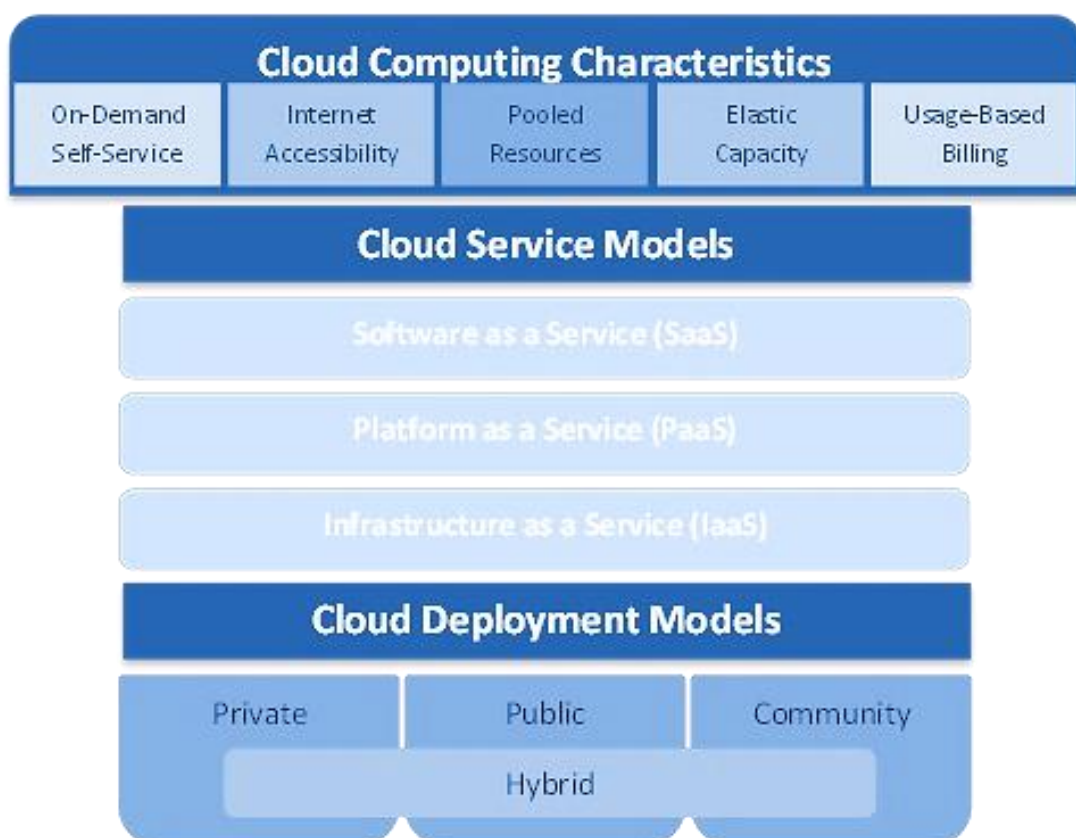


Figure 3.2 Cloud Computing Anatomy (Adapted From Kepes, 2013)

Thus cloud computing can briefly be described as; a set of IT services provided to a customer over a network (the internet) on a leased basis. Service requirements are flexible in the sense that they can be scaled up or down depending on the demand. These services are usually delivered by a third party provider who owns the infrastructure (Centre for the Protection of National Infrastructure

(CPNI), 2010). These definitions collectively define the broad topic of cloud computing adequately for the purposes of this research project. It is not required or intended for this research project to define specific cloud strategies, vendors or other cloud computing details.

The internet is therefore referred to as the carrier of cloud computing which is enabled by a set of technologies combined, and is depicted as one element of cloud computing in figure 3.2 above. All the above mentioned elements are essential before creating or adopting a cloud computing environment. These elements are discussed in more details in the following sections

3.2.3 Characteristics

Before something can be referred to as cloud computing, Parakala, Udhas and Khanapurkar (2011) reason that specific key characteristics should be present. As mentioned previously these characteristics include: on-demand self-service, broad network or internet access, resource pooling, rapid elasticity, and measured service or usage based billing. Explanations from Hurwitz, Kaufman, Kirsch and Halper (2012) and Kepes (2013) have been synthesised in order to provide the following explanations of each characteristic:

- ***On-demand self-service:*** Quick sign-up and receiving of services (without having to interact with the service provider).
- ***Broad network access:*** Services are accessible via multiple standard platforms (desktop, laptop and mobile) over the internet.
- ***Resource pooling:*** The sharing of physical and virtual resources with multiple customers.
- ***Rapid elasticity:*** Quick up-scaling or down-scaling of resource allocation to suit the specific demand and number of users.
- ***Measured service:*** Pay-as-you-go model, which means you are only billed based on what you use.

For a financial services organisation the ability to increase availability of services during peak periods such as around pay days, debit order strike dates and holiday periods allows for increased availability of services. Through the implementation of cloud computing as depicted in figure 3.2 these characteristics should be configured within the operating structure in order to ensure proper cloud computing principles are observed.

3.2.4 Service Models

It is recommended by Cisco Systems Incorporated (2010) that prior to adopting cloud computing an organisation should develop a better understanding of the different types of cloud computing

approaches (in terms of service and deployment models). Sriram (2011, p. 5) expands on this by stating the importance of choosing the right model and that, “Cloud service models offer financial institutions the option to move from a capital intensive approach to a more flexible business model that lowers operational costs. The key to success lies in selecting the right cloud services model to match business needs.”

Figure 3.3 is referred to by Kepes (2013) as the cloud computing stack. The stack depicts the three main categories within cloud computing, namely: SaaS, PaaS and IaaS.

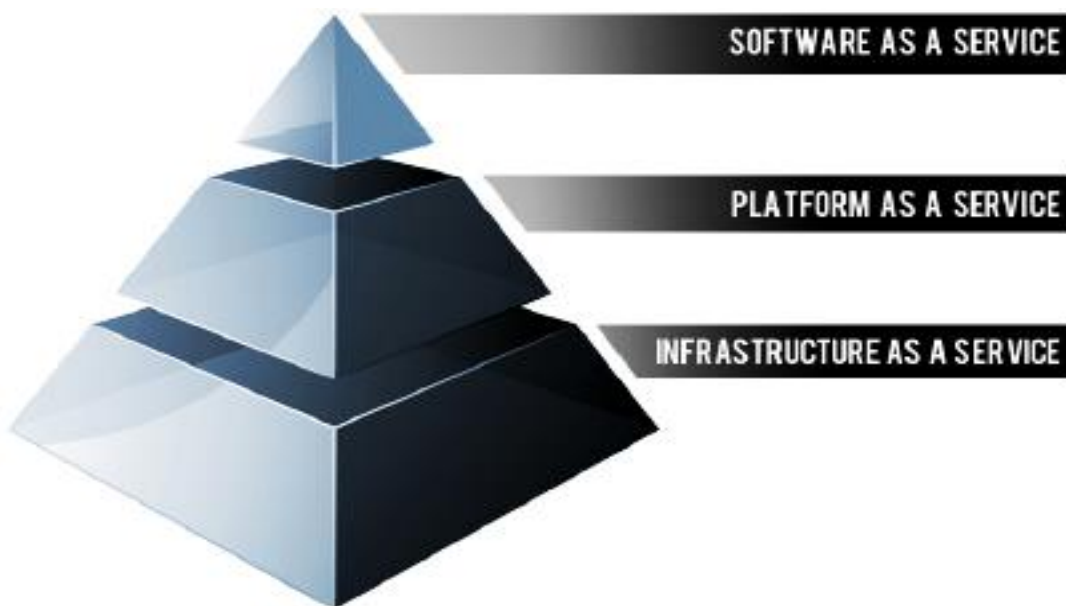


Figure 3.3: Cloud Computing Stack (Kepes, 2013)

These three main categories (IaaS, PaaS and SaaS) are defined briefly below. Table 3.1, table 3.2, and table 3.3. provide a detailed description of the categories as provided by Kepes (2013), Hurwitz, *et al* (2012) and Huth and Cebula (2011). The purpose of Table 3.1, table 3.2, and Table 3.3. is therefore to concisely summarise the characteristics, advantages and disadvantages of the cloud computing stack. Additionally, industry examples and adoption guidelines are included for each service model.

3.2.4.1 Infrastructure as a Service (IaaS)

IaaS forms the foundation of the cloud and consists of virtual servers, network devices, storage disks and operating systems (thus the computational infrastructure or physical assets) all of which are provided by a service provider as an on-demand service to an organisation. This forms a platform upon which organisations can develop and execute applications (Walker, 2010).

Table 3.1 - Analysing IaaS [Kepes (2013), Hurwitz, Kaufman, Kirsch, and Halper (2012) and Huth and Cebula (2011)]

Characteristics	Storage and computer resources are provided as a service enabling organisations to deliver various business solutions. Generally allows for multiple users on a single piece of hardware.	
Example	Amazon Web Services and Dropbox	
Advantages	<ul style="list-style-type: none"> • Delivery of services is on a request basis (pay as you need) and infrastructure is easily scalable (up or down). • Public and private versions of IaaS. • All storage and resources are outsourced thus reducing infrastructure costs. 	
Disadvantages	<ul style="list-style-type: none"> • Organisation has maximum control over the cloud (service provider has limited control). • Large dependency is placed on the vendor's capabilities. 	
Where IaaS makes sense	Where IaaS may not be the best option	
<ul style="list-style-type: none"> • Instances where demand is unpredictable (particularly relating to infrastructure). • New organisations with minimal start-up capital (to spend on hardware). • Organisations that are growing in size and thus require up-scaling of their hardware (which may be problematic). • Where capital expenditure needs to be reduced (or is limited). • Instances where infrastructure needs are short term. 	<ul style="list-style-type: none"> • Instances where regulatory compliance needs to be strictly adhered to by an organisation (especially outsourcing data storage or processing offshore). • High levels of performance are essential to an organisation. 	

According to Gartner, the spending on IaaS will increase by 32.8 percent in 2015 when compared to 2014, this increase equates to \$16.5 billion (Babcock, 2015). This increase in spending is due to more companies making use of the public cloud data centres, as opposed to their own.

3.2.4.2 Platform as a Service (PaaS)

PaaS is the middle layer and provides the application infrastructure. Thus the service provider gives organisations access to the necessary components (tools and services) required for the development, operation and deployment of applications over the internet (Walker, 2010).

Table 3.2: Analysing PaaS [Kepes (2013), Hurwitz, Kaufman, Kirsch, and Halper (2012) and Huth and Cebula (2011)]

Characteristics	This model offers third party services, which developers can use to develop, test, deploy, host and maintain applications in the same development environment. Allows multiple concurrent users on the same development application.
Example	Windows Azure, Google App Engine and Force.com

Advantages	<ul style="list-style-type: none"> • Consistent set of programming and middleware services, with a well-integrated and tested environment which allows for the quick building and deployment of applications. • No buying and maintaining of software and infrastructure. • Supports team collaboration and development.
Disadvantages	<ul style="list-style-type: none"> • Organisation and the service provider have moderate control over the cloud. • Lack of interoperability and portability amongst providers (cannot move from one provider to another very easily). • Risk of vendor “lock-in” (programming languages differ per service provider).
Where PaaS makes sense	Where PaaS may not be the best option
<ul style="list-style-type: none"> • If multiple developers (including external parties) are working on a development project and need to interact with the development process. • Where automated testing and deployment services are required, this is especially important with agile software development. • Organisation with an existing data source, who wish to leverage off the data (with new applications). 	<ul style="list-style-type: none"> • Instances where portability is highly important which makes where it is hosted very important. • The development process may be negatively influenced due to proprietary languages. • The inability to move from one service provider to another (due to proprietary language). • Hardware and software customisation is required for application performance.

3.2.4.3 Software as a Service (SaaS)

SaaS is referred to as the upper layer or the application layer. With this approach organisations make an on-demand use of both computational resources and applications offered by the service provider (over the internet) (Walker, 2010).

Table 3.3: Analysing SaaS [Kepes (2013), Hurwitz, Kaufman, Kirsch, and Halper (2012) and Huth and Cebula (2011)]

Characteristics	Software is hosted by the service provider. This means that organisations do not need to install, manage or buy the hardware. All that is required by an organisation is connecting to the service and making use of it. This model incorporates both IaaS and PaaS.
Example	Customer Relationship Management as a service, Video conferencing, Google mail and docs and Salesforce.com
Advantages	<ul style="list-style-type: none"> • Pay for the service as you need (monthly or yearly contracts). • Access to both resources and applications. • Ability to access all software on multiple devices (anywhere anytime if web access is available). • No maintenance or support required from the organisation. • Cost savings (over purchasing application). • Customisable applications.
Disadvantages	<ul style="list-style-type: none"> • Organisation has limited control over the cloud (service provider has maximum control). • No control over availability, support and maintenance. • Risk of vendor “lock-in”.

Where SaaS makes sense	Where SaaS may not be the best option
<ul style="list-style-type: none"> • Undifferentiated solutions – for example email. • Applications which require interaction from both internal (employees) and external (customers) people. • Where the need for external or mobile access is very high. • Software only required for short periods on specific projects. • Software where spikes in demand are significant (billing software used monthly). 	<ul style="list-style-type: none"> • Real-time fast processing of data. • If legislation or regulations stipulate that the external hosting of data is not allowed. • Organisational needs are currently being met by on-premise application solutions.

In order to explain how the above three service models are related to one another, Kepes (2013, p. 3) makes use of an interesting yet simplistic transportation analogy.

“By itself, infrastructure isn’t useful - it just sits there waiting for someone to make it productive in solving a particular problem. Imagine the Interstate transportation system in the U.S. Even with all these roads built, they wouldn’t be useful without cars and trucks to transport people and goods. In this analogy, the roads are the infrastructure and the cars and trucks are the platform that sits on top of the infrastructure and transports the people and goods. These goods and people might be considered the software and information in the technical realm.”

3.2.5 Service Models in this Research Project

This research project does not target a specific service model, as the cloud is understood to encompass all three levels. Instead a recommended solution would be to consider multiple models within the overall solution. It can be reasoned that certain financial services may be better suited to one particular model, while others might employ a combination of many. Any reference to cloud computing within this research project refers to all three levels unless otherwise indicated.

Now that the relationship and explanation of the cloud computing service models has been provided, the same is provided for the cloud computing deployment models in the following sections.

3.2.6 Deployment Models

Financial service providers have specific business, operational and technical requirements. As all organisations are unique, the level of ownership and the technical architecture may vary across organisations within the same sector. The Centre for the Protection of National Infrastructure

(2010) explains that this influences the manner in which cloud computing services may be delivered.

A recent study conducted by RightScale aimed to analyse the current state of the cloud, 930 IT professionals (ranging from technical executives to managers and practitioners) were surveyed about their cloud adoption strategy (Weins, 2015). Figure 3.4 depicts one of the key findings from the RightScale survey.

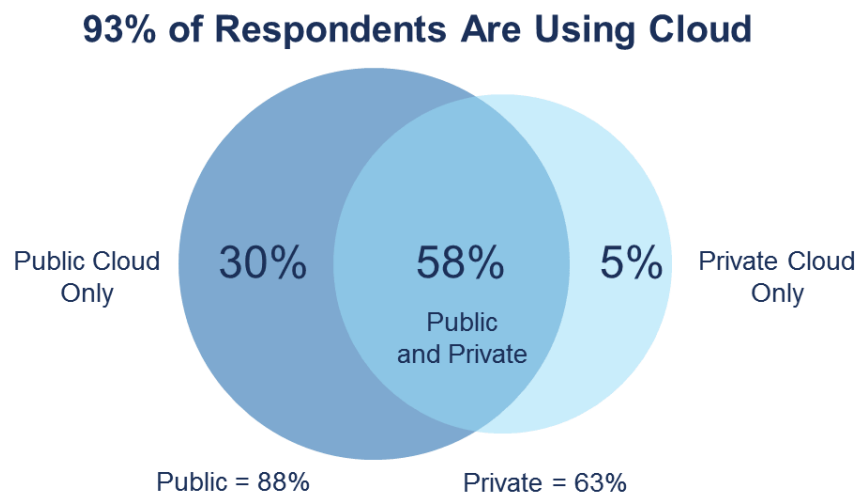


Figure 3.4 - Public versus Private Cloud Usage (Weins, 2015)

This means that 93 percent of respondents are making use of the cloud, with 88 percent using the public cloud, 63 percent using the private cloud and 58 percent making use of both. These three deployment models and one additional model, the community cloud, will be discussed in the section below.

3.2.6.1 Public Clouds

This cloud infrastructure and collection of resources is made available to the public or a large industry group and is owned by an organisation that sells cloud services (Sriram, 2011). A collection of resources which are offered to external users, are maintained by the associated organisations (Babar & Chauhan, 2011). An advantage with using a public cloud is the fact that the subscribing organisation is not responsible for the cloud computing infrastructure or the operational maintenance activities.

However, the disadvantage is that the organisations are making use of services that are dependent on a third party (the service provider of the public cloud). This in turn raises concerns around data storage security. For this reason, Babar and Chauhan (2011) explains that many organisations

might then chose to adopt a hybrid cloud which gives organisations the ability to separate critical resources onto a private cloud and non-critical business operations onto a public cloud.

3.2.6.2 Private Clouds

This model comprises of a collection of computing resources, storage resources and cloud technologies. Babar and Chauhan (2011) explain that this collection is usually owned and used by the organisation for its private use. Due to the organisation owning this collection, they have full control over the resources and technologies and thus are responsible for the maintenance and the infrastructure. Sriram (2011) adds that this deployment approach and the collection of computing resources, storage resources and cloud technologies may be managed by a third party and be located on or off the premises. In addition to this Sriram (2011) is of the opinion that this is the most secure of all the cloud options.

The advantage of using a private cloud is that the organisation will have full control of the resources associated with the cloud infrastructure. With this being said organisations then have to invest capital in computing and storage resources as well as conduct software and maintenance activities (Babar & Chauhan, 2011).

3.2.6.3 Community Clouds

This approach involves a small number of organisations coming together and forming a shared cloud amongst them. These organisations usually have similar objectives and concerns thus allowing them to share infrastructure and services (Centre for the Protection of National Infrastructure (CPNI), 2010). An advantage of this approach is that infrastructure and maintenance costs are shared by the group of organisations, thus this is cheaper than maintaining a private cloud. In addition to this, a community cloud will have a higher level of security and privacy as it is only made available to a small group of associated organisations (Babar & Chauhan, 2011).

3.2.6.4 Hybrid Clouds

This cloud infrastructure is composed of two or more clouds (private or public) that remain unique entities but are linked in order to provide services (Sriram, 2011). This is explained slightly differently by the Centre for the Protection of National Infrastructure (2010) who says this approach is a mixture of public and private cloud computing architectures and IT infrastructure. This combination forms a hybrid model which then makes use of industry best practices and technologies. Hybrid clouds share the relative advantages and disadvantages of both private and public cloud models respectively.

3.2.7 Deployment Model for this Research Project

Similar to the cloud model, this research project does not recommend any specific deployment model. Parakala, *et al* (2011, p. 8) confirms this by pointing out the results from a survey which was conducted by KPMG in India about cloud computing, “Over 50 percent of the respondents to the survey have indicated that they use or intend to use Private Clouds. Large organizations indicated that they plan to implement Private Clouds due to issues related to data security and performance. Smaller companies indicated reluctance towards the deployment of Private Clouds probably due to costs concerns.”

The deployment models described above present various methods of implementing cloud computing within financial service providers. Similar to the various levels available to such organisations these deployment models must be carefully applied at an organisation once its specific operational needs are understood.

3.3 Cloud Enablement

It is recommended by Parakala, *et al* (2011) that organisations consider various business and technical factors prior to the adoption of cloud computing. Together these factors form the requirements which enable cloud computing. Additionally, these business and technical requirements may give rise to concerns or risks which need to be carefully considered prior to the adoption and implementation of cloud computing within an organisation.

3.3.1 Pre-requisites and Considerations

A report compiled from the 12th Forum on Telecommunication/ICT Regulation and Partnership in Africa by Maaref (2012) highlights very similar cloud computing prerequisites as that of Parakala, *et al* (2011) with the noticeable difference being that they are not categorised into business and technical factors. Figure 3.5 illustrates that although the cloud is often misunderstood as a pure technology concern it requires input from both business and IT for its implementation.



Figure 3.5 - Cloud Computing Pre-Requisites and Considerations

Maaref's (2012) prerequisites for cloud computing include the following: good and reliable internet connectivity; sound hardware and software infrastructure; virtualised applications; trust regarding the security of systems being used; access, privacy, reliability and compliance; and data location. The sections which follow explore the business and IT factors which collectively influence the adoption of cloud computing.

3.3.1.1 Business Factors and Requirements

The following explanations of business factors for consideration are provided by Parakala, *et al* (2011):

3.3.1.1.1 Existing Investments in Information Technology

This varies depending on the size of the organisation. Large organisations will most likely have invested substantially in the IT infrastructure, thus making it far more challenging to move away from the existing IT environment (hardware, network, application support, administration, customisation and integration). This is especially true for legacy systems. Casey (2015, p. 1) agrees and further states that, "*transitioning to the cloud is a complex and involved process*" with no specific route to success, therefore CIO's need to ensure that the proposed cloud solution compliments their existing (or future) business model.

On the other hand, Small and Medium Sized Enterprises (SMEs) are perfectly positioned as they are most likely to have little invested within their IT infrastructure. Applications that might have been unaffordable in the past or complex to manage become a more viable option, when using cloud platforms.

3.3.1.1.2 Costs

Traditional IT expenditure is a combination of capital and operational expenditure. While capital expenditure to cater for peaks and highs in IT requirements is generally very high, it is also much easier to budget and predict. This is in contrast to the unpredictable operational costs which one typically finds in cloud computing services where payment is made by resource usage.

It is critically important that organisations are able to estimate their anticipated usage and therefore operational costs before moving to the cloud. Parakala, *et al* (2011) suggests that before adopting cloud computing organisations must implement the means to accurately monitor and predict usage requirements in order to compare operational costs of the cloud to their existing capital expenditure.

Page (2010) believes that although cost savings should be an advantage, sometimes it can be deceptive, the example used is that of pricing and servicing guarantees from cloud providers. These may be transparent, but in reality it is difficult to compare on a like-for-like basis with an in-house data centre. In contrast, Cox, Darby, Felts and Purvis (2015) believe costs savings is an advantage, this is due to the findings from a recent global survey conducted by KPMG. The survey comprised of 800 technology industry leaders and stated that 70 percent of executive's felt that through implementing cloud technology, they were able to substantially reduce their costs.

3.3.1.1.3 Data Security

This is a fundamental consideration, to all organisations. Information that is highly sensitive and confidential in nature should remain in a private cloud behind an organisations firewall. Information that is less sensitive would be better suited to the cloud. In this instance organisations should carefully classify their highly sensitive information from that of their less sensitive information.

This view is shared with that of Marcos, Leichter, Losa, Medina, Reyes, Rodriguez and Wang (2015), who state that security remains a top barrier to adoption, and thus the need for visibility, quicker access to logs and better protection of data is crucial. Organisations need to be aware of the steps required to secure their data when it is being housed in data centres that are outside of the control of the organisation.

3.3.1.1.4 Regulations

Geographical location and issues should be evaluated carefully; this is especially true for financial organisations. Datacentres may not be located within the same country and thus laws and legislation may differ (from country to country). Gutierrez, Boukrami and Lumsden (2015) support the view of Parakala, *et al* (2011) and further argue that the geographical location of data centres is critical.

Importantly, regulatory requirements may differ between industries depending on the nature of the information stored by organisations within that industry. It is important for organisations to be aware of these regulatory requirements.

3.3.1.1.5 Provisioning

Applications which require quick scalability and have fluctuations regarding their demand are most suited for the cloud (where quick provisioning of resources is more readily available). An

example of a suitable application would be human resource (HR) applications such as payroll (where resources and processing only occurs over specific periods). Enterprise Features Staff (2015) concurs with this view and argues that this is an important factor to consider.

Organisations must remember that not all applications are ready for the cloud, but those that are can be easily stored and accessed.

3.3.1.2 Information Technology Factors and Requirements

Parakala, *et al* (2011) defines the IT factors which organisations should consider prior to the adoption and migration to cloud computing, as follows:

3.3.1.2.1 Existing Infrastructure

Wide area network architecture must be reassessed and redesigned in order to support the delivery of cloud applications. Organisations would have to concentrate on building vendor management competencies. Cheng and Bounfour (2015) recommend the vendor supplies a service level agreement (SLA) which covers adequate compensation should there be a breach the SLA.

3.3.1.2.2 Security Architecture

Identity and access management systems would need to be adapted in order to secure cloud deployments. Network transport security would need to be built into applications while digital signatures could be acquired for ensuring data integrity.

3.3.1.2.3 Complexity

Migration of complex applications may require elaborate planning and testing prior to implementation, while legacy applications and existing enterprise applications could require significant configuration to work on the cloud. Cheng, *et al* (2015) concur and additionally adds that the skills required to adopt cloud computing may be too complex for employees alone.

3.3.1.2.4 Availability

Existing disaster recovery and backup would need to be reconsidered for applications that are migrated to the cloud. Naiburg (2015) goes on to explain the difference between backup and disaster recovery. Backups can occur in multiple ways and can be stored in different types of media in different places such as on-site, off-site, tape or disk. The purpose of backups is to restore data or applications to servers as a result of deletion or corruption, for a single point of time. Disaster

recovery on the other hand is the synchronising of a process, provided from a secondary site (which have servers and storage availability).

3.3.1.2.5 Network and Support

Organisations must plan for better and more reliable network connections to the cloud to ensure that a single point of failure does not exist. Breddy (2015) and Cheng, *et al* (2015) hold the opinion that the most significant and obvious disadvantage is the dependence placed upon the speed and reliability of the internet connection.

3.3.1.2.6 Local Access and Storage

Applications which are designed to process terabytes of local information must be phased or re-designed for the cloud. Cheng, *et al* (2015) therefore highlight the importance of a good internet connection and internet speed.

3.3.1.2.7 IT Skills

Existing IT skills would need to be refined in order to manage cloud technologies and architectures. In terms of human resources Cheng, *et al* (2015) raises concern over the following:

- Are there enough human resources available to support the development of cloud computing technology?
- Do these human resources have the available time?
- Is there budget availability to develop the cloud computing technology

3.3.1.2.8 Service Level Agreements

SLA's must be understood and address the question of availability of the cloud services. Casey (2015, p. 1) is of the opinion that this is “*one of the most significant factors that businesses cite as a reason for not moving their business applications to the cloud.*” Often SLA's provided are inadequate, especially regarding availability, performance and scalability. For this reason, ten questions are recommended by Casey (2015, p. 1) when reviewing an SLA:

1. What are your minimum service levels?
2. What remedies are in place when a failure occurs?
3. What disaster recovery and business continuity procedures are in place?
4. How portable is my data?
5. What is your change management process?

6. What are your infrastructure and security standards?
7. How quickly do you identify and solve problems?
8. What is your escalation process?
9. What is your exit strategy?
10. What is your termination process?

South Africa has traditionally lagged behind the developing world in terms of broadband quality. Recent developments in the industry have made cloud computing services much more feasible. The following section provides some detail of the changes recently experienced in the South African broadband landscape.

3.3.2 Broadband Improvements in South Africa

Until recently the appeal of cloud computing within South African organisations was limited at best. High broadband prices and very low internet speeds are two factors which have restricted the uptake of cloud computing services by organisations in South Africa. However, the recent laying of undersea cabling by Seacom has increased the accessibility and speed of the internet, thus organisations will have access to faster and cheaper broadband (Mashandudze & Dwolatzky, 2015). This improvement is significant, especially when considering cloud adoption.

In addition to improvements in the Seacom cable other improvements were already being realised. Muller (2013) provides a list of what he considers to have been the ‘game changers’ to the South African broadband market, which include the following:

- Multiple speed increases occurred, including the arrival of Very-high-bit-rate Digital Subscriber Line (VDSL) services.
- Standard Asymmetric Digital Subscriber Line (ADSL) services received free speed upgrades.
- A number of mobile broadband and data products launched within the year.

Critically Muller (2013) adds that a price war began to emerge between capped and uncapped products. This resulted in increased affordability of both types of services. The cost of uncapped ADSL has become more affordable to a larger number of consumers. Additionally, mobile broadband prices have also rapidly decreased (Muller, 2013).

These factors create significant opportunity in the provision of cloud-based services and solutions. The increased speed, affordability and data caps allow more clients to engage with services online.

Factoring in the reducing costs of laptops, tablets and smartphones the net effect is that of increased reach to target markets through online channels. This research project is intended to promote the provision of services within such channels.

3.4 The Appeal of Cloud Computing

Recently a survey was conducted by North Bridge Venture Partners and GigaOM Research. Jones (2013) points out that this cloud computing survey is the largest to date. It examines the viewpoints from a sample of 855 respondents (comprising of business users, IT decision makers and cloud vendors). These viewpoints focused on the drivers, inhibitors and opportunities offered by cloud computing. A few interesting statistics are highlighted by Jones (2013, p. 1) from this survey:

- Cloud adoption continued to rise in 2013, with 75 percent of those surveyed reporting the use of some sort of cloud platform, an increase from 67 percent in 2012.
- GigaOM Research expects the total worldwide addressable market for cloud computing to reach \$158.8 billion by 2014, an increase of 126.5 percent from 2011.
- Both business and IT (68% of total respondents) see greater migration to the cloud as bringing equal or better total cost of ownership (TCO) to the organization.

These statistics illustrate the importance for organisations to begin preparing for a migration of services to the cloud. Key drivers and benefits, such as those listed in the following sections, reinforce such initiatives.

3.4.1 Cloud Computing Adoption Drivers

Factors which contribute to organisation adopting cloud computing are said to be the “drivers.” Many authors cite the characteristics of cloud computing (on-demand self-service, broad network access, resource pooling, rapid elasticity and measured service) as the drives which encourage the adoption of cloud computing. Ernst and Young (2012) mention these characteristics but categorise them slightly differently. They do however, additionally, include the following drivers:

- **Business agility:** The ability to elastically scale IT resource availability up or down.
- **Cost saving:** Though migrating the IT infrastructure costs to cloud service providers.
- **Innovation platform:** Reduces IT barriers which may limit entry to the market, encouraging more start-ups with lower infrastructural costs thus allowing increases in innovation.

- **Market research:** There has been a rapid adoption rate and this in turn motivates other organisations, especially when they can reap all the potential benefits offered by cloud computing.
- **Standardisation efforts:** These are lacking and currently forms an adoption barrier to cloud computing, for this reason organisations and governments are working together to close this gap.
- **Cloud brokers:** Assist with the migration process to the cloud; they have the experience and expertise (regarding security, privacy and compliance) which organisations can leverage during their transition period.
- **Risk of missing out:** If organisations chose not to adopt and their competitors do, they may not reap the potential benefits that their competitors are.

Jones (2013) agrees with the above and further mentions that the primary drivers of cloud adoption are agility and scalability. Jones (2013, p. 1) validates this statement from the recent findings of a cloud computing survey (conducted by North Bridge Venture Partners and GigaOM Research) whereby, *“More than half of respondents cited business agility (54.5%) and scalability (54.3%) as the main drivers. Cost is close behind with 48% citing it as a driver.”* The following sections describe additional related drivers for the adoption of cloud computing.

3.4.1.1 The South African Economy

In an economic study conducted by Schüssler and Urbach (2012) it is estimated that cloud computing has the potential to increase economic growth, through the creation of an additional 1 000 jobs per 80 000 existing jobs within South Africa. Schüssler and Urbach (2012, p. 3) further explain that, *“In an economy which has struggled to attract sufficient investment and has only created around 400,000 jobs over the last decade this should make a welcome contribution to job creation.”*

3.4.1.2 Economies of Scale

In addition to the benefit of job creation, Schüssler and Urbach (2012) also mention economies of scale. Organisations within South Africa now have the opportunity to access software at a lower capital cost in turn decreasing their fixed costs. These programs, software and features may not previously have been available to local organisations. Software and infrastructure which would have been prohibitively expensive in the past can now be accessed for a much lower subscription fee as a result of cloud computing. This allows South African companies to access technologies that enable them to compete on a global scale.

Cloud computing allows companies to move the management of such technologies to the service providers. Service providers in turn manage a single shared platform for multiple clients. Mashandudze & Dwolatzky (2015) explain that by bundling up multiple management layers and data connectivity cloud computing can reap massive economies of scale

These services can now be accessed on a pay as you go basis and be scaled up or down depending on the demand thus avoiding costly purchases. Additionally, cloud providers are geographically dispersed, allowing South African organisations to leverage off their expertise. Collaboration can now occur on a real-time basis. Overall, cloud computing can be said to offer many organisations within South Africa, more effective IT.

In light of these benefits, Schüssler and Urbach (2012, p. 3) do however highlight a few limitations: *“the expansion and effectiveness of the adoption of cloud technology depends to a large extent on the policies adopted by governments. This requires governments to create enabling environments by allowing the market to effectively and efficiently provide broadband at internationally competitive rates.”*

This being said, if more people have access to broadband at a competitive rate, the full potential and benefits of cloud computing could be a possibility for many organisations within South Africa. This point is reiterated by Schüssler and Urbach (2012) who argue that organisations still need to be provided with a better quality and higher quantity of internet connections in order to benefit from the top level offerings of cloud computing. Closely related to such drivers are the perceived benefits of cloud computing which are provided in the following section.

3.4.2 Perceived Benefits of Cloud Computing

One of the main advantages of cloud computing is the provision of Information and Communication Technology (ICT) services as a service to organisations, eliminating the need for organisations to establish, maintain and support technology infrastructure. Through this, organisations are able to focus on key deliverables without the burden of running an ICT operation. Tao, Marten, Kramer and Karl (2011) state that cloud computing offers numerous benefits including, elasticity, economy, reliability and on-demand environments.

Marston, Li, Bandyopadhyay, Zhang and Ghalsasi (2011) agree with Tao, *et al* (2011) and additionally include energy savings as a benefit. Further to these benefits Foddering (2011) states that the main contributor to cloud computing adoption is cost savings followed by easy

maintenance, automatic updates, rapid deployment or speed to market and finally improved collaboration and communication.

Richmond (2013, p. 1) is also of the opinion that the most cited benefit of cloud computing is that of cost savings with “*six in ten cloud computing customers admitting they’ve reduced their IT capital costs, according to a study by Enterprise Management Associates.*” In addition to this benefit Richmond (2013) mentions an additional five:

- ***Decreased total cost of ownership:*** No purchasing of hardware or software thus no maintenance or up-keep is required.
- ***Minimal IT support:*** All issues are handled by the service provider thus minimising the cost of IT infrastructure support.
- ***Business continuity:*** All services and work can be accessed as long as there is an internet connection. Should a disaster or emergency occur all data is located offsite, thus services and business can continue as usual.
- ***Scalability:*** As the business grows or if there is a change in demand for resources, the upgrading or downgrading is highly scalable and flexible, in turn accommodating business needs.
- ***Improved focus on business:*** As there is no longer a need for maintenance, upgrades and costly IT purchases, resources are able to spend more time focusing on the organisations core business functions.

Further to the benefits cited by Richmond (2013) above, Tsagklis (2013, p. 1) adds the following:

- ***Convenience and continuous availability:*** Easy access to information regardless of time zones or geographical location thus promoting improved collaboration. Additionally, service uptime is guaranteed in most instances by service providers.
- ***Backup and recovery:*** This process is simplified as it is managed by the service provider. These solutions are often reliable and flexible.
- ***Environmentally friendly:*** Generally, the cloud is more efficient and requires fewer resources thus saving energy, for example when servers are not used the infrastructure is scaled down in turn freeing up resources and consuming less power.
- ***Resilience and redundancy:*** The cloud offers automatic failover between hardware platforms out of the box, while disaster recovery services are also often included.
- ***Performance:*** A distributed architecture is used by cloud providers this in turn provides organisations with excellent computation speed.

- **Quick deployment:** A cloud system can be up and running in a very short period, making quick deployment a key benefit. On the same aspect, the introduction of a new user in the system happens instantaneously, eliminating waiting periods.
- **Ease of integration:** Software integration occurs automatically and organically in cloud installations. An organisation is allowed to choose the services and applications that best suit their preferences, while there is minimum effort in customising and integrating those applications.
- **Increased storage capacity:** When compared to personal computers, storage capacity is virtually unlimited. Organisations need not worry about increasing their storage capacity.
- **Device diversity and location independence:** Multiple electronic devices are able to access the cloud, regardless of geographical location, as long as an internet connection is available. This is especially appealing to international companies.

It is argued by Ross (2013) that benefits such as lower costs, scalability and flexibility are well known when considering the benefits of cloud computing. Ross (2013, p. 1) however challenges the general statement made by many that “*the larger the company, the greater the resistance.*” In the view of Ross (2013, p. 1) cloud computing provides organisations with numerous benefits, such as “*increased flexibility, lower costs, greater scalability, ease of use and, if done correctly, increased security and disaster recovery.*” He does however argue that even though these benefits are equal for small and large organisations, larger organisations do find it slightly more challenging to adopt or migrate to the cloud.

3.5 Conclusion

To summarise, this chapter began by explaining the history and evolution of cloud computing. Cloud computing was then defined in terms of the characteristics, service and deployment models. From this it became apparent that cloud computing is a maturity of a combination of numerous technological advances and thus has become a more realistic option for many organisations. This is especially true for organisations wanting to reduce their costs, often associated with operational infrastructure and the management of in-house IT infrastructure (Centre for the Protection of National Infrastructure (CPNI), 2010).

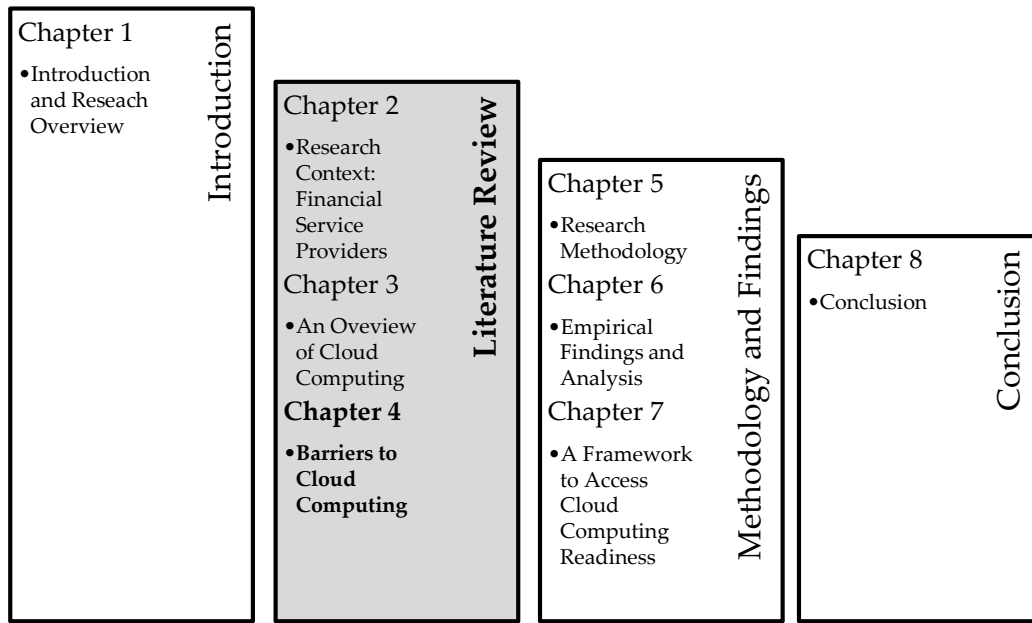
Cloud computing offers multiple advantages which organisations of all sizes and industries can benefit from should they choose to adopt such an approach. In light of this, this chapter then proceeded to discuss the cloud enablers; or more specifically the prerequisites and considerations

(from a business and IT perspective). These prerequisites and considerations are the factors organisations should think about prior to the migration of their financial services to the cloud.

With any topical technology, the benefits, weaknesses and compatibilities of cloud computing need to be considered prior to adoption (Lin & Chen, 2012). For this reason, the chapter proceeded by investigating the drivers which encourage adoption followed by the benefits of adopting cloud computing. For financial service providers in South Africa, the context for this research project, it is important to leverage off the benefits that cloud computing can contribute to their business and clients. However, with any benefits or advantages there are also weaknesses or disadvantages, these will be investigated in the next chapter (Chapter Four).

Chapter 4

Barriers to Cloud Computing



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4 Barriers to Cloud Computing

4.1 Introduction

As described in previous chapters, interest in cloud computing has grown significantly within the information technology (IT) industry (Low, Chen, & Wu, 2011). However, the adoption of cloud computing, amongst South African organisations has been dramatically slower when compared to other countries (Moyo, 2015). For financial service providers in South Africa, which provide the context for this research project, it is important to leverage the benefits that cloud computing could contribute to their business and clients. However, a number of issues influence the relative ease with which business managers and executives are able to assess the readiness of their financial services for such a technology.

The problem or risk specifically being addressed in this research project is that financial service providers are not capable of assessing their own services for readiness to migrate to the cloud. As the financial services industry is highly competitive this results in an increased risk of loss of revenue through competitor adoption of similar services. The previous chapter (Chapter Three) provided numerous reasons as to why organisations could benefit by adopting a cloud computing strategy.

The greater South African financial services industry stands the risk of falling behind the innovation of other organisations in countries which are making progress to adopting cloud computing. This risk of a potential loss of revenue needs to be weighed up against the risk of moving highly confidential financial services to the public cloud, which can be enormous if not properly controlled (Howarth, 2009). This is evident from an IT and Technology (2015) report which found that 82 percent of companies reportedly saved money by moving to the cloud in 2015 and 80 percent of cloud adopters saw improvements within six months of moving to the cloud.

There has not been sufficient research into migration readiness factors in the financial services industry and this research aims to fill this gap in order to establish structured adoption processes for financial services. By doing so, the rate of adoption and success of migration activities is likely to improve.

This chapter proposes a framework for assessing the readiness of financial services for migration to the cloud based on a literature survey of recent publications related to cloud computing adoption. From this literature, the inhibitors of adoption success are derived and classified according to the Technology Organisation Environment Framework (TOE). Additionally, the steps of the

Innovation-Decision model are incorporated, to provide a means of determining the progress toward adopting cloud computing for a particular financial service.

This chapter first considers the definitions and benefits of cloud computing relevant to this research paper. This is followed by a content analysis of factors which inhibit cloud computing adoption and a discussion of the TOE framework and Innovation-Decision Model which provide the basis for the framework proposed in this chapter. Finally, the proposed Cloud Computing Readiness Assessment Framework is then discussed. This framework will form the basis for the empirical evaluation in Chapters Six and Seven.

4.2 Inhibitors of Cloud Computing Adoption

The adoption of cloud computing, as previously discussed, offers organisations a variety of benefits, but as with any new technology there are various challenges, issues and risks which exist (Alter, Peng, Runhua, & Harris, China's Pragmatic Path to Cloud Computing, 2010). In this regard, Low, *et al.* (2011) point out that even with the advantages offered by cloud computing, both strategically and operationally, there is still a relatively slow adoption rate. This section aims to identify the commonly attributed inhibitors to cloud computing adoption, which will be done through the assessment of literature articles on the topic.

In South Africa, adoption of cloud computing, amongst organisations has been dramatically slower when compared to other countries (Moyo, 2015). The slow rate of cloud adoption could be due attributed to multiple reasons namely: security concerns, failure downtime resulting from server maintenance or unforeseen outages, implementation complexity and compatibility issues (Low, *et al.*, 2011). In the opinion of Kim, Kim, Lee and Lee (2009) most of these adoption issues can be solved if acknowledged. Six categories of adoption issues can be identified, namely: outage or availability, security and performance (which can be grouped together as quality of service issues), compliance, integration, cost and environment (Kim, *et al.*, 2009).

Alter, *et al.* (2010) provide additional factors impeding the rate of cloud computing adoption, including:

- Insufficient knowledge or understanding of what cloud computing is, resulting in organisations taking a more cautious approach to adoption.
- Viewing cloud computing as a temporary fad, resulting in organisations being unconvinced of the need to adopt cloud computing.
- Low confidence in the ability of cloud computing solving complex problems.

- Inability to provide a long lasting competitive advantage.

Confirming the above issues, Foddering (2011) provides statistics from a Cisco commissioned study where 250 IT decision makers in large United Kingdom (UK) companies across five sectors were telephonically interviewed. The respondents reported on their concerns regarding cloud computing adoption, which include:

- 75% of respondents recognised security and privacy;
- 64% recognised data location;
- 62% integration issues with in-house IT and
- 60% recognised hosted services.

In a more recent study conducted by Marcos, Leichter, Losa, Medina, Reyes, Rodriguez and Wang (2015) which consisted of 102 global participants from various organisation, the overall findings were very similar with:

- 86% of the respondents listed security and compliance as their primary concern;
- 79% listed privacy along with data retention and destruction as the secondary concern and
- 57% cited data residency as their next concern.

These findings are still aligned with those of Carroll and Ramsingh (2012) who surveyed numerous clients and businesses within South Africa. The survey results showed data security and legal issues as being the primary obstacles to adoption. This is closely followed by compliance issues (or legal issues) and vendor lock-in. Other obstacles included: pricing, complexity, loss of control, no financial benefit, unclear licencing agreements and uncertainty of long term offerings. It is however noted by Carroll and Ramsingh (2012) that “uncertainty of long term offerings” is not highly rated as an inhibitor of cloud computing adoption which indicates that cloud computing is maturing as a technology option. Thus, businesses are beginning to take the longevity and viability of cloud computing adoption more seriously.

Additionally, Heyink (2012) highlights the complications which organisations should consider about the geographical locations of cloud services providers. Cloud service providers that are situated in a different geographical location (specifically outside of South Africa) may be exposed to different legal jurisdictions and consequences, business practices and lastly government oversight (Heyink, 2012).

Finally, financial service providers need to be aware of all challenges they may face in implementing cloud computing. Challenges to financial institutions are heightened because of their security-sensitive environment (Howarth, 2009). It is therefore crucial that financial organisations understand these challenges before they implement cloud computing (Marcos, *et al*, 2015). The following section compares the literature in a matrix in order to inform the framework requirements.

4.2.1 Literature Assessment Matrix

To determine the most significant inhibitors of cloud computing adoption, a basic content analysis of key articles was conducted to determine which concepts are the most prominent in this relationship. Table 4.1 below provides a matrix view of the literature reviewed with an intersection of the inhibitors. An indicator is displayed where an inhibitor is included in the literature reviewed. The purpose of this table is to establish the primary inhibitors which prevent the adoption of cloud computing. These inhibitors are generally applicable to all organisations, but those that are specific, applicable and most relevant to financial services will be noted.

Table 4.1: Content Analysis of Common Inhibitors to Cloud Computing

Commonly cited inhibitors to cloud computing	Literature Reviewed								Score
	Kim <i>et al</i> (2009)	Alter <i>et al</i> (2010)	CPNI (2010)	Foddering (2011)	Garg (2011)	Low <i>et al</i> (2011)	Deloitte (2012)	Heyink (2012)	
Absence of Standards			✓		✓			✓	3
Compatibility						✓			1
Complexity						✓	✓		2
Compliance	✓		✓		✓		✓	✓	5
Digital Data Privacy			✓	✓	✓				3
Environment	✓								1
Geographical Location			✓	✓				✓	3
Hosted Services				✓					1
Implementation						✓			1
Insufficient Knowledge		✓							1
Integration	✓			✓					2
Legal Issues			✓				✓	✓	3
Loss of Control							✓		1
Low Confidence		✓							1
Maintenance						✓			1

No financial benefit							✓		1
Outage / Availability	✓		✓		✓	✓			4
Performance	✓		✓						2
Pricing / Cost	✓						✓		2
Security	✓		✓	✓	✓	✓	✓		6
Temporary fad		✓							1
Uncertainty of long term offering		✓					✓		2
Unclear licensing agreements							✓		1
Vendor Lock In					✓		✓		2

The inhibitors in table 4.1 are scored according to the number of articles which attributed adoption failure to the factor. The primary inhibitors are selected based on the highest score and are provided below:

- Security (of data and information)
- Compliance
- Digital data privacy
- Outage and availability
- Geographical location
- Legal issues
- Absence of standards
- Internet bandwidth and costs

Internet bandwidth and costs have been included in the primary inhibitor list due to its specific relevance to cloud computing adoption within South Africa. High dependency is placed on the reliability and efficiency of network cables that link South Africa with other countries abroad, where most IT investment has occurred. Additionally, the telecommunications costs are very high within South Africa (Mashandudze & Dwolatzky, 2015). Thus broadband prices need to drop substantially before the greater South African market is able to make use of the internet, and therefore cloud computing. Critically Muller (2013) adds that a price war has emerge between capped and uncapped products. This resulted in increased affordability of both types of services. The cost of uncapped ADSL has become more affordable to a larger number of consumers. Additionally, mobile broadband prices have also rapidly decreased (Muller, 2013)

The primary inhibitors to cloud computing adoption, identified above, are all fundamentally important to the financial services industry. Financial organisations collect information from their customers which is processed and stored. This information contains personal and transactional customer information which is highly sensitive in nature and thus explains why data security is a high priority for financial organisations (Howarth, 2009).

There are also regulatory and compliance inhibitors to adoption. In some instances, financing regulators may stipulate that information must be stored in the home country (this coincides with the geographical location challenge). While certain compliance may also state that data cannot be intermixed with other data on a shared server or database (Khajeh-Hosseini, Sommerville, & Sriram, 2010)

The inhibitors all affect the adoption of cloud computing at financial organisations. For this to be improved organisations must systematically address each of these points in a structured and managed manner. This is the key problem addressed by this research project. The following section presents and discusses the proposed Cloud Computing Readiness Assessment Framework for financial services as a solution to the research problem.

4.3 Developing the Cloud Computing Readiness Assessment Framework

This section sets out to propose a framework to overcome adoption issues encountered when migrating financial services to a cloud platform. The proposed Cloud Computing Readiness Assessment Framework for financial services is based on the TOE framework.

Below, the TOE framework is briefly described and the inhibitors identified in the previous section are aligned with this framework. In order to provide a means of assessment of readiness of a financial service, the phases of the Innovation-Decision Model are incorporated into the proposed framework. Thus, the proposed framework provides a phased approach for addressing the adoption of cloud computing for financial services.

The approach used to establish the framework was extensive literature analysis, critical thought and analysis. The research process includes the identification of key theory which addresses the application of new technologies at an organisational level. Following this, an analysis of key inhibitors from related literature should reveal more commonly featured inhibitors. Thereafter applying these findings to the theory provides a framework from which organisations are able to base their investigation into cloud computing. A maturity step process provides a phased

implementation approach to implementing the model. The following sections describe the framework components in more detail.

4.3.1 The Technology Organisation Environment Model

The TOE model, as depicted in figure 4.1 can be described as a framework which examines the process of how an organisation goes about adopting and implementing technological innovations. The adoption and implementation process is believed to be largely influenced by the various contexts namely, technology, organisation and environment (Tornatzky & Fleischer, 1990). The three contexts aim to represent the constraints and opportunities faced when considering technological innovation.

Thus, when assessing the technology innovation of cloud computing and more specifically the adoption of cloud computing – organisations can factor in all possible strengths and weaknesses. Further to this, Tornatzky *et al* (1990) state that these three elements influence the way in which organisations view the need, search for and lastly adopt new technology (which is a fundamental theme to the research project).

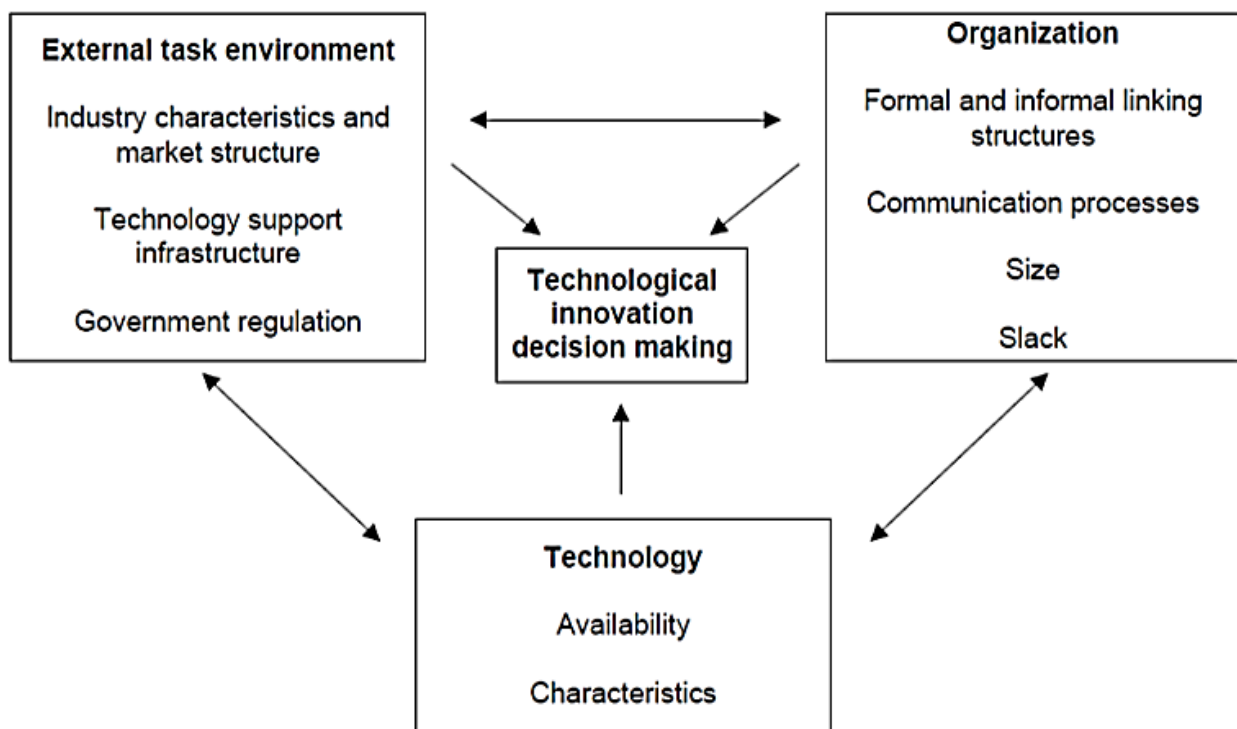


Figure 4.1: Technology, Organisation, Environment (TOE) Model (Tornatzky & Fleischer, 1990)

The TOE model is relevant for this research project as it emphasises adoption at an organisational level as opposed to an individual level. Other models, such as the Diffusion of Innovation, Technology Acceptance Model and Unified Theory of Acceptance and Use of Technology are

more focused on the individual (Oliveira and Martins, 2011) and were thus not considered for this research study. The TOE model provides three context areas which are explained in the following sections.

4.3.1.1 Technology

Technology describes the hardware and software available to the organisation. The relationship which technology plays is that of an enabler to the organisation to achieve its objectives.

4.3.1.2 Organisation

This context encompasses the organisational factors such as policies, procedures and operational model. In addition to this the size of the organisation and capacity are all factors relating to the organisational context. These include other items which the organisation has some level of control over.

4.3.1.3 Environment

The environment provides a context within which the organisation operates. Some of the components of this context include the industry characteristics and market dynamics. These are typically items which are outside of the control of the organisation. Legal and regulatory requirements are also included within this context.

4.3.2 Application of Inhibitors to the TOE Model

The primary inhibitors, identified from the content analysis were: Security (of data and information); Compliance; Digital data privacy; Outage and availability; Geographical location; Legal issues; Absence of standards; and Internet bandwidth and costs. In order to determine a means of overcoming these inhibitors, they are aligned to the three views of the TOE model (technology, organisation and environment). This is shown in figure 4.2.

With regards to the technology itself, the absence of proper cloud standards and the issue of digital data privacy remain key technology challenges to be addressed. At the organisational level three inhibitors are relevant. These are security, compliance and geographical concerns. The organisation has some level of influence or control of these inhibitors. Finally, at the environmental level the organisation has no control over these inhibitors.

Availability (or outages) of the service are outside of the organisation control, and is managed by third party cloud providers. The legislative controls around cloud computing are relatively

immature and under no control of the organisation. Finally, bandwidth costs and capacity remain major concerns which organisations are unable to directly influence.

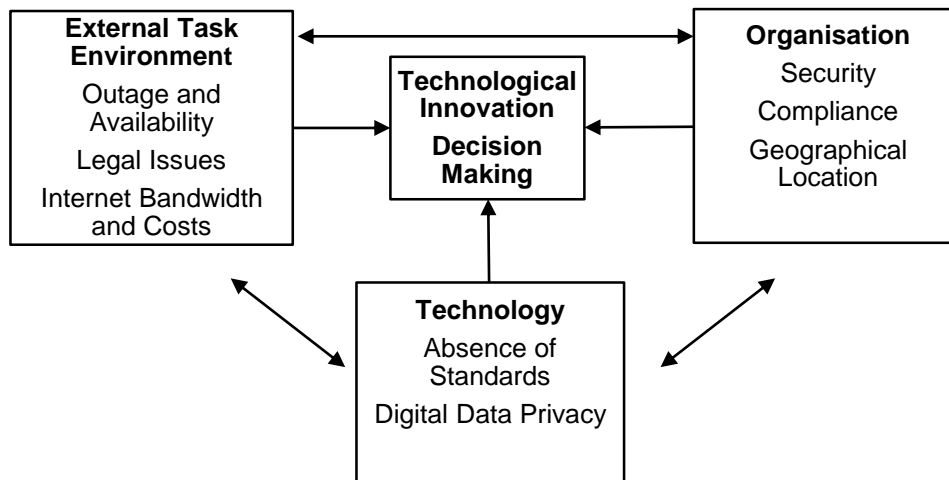


Figure 4.2: Adapted Technology, Organisation, Environment (TOE) Model

While this classification of the inhibitors of cloud computing adoption into the TOE framework provides a structured way of understanding the key reasons for failure, in order to provide a means of assessing the readiness of a financial service to be migrated to the cloud, the innovation-decision model is discussed and incorporated into the framework. This model is described in the following section.

4.3.3 Innovation Decision Making Process for Adoption

The Innovation-decision making process (Rogers, 2003) is depicted in figure 4.3 and is used to explain the steps of the process in which individuals or groups of people adopt an innovation, such as cloud computing. The innovation-decision making process is said to consist of the following stages;

- **Knowledge:** At this stage an individual becomes more aware of the innovation (cloud computing) and begins to develop a better understanding of its abilities.
- **Persuasion:** Here individuals will start developing either a favourable or unfavourable attitude towards the innovation (cloud computing).
- **Decision:** A decision is made to either adopt or reject the innovation (cloud computing).
- **Implementation:** This involves putting the innovation (cloud computing) into practice or use.

- Confirmation:** This is the review stage after implementation whereby individuals evaluate the results of the innovation-decision already made (i.e. accepting or rejecting the adoption of cloud computing) (Rogers, 2003).

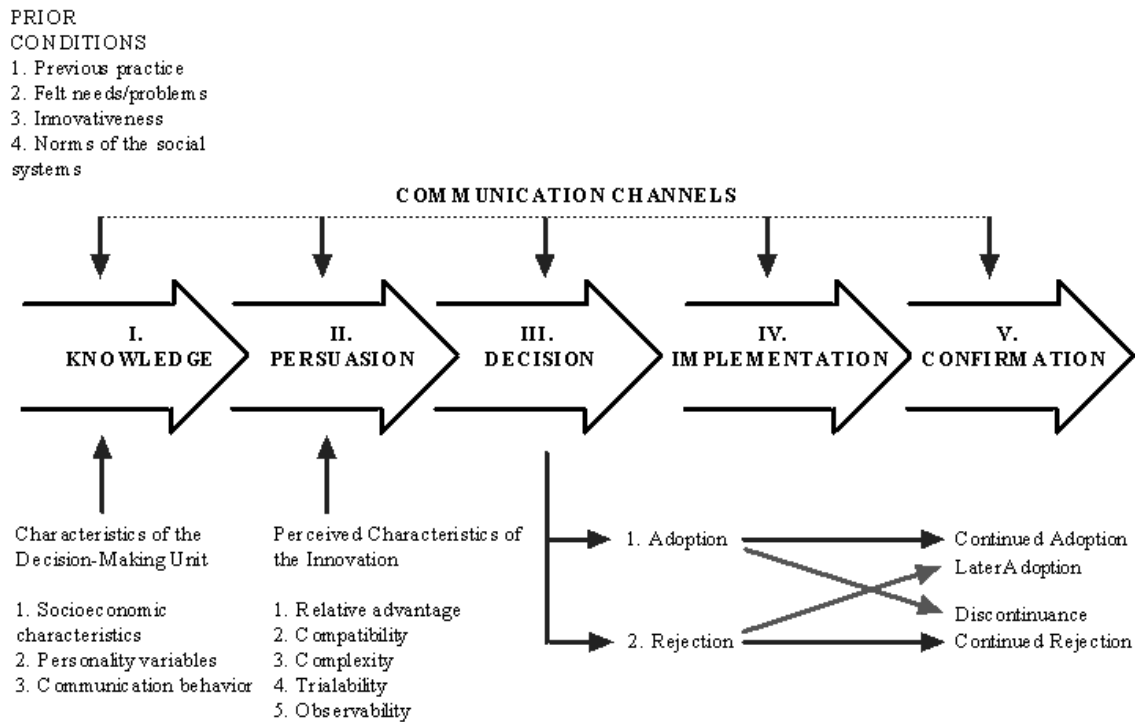


Figure 4.3: A Model of Stages in the Innovation-Decision Process (Rogers, 2003)

This model is incorporated into the framework as a measure of progression towards the adoption of cloud computing. This provides a structured and logical set of steps to measure progress of such adoption. The model provides a logical and systematic set of steps to follow through the adoption of a new innovative technology. This provides a set of steps against which each inhibitor could be measured as the readiness assessment framework is being applied.

The purpose of this is to ensure that the organisation applies techniques to first improve knowledge around the cloud computing and increase employee buy-in through persuasive measures. Once this is performed a decision could take place and only then the decision to implement cloud computing could be taken. This will reduce costs which may occur if cloud computing is implemented without any readiness evaluation steps.

4.4 Cloud Computing Readiness Assessment Framework

The proposed framework accommodates each step as a phase, and provides a high level indicator of the required output for each phase. The phases must be performed in the order provided to be effective. The table below (Table 4.2) presents the consolidated final framework for addressing

and resolving the inherent inhibitors to the adoption of cloud computing at a financial services organisation. The first column provides a list of the primary inhibitors identified in the content analysis of literature on the topic. These are categorised according to the TOE framework headings.

The first row presents the phases of the Innovation-Decision Model. For each phase, the framework defines a desired response or state objective to each of the inhibitors. Each of these must be satisfied inside a vertical phase before moving to the next phase. The result is a framework which provides organisations in the financial sector with the means to plan for and address each primary inhibitor, and assess progress towards the resolution of these inhibitors.

Table 4.2: Cloud Computing Adoption Process Framework

	Knowledge	Persuasion	Decision	Implementation	Confirmation
<u>Technology</u>					
Standards	Standards are researched and understood. Output is a report.	Standards are motivated within the business case. Output is a business case,	Adoption or rejection decision is made based on the report and business case	Standards are implemented	Post implementation assessment of standards. Output is an assessment report.
Digital data privacy	Digital data privacy is researched and understood. Output is a report.	Digital data privacy is motivated within the business case. Output is a business case,		Digital data privacy is implemented	Post implementation assessment of digital data privacy. Output is an assessment report.
<u>Organisation</u>					
Security	Security is researched and understood. Output is a report.	Security is motivated within the business case. Output is a business case	Adoption or rejection decision is made based on the report and business case	Implementation of security measures	Post implementation assessment of security. Output is an assessment report.
Compliance	Compliance is researched and understood. Output is a report.	Standards are motivated within the business case. Output is a business case		Implementation of compliance measures	Post implementation assessment of compliance. Output is an assessment report.

Geographical location	Geographical location is researched and understood. Output is a report.	Geographical location is motivated within the business case. Output is a business case		Implementation of geographical location strategy	Post implementation assessment of geographical location. Output is an assessment report.
	Knowledge	Persuasion	Decision	Implementation	Confirmation
<u>Environment</u>					
Availability	Availability is researched and understood. Output is a report.	Availability is motivated within the business case. Output is a business case	Adoption or rejection decision is made based on the report and business case	Implementation of availability measures	Post implementation assessment of availability. Output is an assessment report.
Legal	Legality is researched and understood. Output is a report.	Legality is motivated within the business case. Output is a business case		Implementation of legal measures	Post implementation assessment of legal measures. Output is an assessment report.
Bandwidth and Costs	Bandwidth and costs are researched and understood. Output is a report.	Bandwidth and costs are the business case. Output is a business case		Implementation of measures to manage bandwidth constraints	Post implementation assessment of bandwidth and cost. Output is an assessment report.

This framework is generic in nature and applicable to all financial services organisations. Through managed application of such a framework, the adoption process can be planned and executed accordingly. An organisation would typically assemble a task team to manage the adoption of cloud computing. Using the framework, the task team could easily allocate objectives to individuals or groups. The organisation would follow each phase until they have satisfied the objective for each inhibitor.

The framework is evaluated as part of the design science process guidelines (Hevner, March, Park, & Ram, Design Science in Information Systems Research, 2004) in the empirical component of this research project found in chapter 6. This is to ensure that the organisation and its employees

agree to the findings from the secondary data research, and provides rigor to the research contribution.

4.5 Initial Expert Review

Three subject matter experts were consulted for feedback relating to the framework. The subject matter experts were qualified in the area of cloud computing with significant collective experience. Each expert was independently provided a copy of the framework. The following sections describe the feedback which was received.

4.5.1 Subject Matter Expert 1

Subject matter expert 1 (SME1) indicated that the framework was very relevant as it addressed an area which requires significant attention by researchers. The SME1 indicated that the methodology used to produce the model was unclear, this has been addressed in this research project through the explanation provided in chapter 5. SME1 expressed that the framework was a good representation of the requirements within the industry.

4.5.2 Subject Matter Expert 2

Subject matter expert 2 (SME2) provided the following recommendation: “establish an implementation guide for the framework which organisations could use to perform their assessments”. This recommendation falls outside the scope of this research project however it is noted in the recommendations for future studies in the conclusion. The SME2 indicated that they were satisfied with the content of the framework.

4.5.3 Subject Matter Expert 3

Subject matter expert 3 (SME3) was in agreement that the framework provided a concise and simple mechanism for an organisation to measure their readiness for cloud computing. The SME3 recommended that the ‘Decision’ step be consolidated in order to ensure that decisions are processed within a holistic view of all other elements. This recommendation was considered very useful and represented in the framework as a single step for each context area.

4.6 Conclusion

This chapter aimed to propose a means of assessing the readiness of financial services for migration to the cloud. This addresses the primary objective of the research project to provide a means for an organisation within the financial sector to assess its level of readiness for cloud computing. This was achieved by highlighting the impediments to cloud computing and applying

these to a framework for readiness assessment. Through this framework, financial organisations are able to make a decision to adopt cloud computing or not. Awareness of the readiness level for each inhibitor positively or negatively influences the rate of adoption.

The main research problem addressed was that of evaluating the readiness of a financial services organisation for cloud computing. Risks or concerns were evaluated and summarised with the aid of a literature matrix. The matrix provided a view of the literature reviewed with an intersection of the inhibitors identified from this literature.

The purpose was to establish the primary inhibitors which prevent the adoption of cloud computing. The inhibitors were generally applicable to all organisations, but those that were specific, applicable and most relevant to financial services were noted, namely: security (of data and information), compliance, digital data privacy, outage and availability, geographical location, legal issues, absence of standards, internet bandwidth and costs.

The above mentioned inhibitors negatively influence the adoption of cloud computing at financial organisations. For this to be improved organisations should systematically address each of these points in a structured and managed manner. A way in which to do this is through aligning the inhibitors to the three components of the TOE framework. Next the innovation-decision making process was introduced and used to explain the phases in which individuals or groups of people adopt an innovation.

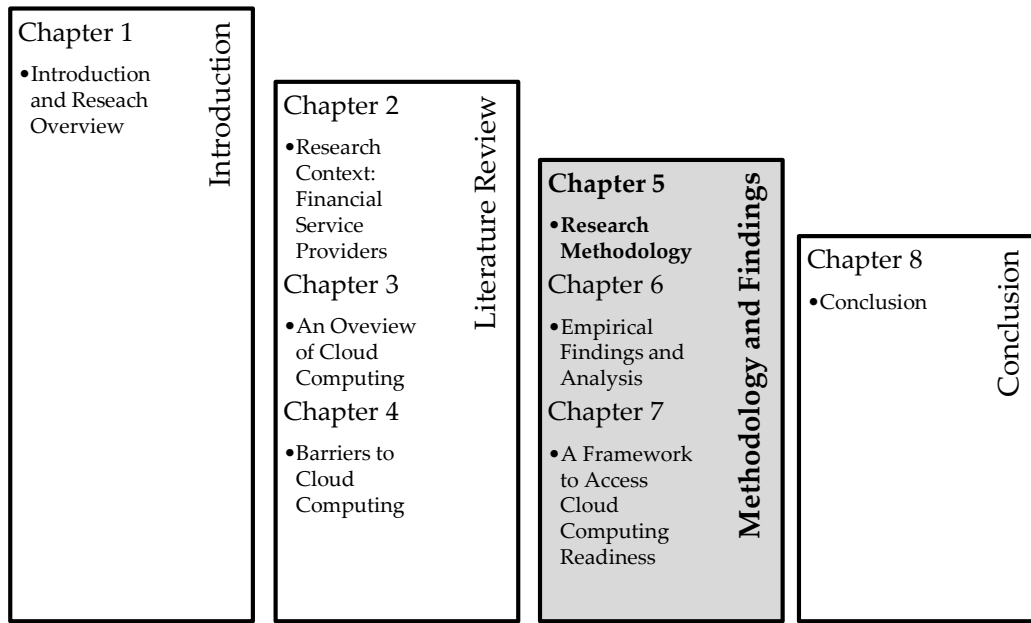
The innovation-decision making process was then incorporated into the framework as a mechanism to measure progression towards the adoption of cloud computing. This provided a structured and logical set of steps to measure progress of adoption. Finally, the consolidated framework for addressing and resolving the inherent inhibitors to the adoption of cloud computing at a financial services organisation was explained. This framework is seen as a means to plan for and address each primary inhibitor, and assess progress towards the resolve of these inhibitors. In chapter 6 this framework will be evaluated through the empirical process.

The preceding chapters have established the theoretical foundation of this study, now the research design and methodology need to be described. The preceding chapters dealt with the relevant elements of this research project namely, establishing the context (financial service industry), cloud enablement and perceived benefits and the impediments to cloud computing. The theoretical foundation was therefore the starting point. The empirical work needs to begin in order to investigate how South African financial service providers can determine the readiness of their

financial services for the adoption of public cloud computing. The following chapter describes the research design and methodology.

Chapter 5

Research Design and Methodology



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5 Research Design and Methodology

5.1 Introduction

Financial service providers in South Africa are failing to leverage off the benefits that cloud computing could contribute to their business and clients. This is due to a number of issues – as mentioned in Chapter Four. As argued in Chapter One - financial service providers are not capable of assessing their own services for readiness of cloud computing. The literature reviewed in Chapter Two, Three and Four collectively set out the foundational arguments in favour of the adoption of cloud computing, while cautioning against the primary inhibitors to cloud computing.

In light of the above problem, the objective of this research project, is to produce a framework which will assist business managers and executives in assessing the readiness of their financial service offerings for delivery using cloud computing. Using this framework, managers and executives should be better informed of the major impediments and key requirements of preparing their services for cloud computing. The framework provides the artefact from which the design science guidelines can be applied. These guidelines are described later in section 5.3.1.

It is advised by Collis and Hussey (2009) that research be conducted within the boundaries of a specific research paradigm, the proceeding section will therefore begin by discussing appropriate philosophical research paradigms, highlighting the most applicable paradigm to this research project. Next the research methodology and design will be discussed.

The aim of this chapter is to provide a clear plan or direction as to: How the research was conducted, how the results were derived and how the results were used. This highlights the important linkage between the chosen method and how it enables the research objective to be addressed. Lastly, the primary and secondary data collection methods are discussed followed by the data analysis methods.

Hofstee (2006) argues the importance of paying attention to the method before commencing research or writing. By detailing the method, the overall academic work and writing will be strengthened. Thus the reader should have a clear overview of the detailed research plan, from which the solution to the problem is pursued.

When the research design and methodology are clear only then can one better understand the overall context and direction. Further to this the research design and methodology creates a

linkage between the theory and argument of the research project, reflecting the range of dimensions within the research process (Limpanitgul, 2009).

5.2 Philosophical Research Paradigm

The following sections describe the positivistic and interpretive research paradigms and the paradigm selected for this research project.

5.2.1 Understanding Positivism and Interpretivism

The two main philosophical research paradigms considered for this research project were positivism and interpretivism, which are compared in table 5.1 below. The comparative views are based on the opinions of Collis and Hussey (2009), Myers (1997) and Oates (2006). It is important to understand the meaning, characteristic and weaknesses of each paradigm in order to select the approach which will be most suitable to this research project.

Table 5.1: Comparing the Philosophical Research Paradigms [Collis and Hussey (2009), Myers (1997) and Oates (2006)]

	Positivism	Interpretivism
Origin	Natural Sciences.	Social Sciences. Criticisms of positivism.
Description	Social reality is singular and objective – not affected by the act of investigation.	Assumes that social reality is in our minds making it subjective and multiple. Social reality can be affected by the act of investigation.
Process	Deductive process with a view of providing explanatory theories to understand social phenomena.	Inductive process with a view of providing interpretive understanding to social phenomena.
Suitability	Studies which test theories with the purpose of increasing the predictive understanding of the observed phenomenon.	Studies which attempt to understand phenomena (identify, explore and explain) through the various meanings that people assign to them.

	Positivism	Interpretivism
Main Characteristics	<ul style="list-style-type: none"> • The world exists independently of humans (there is a physical and a social world). • Measurement and modelling (observe, measure and produce hypotheses or theories). • Objectivity where the researcher is impartial observer, facts independent of the researcher's values and beliefs. • Hypothesis testing where the research is either confirmed or refuted. • Quantitative analysis through mathematical modelling and statistical analysis. • Universal Laws – researchers aim to produce generalisations. 	<ul style="list-style-type: none"> • Multiple subjective realities therefore there is no single version of the truth, individuals perceive the world differently. • Dynamic, socially constructed meaning. • Researcher reflexivity – the assumptions, beliefs and values of the research affect the research process. • Study of people in their natural setting as opposed to an artificial environment. • Qualitative analysis is used to generate and analyse data. • Multiple interpretations – more than one explanation is reached but the one most relevant (to the researcher) is discussed and explained.
Main Criticisms	<ul style="list-style-type: none"> • Impossible to separate people from social context. • Highly structured design adds constraints on results – ignoring other relevant findings. • Researchers are not objective. • Capturing complex phenomena in a singular measure is misleading. 	<ul style="list-style-type: none"> • Vague and variable – unable to provide sound basis for comparisons . • Treats meanings as psychological factors, inside people's heads, only accessible for research purposes by a process of intuition. • Displaces scientific research into professional or personal development.
Approaches	<ul style="list-style-type: none"> • Quantitative • Objective • Scientific • Traditionalist 	<ul style="list-style-type: none"> • Qualitative • Subjective • Humanist • Phenomenological

In figure 5.1 below, Collis and Hussey (2009) depict the opposing paradigms in the form of a continuum, with the two opposing paradigms on opposite ends. The extreme left represents the positivist and objective research paradigm and the extreme right represents the interpretive and subjective research paradigm.

Movement along the continuum indicates that the applied assumptions of the one paradigm are slowly being replaced by those of the other paradigm. Few researchers operate solely in one paradigm. It is noted by Collis and Hussey (2009) that when using a combination of both paradigms one is able to achieve a broader and more complimentary view of the specific research problem. The paradigm that was used within this research project was that of interpretivism, which as noted by Williams (2000), is commonly paired with a qualitative approach.

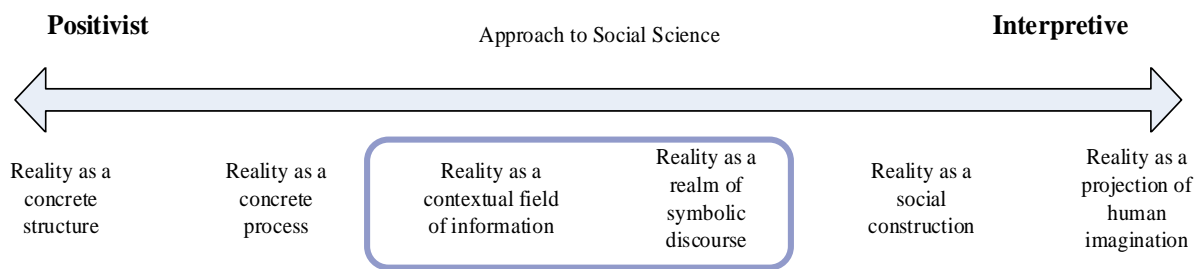


Figure 5.1: Continuum of Core Ontological Assumptions (Collis & Hussey, 2009)

This research project is positioned towards the centre of the extremes of Positivist and Interpretivist research. However, through the literature review process the research was focused more towards the positivistic extreme with quantitative methods being applied to quantify findings. The empirical process positioned the research more towards the interpretive extreme as more qualitative methods were applied.

Collis and Hussey (2009) point out that the researcher needs to choose a methodology that reflects the philosophical assumptions of the chosen paradigm. A research methodology is an approach to the process of research and encompasses a body of methods. The most common differentiator between research approaches is the type of research methods, which can be categorised as either qualitative or quantitative in nature. The distinction between the research methods is explained below.

5.2.1.1 Quantitative Research Methods

Myers (1997) and Collis and Hussey (2009) characterise quantitative research methods as follows:

- **Suitability:** To natural sciences in order to study natural phenomena.
- **Description:** Numbers are important which in turn represent values, social phenomena and concepts. This is said to provide stronger scientific evidence as to how a phenomenon works and is viewed as being scientific and objective.
- **Methods:** Surveys, laboratory experiments, mathematical modelling, simulation, econometrics and structured equation modelling. Various statistical techniques and tools are used to analyse data and then find trends and patterns.
- **Advantage:** The method works best if a large sample size is available, which can be generalised to a larger population. The goal is to study a specific topic across many people and many organisations.
- **Disadvantage:** Often the context (social and cultural aspects) is disregarded by researchers.

- **Associated with:** Positivism (assumes that social phenomena can be measured).

5.2.1.2 Qualitative Research Methods

Myers (1997) and Collis and Hussey (2009) characterise quantitative research methods as follows:

- **Suitability:** To social sciences, enabling the study of social, political and cultural phenomena of people and organisations. Exploratory research when the topic is new with limited previously published research.
- **Description:** Best if a particular subject needs to be studied in depth (in one or a few organisations). Viewed as being humanist and subjective.
- **Methods:** Action research, case study research and grounded theory and narrative and metaphor.
- **Data sources:** Observation, interviews, questionnaires, documents, researcher's impressions and reactions (non-numeric data).
- **Data:** What people have said about a specific topic (based on what they thought or experienced).
- **Advantage:** Helps to understand people, their motivations and actions as well as the broader context in which they work and live.
- **Disadvantage:** Often difficult to generalise to a larger population especially from a sample to a population.
- **Association with:** Interpretivism (explores the complexity and meaning of social phenomena through interpretive understanding).

5.2.1.3 Triangulation and Mixed Methods

By using a technique referred to by Collis and Hussey (2009) as “triangulation”, these two approaches can be applied in one research project, as depicted in figure 5.2.

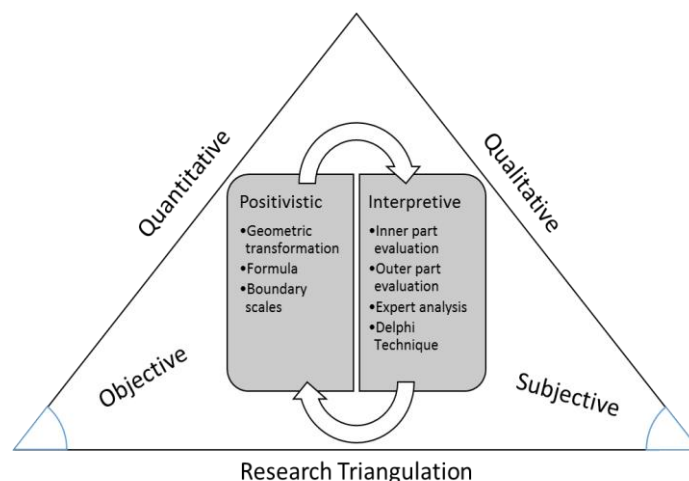


Figure 5.2 - Research Triangulation Illustrated

Tashakkori and Teddlie (2003) indicate that the combination of qualitative and quantitative methods has been used in the social and behavioural sciences since the 1980's referred to as mixed methods. A benefit of this approach is that the researcher can look at the same topic from different angles (Myers, 1997). This view is supported by Collis and Hussey (2009) who believe that a broader and more complimentary view of the specific research problem may be achieved when using a combination of the elements from the extreme paradigms. Table 5.2 below explains how this research project uses triangulation or mixed methods.

Table 5.2: Selection and Application of the Appropriate Research Paradigm

	Paradigm and Method	Application
Literature Review	Positivist Paradigm using Quantitative Methods	The literature review section made use of an assessment matrix to quantify the most significant inhibitors of cloud computing adoption.
Data Analysis	Positivist Paradigm using Quantitative Methods	The analysis of the data gathered made use of quantitative techniques. <ul style="list-style-type: none"> • Microsoft excel (data presentation) • Microsoft SQL Server (storing and processing data) • PowerBI (analyse data)
Empirical Study and Findings	Interpretivist Paradigm using Qualitative Methods	The qualitative methods used included: <ul style="list-style-type: none"> • Questionnaires • Interviews Which made use of open-ended questions - ensuring questions remained subjective.

5.3 Research Methodology

5.3.1 Design Science

The research methodology chosen for this research project is Design Science. Hevner, March, Park and Ram (2004) explain that Design Science focuses on creating and evaluating Information Technology (IT) artefacts which have been designed in order to solve real organisational problems. The purpose of this research project is to produce a framework, more specifically a readiness assessment framework which can be used to assist financial organisations with their cloud computing adoption strategy. Hevner, *et al* (2004) define the types of IT artefacts as follows:

- **Constructs:** Symbols or vocabulary used to define problems and solutions.
- **Models:** Representations of real world situations or problems.
- **Methods:** How to solve problems.
- **Instantiations:** Existing systems that have already been implemented to solve a problem.

Prior to conducting research Hevner, *et al* (2004) have provided an illustration Hevner’s Information Systems Research Framework in figure 5.3. This illustration is aimed at assisting researchers with the process of understanding, executing and evaluating research. Design Science is an appropriate methodology for this research project as it provides the mechanism required to produce and evaluate a research artefact through the duration of the research, while involving the relevant participants of the research context.

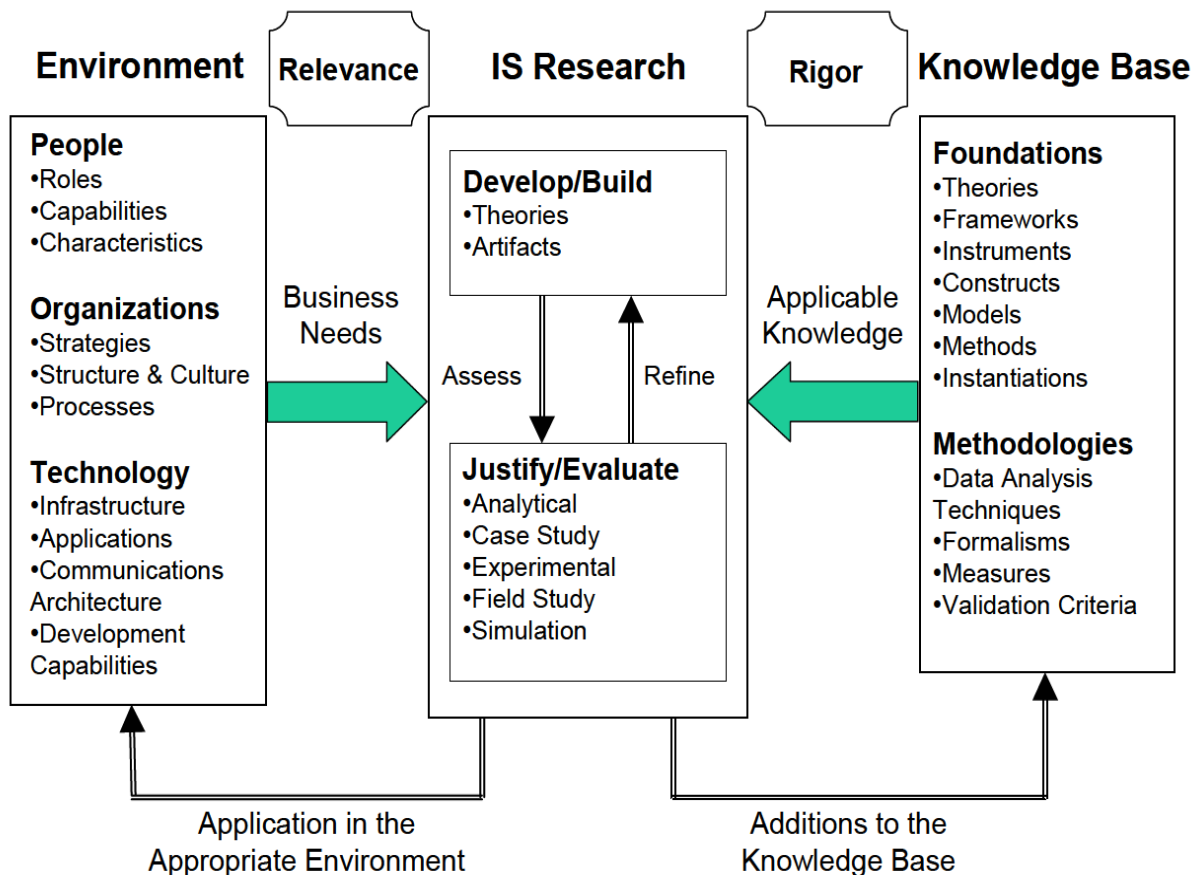


Figure 5.3: Information Systems Research Framework (Hevner, *et al.*, 2004)

The literature review process establishes ‘*relevance*’ by assessing the ‘*people*’, ‘*organisation*’ and ‘*technology*’. In the environment, ‘*relevance*’ was addressed through the expert review process (Chapter Four) in which the framework was ‘*evaluated*’. The organisational context was identified (Chapter Two) and technology frameworks and inhibitors were identified from the literature reviewed (Chapters Three and Four).

The research framework is established as the artefact for which the ‘*rigor*’ and ‘*relevance*’ of the research is ‘*evaluated*’ against. The framework is initially proposed in Chapter Four and ‘*refined*’ further in Chapter Seven by applying the empirical findings from Chapter Six.

Research '*rigor*' is established through the foundational theory uncovered in the literature review process (Chapter Four). The Technology Organisation Environment (TOE) Framework and Innovation Model coupled with the Design Science Guidelines provide '*rigor*' to the research process. The research design ensures '*rigor*' through a structured research methodology guided by the principles of Design Science. More information is provided in the following section. In Chapter Six and Seven the research output framework is shown to be '*applicable*' to the relevant problem environment whilst contributing to the '*knowledge*'.

The research design that was used in this research project is Design Science, which was applied using the Seven Design Science Research Guidelines in Table 5.3 below. The output of this research project will be a tangible assessment framework. Design science is well suited to research that ends in an artefact such as the framework proposed throughout this research project.

Table 5.3: Design Science Research Guidelines (Hevner, *et al.*, 2004)

Guideline	Description	Guideline Completed
1. Design as an Artefact	Design Science research must produce a viable artefact in the form of a construct, a model, a method, or an instantiation.	Establishment of the framework (Chapter 4)
2. Problem Relevance	The objective of Design Science research is to develop technology-based solutions to important and relevant business problems.	Literature Review of Cloud Computing Benefits and Impediments (Chapter 2,3 & 4)
3. Design Evaluation	The utility, quality and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods.	Framework Evaluation (Chapter 6 & 7)
4. Research Contributions	Effective Design Science research must provide clear and verifiable contributions in the areas of the design artefact, design foundation, and/or design methodologies.	The final research framework (Chapter 7)
5. Research Rigor	Design Science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact.	Literature Assessment Matrix, Research Evaluation (Chapter 4, Sections 4.1 to 4.4 & Chapter 6 & 7)
6. Design as a Search Process	The search for an effective artefact requires utilising available means to reach desired ends while satisfying laws in the problem environment.	The empirical process performed in the research context (Chapter 6)
7. Communication of Research	Design Science research must be presented effectively both to technology-oriented as well as management-oriented audiences.	The research output framework communicates the findings of the research (Chapter 7)

Within the confines of the design science guidelines the research was designed to adequately address each guideline step. The following section describes the design of the research.

5.4 Research Design

This section aims to describe how the research was performed. The research was carefully designed to incorporate elements which are aligned to the Design Science Guidelines, as per Hevner, *et al* (2004). Figure 5.4 illustrates the high-level design of the research project.

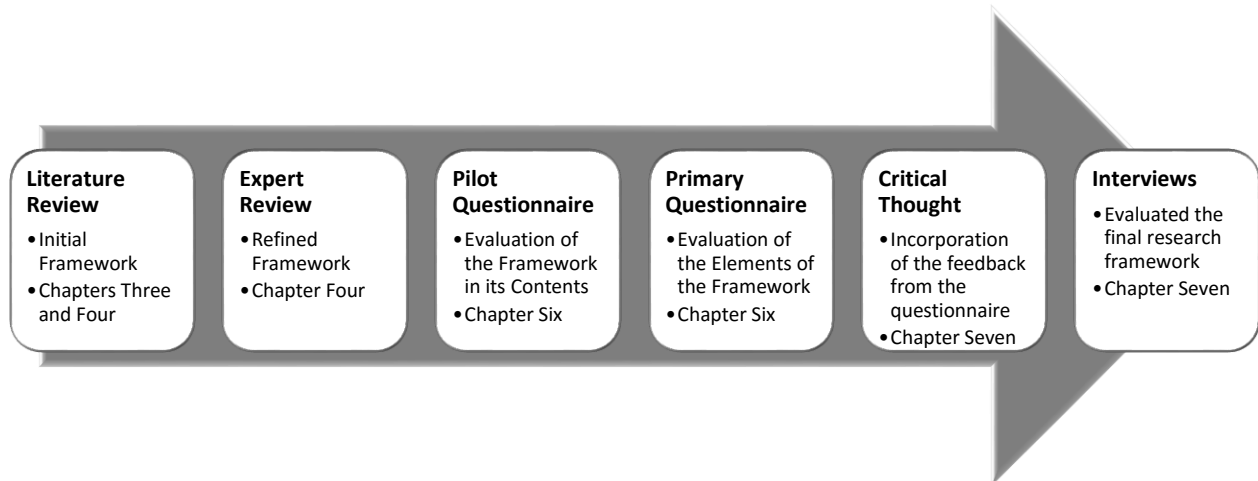


Figure 5.4: High-level Design of the Research Project

Hevner *et al* (2004) note that the design process is a sequence of expert activities that produces an innovative product (i.e., the design artefact). In this research project the artefact is the cloud computing adoption framework. The process above provides a number of independent steps for incorporating the activities which involve experts providing feedback as part of a continuous chain of evaluation. These steps are described in the sections which follow.

5.4.1 Literature and Expert Reviews

First a literature review was conducted (chapters three and four) whereby relevant information was reviewed. Numerous books, journals, articles, conference proceedings and other studies were reviewed at this stage which resulted in the initial draft of the framework. Next was an expert review, this involved the discussion of the initial framework with three academic experts.

The experts assisted in refining the initial framework as described in section 4.5. The primary purpose of the literature and expert reviews are to address the relevance and evaluation guidelines from the design science guidelines. In doing so the guideline for rigor is addressed.

5.4.2 Pilot and Primary Questionnaires

A pilot questionnaire was then used to evaluate the refined initial framework and the research instrument, within the context selected. The elements from which the initial framework was comprised were evaluated within the research context for accuracy and completion. The questionnaire is provided to address both the guidelines of search process and evaluation.

5.4.3 Critical Thought

The process of establishing the objective requirements of the respondents required critical thought from the researcher in order to make relevant changes to the initial proposed framework. This process established additional elements within the framework as a result of the opinion observed in the responses from the participants of the questionnaires.

5.4.4 Interviews

The final evaluation step required the feedback from two industry experts to provide a final insight into the final framework. The two experts were independently interviewed for feedback. The results of the interviews are provided in chapter 6. The following section details the methods used to collect the primary research data.

5.5 Data Collection Methods

In order to answer the research question and meet the research objectives it was decided that the data collection would comprise of both primary and secondary resources. Primary data collection is referred to by Myers (1997) as being unpublished and is usually gathered from the participants of an organisation. Secondary data collection refers to any previously published materials. The primary data collection methods used within this research project was questionnaires, expert reviews and interviews. The secondary data collection method used is that of literature review. These will both be discussed on the proceeding section.

5.5.1 Primary Data Collection Methods

Web-based questionnaires were the primary data collection method used within the research project. Other methods used included interviews and expert reviews. The following section describes the web based questionnaires used.

5.5.1.1 Web-based Questionnaire

The reason questionnaires were chosen is because information can be effectively gathered from a large number of employees at a relatively low cost (Whitten & Bentley, 2008). There is however

a risk of non-response or that questions may be misunderstood. In order to address this a pilot questionnaire was first drafted and then sent for peer review, only after feedback was received was the primary questionnaire then circulated to suitable respondents.

As previously mentioned the questionnaire was web-based. [Www.kwiksurveys.com](http://www.kwiksurveys.com) was used for both the pilot and primary questionnaires. This service provided the following benefits over traditional mail-based surveys or email-based surveys:

- It was accessible over the internet from any location;
- Respondents could take the survey at any time;
- Respondents could use their computer, tablet or phone to respond;
- The service automatically stored responses and
- The results were available for download in a spreadsheet format for easy analysis.

The questionnaire included a combination of questions relating to the key attributes of cloud computing services as defined from multiple sources in the literature review section. It was anonymous, in the hope of encouraging employees to be more honest pertaining to their answers. Open-ended and close-ended questions (in the form of a Likert scale) were used in order to elicit responses that can be evaluated using mixed methods.

The pilot questionnaire was conducted – in order to first test the research instrument and secondly ensure the questions were appropriate for the study and unambiguous. A link to the questionnaire, with detailed instructions for completion was sent to 10 respondents. Post the pilot questionnaire the primary questionnaire link with detail instructions for completion was sent to the relevant 170 participants at the financial organisation. Of the 170 participants contacts, 57 responses were received. The results from the questionnaires are detailed in Chapter Six. It must be noted however that these primary data collection methods (pilot and primary questionnaires) helped to contribute towards establishing the research output framework.

5.5.1.2 Expert Reviews

Subject matter experts were consulted for feedback on the initial research output framework. The subject matter experts were conveniently selected and a copy of the framework was distributed to the experts through email. The experts responded through email with their specific feedback. Feedback from the experts is provided in section 4.5.

5.5.1.3 Interviews

Interviews were performed with two subject matter experts, one a senior employee of Company A while the other is a conveniently selected expert from related industry. The interviews were approximately 20 minutes in length and consisted of open ended discussion. The results of this interview process are provided in chapter 6. The questions were all open ended asking for feedback on the output adoption framework.

5.5.2 Secondary Data Collection Method

Secondary data for this research project will be comprised of information collected from various sources. This information was used throughout the research process. Sources include the following:

- Theories and frameworks (from literature review)
- Past research projects
- Academic websites and articles from various academic journals
- Reports and books
- Conference proceedings
- Various internet sources

All secondary data is referenced, to ensure that the original author is credited. Additionally, all references are listed in full at the end of this research project. Lastly, all efforts were made to ensure the content used is current and relevant to this research project.

5.6 Data Analysis Methods

The following tools were used to perform data analysis of the web-based questionnaire results:

1. **Microsoft Excel:** Was used to download, present and sort the data. This data was then imported into to a database tool.
2. **Microsoft SQL Server:** Is the database tool which was used to store and process the data.
3. **Power BI:** Is the analysis tool which was used to perform queries on the dataset in Microsoft SQL Server.
4. **Microsoft Excel:** Information from Power BI was then imported and various charts, visualisations and graphs were used to establish and identifying visible patterns or trends within the full data set.

The analysis of the data from the web-based questionnaire is detailed in Chapter Six. The analysis of the results of the expert review is provided in section 4.5. The interview analysis is found in Chapter Six. The process of evaluation for the expert reviews and interviews was that of critical thought in which the recommendations and feedback from the experts was carefully considered against the existing findings.

5.7 Research Evaluation

To evaluate the research Oates (2006) outlines a set of measurement parameters for assessing the quality of findings in positivistic and interpretive research. These characteristics must be established for the evaluation to be credible. These are provided in table 5.4 below:

Table 5.4 - Quality in Positivist and Interpretivist Research

Positivism	Interpretivist
Validity	Trustworthiness
Objectivity	Confirmability
Reliability	Dependability
Internal Validity	Credibility
External validity	Transferability

5.8 Ethical Considerations

Ethical norms are important to adhere to as they promote the research aims such as knowledge, truth and avoidance of error (Hofstee, 2006). In light of this University ethical clearance was granted for this research project (see Appendix A). Research can involve different people in different disciplines, therefore standards to promote values that are essential to collaborative work are essential. Ethics such as trust, accountability and mutual respect are included in these standards. Ethical lapses in research can significantly harm human and animal subjects, students and the public. Ethical considerations specific to this research are as follows:

- All data collected will remain anonymous.
- There will be a non-disclosure procedure strictly adhered to regarding the intellectual property of the organisation used within the case study.
- The company was afforded the opportunity to review all information prior to it being made publically available.

Whereby an ethical concern was encountered during the course of this research project, the researcher agreed to confirm any resolution with the assistance of the university ethics committee where necessary.

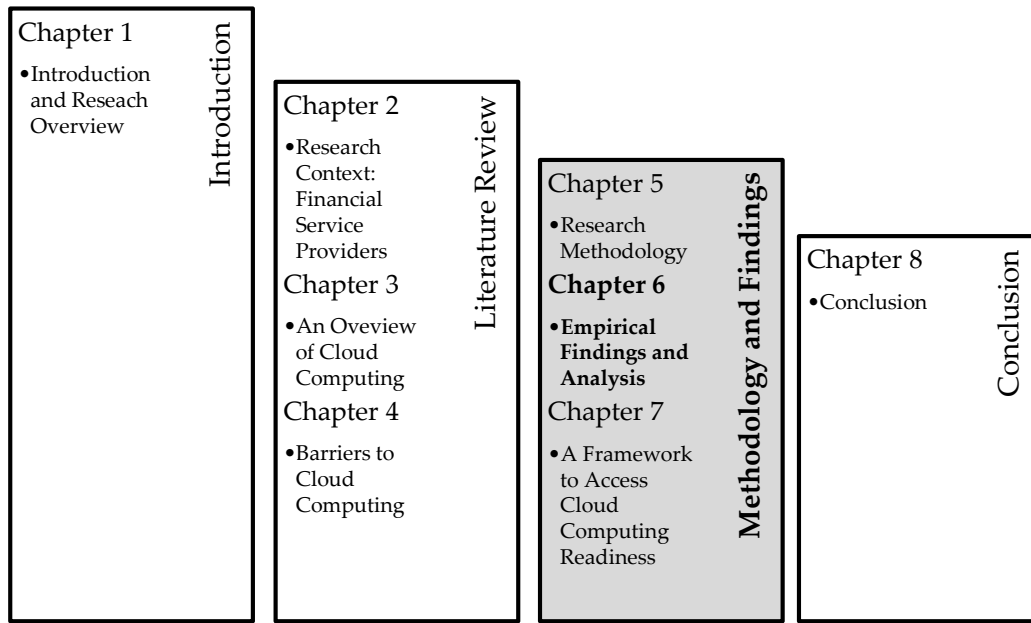
5.9 Conclusion

The objective of this section was to detail the research design and methodology approach, in turn creating a linkage between the theory and argument of the research project, reflecting the range of dimensions within the research process (Limpanitgul, 2009). It has become clear how the research design and methodology provides a clear research plan or blue print that enables the researcher to find the answers to the questions within the research project (Saunders, Lewis, & Thornhill, 2007). In essence, this chapter provided the overall context and direction.

The objective of the research is to establish a way in which organisations in the financial services sector can assess their readiness for the adoption of cloud computing. By using the principles and guidelines of design science the research project is able to establish a framework as the artefact from the literature review. The remainder of the research project follows the guidelines in order to meet the requirements for the application of research within the design science methodology.

Chapter 6

Empirical Findings and Discussion



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6 Empirical Findings and Discussion

6.1 Introduction

The framework provided in chapter 4 was compiled as a result of the literature reviewed within this research project. In order to establish any additional specific requirements from the research context this chapter describes the empirical process performed to establish this. This search process is performed as part of the design science guidelines.

This chapter presents the findings from the empirical research performed. The purpose of the empirical component is to explore some of the concepts found within the literature review of the research project. Such concepts can be put to the research context employees for practical opinion. These findings can thereafter be applied to the assessment framework proposed as part of section 4.4. This will help to refine the framework further by applying the findings from the primary data observation process. The following section outlines the empirical process performed.

6.2 The Empirical Process

As illustrated in Figure 6.1 the empirical process was undertaken by firstly conducting a pilot phase in which subject matter experts were consulted for concentrated feedback about the proposed questionnaire questions.

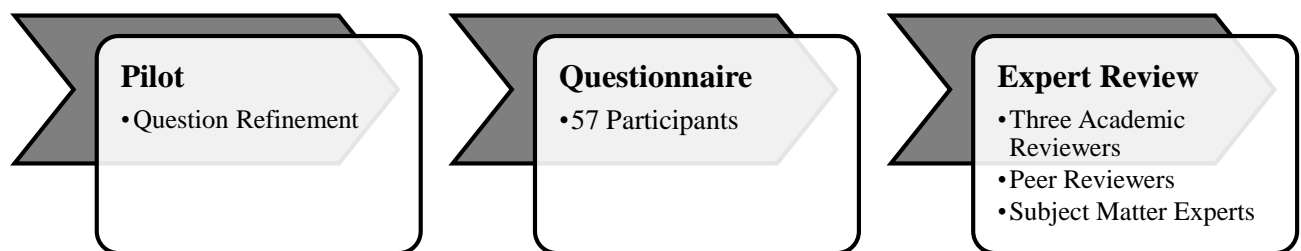


Figure 6.1 - Empirical Process Steps

This process allowed for the refinement of the material selected to form part of the application in the broader empirical questionnaire.

6.3 The Questionnaire Findings

The questionnaire was compiled using an online questionnaire service called Kwiksurveys.com. This allowed for easy distribution of the questionnaire via email. The results were also instantly available as each respondent completed the survey. The results were analysed using a number of data analysis tools. Microsoft Excel was used to download the data and sort the data for importing into a database tool.

The database tool used was Microsoft SQL Server. A database professional was asked to import the data into a relational database for analysis. Once the data was imported an analysis tool called PowerBI was used to perform queries on the dataset. Both Excel and PowerBI were used to produce the charts provided in this section.

6.3.1 Response Rate

This questionnaire was distributed to 170 employees across the organisation. There were 57 respondents to the questionnaire from across the organisation. The respondents represented a good distribution from Information Technology (IT), Business and Finance, and included individuals from different management levels. The response rate is therefore deemed to be representative of the broad organisation and acceptable. The following section details both the questionnaire and responses for each question.

6.3.2 Sample Demographics

The questionnaire was distributed to a subset of employees in the organisation. There were 57 (34%) responses to the questionnaire. It was important to be able to understand the responses in relation to the role that each respondent had at the organisation. The first question provided in the questionnaire was intended to establish the organisational role for each of the respondents. This allows for the answers to be assessed across both the entire organisation sample and within each role category. This might provide some insight into awareness levels or training requirements.

Figure 6.2 indicates that just over half of the respondents (29) indicated they worked within the IT department. This included all levels such as programmers, analysts, senior and executive managers. The remaining respondents were from other roles within the organisation.

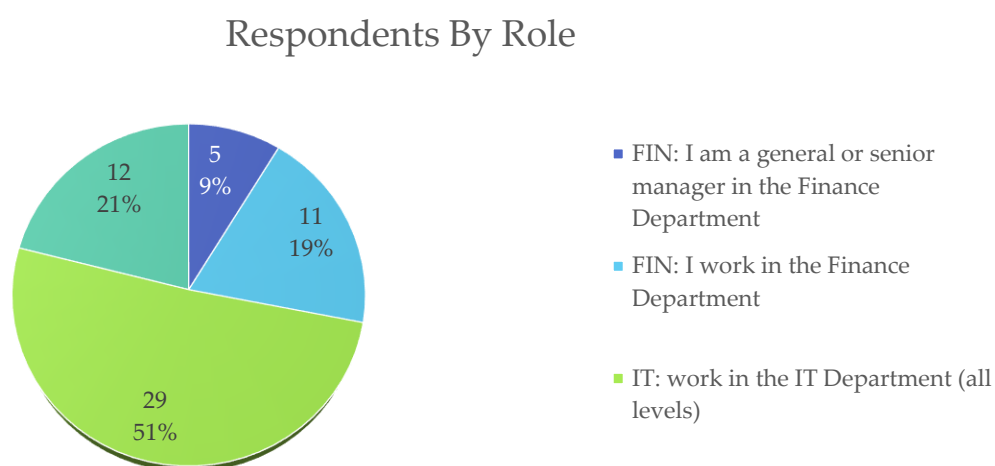


Figure 6.2 - Respondents by Role

Of the remaining 28 respondents, 16 worked within the finance department and the other 12 worked in other departments within the organisation. The respondents represent a fair-cross section of the staff at Company A.

6.3.3 Online Services Experience

Respondents were asked to describe the online services they made use of in either their work or private lives. This question was positioned to explore the level of adoption individuals have to existing cloud services for other day-to-day activities. The purpose here was to explore these results against the results of other questions. This could reveal instances in which respondents are unaware that they are already making use of cloud services. It is a key responsibility for employees to have a general understanding when making the decisions about the methods they use to deliver their solutions. This appears to be aligned to the findings of Bourne (2015) who observed that the average financial services organisation has over 1000 cloud services in use among employees.

Respondents were most familiar with cloud services relating to web based email (communications) and online banking. This was followed by similar usage numbers for social media, online shopping, storage and video streaming services. Cloud service platforms (such as Microsoft Azure and Amazon EC2) was the only category with no respondents indicating they were actively making use of such services. This is sure to change, The Economist (2015) writes that while many other IT spend categories are either stagnating or declining, cloud service providers are experiencing massive growth. Table 6.1 and figure 6.4 illustrate the usage numbers for each service type.

Table 6.1 - Cloud Services Used by Employees at Company A

Cloud Service	Use Service	Do not use Service
1. Web Based Email (Gmail, Yahoo, Hotmail, Outlook.com)	52 (91%)	5 (9%)
2. Social Media (Facebook, Twitter, etc)	34 (60%)	23 (40%)
3. Online Shopping	38 (67%)	19 (33%)
4. Video Streaming (Youtube)	32 (56%)	25 (44%)
5. Storage (Dropbox, Skydrive, Google Drive)	29 (51%)	28 (49%)
6. Windows Azure, Amazon EC2, etc	0 (0%)	57 (100%)
7. Internet Banking	53 (93%)	4 (7%)

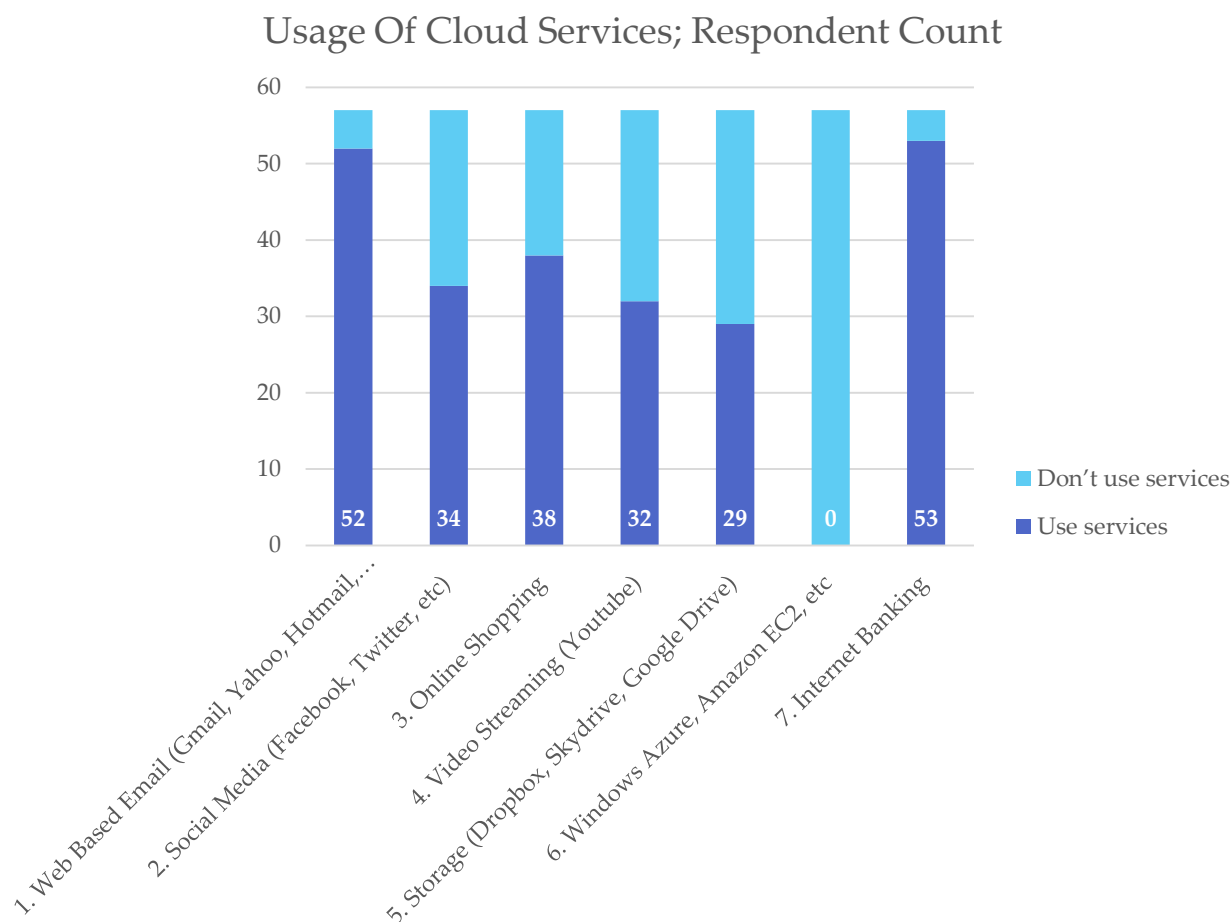


Figure 6.3 - Cloud Services Usage

For this question respondents could select more than one option. With the exception of the cloud computing platform providers, all categories represented employee adoption levels above 50%. For online email and banking this rate was much higher at above 90% for both categories. This indicates that respondents are already adopting cloud computing services, regardless of the level of their understanding of cloud computing.

6.3.4 Cloud Computing Awareness

Question three asked respondents if they had heard of cloud computing before. The results are shown in figure 6.4 and table 6.2 grouped by the respondent role groups.

Table 6.2 - Cloud Computing Awareness

Role	No, I have never heard of cloud computing before	Yes, although I don't really know much about it	Yes, I am familiar with the general concepts
FIN: I am a general or senior manager in the Finance Department		1	4
FIN: I work in the Finance Department	7	3	1
IT: Work in the IT Department (all levels)		6	23
OTH: I do not work in either IT or Finance	4	4	4

Awareness of Cloud Computing

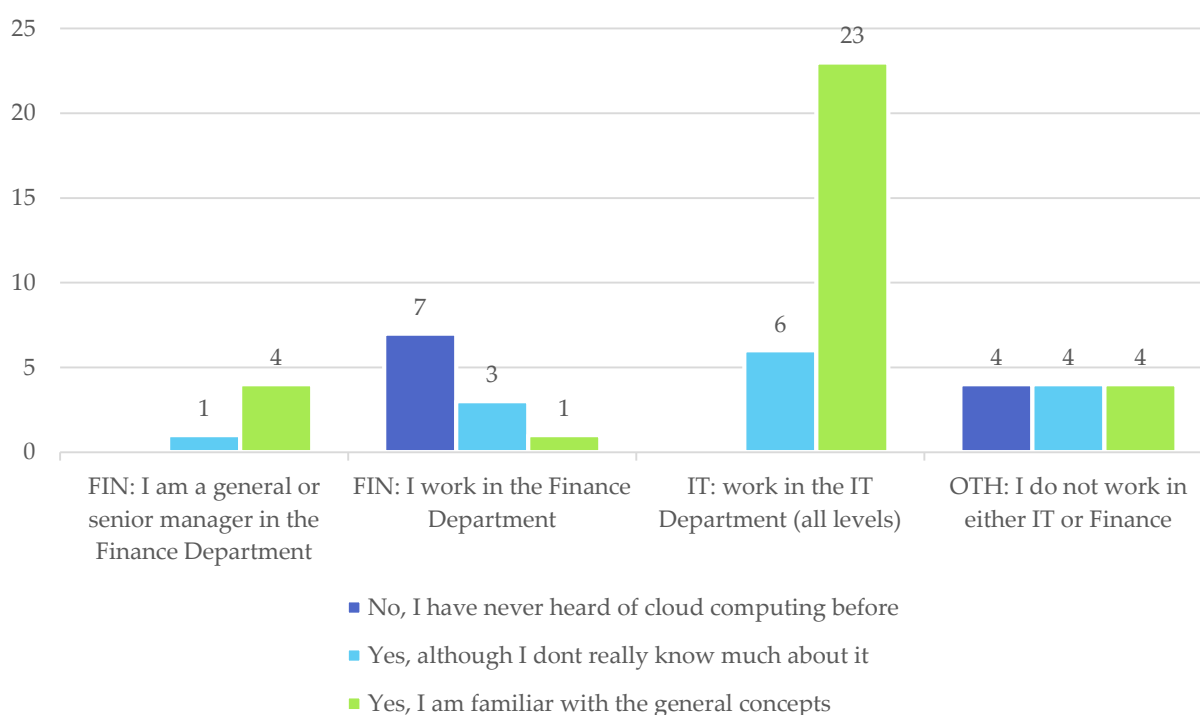


Figure 6.4 - Cloud Computing Awareness Levels

Cloud computing awareness is highest among IT respondents as expected. Although all senior financial managers had at least some level of awareness, they only represent 9% of the total respondents. Employees in the finance department who indicated that they are not part of senior management fared much worse with 7 out of the 11 respondents indicating they had never heard

of cloud computing. For all other employees there was an equal representation between the three answers at 4 respondents each.

6.3.5 Mobile Banking Adoption

Question four asked the respondents, “Do you use your mobile device (smartphone or tablet) for online banking (or another financial service)”. Building on the adoption rate of respondents this question explored the rate of adoption of mobile relating to online banking services. As far as cloud computing goes the provision of services may be a combination of traditional ‘fixed’ computing and mobile computing methods.

Table 6.3 - Mobile Banking Adoption

Mobile Banking Services Adoption	Respondents	Percentage
(No answer provided)	1	2%
1. Yes, all the time	4	7%
2. Yes, but seldomly	51	89%
3. No, I do not trust mobile banking services	1	2%
4. No, I don't know how	0	0%

Use Of Online Banking Or Financial Services From Mobile

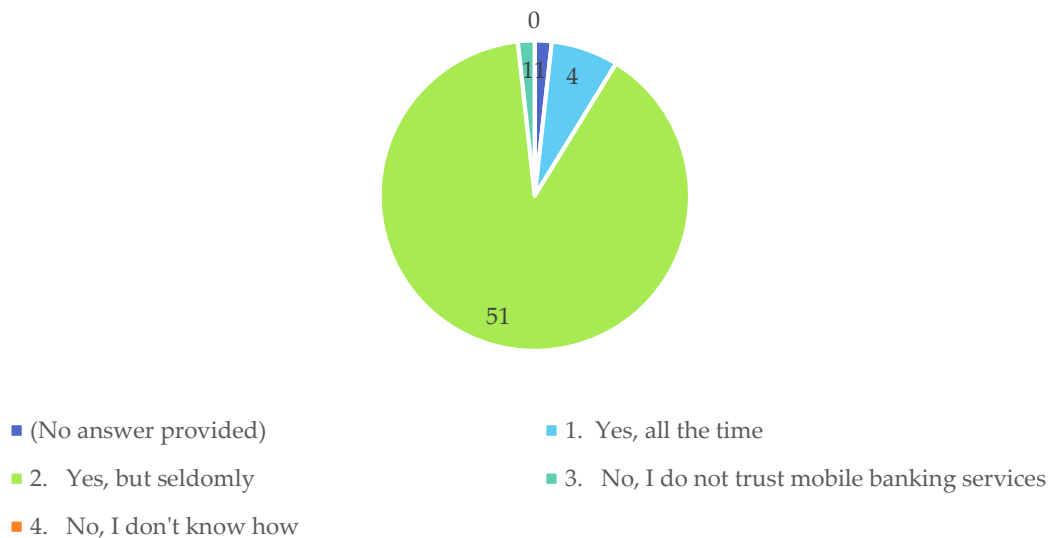


Figure 6.5 - The Use of Mobile in Online Banking Services

The results shown in table 6.3 and figure 6.5 highlight that although the majority (89%) of respondents seldom make use of mobile for online banking services, they do use their mobile

devices from time to time. Only one respondent indicated a trust issue existing relating to the use of mobile devices for online banking. This is an important finding as it shows that employees of this organisation will support the migration of financial services to the cloud.

6.3.6 Contact Options

For question five respondents were asked, “If given an option to perform an activity over the internet (mobile or desktop web browser) instead of through a walk-in process...”. The following options were made available for them to select from:

- I would always use the internet
- I would rather use the internet as long as no financial information is involved
- I would rather walk in and deal with a person

The responses are shown in Figure 6.6.

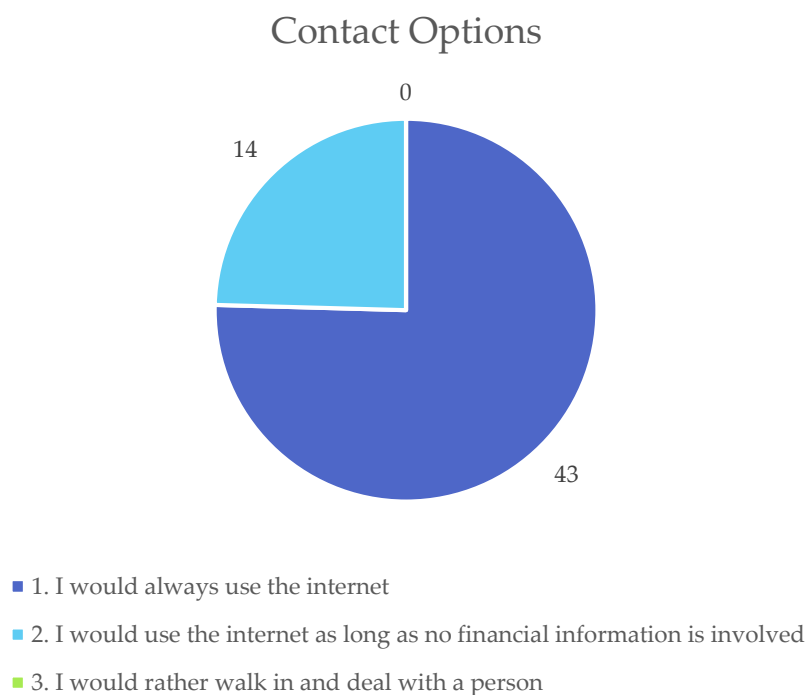


Figure 6.6 - Contact Options

The significant majority (75%) of respondents indicated that they would prefer to use the internet under any circumstances, although about one quarter of respondents indicated that they would only prefer to use the internet were no financial information is involved in the process. Table 6.4 shows that none of the respondents indicated a preference to dealing with a person as part of a walk in process.

Table 6.4 - Contact Options Preferred

Contact Option	Count	Percentage
1. I would always use the internet	43	75%
2. I would use the internet as long as no financial information is involved	14	25%
3. I would rather walk in and deal with a person	0	0%

This question illustrates that individuals favour interacting via the internet for convenience over having to physically be present for a walk-in contact session. This reinforces the importance of adopting cloud technologies at the organisation.

6.3.7 Organisational Dynamics

In order to understand respondent sentiment towards the unique dynamics at the organisation respondents were asked to “Select (tick) those that are true...” for question six. There were four different answers provided to which respondents were asked whether they agreed (true) or disagreed (false).

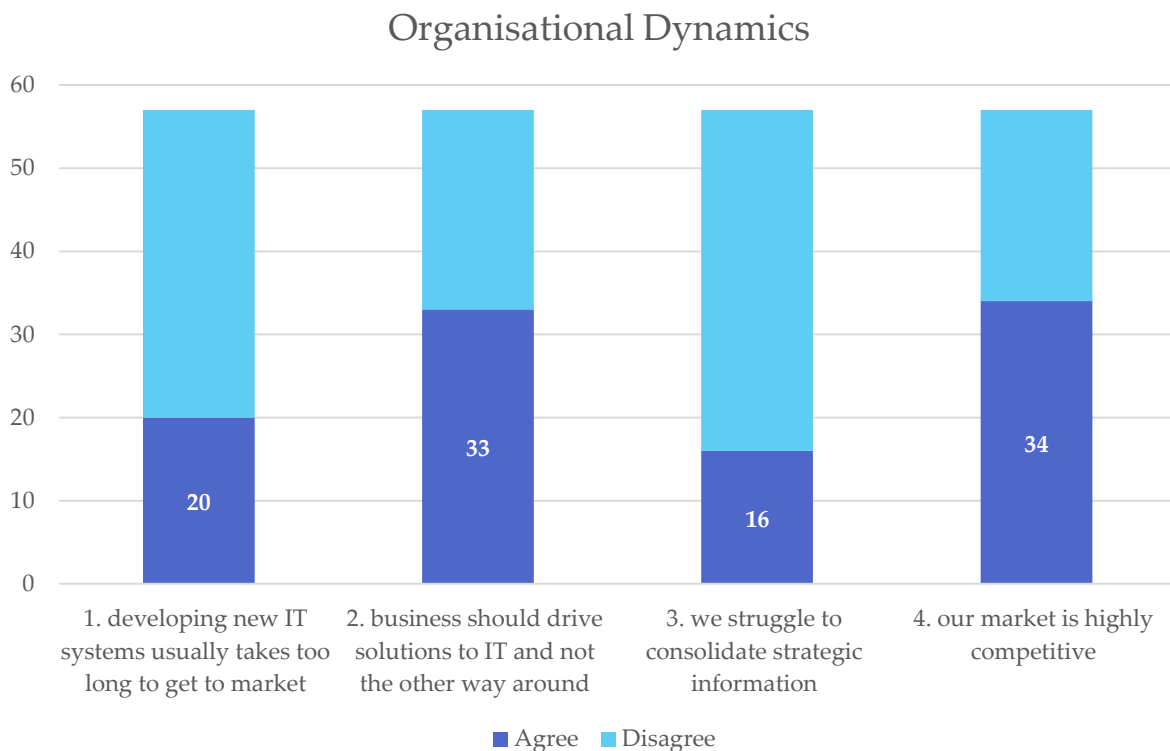


Figure 6.7 - Organisational Dynamics Responses

Figure 6.7 shows the responses to each of the four questions. The first question asked respondents to indicate if they agreed that developing new IT systems usually resulted in delays to get out to

market. Only 20 (35%) of respondents felt that this was a challenge at the organisation. This indicates that a majority of employees are confident that the IT department is able to deliver value to market in a reasonable timeframe.

Table 6.5 - Organisational Dynamics

Dynamic	Agree	Disagree
1. Developing new IT systems usually takes too long to get to market	20 (35%)	37 (65%)
2. Business should drive solutions to IT and not the other way around	33 (58%)	24 (32%)
3. We struggle to consolidate strategic information	16 (28%)	41 (72%)
4. Our market is highly competitive	34 (60%)	23 (40%)

The next question asked respondents if they felt that business should be driving solutions to the IT environment. Just under 60% of respondents agreed that it is the responsibility of business to drive solutions to the IT environment. The third question asked whether the organisation experiences difficulty in consolidating strategic information. Only 28% of respondents felt that this was true indicating a mature information management strategy is in place at this organisation. The final question asked respondents if they felt that their market is highly competitive. Table 6.5 shows that approximately 60% of respondents agreed, indicating that this organisation faces high levels of competition from other organisations in the market.

6.3.8 Primary Strategy

Question seven requested respondents to provide their view on the following question, “Which IT Strategy is MOST important over the next 3 years”. The options available were:

- Improve quality / efficiency
- Increase the sales volume (new markets)
- Reduce costs / increase profit

Primary Company Strategy

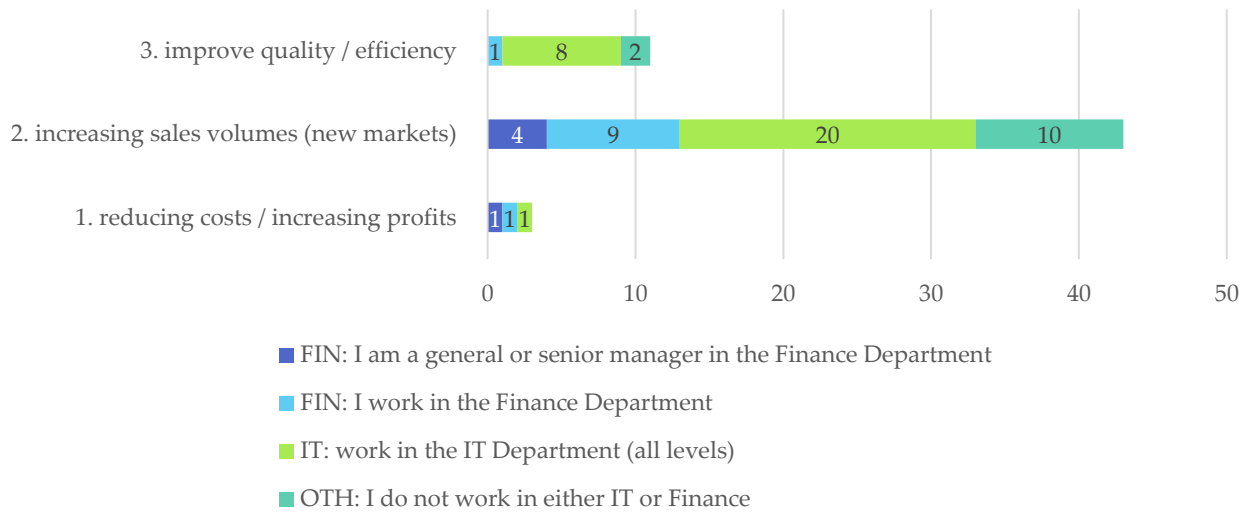


Figure 6.8 - Primary Strategy Response Per Role Group

As evident in figure 6.8 and table 6.6 the responses were similar for all the grouped roles of respondents. The primary strategy (75%) identified for all groups was to increase the sales volume of the organisation. This means increasing the number of individuals who subscribe to the services provided by this organisation.

Table 6.6 - Primary Strategy Responses

Role	1. Reducing costs / increasing profits	2. Increasing sales volumes (new markets)	3. Improve quality / efficiency	Grand Total
FIN: I am a general or senior manager in the Finance Department	1	4		5
FIN: I work in the Finance Department	1	9	1	11
IT: Work in the IT Department (all levels)	1	20	8	29
OTH: I do not work in either IT or Finance		10	2	12
Grand Total	3	43	11	57

Improving quality and efficiency was the second most selected primary objective for organisational respondents. Only three respondents felt that the company needed to take steps to either increase revenue or decrease costs.

6.3.9 Client Online Capabilities

In question eight respondents were asked what level of control they should have through an online service. The question wording was provided as, “Through an online service our clients should ideally...”. The options available for selection were:

- Be able to manipulate their services, with minimal organisational contact
- Be able to request changes to their services, but not manipulate it
- Be able to view but not be able to change anything.

Table 6.7 - Client Capabilities

Capability	Respondents	Percentage
Be able to manipulate their services, with minimal organisational contact	23	40%
Be able to request changes to their services but not manipulate it	27	47%
Be able to view but not be able to change anything	7	3%

Respondents mostly (87%) opted for the options which allowed clients to either change or request changes to their information. A minority of respondents felt that clients should only be able to view their information. Interestingly, no individuals from the finance roles felt that clients should only be entitled to view information. This could be explored further in future studies. The capabilities are provided along the x-axis of figure 6.9 with the quantity and composition selecting that capability projected on the y-axis.

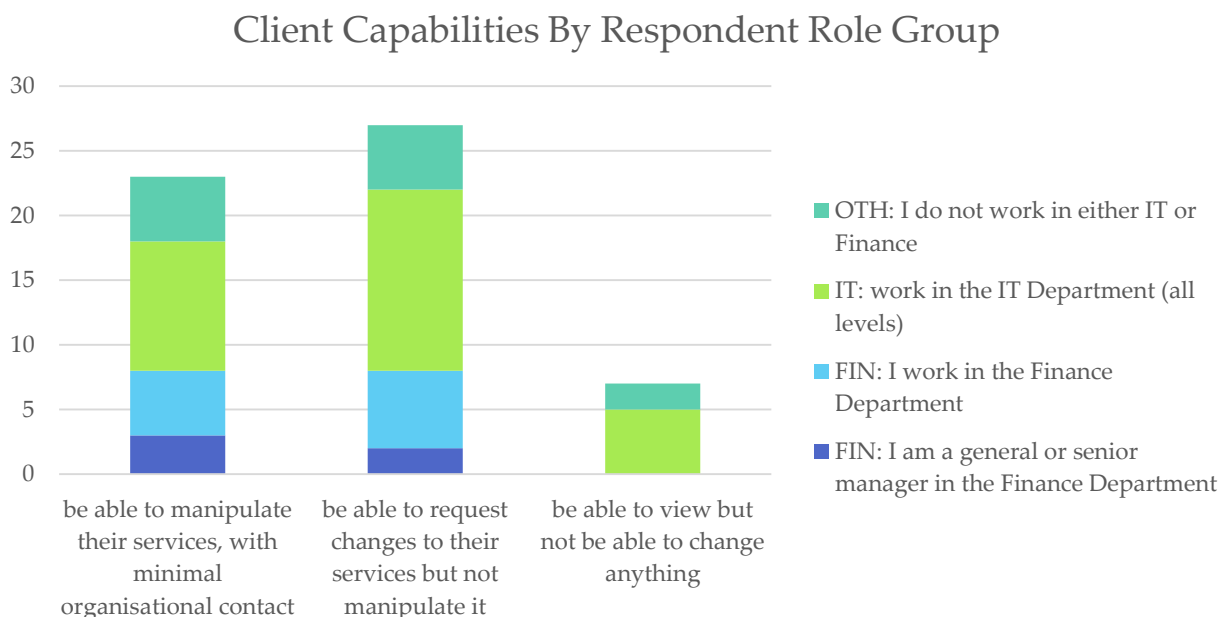


Figure 6.9 - Client Capabilities by Respondent Role Group

6.3.10 Client Online Capabilities by Respondent Group

Question nine asked respondents to indicate the level of familiarity they had with the inhibitors to cloud computing identified in chapter 4. This was provided to identify the level of knowledge which existed at the organisation for the inhibitors. “Familiarity” was selected to avoid negative sentiment from individuals who were not technically sufficient but still had good awareness around a topic. A Likert scale of familiarity levels was used as follows, 1 was the most unfamiliar and 5 the most familiar:

1. Very unfamiliar (Weighting Value of 1)
2. Bad (Weighting Value of 2)
3. Neutral (Weighting Value of 3)
4. Good (Weighting Value of 4)
5. Very familiar (Weighting Value of 5)

The mean selection value for each item was provided with a weighting value score for each selection similar to the numbering of the bullet points above. This creates a weighting level which could be applied to ascertain the inhibitors which are considered most familiar to the respondents. Therefore, for each inhibitor, the higher the overall average score the higher the group familiarity to that inhibitor. By understanding the most and least familiar inhibitors the framework could be adapted to include items which respondents could make the biggest impact in the adoption of cloud computing.

Associating a weighing to each familiarity level for the inhibitors they could each be scored a value by the selection for the familiarity rating. Using this value, a mean value for each inhibitor could be established. Once each rating was calculated the inhibitors could be ranked from most to least familiar. This provides interesting insight into areas in which the adoption of cloud computing is most likely to require the most attention. In figure 6.10, figure 6.11 and figure 6.12, higher bars indicate higher levels of familiarity (the familiarity weighting) by mean value.

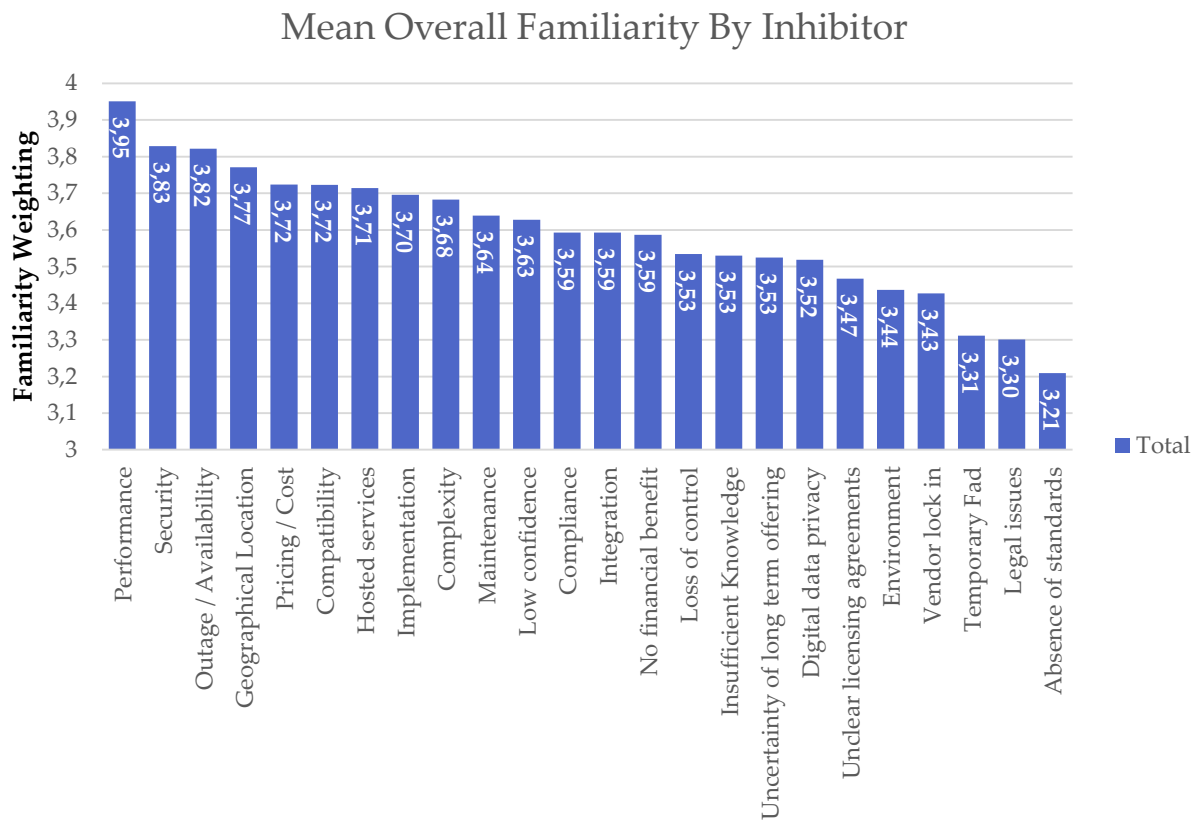


Figure 6.10 - Inhibitor Familiarity Average Score

In Figure 6.10 the each of the inhibitors is displayed along the x-axis in descending value according to the average selection value each respondent selected for that inhibitor. From this the most and least familiar inhibitors could be identified.

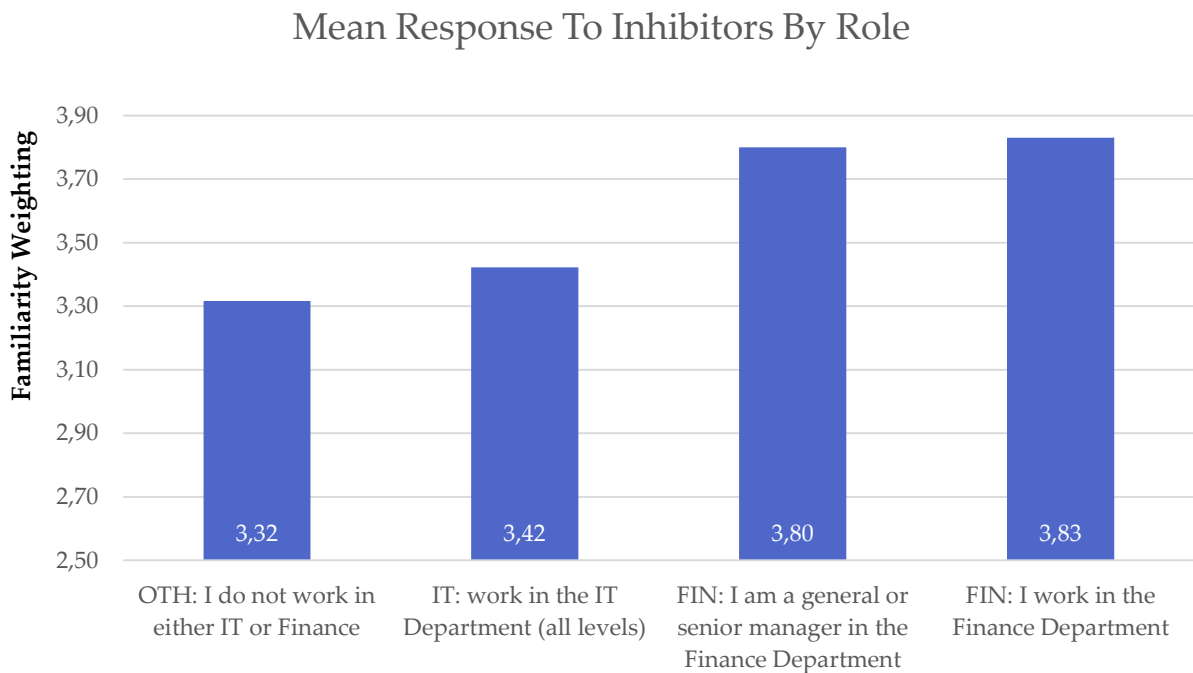


Figure 6.11 - Inhibitors by Role

When viewed by role at the organisation, respondents from finance indicated the highest overall familiarity level. This may indicate that respondents in other business roles are not sufficiently aware of business inhibitor topics.

To assess this further the researcher allocated a class for each of the inhibitors. Each inhibitor was allocated to one of the following classes:

- Business
- Legal
- Technical

While it is true that some inhibitors would have elements of more than one class, one primary class was selected for each inhibitor. The results show that inhibitors which are most closely aligned to the legal class are the least familiar with respondents. Business and technical inhibitors both scored a very similar mean response, business ultimately was the highest. Figure 6.12 shows the responses by class.

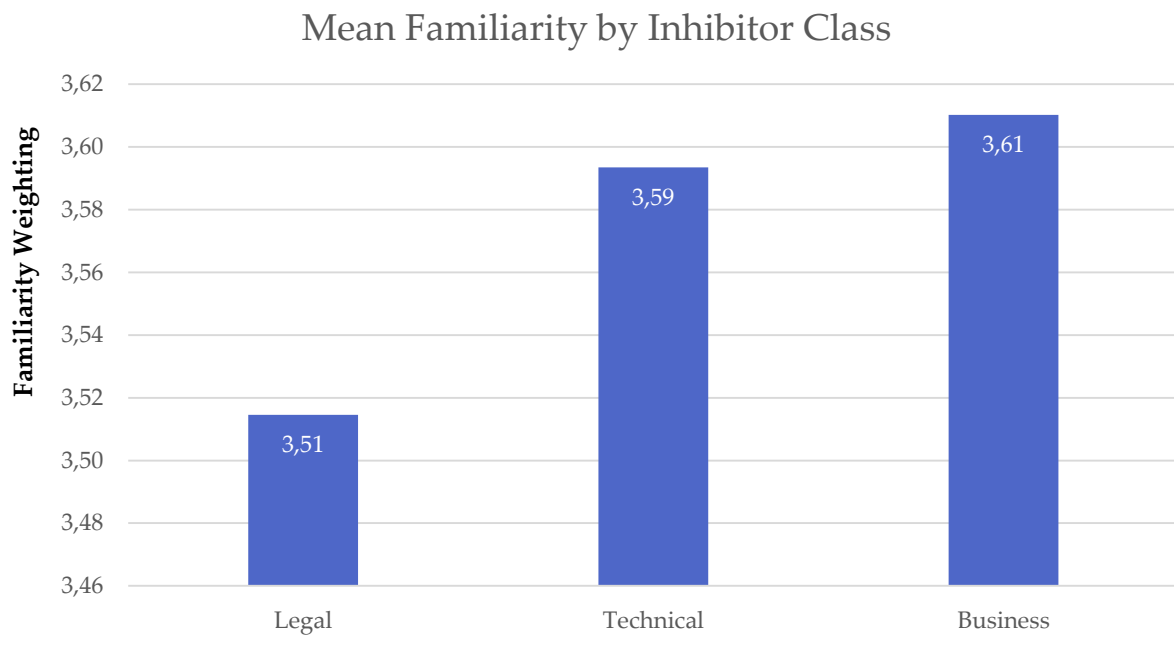


Figure 6.12 - Inhibitor Responses by Class

In order to view the disparity or alternatively the conformity of familiarity between respondent roles, a radar chart was constructed using the information. This chart, shown in figure 6.13, illustrates where there are areas in which the various respondent role groups are simply not in common understanding. This allows awareness programmes and maturity enhancement steps to be focused towards such areas. For example, the inhibitor ‘Geographic Location’ shows a fairly significant variation between the role groups, while ‘Environment’ shows very close responses.

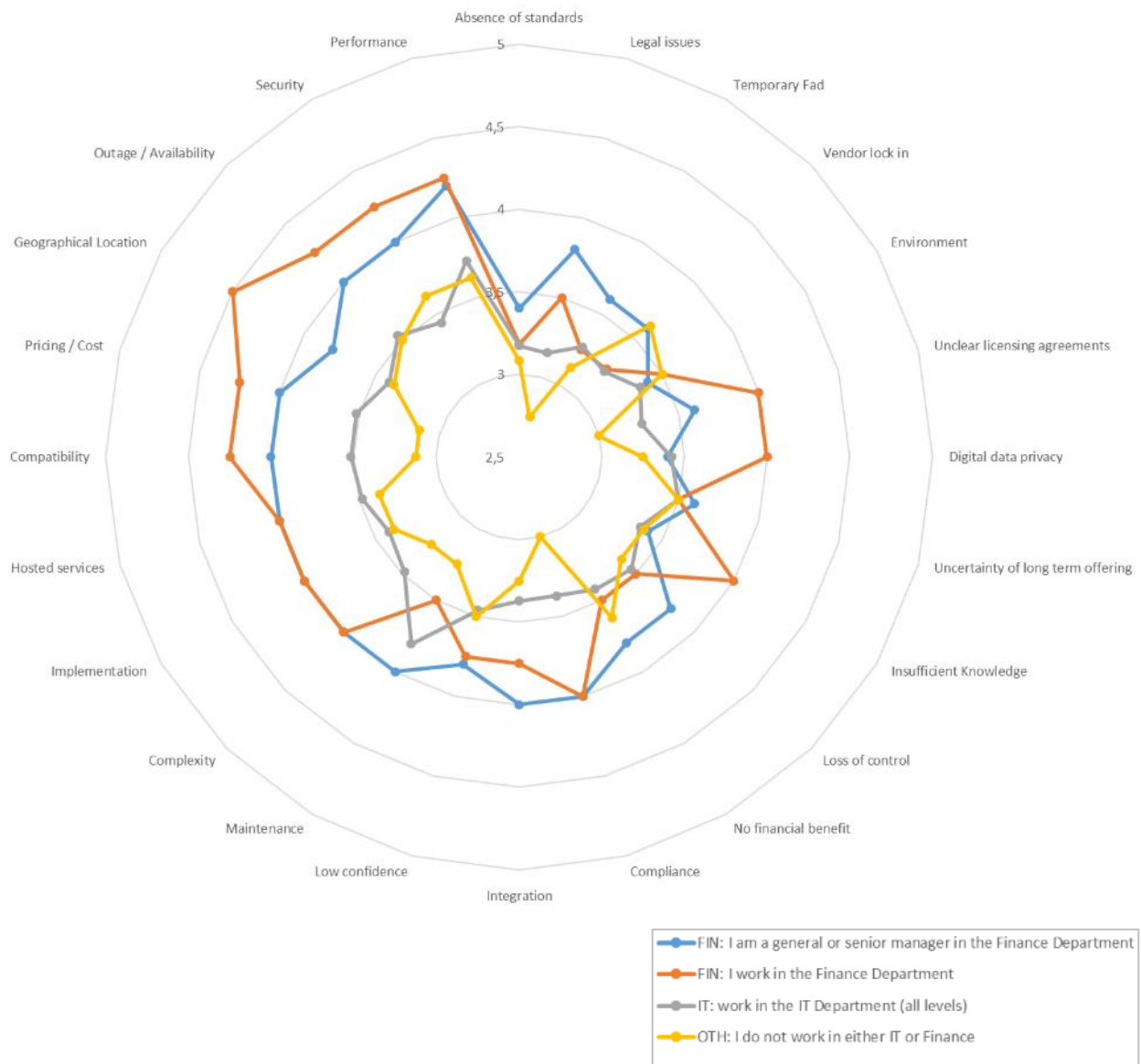


Figure 6.13 - Responses by Inhibitor and Class

Another observation is the size of the ‘rings’ for each role group. This shows that the general familiarity for the finance role groups is higher, as the rings are bigger, than that of the IT and Other role groups. This highlights the importance of including business stakeholders as part of the cloud computing evaluation process.

6.3.11 Statements About the Organisation

Question 10 comprised of seven unique statements, each of which respondents had to indicate the level to which they agreed or disagreed with that statement. The options available for the respondents were along a Likert scale of agreement ranging from Strongly disagree (1) through

to strongly agree (5). The results for each question are provided in the following sections, grouped by the responses given and composition by role.

6.3.11.1 Question 10.1

In question 10.1 respondents were asked to what extent they agreed that “our products cannot be provided as online services”. The overwhelming majority selected disagree or strongly disagree. There were no respondents who indicated that they agreed that products of this organisation could not be provided as online services. This indicates that there is at least some interest in exploring the migration of such products into cloud computing platforms. Figure 6.14 details the selections made for question 10.1.

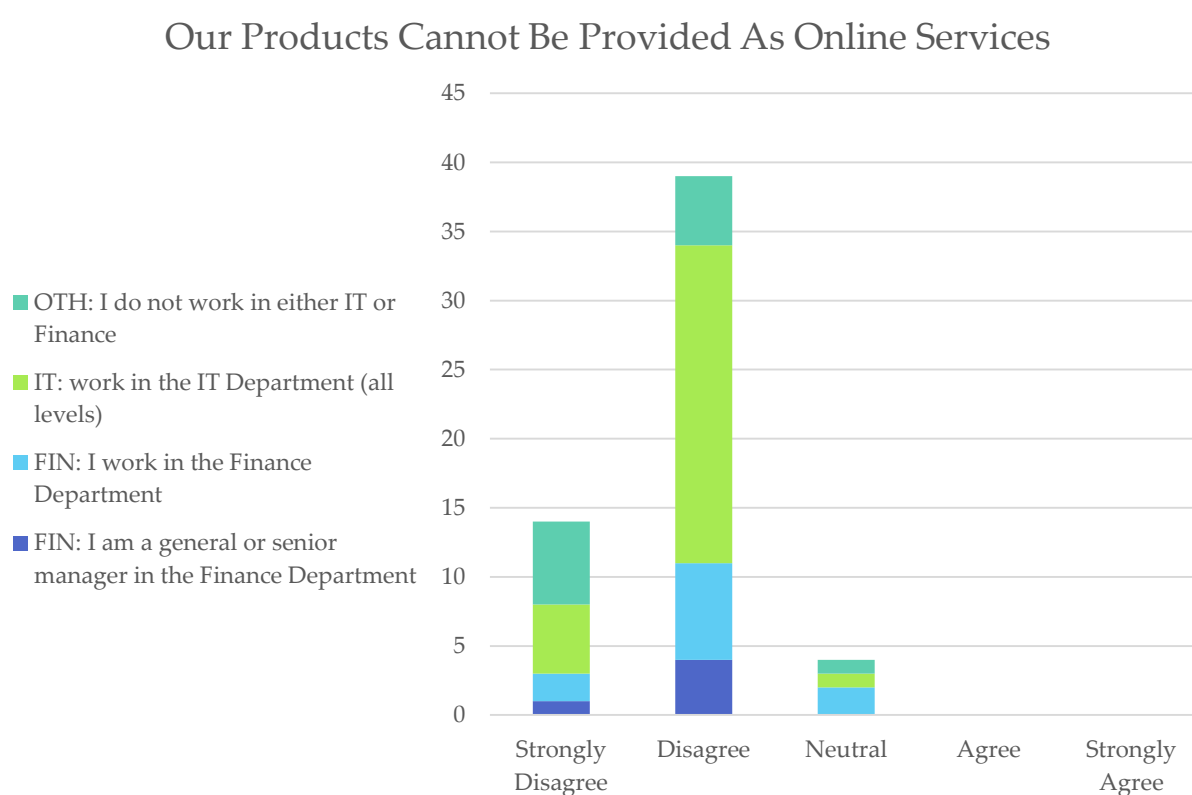


Figure 6.14 - Question 10.1 Responses

It is important that employees believe that their products are capable of being provided as online services. Noting the importance of persuasion within the innovation readiness assessment framework process (Rogers, 2003), employees must have the belief that it is possible.

6.3.11.2 Question 10.2

Figure 6.15 shows that the sentiment towards the technical competency of clients is split at this organisation. Almost perfectly symmetrical responses were observed on both sides of the neutral response option. This area is one where more exploration should be undertaken, perhaps in a separate future study.

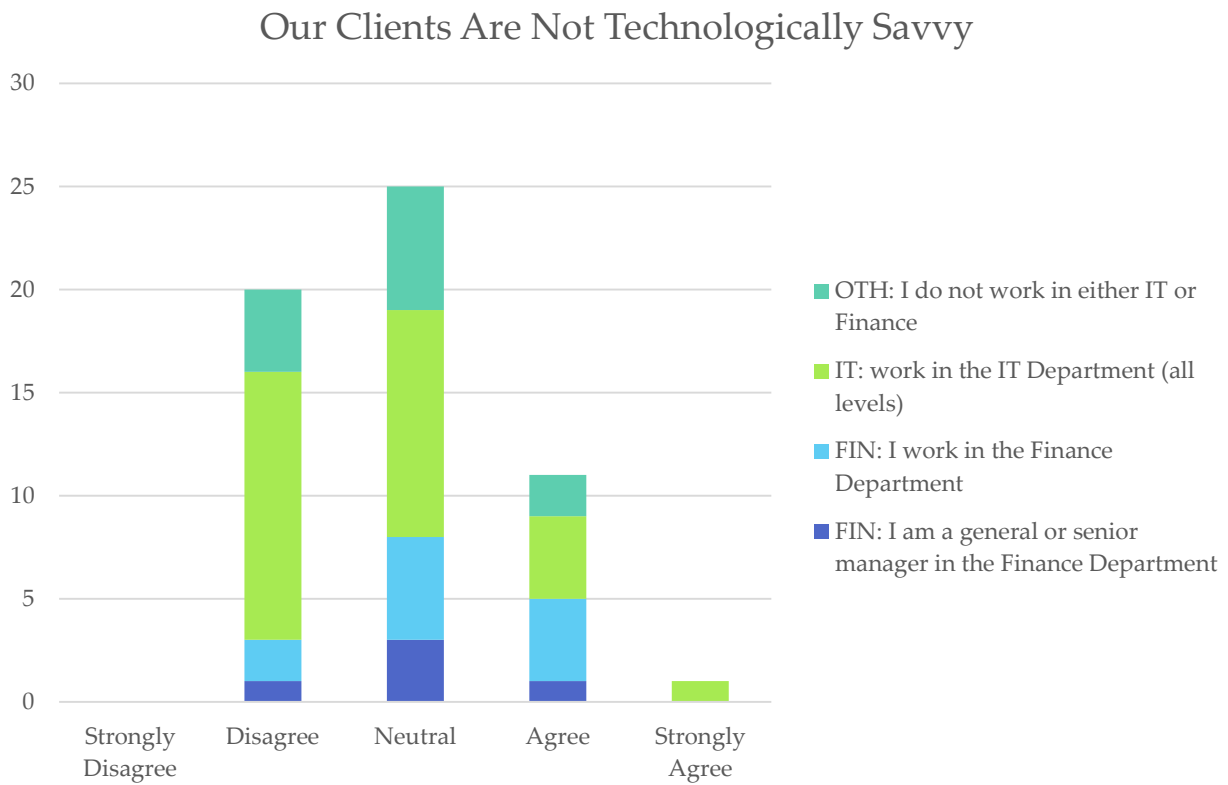


Figure 6.15 - Question 10.2 Responses

Table 6.8 shows the split among respondents regarding the level of technical savvy clients of Company A have.

Table 6.8 - Technology Savvy Clients

Role	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
FIN: I am a general or senior manager in the Finance Department	0	3	1	1	0
FIN: I work in the Finance Department	1	4	2	3	1
IT: work in the IT Department (all levels)	0	8	7	11	3
OTH: I do not work in either IT or Finance	2	6	1	3	0

6.3.11.3 Question 10.3

The next question asked respondents to what extent they agreed that face-to-face contact is essential for all clients. The ability for any client to access a face-to-face consultant was not viewed as essential for the majority of respondents as indicated in figure 6.16. A small amount of respondents did agree with this statement; it would be useful to conduct future research to explore why they felt that personal contact should be made available to all clients.

Face To Face Contact Is Essential For All Clients

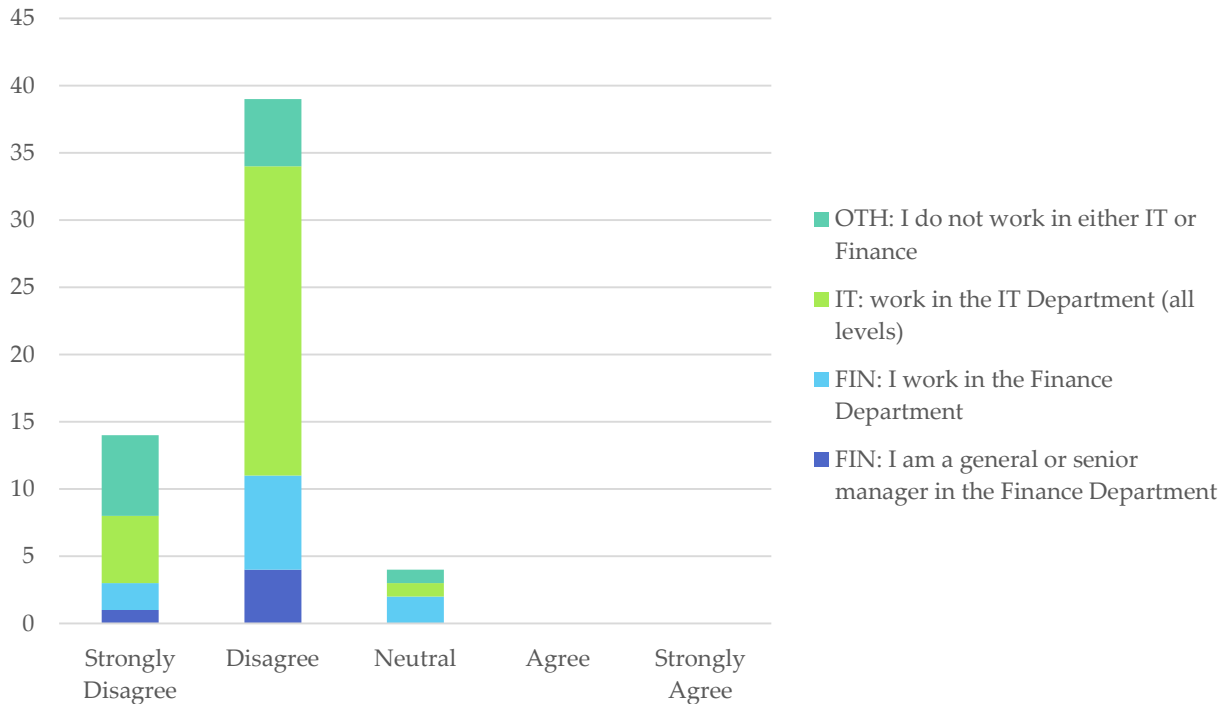


Figure 6.16 - Question 10.3 Responses

6.3.11.4 Question 10.4

Figure 6.17 and table 6.9 illustrate that there is still a mixed response to the question surrounding the ability of providing services where the national infrastructure is not perceived to be capable. This question could only truly be addressed through the implementation of a pilot project whereby the infrastructure could be properly assessed.

Table 6.9 - National Infrastructure

Role	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
FIN: I am a general or senior manager in the Finance Department	0	3	0	2	0
FIN: I work in the Finance Department	0	6	3	2	0
IT: work in the IT Department (all levels)	1	8	8	10	2
OTH: I do not work in either IT or Finance	1	5	3	3	0

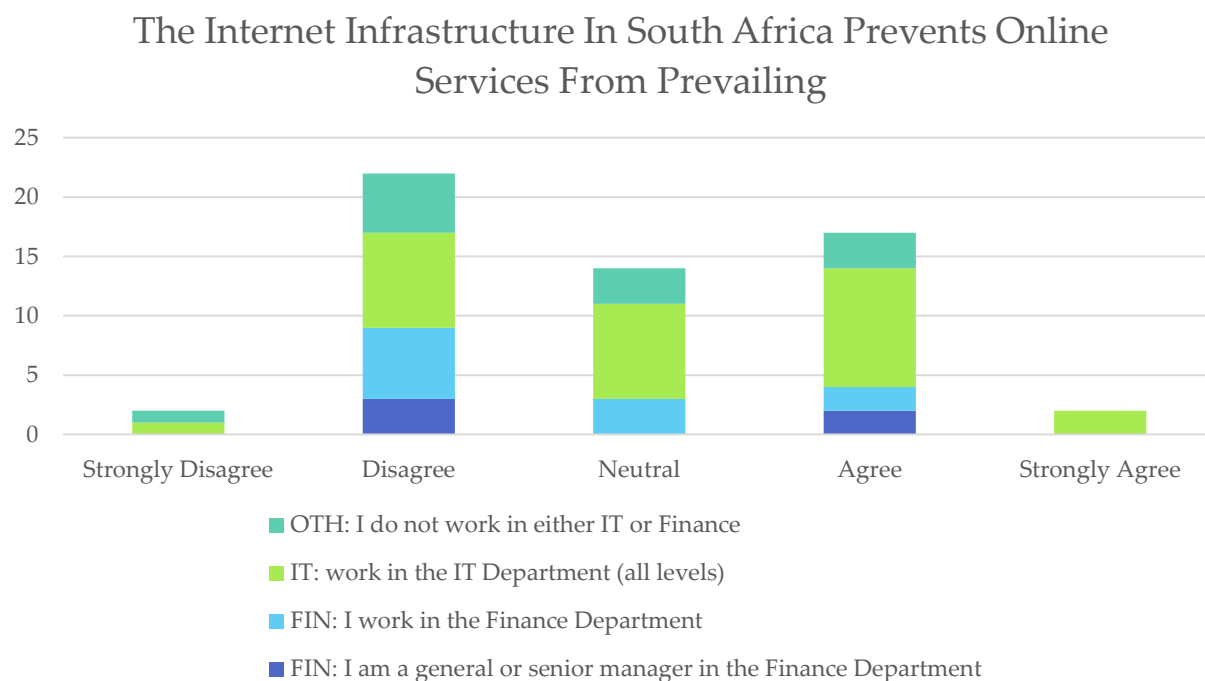


Figure 6.17 -- Question 10.4 Responses

6.3.11.5 Question 10.5

The next question explored the level to which respondents agreed that clients did not trust computer systems with their finances. Here the respondents highlighted a slight majority towards agreeing to that statement. Table 6.10 and figure 6.18 show the breakdown of responses indicating the majority disagree and strongly disagree.

Table 6.10 - Clients Trust Computer Systems

Role	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
FIN: I am a general or senior manager in the Finance Department	1	4	0	0	0
FIN: I work in the Finance Department	2	7	2	0	0
IT: work in the IT Department (all levels)	5	23	1	0	0
OTH: I do not work in either IT or Finance	6	5	1	0	0

This is an important area to address in the exploration of a cloud computing migration strategy. The view at Company A is that their clients would trust computer systems and therefore cloud computing would be a good candidate here.

Our Clients Do Not Trust Computer Systems With Their Finances

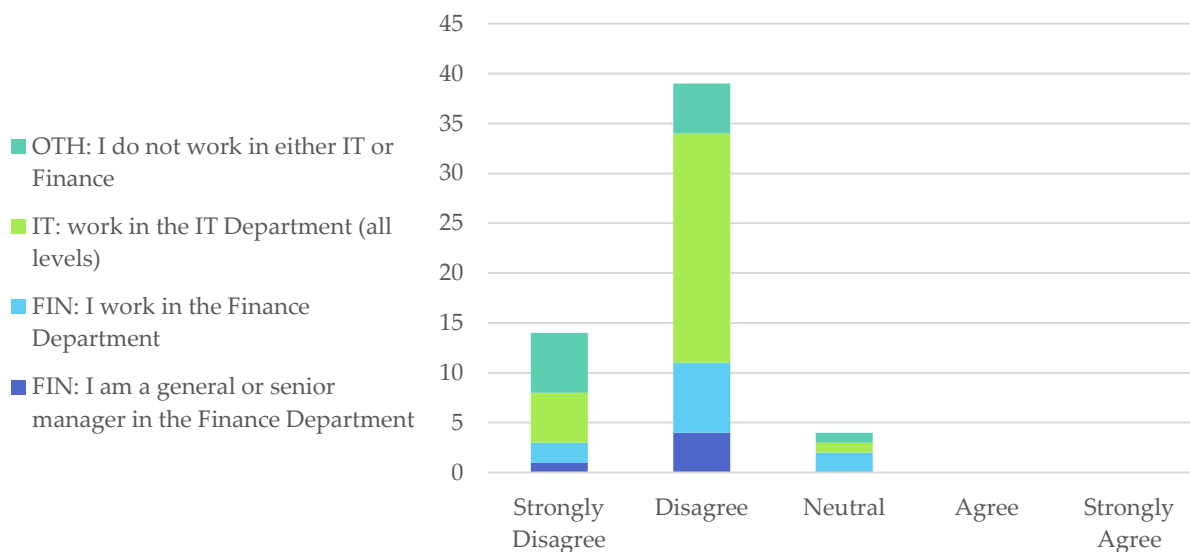


Figure 6.18 - Question 10.5 Responses

6.3.11.6 Question 10.6

Figure 6.19 shows another key concern in which respondents indicated that the majority of clients did not have a permanent internet connection. This would be a critical point when considering the solution as bandwidth on mobile internet connections is still comparatively more expensive.

Most Of Our Clients Do Not Have Internet Access

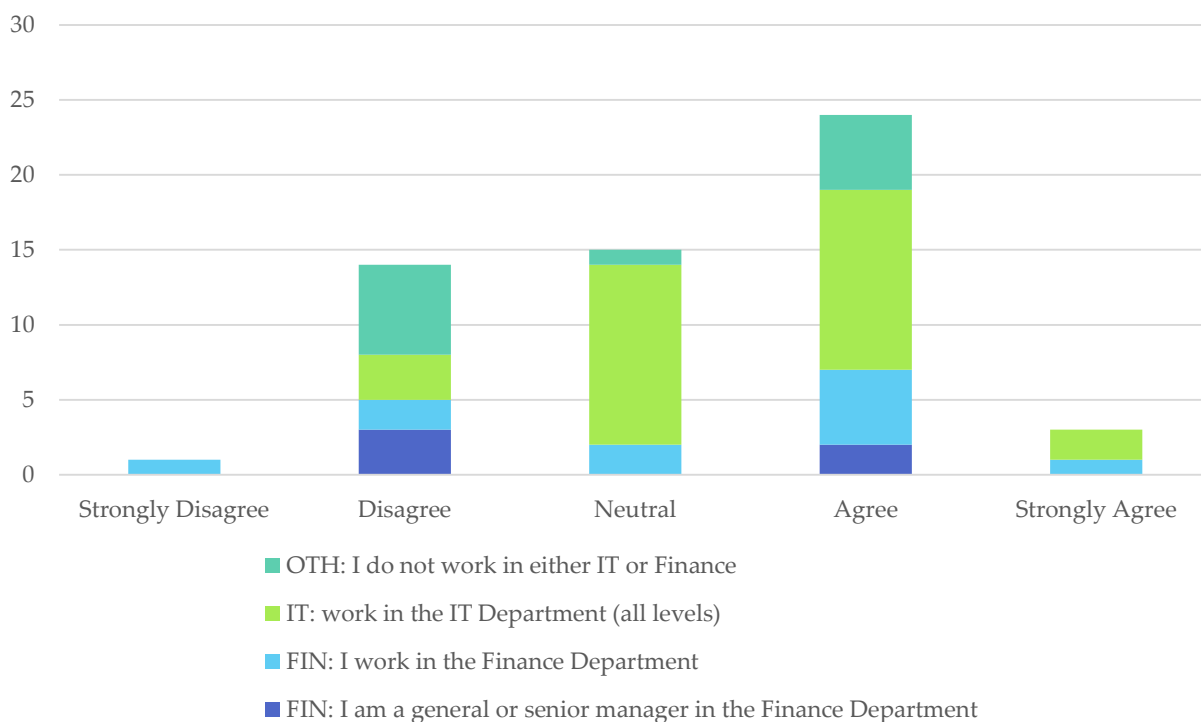


Figure 6.19 - Question 10.6 Responses

6.3.11.7 Question 10.7

The question provided for 10.7 asked respondents to what extent they agreed that accessing information from cellular phones was safer than from web browsers. The majority of respondents indicated that they disagreed as shown in figure 6.20. However, considering the result above indicating that the majority of clients did not have internet access this may result in the use of relatively less safe access locations such as free unsecured WiFi connections or coffee shop terminals. This is an interesting dynamic to explore in future research.

Allowing Clients To Access Information From Their Cellular Phones Is Safer Than From Web Browsers

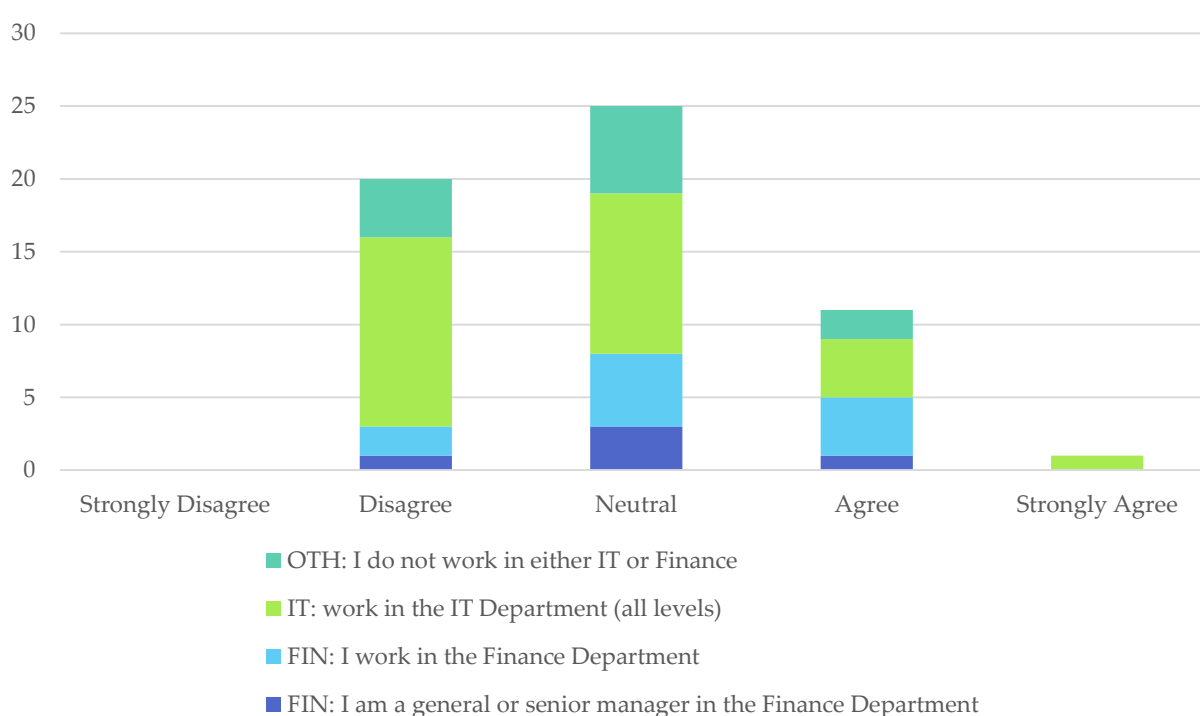


Figure 6.20 - Question 10.7 Responses

Table 6.11 provides the detailed responses to question 10.7. Here employees indicate a neutral stance with a slight advantage towards those in disagreement.

Table 6.11 - Mobile Phone Security

Role	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
FIN: I am a general or senior manager in the Finance Department	0	1	3	1	0
FIN: I work in the Finance Department	0	2	5	4	0
IT: work in the IT Department (all levels)	0	13	11	4	1
OTH: I do not work in either IT or Finance	0	4	6	2	0

6.4 Discussion of the Findings

A number of significant findings were observed in the process of analysing the questionnaire findings. When viewed against the framework proposed as part of the literature review process there are a number of interesting findings which emerge. Although one could extract a number of findings from the results of the questionnaire, the primary purpose is to identify elements which would have an impact on the proposed framework which was described in section 4.4. As the primary research output, only findings which either contradict, support or contribute to that framework are required. The following findings provide the most meaningful contribution toward the framework.

6.4.1 Finding 1 – Cloud Computing Platforms

Question two found one significant area that cloud services adoption is lacking among respondents, namely cloud platforms. This area should be incorporated into the framework to ensure proper maturity of this area is followed within the organisation. No respondents indicated any experience with one of the cloud computing platforms such as Microsoft Azure or Amazon EC2.

6.4.2 Finding 2 – Mobility is Critical

A significant finding was observed in the responses to question four. The topic of mobility is becoming significantly more important each year. Question four identified that the majority of the respondents indicated they were making use of mobile devices to perform online banking services. One of the advantages of cloud computing is the ability to enable mobile computing. The KPMG Cloud Survey Report (2014) reinforces this as it found that mobility was actually one of the critical reasons organisations were taking steps to adopting cloud computing.

6.4.3 Finding 3 – Strategic Alignment

Considering the organisational dynamics described in the responses to question six, the strategic alignment benefits provided by adopting cloud computing could respond to both business and market concerns raised. In this question it was found that respondents were most concerned with the highly competitive nature of the market, and the importance of business driving solutions to the IT environment to improve market share. This view is reiterated in the findings to question seven which found the desire to improve sales volumes as the key company strategy.

6.4.4 Finding 4 – Awareness and Training

One of the broader findings to come out of the questionnaire was the variation in levels of understanding of the cloud computing inhibitors between both business, IT and legal. The result of which is the need for improved awareness, education and training. Alarming the average familiarity level of cloud computing inhibitors was relatively low among IT respondents. This illustrates that the adoption of cloud computing is much broader than simply technical concerns.

6.4.5 Finding 5 – Bandwidth and Connectivity

Globally, cloud apps will account for 90% of total mobile data traffic by 2019, compared to 81% at the end of last year (Columbus (A), 2015).

One topic which is apparent in a two of the responses (questions 9 & 10.4) centres around some of the changes which we face, specifically in South Africa, of low speed and high cost bandwidth. This is an important point which must form part of the framework and any considerations towards the adoption of cloud computing for any product. This in light of the ‘game-changers’ described by Muller (2013) in section 3.3.2 highlights the importance of understanding the mobile strategy for cloud adoption at an organisation.

6.5 Interviews

Two experts were independently consulted for feedback and evaluation of the final framework.

6.5.1 Expert Interview 1

The first interview was conducted with a senior manager who works at Company A. The following findings resulted from this interview through open ended discussion. The senior manager expressed the view that the framework adequately addressed the objectives set out by the research project to establish a mechanism for assessing the readiness of a financial services organisation for cloud computing. Some additional findings provided by the senior manager:

- The components of the model could be easily assigned to different department or individuals who would become responsible.
- A standardised assessment should be established to perform the ‘decision’ step for the framework. This suggestion is included as part of the recommended future studies in chapter 8 as it does not require any changes to the framework itself.

6.5.2 Expert Interview 2

A subject matter expert interviewed from outside the organisation provided additional insight in the evaluation of the model. The expert recommended that a scoring criteria be applied to each position along the maturity path for each element. This suggestion would provide an easy way in which the organisation could quantify its readiness and compare the score it receives between subsequent evaluations. This suggestion could be incorporated into a future research project as the model could still be applied with no scoring criteria in place. The subject matter expert was satisfied that the model adequately addressed the objective of the research project. Additional suggestions provided by this subject matter expert included the following:

- Provide a guide for implementing the framework.
- Allow an organisation to adapt the framework by weighting the elements of the framework according to those that have the highest relevance for that specific organisation.

6.5.3 Interview findings

The finding from the interviews indicate that the model adequately addresses the objectives set out by this research project. Both experts evaluated the contents and composition of the model and agreed that none of the items should be removed. In addition to this, the experts were satisfied that none of the omitted inhibitors would discredit the effectiveness of the framework in achieving the research project objectives. A number of value adding improvements were provided which could be incorporated in future research.

6.6 Conclusion

This chapter provided the findings to the questionnaire provided as the empirical component of this research project. The questionnaire was provided electronically to employees of the financial services organisation described further as part of the research context. Respondents were asked to answer one demographic question and nine questions relating to the research problem statement. The results were collected and digitally analysed using a number of analysis tools.

Out of 170 individuals who were asked to participate through the questionnaire, 57 responded. The responses were collated and processed using a relational database for storing the information and PowerBI and Excel for processing and preparing graphs and data. The resulting data produced a number of findings which are important to the participants at Company A

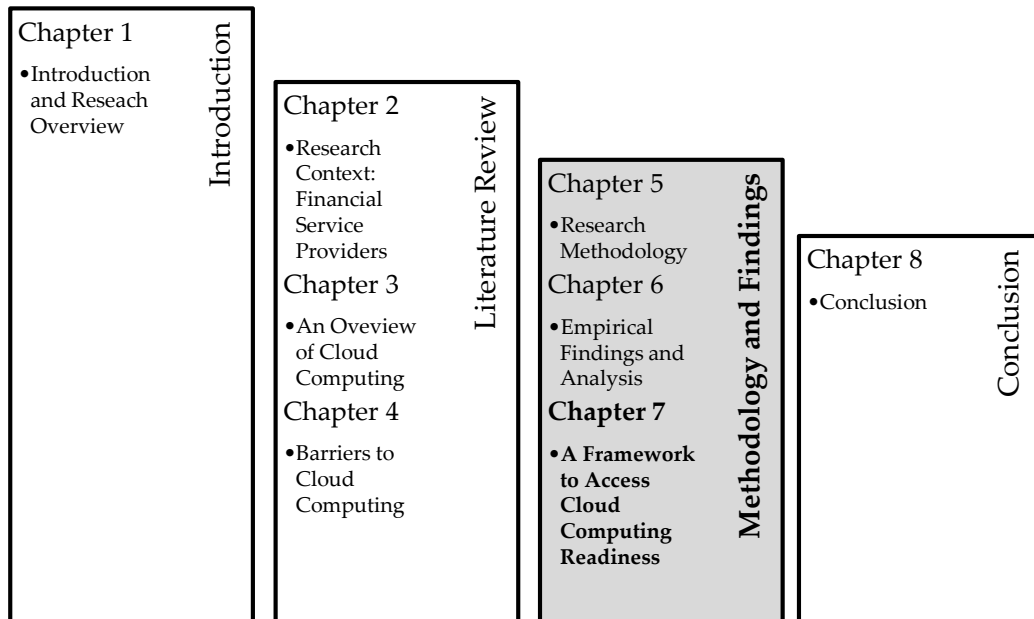
Chapter 4 provides the cloud readiness assessment framework as established in the literature review and refined with the findings from this empirical process. The key finding from chapter 6 highlighted the following critical topics raised by respondents in the questionnaire process:

- Cloud computing platforms
- Mobility
- Strategic alignment
- Awareness levels
- Bandwidth

Chapter 7 expands on these and applies these findings to the framework as defined from the literature review. A final framework is established combining these findings and those from the literature review.

Chapter 7

A Framework to Access Cloud Computing Readiness



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7 A Framework to Access Cloud Computing Readiness

7.1 Introduction

Donnelly (2015) notes that over 60% of companies surveyed that were within the financial services sector are actively preparing their cloud strategies. She points out that the challenge is trusting applications and data to the cloud. Columbus (2015) estimates as much as 25% of total Information Technology (IT) budget will be allocated to cloud computing in the year 2016. Companies are beginning to realise the benefits of cloud computing and require a way to assess their readiness.

The purpose of this chapter is to apply the findings from the empirical component of this research project against the original proposed framework. The original framework was established from the literature review as a mechanism for companies within the financial services industry to measure their readiness. The adaptation in this chapter provides a mechanism for financial service providers to assess their cloud readiness position which is the primary objective for this research project.

This process is necessary in order to assess the framework within the context of the research project. The original proposed framework from the literature review process (secondary research) incorporated the elements which featured the most in the literature reviewed. This chapter expands on that original model. The chapter begins by recapping on the findings from the empirical process and establishing the correct adaptation for each finding to the framework. Following this a detailed breakdown of the framework components is provided. The Chapter concludes with a discussion around the application of the framework.

7.2 Application of Findings

From the literature review seven key inhibitors were found which appeared in three or more papers. These key inhibitors were then grouped according to the context under either technology, environment or organisation. The three contexts aim to represent the constraints and opportunities faced when considering technological innovation as described by the Technology, Organisation and Environment (TOE) model by Tornatzky and Fleischer, (1990).

The proposed model consisted of the seven highest ranking impediments to cloud computing as discovered during the literature review process in chapter 4. These key impediments are provided in table 7.1.

Table 7.1 - Key Impediments from Proposed Framework (From Chapter 4)

Commonly Cited Inhibitors to Cloud Computing	Framework Element	TOE Context	Prevalence
Absence of Standards	Standards	Technology	3
Compliance	Compliance	Organisation	5
Digital Data Privacy	Digital Data Privacy	Technology	3
Geographical Location	Geographical Location	Organisation	3
Legal Issues	Legal	Environment	3
Outage / Availability	Availability	Environment	4
Security	Security	Organisation	6

Interestingly, of these seven key impediments the ones which respondents indicated the lowest level of understanding were: standards, legal issues and digital data privacy. These were also the only items which were found in the seven impediments that were least familiar to respondents. A similar exercise can be applied for the impediments which were identified as having the highest level of familiarity amongst respondents. These were: security, outage or availability and geographic location.

This highlights the importance of awareness as respondents are not aware of some of the most important impediments as described in the literature review. The following sections describe the adaptation to the framework in incorporating the findings from chapter 6. These findings are the result of the empirical process and build on top of the literature review process.

7.2.1 Questionnaire Finding 1 - Platform

The relative inexperience towards cloud platforms becomes a significant factor which may impact on the adoption rate of cloud computing in an organisation. Therefore, to mitigate this the framework would need to incorporate a maturity path for cloud frameworks. As these frameworks form the underlying technologies to enable cloud computing, 'Platform' has been included in the context of 'Technology'.

The following line provides the additional element as it is to be included in the final framework.

Platform	Platforms are researched and understood. Output is a report.	A Platform is motivated within the business case. Output is a business case,	Adoption or rejection decision is made based on the report and business case	Platform is implemented	Post implementation assessment of Platform. Output is an assessment report.
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7.2.2 Questionnaire Finding 2 - Mobility

The importance of incorporating a maturity path for mobility was found to be a key finding in the empirical research component. Respondents of the questionnaire indicated their familiarity with performing activities on mobile devices. By applying their existing familiarity employees could use this in adopting cloud computing for their companies own products. In order to provision for mobility within the cloud adoption framework an element for ‘Mobility’ is included in the context of ‘Environment’.

The following line provides the additional element as it is to be included in the new proposed framework.

Mobility	Mobility is researched and understood. Output is a report.	Mobility is motivated within the business case. Output is a business case,	Adoption or rejection decision is made based on the report and business case	Mobility is implemented	Post implementation assessment of Mobility. Output is an assessment report.
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7.2.3 Questionnaire Finding 3 - Strategy

The responses to question six highlighted the emphasis which market strategy plays at this organisation. The majority of respondents found the strategic innovation from business to be an important role in influencing the IT department and solutions. Secondly, the importance of understanding and being able to gain an advantage over competitors was highlighted by a similar majority of respondents. To make provision for this, the inhibitor described as ‘uncertainty of long term offering’ is incorporated under an element called ‘Cloud strategy’ within the context of ‘Organisation’. This provides the important maturity path for cloud-enabled business strategy.

The following line provides the additional element as it is to be included in the new proposed framework.

Cloud strategy	Cloud strategy is researched and understood. Output is a report.	Cloud strategy is motivated within the business case. Output is a business case,	Adoption or rejection decision is made based on the report and business case	Cloud strategy is implemented	Post implementation assessment of Cloud strategy. Output is an assessment report.
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7.2.4 Questionnaire Finding 4 - Awareness

The findings from section nine and a number of other sections highlight the reliance which cloud computing has on elements which are not technical in nature. It becomes critical that elements of awareness, education and training are made available through the framework. This crucial component is quite often omitted from literature on the topic. The final element to be added to the framework is that of ‘Awareness Training’ within the context of ‘Organisation’.

The following line provides the additional element as it is to be included in the new proposed framework.

Awareness Training	Awareness Training is researched and understood. Output is a report.	Awareness Training is motivated within the business case. Output is a business case,	Adoption or rejection decision is made based on the report and business case	Awareness Training is implemented	Post implementation assessment of Awareness Training. Output is an assessment report.
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7.2.5 Questionnaire Finding 5 - Bandwidth

The challenge which exists around the low speed and high costs of bandwidth in South Africa results in such sentiment coming through in responses to numerous questions. This is especially true of the clients of the research context organisation. The framework already includes a section for bandwidth and costs, this finding is therefore supported by the initial proposed framework and no further changes are required.

7.3 Final Proposed Framework

The final proposed framework is a culmination of both the literature review and empirical components of the research project. It includes some of the recommendations from the expert reviews and interviews. Figure 7.1 highlights the incorporation of elements from both the literature review and empirical components into the final framework, with an evaluation step provided through both the expert review and interviews.

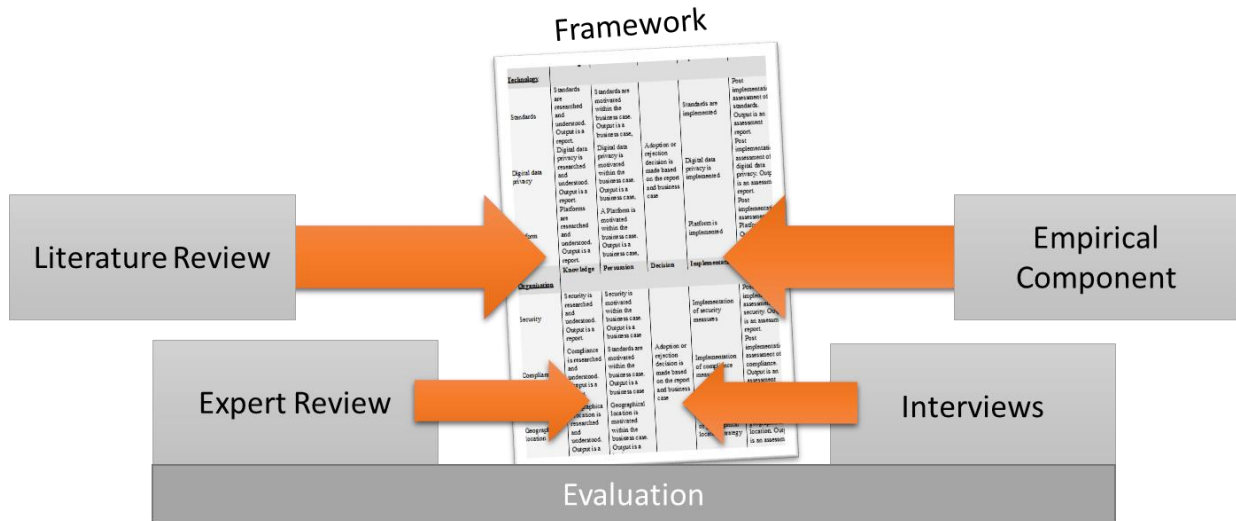


Figure 7.1 - Incorporation of the Final Framework

7.3.1 The Cloud Readiness Assessment Framework

The following table is the final proposed framework. As a framework it is intended to provide a high level structure from which the organisation could begin measuring its readiness for the adoption of cloud computing.

	Knowledge	Persuasion	Decision	Implementation	Confirmation
Technology					
Standards	Standards are researched and understood. Output is a report.	Standards are motivated within the business case. Output is a business case,	Adoption or rejection decision is made based on the report and business case	Standards are implemented	Post implementation assessment of standards. Output is an assessment report.
Digital data privacy	Digital data privacy is researched and understood. Output is a report.	Digital data privacy is motivated within the business case. Output is a business case,		Digital data privacy is implemented	Post implementation assessment of digital data privacy. Output is an assessment report.
Platform	Platforms are researched and understood. Output is a report.	A Platform is motivated within the business case. Output is a business case,		Platform is implemented	Post implementation assessment of Platform. Output is an assessment report.

	Knowledge	Persuasion	Decision	Implementation	Confirmation
<u>Organisation</u>					
Security	Security is researched and understood. Output is a report.	Security is motivated within the business case. Output is a business case	Adoption or rejection decision is made based on the report and business case	Implementation of security measures	Post implementation assessment of security. Output is an assessment report.
Compliance	Compliance is researched and understood. Output is a report.	Standards are motivated within the business case. Output is a business case		Implementation of compliance measures	Post implementation assessment of compliance. Output is an assessment report.
Geographical location	Geographical location is researched and understood. Output is a report.	Geographical location is motivated within the business case. Output is a business case		Implementation of geographical location strategy	Post implementation assessment of geographical location. Output is an assessment report.
Cloud strategy	Cloud strategy is researched and understood. Output is a report.	Cloud strategy is motivated within the business case. Output is a business case,		Cloud strategy is implemented	Post implementation assessment of Cloud strategy. Output is an assessment report.
Awareness Training	Awareness Training is researched and understood. Output is a report.	Awareness Training is motivated within the business case. Output is a business case,		Awareness Training is implemented	Post implementation assessment of Awareness Training. Output is an assessment report.

	Knowledge	Persuasion	Decision	Implementation	Confirmation
<u>Environment</u>					
Availability	Availability is researched and understood. Output is a report.	Availability is motivated within the business case. Output is a business case	Adoption or rejection decision is made based on the report and business case	Implementation of availability measures	Post implementation assessment of availability. Output is an assessment report.
Legal	Legality is researched and understood. Output is a report.	Legality is motivated within the business case. Output is a business case		Implementation of legal measures	Post implementation assessment of legal measures. Output is an assessment report.
Bandwidth and Costs	Bandwidth and costs are researched and understood. Output is a report.	Bandwidth and costs are the business case. Output is a business case		Implementation of measures to reduce bandwidth and costs	Post implementation assessment of bandwidth and cost. Output is an assessment report.
Mobility	Mobility is researched and understood. Output is a report.	Mobility is motivated within the business case. Output is a business case,		Mobility is implemented	Post implementation assessment of Mobility. Output is an assessment report.

7.4 Composition of Framework

The framework is logically grouped according to the contextual components of the TOE model. This provides for three separate areas under which the maturity assessment process must be performed. The maturity process itself is adapted from the model of Stages in the Innovation-Decision Process (Rogers, 2003). Following the maturity scale each of the component areas is provided with the elements in each component area and the source of their inclusion as the literature review or empirical process.

7.4.1 Maturity Scale (Stages of Innovation)

The stages of innovation are described comprehensively in section 4.3.3. These serve to guide the adoption process through a structured mechanism from exploring the new innovation, to decision

making and implementation. The maturity scale is provided below, and located along the top edge of the framework:

	Knowledge	Persuasion	Decision	Implementation	Confirmation
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The process provides deliverable outputs to monitor progress and evaluate outcomes from each step. The scale is based on the innovative decision making process for adoption (Rogers, 2003).

7.4.2 Technology Components

The technology context is provided to explore the adoption requirement at the technical Information and Communication Technology (ICT) level. This is absolutely essential to ensuring the cloud adoption process is grounded in practical and achievable technological foundation.

Technology	Description	Source
Standards	Standards describe the agreed principle processes and technologies implemented such that they adhere to best practice.	Literature Review
Digital data privacy	Privacy of digital data relates to the protection, confidentiality and security of personal information	Literature Review
Platform	Platforms describe the technical solutions on which the cloud adoption would take place.	Empirical

7.4.3 Environmental Components

The environmental context is provided to explore the adoption requirement at the organisational level. This ensures significant support is achieved from the business stakeholders.

Environment	Description	Source
Availability	Availability provides a level of assurance that access to the solution is available when required, in the desired format	Literature Review
Legal	Legal encompasses all legislative requirements	Literature Review
Bandwidth and Costs	Bandwidth and costs describe the operating expense required to serve and consume services	Literature Review & Empirical
Mobility	Mobility describes the reach of the solutions to mobile devices and locations.	Empirical

7.4.4 Organisational Components

The organisational context represents the organisation, policies, procedures and other items which the organisation has a level of control over.

<u>Organisation</u>	Description	Source
Security	Security protects your solutions, information and networks from attack and theft	Literature Review
Compliance	Compliance ensures procedure and policy for cloud adoption follows global best practices	Literature Review
Geographical location	Geographical location ensures the jurisdiction concerns relating to data ownership are addressed.	Literature Review
Cloud strategy	Cloud strategy is explores the long term goal for the cloud solution implemented.	Empirical
Awareness Training	Awareness Training describes the education and training aimed at ensuring all employees understanding the operations and benefits of cloud computing.	Empirical

7.5 Framework Application

The method of application for the framework would be an independent assessment for each product or service. For each product or service being considered for migration into a cloud computing environment the framework would guide the process and ensure sufficient attention is being applied to the critical impediments which may be delaying such adoption. To perform the assessment, the following steps would need to be performed for each service being assessed:

- Identify Service.
- Assess Component Areas.
 - Assess Technology Elements.
 - Assess Organisational Elements.
 - Assess Environmental Elements.
- Establish maturity level for each (see table 7.2).
- Implement steps to improve maturity for areas which are lower.
- Reassess periodically.

The framework guides the adoption process by providing a structured approach to migrating services which operate on traditional IT platforms to cloud computing environments. This is achieved by the innovation maturity process which is incorporated into the framework. Each of the elements of the framework can be independently assessed and executed. This avoids any bottlenecks, and allows for the progress of a product to be monitored for impediments which are hindering progress.

Table 7.2 shows an example of a sample product (Product X) being assessed for cloud computing readiness. As is shown, the inhibitor assessment shows varying levels of maturity to innovation. Legal and Awareness Training are areas in which little progress is being made. Therefore, the reviewer of this framework assessment could focus the attention of more resources in these areas.

Table 7.2 - Product Assessment Example (Random Sample Data)

	Knowledge	Persuasion	Decision	Implementation	Confirmation
<u>Technology</u>					
Standards		✓			
Digital data privacy				✓	
Platform					✓
<u>Environment</u>					
Availability		✓			
Legal	✓				
Bandwidth and Costs				✓	
Mobility		✓			
<u>Organisation</u>					
Security				✓	
Compliance		✓			
Geographical location				✓	
Cloud strategy					✓
Awareness Training	✓				

A similar dashboard could be presented for each product item which is being assessed for cloud readiness. These clear and concise views establish the strategic progress of the cloud adoption process for each product. The process of assessment for each product could also be standardised against this framework. The decision step must always reflect collectively on all elements within a context and therefore it is provided as a single maturity step for each context.

7.6 Conclusion

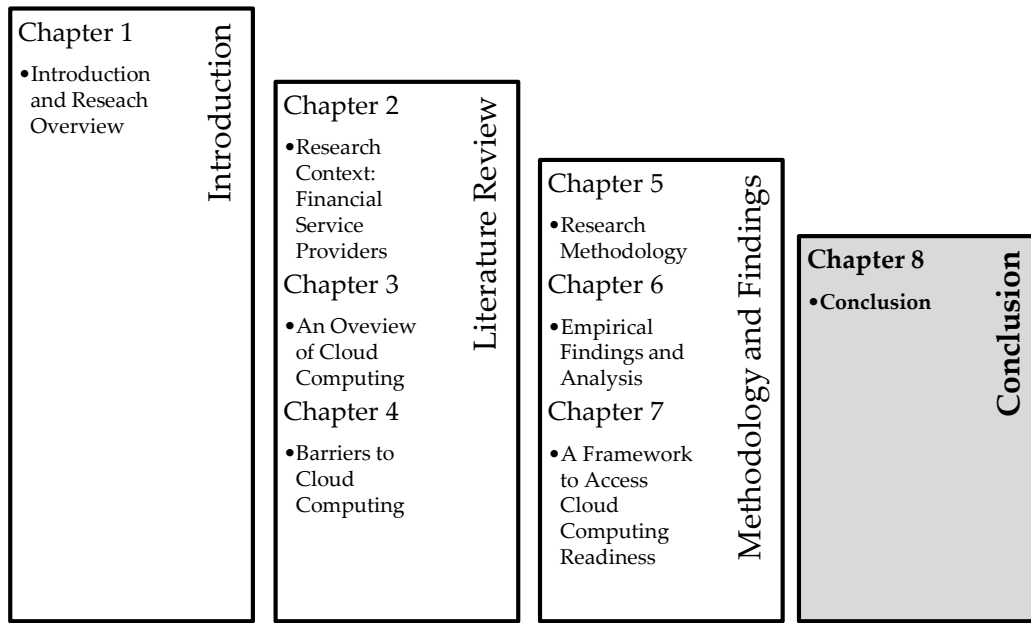
The framework provided in this chapter achieves the objectives set out by this research project to establish a means to identify the adoption maturity level of an organisation to migrate its services to a cloud computing environment. The chapter initially provided an introduction to the framework and an application of the findings from the empirical process to the initial proposed framework.

A modified and improved framework was established highlighting each of the new impediment recommendations. The new impediment elements were grouped according to either the Technology, Environmental or Organisational context. In conclusion the chapter discussed the application of the framework for a single sample product. This chapter provided a framework to address the primary research question which sought a means for a financial services company to assess its readiness for the adoption of cloud computing.

Using this framework financial services organisations are better positioned to not only assess their own readiness level, but follow a maturity path for a number of critical elements of cloud computing. By improving the maturity level at the organisation realising the benefits of cloud computing becomes possible. The next chapter provides the conclusion for the research and describes potential future research areas emanating from this research.

Chapter 8

Concluding Remarks



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8 Concluding Remarks

8.1 Introduction

Chapter one provided the introduction and background, and discussion of the research problem area and objectives. The second chapter outlined the context of the research project within a financial services organisation in South Africa. Chapter three detailed the benefits of cloud computing with the impediments and original framework following in chapter four. The fifth chapter provided the methodology and design of the research. In chapter six, the empirical questionnaire process was described and followed by the findings in chapter seven.

Finally, this chapter provides a conclusive summary or discussion for this research project. It begins by discussing the contribution made by this study. Next the research objectives will be discussed, this will be done by looking at the primary research question the three secondary research questions. An outline of the research methodology and the theoretical framework will then be provided. The chapter will then conclude with an evaluation of the research project in respect of the overall findings, recommendations for implementation and lastly suggestions for future studies.

8.2 Theoretical Frameworks

The primary underlying theory of this research project is the TOE Framework. The TOE was chosen as a result of the emphasis it places upon adoption at an organisational level as opposed to an individual level. It is at this level which the Diffusion of Innovation, Technology Acceptance Model and Unified Theory of Acceptance and Use of Technology is primarily focused on (Oliveira & Martins, 2011).

The TOE examines the process of how an organisation goes about adopting and implementing technological innovations, which made it appropriate for this research project. The adoption and implementation process is believed to be largely influenced by the various contexts namely, technology, organisation and environment (Tornatzky & Fleischer, 1990). The three contexts aim to represent not only the constraints but also the opportunities faced when considering technological innovation.

Thus when assessing the technology innovation of cloud computing and more specifically the adoption of cloud computing organisations can factor in all possible strengths and weaknesses. Further to this, Tornatzky and Fleischer (1990) state that these three contexts influence the way in

which organisations: view the need, search for and lastly adopts new technology (which is a core element to this research project).

In Chapter Four a framework is proposed for assessing the readiness of financial services for migration to the cloud based on a literature survey of recent publications related to cloud computing adoption. From this literature, the inhibitors of adoption success are derived and classified according to the TOE. The primary inhibitors, identified from the content analysis were: Security (of data and information); Compliance; Digital data privacy; Outage and availability; Geographical location; Legal issues; Absence of standards; and Internet bandwidth and costs. In order to determine a means of overcoming these inhibitors, they were aligned to the three contextual components of the TOE model (technology, organisation and environment).

The Innovation-decision making process explains the steps of the process in which individuals or groups of people adopt an innovation, such as cloud computing (Rogers, 2003). The steps of the Innovation-Decision model are incorporated, to provide a means of determining the progress toward adopting cloud computing for a particular financial service. The innovation-decision making process consists of the following stages;

- **Knowledge:** Individuals become more aware of the innovation (cloud computing) and begin to develop a better understanding of its abilities.
- **Persuasion:** Individuals will start developing either a favourable or unfavourable attitude towards the innovation (cloud computing).
- **Decision:** A decision is made to either adopt or reject the innovation (cloud computing).
- **Implementation:** this involves putting the innovation (cloud computing) into practice or use.
- **Confirmation:** The review stage after implementation whereby individuals evaluate the results of the innovation-decision already made (i.e. accepting or rejecting the adoption of cloud computing) (Rogers, 2003).

This model is incorporated into the framework as a measure of progression towards the adoption of cloud computing. This provides a structured and logical set of steps to measure progress of such adoption. Chapter eight details the application of the findings to the framework. The following section provides an overview of the research methodology used to conduct the study.

8.3 Research Objectives

The primary objective of this research project is to produce a framework which will assist business managers and executives in assessing the readiness of their financial service offerings for delivery using cloud computing.

At the commencement of this research project, a primary research question was proposed and three sub-questions, in Sections 1.2.1 and 1.2.2 respectively. The purpose of these questions was to guide the focus of the research project. In order to determine or evaluate the success of this research project, an assessment of the research questions was conducted. The Primary research question that is research project investigates is as follows: *How can a South African financial service provider determine the readiness of financial services for adoption of public cloud computing?*

Using the framework, managers and executives should be better informed of the major impediments and key requirements of preparing their services for cloud computing, and the steps required to improve the organisational maturity of those services. In order to achieve this primary objective three secondary objectives (sub-research questions) were considered:

1. *How can cloud computing be used to improve the financial services of a medium-sized South African financial service provider?*

The theoretical baseline (TOE) of this research objective was addressed in Chapter Three. The background of cloud computing was discussed along with a concise overview of its definition, characteristics, service models and deployment models, all of which formed the foundation of this research project. Next the enablement options of cloud computing were explored followed by the potential added value.

From the literature reviewed it has been noted that, cloud computing is a maturity of a combination of numerous technological advances and thus has become a more realistic option for many organisations. The cloud can offer multiple advantages (from both a business and Information Technology (IT) perspective) which organisations of all sizes and industries can benefit from should they choose to adopt such an approach. For financial service providers in South Africa, the context for this research project, it is important to leverage the benefits that cloud computing can contribute to their business and clients, whilst having a digital presence and quickly bringing new products and services to the market (Scott, 2015).

The empirical component of this research project refined a framework which financial service providers can use to assess their readiness for cloud computing. As part of the process of assessment, there is a maturing of the financial services of the organisation in anticipation for cloud computing migration. In doing so these, organisations will benefit from some of the benefits described in chapter three. This was recognised by respondents as part of the empirical research questionnaire.

The findings in chapter seven explored some of the benefits the organisation would be able to achieve. The respondents indicated a desire to adopt cloud computing technologies in order to improve their market position.

2. What are the factors which impede the adoption of cloud computing at South African financial service providers?

Chapter Four, proposed a means of assessing the adoption maturity of financial services for migration to the cloud, and more specifically the moving of highly confidential financial services to the public cloud. This chapter therefore began by discussing the perceived weaknesses of cloud computing. Firstly, the risks or concerns were evaluated and summarised with the aid of a literature matrix. The matrix provides a view of the literature reviewed with an intersection of the inhibitors identified from this literature, thus the primary inhibitors which prevent the adoption of cloud computing were established. The original inhibitors that were applicable and most relevant to financial services were noted, namely: security (of data and information), compliance, digital data privacy, outage and availability, geographical location, legal issues, absence of standards, internet bandwidth and costs.

From the literature reviewed it has been noted that, the above mentioned inhibitors were found to delay the adoption of cloud computing at financial organisations. In South Africa, adoption of cloud computing, amongst organisations was found to be dramatically slower when compared to other countries (Moyo, 2015). For this to be improved organisations should systematically address each of these points in a structured and managed manner. A way in which to do this is through aligning the inhibitors to the three views of the Technology, Organisation and Environment (TOE) framework, however the requirement for a maturity process remained. Consequently, the innovation-decision making process was introduced and used to explain the phases in which individuals or groups of people

adopt an innovation. The innovation-decision making process was then incorporated into the framework as a measure of progression towards the adoption of cloud computing. This provided a structured and logical set of steps to measure progress of adoption.

The impediments for cloud computing adoption which were identified in chapter four formed the foundation of the questionnaire which was used in the empirical component. It is these impediments which inform the maturity path to cloud computing, therefore they are the critical components of the research output framework. One item which respondents were quick to point out was, the importance of improvement to the national infrastructure and bandwidth, in order to enable cloud services.

3. What attributes of a financial service are required before cloud migration can be achieved?

Chapter Four defined the impediments to cloud computing and provided the attributes for assessment which are required to migrate financial services to cloud computing (Introna & Piderit, 2013). The impediments were then analysed further in the empirical component of the research project. As part of this process the attributes of the research context organisation and therefore its associated services were assessed by respondents. This provided the insight into which attributes were key for consideration before migrating to cloud computing by using the research framework.

The findings suggested five key attributes of a financial service which should be assessed in addition to the impediments described in chapter four. The five attributes were found to be the platform requirements, mobility, cloud strategy, awareness levels and bandwidth requirements for each financial services which was being applied to the readiness assessment framework. These attributes were incorporated into the original framework to address the specific requirements for each attribute.

As described above the objectives of the research were achieved in the development of the output framework. The refinement of the framework was completed by following the Design Science Methodology and associated Design Science Guidelines, Hevner, March, Park and Ram (2004) and an empirical component. This process incorporated steps which systematically addressed each of the research questions as described previously. The next section provides more details pertaining to the theoretical frameworks which were used to develop the readiness assessment framework.

8.4 Research Methodology

The research methodology was addressed in Chapter One (section 1.6) with the aid of Table 1.1, which explained the research areas approach and the reason for selecting the approach – all of which was reiterated and expanded upon in Chapter Five. The paradigm that was used within this research project was that of interpretivist. This research project is positioned towards the centre of the extremes of Positivist and Interpretivist research. However, through the literature review process the research was focused more towards the positivistic extreme with quantitative methods being applied to quantify findings. The empirical process positioned the research more towards the interpretive extreme as more qualitative methods were applied. The most common differentiator between research approaches is the type of research methods, which can be categorised as either qualitative or quantitative in nature. This research project uses triangulation or mixed methods as follows:

- **Literature Review: Positivist Paradigm using Quantitative Methods**
 - The literature review section made use of an assessment matrix to quantify the most significant inhibitors of cloud computing adoption.
- **Data Analysis: Positivist Paradigm using Quantitative Methods**
 - The analysis of the data gathered made use of quantitative techniques i.e. Microsoft excel (data presentation), Microsoft SQL Server (storing and processing data), PowerBI (analyse data)
- **Empirical Study and Findings: Interpretive Paradigm using Qualitative Methods**
 - Methods used included: Questionnaires and Interviews, which made use of open-ended questions and a Likert scale - ensuring questions remained subjective.
- **Expert Review and Interviews**
 - Used qualitative techniques to establish the evaluator component required by the design science guidelines.

The research methodology chosen for this research project is Design Science. The Design Science Methodology was applied using Hevner, *et al* (2004) Seven Design Science Research Guidelines.

1. **Design as an Artefact:** This research project produces a framework for assessing the readiness of financial services for cloud computing.
2. **Problem Relevance:** The technical complexity of cloud computing creates a level of confusion in which business decision makers are unable to assess the feasibility of their services.

3. **Design Evaluation:** Numerous techniques are utilised to evaluate the effectiveness of the framework towards providing readiness assessment ability.
4. **Research Contributions:** The contribution of this research is a framework which business managers and executives from financial service organisations are able to assess their unique products for cloud computing.
5. **Research Rigor:** Using techniques and methods incorporating expert reviews and questionnaires, the research project seeks intensive rigor towards ensuring a credible output.
6. **Design as a Search Process:** Experts will be essential in establishing the relevance and practicality of the output towards seeking a solution to the problem area.
7. **Communication of Research:** By presenting findings from this research project at relevant conferences and publishing findings in academic journals relating to this problem area, exposure to the research project will be maximised.

Hevner, *et al* (2004) explain that Design Science focuses on creating and evaluating IT artefacts which have been designed in order to solve real organisational problems. Design Science is therefore well suited to research that ends in an artefact such as the readiness assessment framework proposed throughout this research project.

Web-based questionnaires were used as one of the primary data collection method within the research project. First a pilot questionnaire was drafted and sent for peer review, only after feedback was received was the primary questionnaire then circulated to the suitable respondents. The questionnaire was web-based and made use of www.kwiksurveys.com for both the pilot and primary questionnaires. Secondary data for this research project comprised of information collected from various sources (Theories and frameworks, past research projects, academic websites and articles from various academic journals, reports and books, conference proceedings and various internet sources. This information was used throughout the research process.

8.5 Research Evaluation

The expert review process and interviews provided an evaluation component to the research project. During these processes the research was evaluated through the identification of characteristics as described in section 5.7.

8.6 Contribution of this Study

The problem or risk specifically being addressed in this research project is that financial service providers are not capable of assessing their own services for readiness to migrate to the cloud (Marcos, Leichter, Losa, Medina, Reyes, Rodriguez and Wang, 2015). As the financial services industry is highly competitive, this results in an increased risk of loss of revenue through competitor adoption of similar services. The greater South African financial services industry also stands the risk of falling behind the innovation of other organisations in countries which are making progress to adopting cloud computing.

This research project provides a few significant contributions described below:

- The research establishes a list of impediments which organisations within the South African financial services sector might experience when attempting to adopt cloud computing.
- The research project contributes a framework for assessing the readiness of financial services for cloud computing.
- The framework provides some maturity assessment steps for improving that readiness level.
- A questionnaire for assessing the level of awareness that exists for cloud computing at a financial services organisation in South Africa.

The contribution is a unique combination of both secondary and primary research on the topic of cloud computing readiness for an organisation that operates within the South African financial services sector.

8.7 Limitations of the Study

This research project was undertaken within the context of a South African financial services organisation. This influenced the framework as it incorporated elements which are specific to the context of the South African market. For example, bandwidth is a significant impediment in South Africa. In other regions specific legislation such as privacy or governance laws may have a much greater influence.

8.8 Directions for Future Studies

The output framework of this research project provides a cloud readiness assessment tool which financial services organisations can use as a part of their migration to cloud computing. This

research project has identified a number of future studies which would contribute to the research area. Future research could be conducted to establish the effectiveness of the research framework in other industries outside of the financial services sector. Cloud computing is applicable across many domains and therefore the framework should be applicable in those domains.

Another area in which future research could contribute would be in the application of the maturity assessment using the framework. Providing a detailed set of instructions for organisations to follow when implementing the model would improve its adoption. One of the subject matter experts reviewed suggests an implementation guide be developed for the framework which organisations could use to perform their assessments. Specifically, a standardised assessment should be established to perform the 'decision' step for the framework.

Another direction for future studies which was discovered during the empirical phase involves the exploration of the optimal level of control which clients should be authorised over their information over cloud services.

8.9 Conclusion

In conclusion, there are a number of benefits which organisations can realise through the adoption of cloud computing, however certain impediments often result in hesitation. Through the application of the framework provided as the output of this research, organisations within the South African financial services sector could assess the readiness of their cloud services by following the maturity path provided in the framework.

This research project set out to establish a means for a financial services organisation to measure its readiness for the adoption for cloud computing. In response to this a framework was established by combining the secondary data from literature reviews with the primary data collected in an empirical process. The resulting framework provides a set of maturity steps for the introduction of an innovation technology, namely cloud computing, by following a migratory path to implementation. This was achieved by using the design science guidelines.

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List of Acronyms

ADSL	Asymmetric Digital Subscriber Line
BA	Business Analyst
CEO	Chief Executive Officer
CIO	Chief Information Officer
CPNI	Centre for the Protection of National Infrastructure
EC2	Elastic Compute Cloud
FET	Further Education Training
FIN	Financial
FSB	Financial Service Board
HR	Human Resource
IaaS	Infrastructure as a Service
ICT	Information and Communication Technology
IDC	International Data Corporation
IS	Information Systems
IT	Information Technology
NCR	National Credit Regulator
NIST	US National Institute of Standards and Technology
OTH	Other
PaaS	Platform as a Service
SaaS	Software as a Service
SLAs	Service Level Agreements
SME	Small and Medium Sized Enterprises
SMS	Short Message Service
SQL	Structured Query Language
TCO	Total Cost of Ownership
TOE	Technology Organisation Environment Framework
UK	United Kingdom
USSD	Unstructured Supplementary Service Data
VDSL	Very-high-bit-rate Digital Subscriber Line

Glossary

Adoption	The act or process of beginning to use something new or different, or process of giving official acceptance or approval to something.
Awareness	Concern about and well-informed interest in a particular situation or development.
Bandwidth	Network bandwidth is usually expressed in bits per second (bps); modern networks typically have speeds measured in the millions of bits per second (megabits per second, or Mbps) or billions of bits per second (gigabits per second, or Gbps).
Cloud Computing	The practice of using a network of remote servers hosted on the Internet to store, manage, and process data, rather than a local server or a personal computer.
Design Science	An outcome based information technology research methodology, which offers specific guidelines for evaluation and iteration within research projects.
Enablement	Any approach which provides means or opportunity.
Framework	A hypothetical description of a complex entity or process.
Impediment	A hindrance or obstruction in doing something.
Maturity	State of being mature; full development.
Migration	Movement from one part of something to another.
Paradigm	The generally accepted perspective of a particular discipline at a given time.
Qualitative	Relating to or involving comparisons based on qualities.
Quantitative	Relating to the measurement of quantity.
Readiness	The state of being fully prepared for something.
Strategy	A plan of action designed to achieve a long-term or overall aim.

Appendices

A: Ethical Clearance



University of Fort Hare
Together in Excellence

ETHICAL CLEARANCE CERTIFICATE

Certificate Reference Number: PID021SINT01

Project title: **Towards a financial services cloud computing readiness assessment framework for improved adoption**

Nature of Project: Masters

Principal Researcher: Nicolette Introna

Supervisor: Dr R Piderit

Co-supervisor:

On behalf of the University of Fort Hare's Research Ethics Committee (UREC) I hereby give ethical approval in respect of the undertakings contained in the above-mentioned project and research instrument(s). Should any other instruments be used, these require separate authorization. The Researcher may therefore commence with the research as from the date of this certificate, using the reference number indicated above.

Please note that the UREC must be informed immediately of

- Any material change in the conditions or undertakings mentioned in the document
- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research

The Principal Researcher must report to the UREC in the prescribed format, where applicable, annually, and at the end of the project, in respect of ethical compliance.

The UREC retains the right to

- Withdraw or amend this Ethical Clearance Certificate if
 - Any unethical principal or practices are revealed or suspected
 - Relevant information has been withheld or misrepresented
 - Regulatory changes of whatsoever nature so require
 - The conditions contained in the Certificate have not been adhered to

- Request access to any information or data at any time during the course or after completion of the project.

- In addition to the need to comply with the highest level of ethical conduct principle investigators must report back annually as an evaluation and monitoring mechanism on the progress being made by the research. Such a report must be sent to the Dean of Research's office

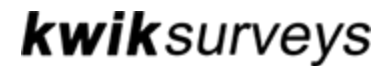
The Ethics Committee wished you well in your research.

Yours sincerely


Professor Gideon de Wet
Dean of Research

18 November 2013

B: Research Instrument



Introduction

Thank you for making some time available to assist with this research project. This survey consists of ten questions. There are eight questions which cover demographical topics relating to yourself. None collect any personal information. This is followed by two main questions. The first question asks that you rate 24 items on a likert scale of importance, the second question asks that you to indicate to what level you agree with seven statements.

The purpose of this survey is to collect information relating to the factors impeding the adoption of cloud computing within the financial services industry.

Participation is completely anonymous, no personally identifiable information is collected.

1) Please select the option that best describes your role at the organisation	
IT: work in the IT Department (all levels)	
FIN: I work in the Finance Department	
FIN: I am a general or senior manager in the Finance Department	
FIN: I am an executive in the Finance Department	
OTH: I do not work in either IT or Finance	

2) Please indicate any online services you routinely make use of from your internet browser	
Web Based Email (Gmail, Yahoo, Hotmail, Outlook.com)	
Social Media (Facebook, Twitter, etc)	
Online Shopping	
Video Streaming (Youtube)	
Storage (Dropbox, Skydrive, Google Drive)	
Windows Azure, Amazon EC2, etc	
Internet Banking	

3) Have you heard of Cloud Computing before?	
Yes, although I dont really know much about it	

Yes, I am familiar with the general concepts	
No, I have never heard of cloud computing before	

4) Do you use your mobile device (smartphone or tablet) for online banking (or another financial service)	
Yes, all the time	
Yes, but seldomly	
No, I do not trust mobile banking services	
No, I don't know how	

5) If given an option to perform an activity over the internet (mobile or desktop web browser) instead of through a walk-in process...	
I would always use the internet	
I would use the internet as long as no financial information is involved	
I would rather walk in and deal with a person	

6) Select (tick) those that are true...	
developing new IT systems usually takes too long to get to market	
business should drive solutions to IT and not the other way around	
we struggle to consolidate strategic information	
our market is highly competitive	

7) Which IT Strategy is MOST important over the next 3 years	
reducing costs / increasing profits	
increasing sales volumes (new markets)	
improve quality / efficiency	

8) Through an online service our clients should ideally...	
be able to manipulate their services, with minimal organisational contact	

be able to request changes to their services but not manipulate it	
be able to view but not be able to change anything	

9) The list below provides some of the key technology inhibitors to the introduction of cloud computing within an organisation. Please indicate the **LEVEL of UNDERSTANDING** that **YOU HAVE** of each of the inhibitors. **If an inhibitor is unfamiliar to you, please select "Neutral"**.

NOTE: If you selected (No, I have never heard of cloud computing before) for question three above, **please skip this question.**

	Very Unfamiliar	Bad	Neutral	Good	Very Familiar
Absence of standards					
Compatibility					
Complexity					
Compliance					
Digital data privacy					
Environment					
Geographical Location					
Hosted services					
Implementation					
Insufficient Knowledge					
Integration					
Legal issues					
Loss of control					
Low confidence					
Maintenance					
No financial benefit					
Outage / Availability					
Performance					
Pricing / Cost					

Security					
Temporary Fad					
Uncertainty of long term offering					
Unclear licensing agreements					
Vendor lock in					

10) Please answer for each statement...					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Our products cannot be provided as online services					
Our clients are not technologically savvy					
Face to face contact is essential for all clients					
The internet infrastructure in South Africa prevents online services from prevailing					
Our clients do not trust computer systems with their finances					
Most of our clients do not have internet access					
Allowing clients to access information from their cellular phones is safer than from web browsers					

C: Research Paper

Towards a financial services cloud computing readiness assessment framework for improved adoption

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Abstract

Financial service providers in South Africa are failing to leverage off the benefits that cloud computing could contribute to their business and clients. The primary objectives of cloud computing include reducing overall IT service costs and processing time whilst increasing process throughput, reliability, availability and flexibility. However, despite these advantages, both strategically and operationally, there is still a relatively slow adoption rate. This can be attributed to the potential pitfalls of the technology such as security concerns, failure downtime resulting from server maintenance or unforeseen outages, implementation complexity and compatibility issues (Low et al., 2011). Therefore, a gradual implementation approach is suggested, which follows a slow migration process that steadily increases the number of processes or functions being hosted by the cloud. This migration approach is dependent on the ability for an objective assessment of the readiness of each individual service, and the components thereof, to be migrated to the cloud.

The risk of moving highly confidential financial services to the public cloud can be enormous if not properly controlled. Business managers and executives are faced with numerous technical decisions in deciding which route to take when migrating their portfolios to the cloud. This can often result in timely delays or the complete abandonment of such ambitions. Babar and Chauhan (2011) point out that very few migration readiness assessment strategies exist, and those that do exist are focused at a much higher level of abstraction. No framework exists within which financial service providers can assess the feasibility or readiness of their unique financial services for cloud computing. This is supported by Foddering (2011) who notes that the development and demand for cloud industry standards (the assessment of service readiness) is the foremost concern of IT decision makers. Thus, this paper is relevant in addressing the lack of concise direction towards migration of services for public cloud computing.

This paper examines ways in which South African financial service providers are able to increase the rate of adoption of cloud computing services. To achieve this financial service providers require a means to assess the readiness of their services for the adoption of cloud computing. The contribution of this paper is a framework, based on the Technology Organisation Environment Framework (TOE), that medium sized financial organisations can make use of in order to assess the feasibility and readiness of their financial services for migration to cloud computing.

Keywords: Adoption, cloud computing, financial services, readiness

1. Introduction

Interest in cloud computing has grown significantly within the information technology (IT) industry (Low et al., 2011). It is estimated by Lin and Chen (2012) that spending on cloud computing will reach \$8.1 billion in 2013. As a result of this rapid growth and investment, cloud computing is fast becoming a focal area within organisations who aim to attain IT innovation, investment and a competitive edge. However, Lin and Chen (2012) highlight that, as with any topical technology, the benefits, weaknesses and compatibilities of cloud computing need to be considered prior to adoption. For financial service providers in South Africa, which provide the context for this research paper, it is important to leverage off the benefits that cloud computing could contribute to their business and clients. However, a number of issues influence the relative ease with which business managers and executives are able to assess the readiness of their financial services for such a technology.

The problem or risk specifically being addressed in this paper is that financial service providers are not capable of assessing their own services for readiness to migrate to the cloud. As the financial services industry is highly competitive, this results in an increased risk of loss of revenue through competitor adoption of similar services. The greater South African financial services industry also stands the risk of falling behind the innovation of other organisations in countries which are making progress to adopting cloud computing. This risk of a potential loss of revenue needs to be weighed up against the risk of moving highly confidential financial services to the public cloud, which can be enormous if not properly controlled (Howarth, 2009). There has not been sufficient research into migration readiness factors in the financial services industry and this research aims to fill this gap in order to establish structured adoption processes for financial services. By doing so, the rate of adoption and success of migration activities will improve. Finally, by not adopting measures to reduce operating costs, such as cloud computing, costs may rise to the point at which jobs are threatened or services need to be priced at levels which are not sustainable.

This paper proposes a framework for assessing the readiness of financial services for migration to the cloud based on a literature survey of recent publications related to cloud computing adoption. From this literature, the inhibitors of adoption success are derived and classified according to the Technology Organisation Environment Framework (TOE). Additionally, the steps of the Innovation-Decision model are incorporated, to provide a means of determining the progress toward adopting cloud computing for a particular financial service.

This paper first considers the definitions and benefits of cloud computing relevant to this research paper. This is followed by a content analysis of factors which inhibit cloud computing adoption and a discussion of the TOE framework and Innovation-Decision Model which provide the basis for the framework proposed in this paper. Finally, the proposed Cloud Computing Readiness Assessment Framework is then discussed.

2. Cloud Computing: Definitions and Benefits

The factors which positively or negatively influence the rate of adoption, such as the overall benefits and weaknesses, need to be fully understood by an organisation in order to successfully migrate to a cloud platform. Before this can be done cloud computing needs to be defined and understood.

Numerous definitions exist for cloud computing but to date there is no universally agreed on industry definition. The most commonly cited definition is that of the US National Institute of Standards and Technology (NIST) which reads as follows: “a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (such as networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction” (Mell and Grance, 2011). Additionally, NIST provides other aspects of cloud computing which need to be considered, namely;

- Five characteristics which include on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service.
- Four deployment models being private clouds, community clouds, public clouds, and hybrid clouds.
- Three service models which are Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) (Khajeh-Hosseini et al., 2010).

Thus, cloud computing can briefly be describes as: a set of IT services provided to a customer over a network (the internet) on a leased basis. Service requirements are flexible in the sense that they can be scaled up or down depending on the demand, and these services are usually delivered by a third party provider who owns the infrastructure (Centre for Protection of National Infrastructure, 2010).

Tao et al.(2011) are of the opinion that cloud computing offers numerous benefits, including: elasticity, economy, reliability and on demand environments. This is confirmed by Marston et al. (2011) who emphasises energy savings as a benefit. Additionally, Foddering (2011) states that the main contributor to cloud computing adoption is that of cost savings followed by easier maintenance, automatic updates, rapid deployment or speed to market, and improved collaboration and communication. There are however various inhibitors which affect adoption of cloud computing and will be discussed in the next section.

3. Inhibitors of Cloud Computing Adoption

The adoption of cloud computing, as previously discussed, offers organisations a variety of benefits, but as with any new technology there are various challenges, issues and risks which exist (Alter et al., 2010). In this regard, Low et al. (2011) point out that even with the advantages offered by cloud computing, both strategically and operationally, there is still a relatively slow adoption rate. This section aims to identify the commonly attributed inhibitors to cloud computing adoption, which will be done through the assessment of literature articles on the topic.

The slow adoption rate of cloud computing can be attributed to the potential pitfalls of the technology such as security concerns, failure downtime resulting from server maintenance or unforeseen outages, implementation complexity and compatibility issues (Low et al., 2011). In the opinion of Kim et al. (2009) most of these adoption issues can be solved if acknowledged. Six categories of adoption issues can be identified, namely: outage or availability, security and performance (which can be grouped together as quality of service issues), compliance, integration, cost and environment (Kim et al., 2009).

Alter et al. (2010) provide additional factors impeding the rate of cloud computing adoption, including:

- Insufficient knowledge or understanding of what cloud computing is, resulting in organisations taking a more cautious approach to adoption.
- Viewing cloud computing as a temporary fad, resulting in organisations being unconvinced of the need to adopt cloud computing.
- Low confidence in the ability of cloud computing solving complex problems.
- Inability of being able to provide a long lasting competitive advantage.

Confirming the above issues, Foddering (2011) provides statistics from a Cisco commissioned study where 250 IT decision makers in large UK companies across five sectors were telephonically interviewed. The respondents reported on their concerns regarding cloud computing adoption, which include:

- 75% of respondents recognised security and privacy;
- 64% recognised data location;
- 62% integration issues with in-house IT; and
- 60% recognised hosted services.

These findings are very similar to those by Carroll and Ramsingh (2012) who surveyed numerous clients and businesses within South Africa. The survey results showed data security and legal issues as being the primary obstacles to adoption. This is closely followed by compliance issues (or legal issues) and vendor lock-in. Other obstacles included: pricing, complexity, loss of control, no financial benefit, unclear licencing agreements and uncertainty of long term offering. It is however noted by Carroll and Ramsingh (2012) that “uncertainty of long term offerings” is not highly rated as an inhibitor of cloud computing adoption which indicates that cloud computing is maturing as a technology option. Thus, businesses are beginning to take the longevity and viability of cloud computing adoption more seriously.

Additionally, Heynik (2012) highlights the complications which organisations should consider about the geographical locations of cloud services providers. Cloud service providers that are situated in a different geographical location (outside of South Africa) may be exposed to different legal jurisdictions and consequences, business practices and lastly government oversight (Heyink, 2012). Finally, financial service providers need to be aware of all challenges they may face in implementing cloud computing. Challenges to financial institutions are heightened because of their security-sensitive environment (Seruga and Hwang, 2012). It is therefore crucial that financial organisations understand these challenges before they implement cloud computing. Seruga and Hwang (2012) also promote security, data privacy, availability, absence of Standards (Vendor Lock-In) and compliance as barriers to cloud computing adoption.

To determine the most significant inhibitors of cloud computing adoption, a basic content analysis of key articles was conducted which concepts are the most prominent in this relationship. Table 1 below provides a matrix view of the literature reviewed with an intersection of the inhibitors. An indicator is displayed where an inhibitor is included in the literature reviewed. The purpose of this table is to establish the primary inhibitors which prevent the adoption of cloud computing. These inhibitors are generally applicable to all organisations, but those that are specific, applicable and most relevant to financial services will be noted.

Table 1: Content Analysis of Common Inhibitors to Cloud Computing

Commonly cited inhibitors to cloud computing	Literature Reviewed								Score
	Kim <i>et al</i> (2009)	Alter <i>et al</i> (2010)	CPNI (2010)	Foddering (2011)	Garg (2011)	Low <i>et al</i> (2011)	Deloitte (2012)	Heyink (2012)	
Absence of Standards			✓		✓			✓	3
Compatibility						✓			1
Complexity						✓	✓		2
Compliance	✓		✓		✓		✓	✓	5
Digital Data Privacy			✓	✓	✓				3
Environment	✓								1
Geographical Location			✓	✓				✓	3
Hosted Services				✓					1
Implementation						✓			1
Insufficient Knowledge		✓							1
Integration	✓			✓					2
Legal Issues			✓				✓	✓	3
Loss of Control							✓		1
Low Confidence		✓							1
Maintenance						✓			1
No financial benefit							✓		1
Outage / Availability	✓		✓		✓	✓			4
Performance	✓		✓						2
Pricing / Cost	✓						✓		2
Security	✓		✓	✓	✓	✓	✓		6
Temporary fad		✓							1
Uncertainty of long term offering		✓					✓		2
Unclear licensing agreements							✓		1
Vendor Lock In					✓		✓		2

The above inhibitors are scored according to the number of articles which attributed adoption failure to the factor. The primary inhibitors are selected based on the highest score and are provided below:

- Security (of data and information)
- Compliance
- Digital data privacy
- Outage and availability
- Geographical location
- Legal issues
- Absence of standards
- Internet bandwidth and costs

Internet bandwidth and costs have been included in the primary inhibitor list due to its specific relevance to cloud computing adoption within South Africa. High dependency is placed on the reliability and efficiency of network cables that link South Africa with other countries abroad, where most IT investment has occurred. Additionally the telecommunications costs are very high within South Africa. Thus broadband prices need

to drop substantially before the greater South African market is able to make use of the internet, and therefore cloud computing.

The primary inhibitors to cloud computing adoption, identified above, are all fundamentally important to the financial services industry. Financial organisations collect information from their customers which is processed and stored. This information contains personal and transactional customer information which is highly sensitive in nature and thus explains why data security is a high priority for financial organisations (Howarth, 2009). There are also regulatory and compliance inhibitors to adoption. In some instances financing regulators may stipulate that information must be stored in the home country (this coincides with the geographical location challenge). While certain compliance may also state that data cannot be intermixed with other data on a shared server or database (Khajeh-Hosseini et al., 2010).

The inhibitors all affect the adoption of cloud computing at financial organisations. For this to be improved organisations must systematically address each of these points in a structured and managed manner. This is the key problem addressed by this paper. The following section presents and discusses the proposed Cloud Computing Readiness Assessment Framework for financial services as a solution to the research problem.

4. Developing the Cloud Computing Readiness Assessment Framework

This paper sets out to propose a framework to overcome adoption issues encountered when migrating financial services to a cloud platform. The proposed Cloud Computing Readiness Assessment Framework for financial services is based on the TOE framework. Below, the TOE framework is briefly described and the inhibitors identified above aligned with this framework. In order to provide a means of assessment of readiness of a financial service, the phases of the Innovation-Decision Model are incorporated into the proposed framework. Thus, the proposed framework provides a phased approach for addressing the adoption of cloud computing for financial services.

The methodology used to establish the framework was extensive literature analysis, critical thought and analysis. The research process includes the identification of key theory which addresses the application of new technologies at an organisational level. Following this, an analysis of key inhibitors from related literature should reveal more commonly featured inhibitors. Thereafter applying these findings to the theory provides a framework from which organisations are able to base their investigation into cloud computing. A maturity step process provides a phased implementation approach to implementing the model. The following sections describe the methodology components in more detail.

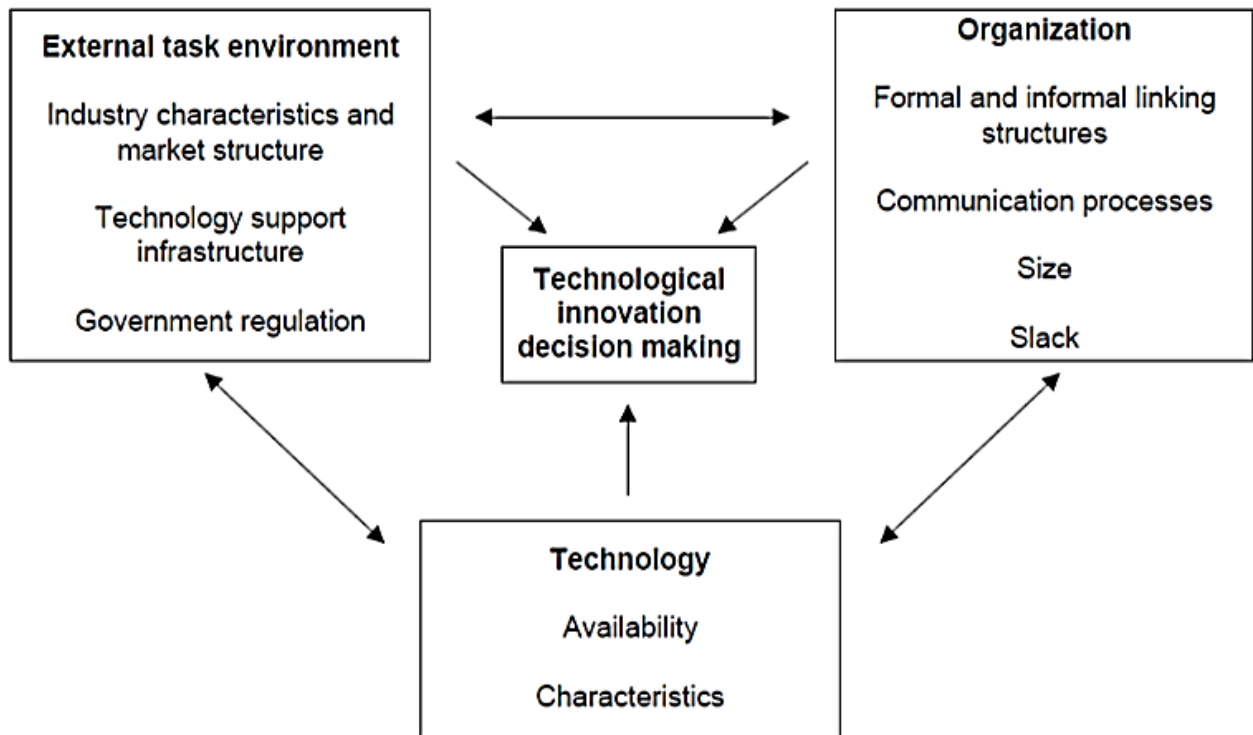
4.1 The Technology, Organization, Environment (TOE) Model

The TOE framework, as depicted in Figure 2, below, can be described as a framework which examines the process of how an organisation goes about adopting and implementing technological innovations. The adoption and implementation process is believed to be largely influenced by the various contexts namely, technology, organisation and environment (Tornatzky et al., 1990). The three contexts aim to represent the constraints and opportunities faced when considering technological innovation.

Thus, when assessing the technology innovation of cloud computing and more specifically the adoption of cloud computing – organisations can factor in all possible strengths and weaknesses. Further to this, Tornatzky et al. (1990) state that these three

elements influence the way in which organisations: view the need, searches for and lastly adopts new technology (which is a fundamental theme to this paper).

Figure 1: Technology, Organisation, Environment (TOE) Model (Tornatzky et al., 1990)



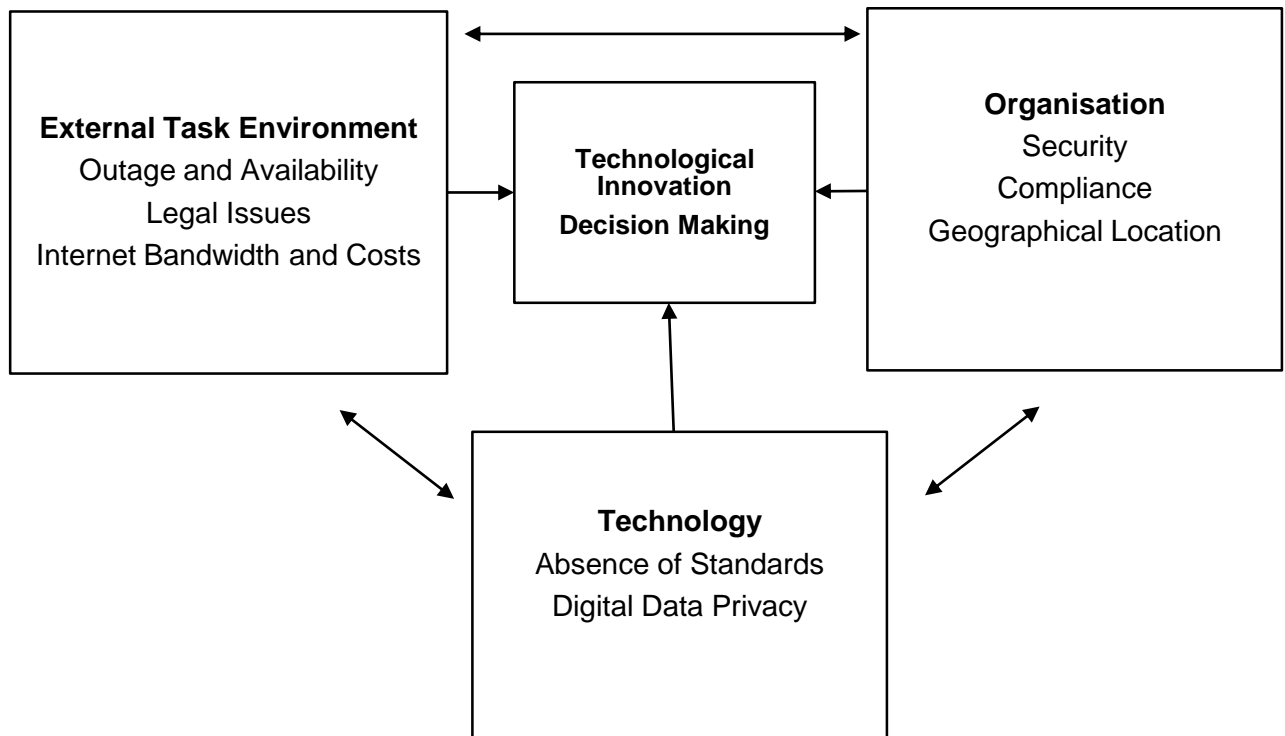
The TOE model is relevant for this research paper as it emphasises adoption at an organisational level as opposed to an individual level. Other models, such as the Diffusion of Innovation, Technology Acceptance Model and Unified Theory of Acceptance and Use of Technology are more focused on the individual (Oliveira and Martins, 2011) and were thus not considered for this research study.

4.2 Application of the Inhibitors to the TOE

The primary inhibitors, identified from the content analysis were: Security (of data and information); Compliance; Digital data privacy; Outage and availability; Geographical location; Legal issues; Absence of standards; and Internet bandwidth and costs. In order to determine a means of overcoming these inhibitors, they are aligned to the three views of the TOE model (technology, organisation and environment).

With regards to the technology itself, the absence of proper cloud standards and the issue of digital data privacy remain key technology challenges to be addressed. At the organisational level three inhibitors are relevant. These are security, compliance and geographical concerns. The organisation has some level of influence or control of these inhibitors. Finally, at the environmental level the organisation has no control over these inhibitors. Availability (or outages) of the service are outside of the organisation control, and is managed by third party cloud providers. The legislative controls around cloud computing are relatively immature and under no control of the organisation. Finally bandwidth costs and capacity remain major concerns which organisations are unable to directly influence.

Figure 2: Adapted Technology, Organisation, Environment (TOE) Model



While this classification of the inhibitors of cloud computing adoption into the TOE framework provides a structured way of understanding the key reasons for failure, in order to provide a means of assessing the readiness of a financial service to be migrated to the cloud, the innovation-decision model is discussed and incorporated into the framework. This model is described in the following section.

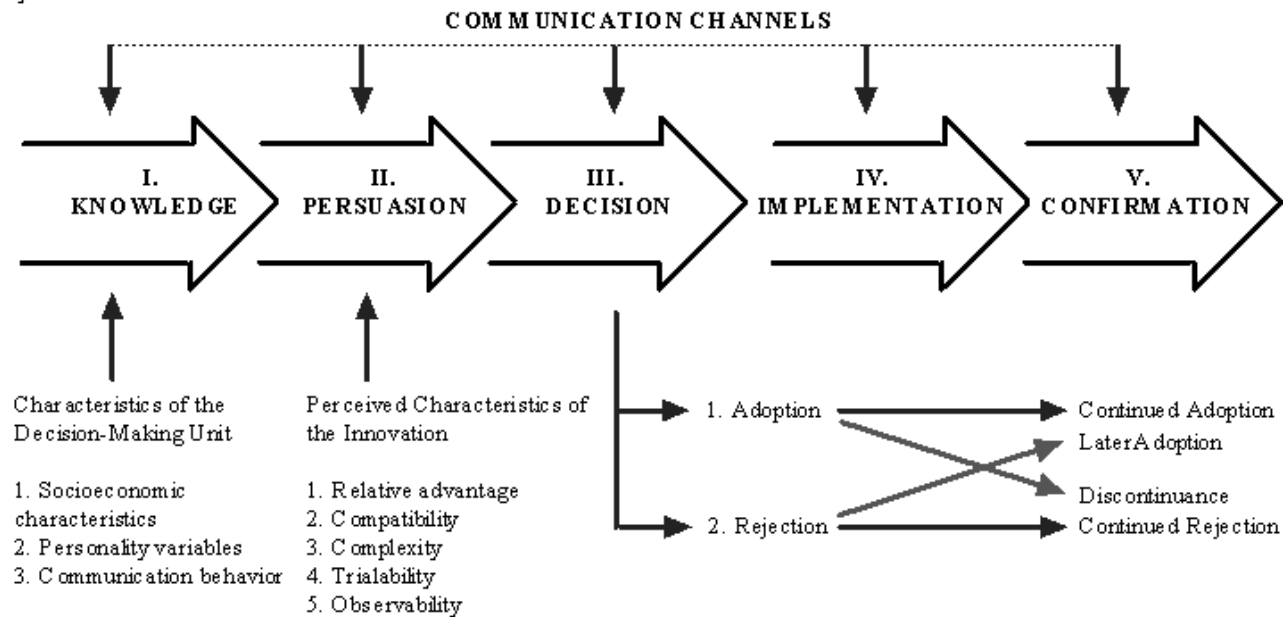
4.3 The innovation-decision making process for adoption

The Innovation-decision making process is depicted in Figure 3 and is used to explain the steps of the process in which individuals or groups of people adopt an innovation, such as cloud computing. The innovation-decision making process is said to consist of the following stages;

- **Knowledge:** At this stage individuals become more aware of the innovation (cloud computing) and begin to develop a better understanding of its abilities.
- **Persuasion:** Here individuals will start developing either a favourable or unfavourable attitude towards the innovation (cloud computing).
- **Decision:** A decision is made to either adopt or reject the innovation (cloud computing).
- **Implementation:** This involves putting the innovation (cloud computing) into practice or use.
- **Confirmation:** This is the review stage after implementation whereby individuals evaluate the results of the innovation-decision already made (i.e. accepting or rejecting the adoption of cloud computing) (Rogers, 2003).

Figure 3: A Model of Stages in the Innovation-Decision Process (Rogers, 2003)

PRIOR
CONDITIONS
1. Previous practice
2. Felt needs/problems
3. Innovativeness
4. Norms of the social systems



This model is incorporated into the framework as a measure of progression towards the adoption of cloud computing. This provides a structured and logical set of steps to measure progress of such adoption.

5. The Cloud Computing Readiness Assessment Framework

The proposed framework accommodates each step as a phase, and provides a high level indicator of the required output for each phase. The phases must be performed in the order provided to be effective. The table below (Table 2) presents the consolidated final framework for addressing and resolving the inherent inhibitors to the adoption of cloud computing at a financial services organisation. The first column provides a list of the primary inhibitors identified in the content analysis of literature on the topic. These are categorised according to the Technology, Organisation and Environment framework headings.

The first row presents the phases of the Innovation-Decision Model. For each phase, the framework defines a desired response or state objective to each of the inhibitors. Each of these must be satisfied inside a vertical phase before moving to the next phase. The result is a framework which provides organisations in the financial sector with the means to plan for and address each primary inhibitor, and assess progress towards the resolve of these inhibitors.

Table 2: Cloud Computing Adoption Process Framework

	Knowledge	Persuasion	Decision	Implementation	Confirmation
<u>Technology</u>					
• Standards	Standards are researched and understood. Output is a report.	Standards are motivated within the business case. Output is a business case,	Adoption or rejection decision is made based on the report and business case	Standards are implemented	Post implementation assessment of standards. Output is an assessment report.
• Digital data privacy	Digital data privacy is researched and understood. Output is a report.	Digital data privacy is motivated within the business case. Output is a business case,		Digital data privacy is implemented	Post implementation assessment of digital data privacy. Output is an assessment report.
<u>Environment</u>					
• Availability	Availability is researched and understood. Output is a report.	Availability is motivated within the business case. Output is a business case	Adoption or rejection decision is made based on the report and business case	Implementation of availability measures	Post implementation assessment of availability. Output is an assessment report.
• Legal	Legality is researched and understood. Output is a report.	Legality is motivated within the business case. Output is a business case		Implementation of legal measures	Post implementation assessment of legal measures. Output is an assessment report.
• Bandwidth and Costs	Bandwidth and costs are researched and understood. Output is a report.	Bandwidth and costs are the business case. Output is a business case		Implementation of measures to reduce bandwidth and costs	Post implementation assessment of bandwidth and cost. Output is an assessment report.
<u>Organisation</u>					
• Security	Security is researched and understood. Output is a report.	Security is motivated within the business case. Output is a business case	Adoption or rejection decision is made based on the report and business case	Implementation of security measures	Post implementation assessment of security. Output is an assessment report.
• Compliance	Compliance is researched and understood. Output is a report.	Standards are motivated within the business case. Output is a business case		Implementation of compliance measures	Post implementation assessment of compliance. Output is an assessment report.
• Geographical location	Geographical location is researched and understood. Output is a report.	Geographical location is motivated within the business case. Output is a business case		Implementation of geographical location strategy	Post implementation assessment of geographical location. Output is an assessment report.

This framework is generic in nature and applicable to all financial services organisations. Through managed application of such a framework, the adoption process can be planned and executed accordingly. An organisation would typically assemble a task team to

manage the adoption of cloud computing. Using the framework the task team could easily allocate objectives to individuals or groups. The organisation would follow each phase until they have satisfied the objective for each inhibitor. Through this process the adoption of cloud computing is greatly improved and the level of risk is reduced.

6. Conclusion

This paper aimed to propose a means of assessing the readiness of financial services for migration to the cloud. This paper highlighted the benefits and weaknesses of cloud computing. Through this evaluation, financial organisations are better positioned in deciding whether to adopt cloud computing or not. Awareness of benefits and weaknesses positively or negatively influences the rate of adoption.

The main problem or risk specifically addressed was that of moving highly confidential financial services to the public cloud. Risks or concerns were evaluated and summarised with the aid of a literature matrix. The matrix provided a view of the literature reviewed with an intersection of the inhibitors identified from this literature. The purpose was to establish the primary inhibitors which prevent the adoption of cloud computing. The inhibitors were generally applicable to all organisations, but those that were specific, applicable and most relevant to financial services were noted, namely: security (of data and information), compliance, digital data privacy, outage and availability, geographical location, legal issues, absence of standards, internet bandwidth and costs.

The above mentioned inhibitors were found to negatively influence the adoption of cloud computing at financial organisations. For this to be improved organisations should systematically address each of these points in a structured and managed manner. A way in which to do this is through aligning the inhibitors to the three views of the TOE framework. Next the innovation-decision making process was introduced and used to explain the phases in which individuals or groups of people adopt an innovation.

The innovation-decision making process was then incorporated into the framework as a measure of progression towards the adoption of cloud computing. This provided a structured and logical set of steps to measure progress of adoption. Finally, the consolidated final framework for addressing and resolving the inherent inhibitors to the adoption of cloud computing at a financial services organisation was explained. This final framework is seen as a means to plan for and address each primary inhibitor, and assess progress towards the resolve of these inhibitors.

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