Readiness Assessment of Cloud-Computing Adoption within a Provincial Government of South Africa

A thesis submitted in fulfilment of the requirements for the Master's degree in Information Management

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ABSTRACT

Cloud computing, as a shifting paradigm, is expanding its "bandwagon effect" across industries worldwide. This is due to the several advantages of cloud computing that have been revealed by the public sectors (empirical setting of this study), including improved levels of flexibility and mobility, lower total cost of ownership, reduced energy savings and carbon missions. Most importantly, cloud computing can free government from building, maintaining and upgrading its infrastructures and technologies, and focus more on serving the citizens with optimised resources. Hence, this paper focuses on the readiness assessment of cloud-computing adoption within a Provincial Government of South Africa, which is in its cloud-computing embryonic phase. An extensive study of the literature on cloud-computing concepts, its characteristics, the possible non-technological readiness indicators for cloud-computing adoption, was conducted. This led to the identification of three main groups of readiness indicators: (i) Infrastructural indicators; (ii) organisational indicators; and (iii) environmental indicators. A conceptual model was then developed, according to these three main groups, with twelve sub-indicators. This model was subsequently tested in the empirical setting of the studied Provincial Government of South Africa by using the qualitative approach through the case-study methodology. The intended audience for this study are both academic and practitioners as it brings a conceptual model and the guidelines for assessing the government's readiness for the adoption of these cloud-computing technologies and services.

Keywords: *Cloud-computing adoption, government, readiness indicators, developing economies, Africa, South Africa*

DECLARATION

I, Liya Xi, hereby declare that "**Assessing readiness for Cloud Computing within a Provincial Government in South Africa**" is my own original work, that it has not been submitted before for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by way of complete references.

Signed Date

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Last, but not least, to my dearest parents, your love, unconditional support and encouragement have given me the necessary strength to carry on.

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ABBREVIATIONS

CapEx: Capital Expenditure

CC: Cloud Computing

CEGP: Carbon-Efficient Green Policy

DaaS: Desktop as a Service

E-Commerce: Electronic Commerce

E-Government: Electronic Commerce

G2B: Government-to-Business

G2C: Government-to-Citizens

G2G: Government-to-Government

IaaS: Infrastructure as a Service

ICT: Information and Communications Technology

IT: Information Technology

OPaaS: Office Productivity as a Service

OpeEx: Operating Expenditure

PaaS: Platform as a Service

SaaS: Software as a Service

SLA: Service Level of Agreement

TCO: Total Cost of Ownership

VM: Virtual Machine

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CHAPTER 1: INTRODUCTION TO THE STUDY

1.1 Introduction

This study focuses on identifying and testing the readiness indicators of Cloud-Computing (CC) adoption within a Provincial Government of South Africa. The general underlying premise is that the advent of cloud computing and its vibrant cloud services have spurred interests in both the private and the public sectors. This is due to the novel economic model of Information Technology (IT) that it advocates to introduce. Although the benefits of performing and delivering better services – without investing extensively in the onsite infrastructures and technologies – appear to be striking, a successful adoption of cloud computing requires a thorough understanding of all the possible influencing factors in a unique socio-economic climate, and how these factors could influence one another.

This chapter gives a brief introduction to the study. Section 1.2 provides an overall background to the study; section 1.3 states the research problem, followed by descriptions of research questions and sub-questions in section 1.4; section 1.5 describes the research objectives; the research methodology is included in section 1.6; this is followed by section 1.7 with the limitations of the study; section 1.8 describes the contribution of the study; and section 1.9 indicates the overall chapter layouts; while section 1.10 concludes this chapter.

1.2 Background of research problem

In the 1990s, the need for more efficient government services, the advent of the Internet era, and the utilisation of Electronic Commerce (e-Commerce), together brought about the rise of Electronic Government (e-Government) worldwide (Fang, 2002). E-government refers to an evolutional way to provide government services onto an Internet-based platform, in order to provide convenient services to the public in a user-friendly, transparent and efficient way. Most e-government services strive to promote the government services in the following

domain: Efficiency of the internal government affairs, Government-to-Government (G2G), in addition to Government-to-Business (G2B), and Government-to-Citizens (G2C) services (DPSA, 2001).

With the realisation of an easily accessible Internet service, and effectively functioning information systems, e-Government has gradually becoming the new form of government: as a single unit delivering improved government services to citizens, by utilising the support of modern Information and Communications Technologies (ICTs).

However, with the increasing demand of service and budget pressure, government should rather turn to technology innovation, as a way to deliver better information and services, together with lower IT costs (Zhang & Chen, 2010). In order to deliver quality services efficiently with a cash-strapped budget, a new computing paradigm, cloud computing, promises a shift from an organisation required to invest heavily for limited IT resources that are internally managed – to a model where the organisation can buy or rent resources that are managed by a cloud-service provider. In addition, it also promises the scalability of resources and the on-demand availability of such resources (Shimba, 2010).

Cloud computing is an abstract term, which encompasses several services that are remotely controlled by a server, managed by a third party, and accessed via the Internet. The unique technological and business advantages of this paradigm are becoming increasingly evident; and it is expected that, in the coming years, the cloud-computing adoption will radically increase, to see the majority of IT services being delivered via public or private clouds (Anjomshoaa & Tjoa, 2011).

Therefore, this study has been envisaged to investigate a readiness-testing model that can assist the studied Government in successfully initiating and deploying government-cloud computing. Factors such as, the level of maturity of necessary telecommunication

infrastructures within a defined geographical region, the compatibility and effectiveness of cloud-related services, and the macro-environmental factors may affect the adoption of the cloud-computing need to be addressed when developing a readiness-assessment testing model for a cloud-based government platform (Nelson, 2009).

In the section below, the research problem and the research questions of this study will be presented.

1.3 Statement of the research problem

The advent of cloud computing has rapidly triggered interests in many industries, especially in the developing countries. Theoretically, cloud computing reduces infrastructure costs, and leverages the service demand and resource supply. However, issues, such as broadband connectivity (e.g. Wyld, 2010), security (e.g. Dhiman, 2010), contract issues (e.g. Federal Financial Institution Examination Council Agencies, 2012) and regulatory environment (e.g. ITU, 2012) hinder this adoption in both the private and the public sectors. Moreover, in order to efficiently and effectively initiate a successful deployment of cloud computing, a comprehensive examination of the current state of readiness is vital, especially when taking into consideration the unique opportunities and challenges of a country or region.

Adopting cloud computing would add value and benefit to government. First of all, cloud services could improve the level of service delivery, while lowering the overall costs (e.g. Lam, 2011). Secondly, optimised utilisation of onsite resources could be achieved by leveraging the purchasing power amongst different departments – through the use of cloud-computing technologies (e.g. Creeger, 2009). Lastly, the adoption of cloud computing could enrich government's ability to develop innovative ways to interact with the citizens in a broader realm (e.g. Wyld, 2009 & 2010).

Given the above information and the current impact of the global economic downturn, cloud-computing technology affords a viable strategy for government to be effective and efficient in service-delivery outcomes. As such, this study will recommend a conceptual testing model that can identify readiness indicators as key enablers toward building a broader digital society.

According to the above information, the research problem of this study focuses on identifying and testing the readiness indicators of cloud-computing adoption, and applying them to a Provincial Government of South Africa – due to the limited literature and information related to this subject in the African context. Here, it should be emphasised that this study explores the *non-technological* readiness factors, i.e. it concentrates on the managerial (i.e. organisational or environmental) factors, rather than on the core technological factors, such as hardware, software or the networking equipment.

This is motivated by the nature of the studies in the Information Systems Department, in which this study was originally conducted.

1.4 Research question and sub-questions

In accordance with the identified research issue, below is the question and sub-questions that the study intends to answer, and on which the research will focus.

The main question:

What are the readiness factors that influence a successful cloud-computing adoption; and what is the actual readiness of a Provincial Government in South Africa for this adoption?

The research sub-questions include:

1) What are characteristics of cloud computing?
2) What are the necessary factors for the effective introduction of cloud computing into a public organisation?

3) What is the extent of readiness of a studied Provincial Government for the cloud-computing platform?

1.5 Research objectives

The main objective of this study is to identify the readiness factors that influence successful cloud-computing adoption, and to assess the actual readiness of a Provincial Government in South Africa for this adoption.

The particular objectives that stem from the research sub-questions are as follows:

1) To determine and explain the characteristics of cloud computing.
2) To identify those factors that influence the effective introduction of cloud-computing technologies into a government environment.
3) To determine the extent of readiness of a studied Provincial Government for the cloud-computing platform.

1.6 Research methodology

The primary purpose of this study was to identify and test the possible readiness indicators of cloud-computing adoption in the studied Provincial Government in South Africa. In order to answer the research questions, and to meet the research objectives, this study was primarily qualitative in nature. This study selected a single division in a relevant department of the studied Provincial Government that is directly involved with the delivery of IT services.

This study adopted a Case-Study methodology – since, according to Yin (1994), this methodology is designed for examining in-depth meanings of studied phenomena (i.e. the readiness for adopting CC technology) in a real-life environment (a studied Provincial Government). This study focused on investigating the participants' perceptions and experiences associated with their knowledge of cloud computing and the adoption issues.

Thus, the case study method is best suited in this study, as it is used to understand the research questions *via* the meanings that participants assign to them (Klein & Myers, 1999).

Multiple data evidences were collected from both non-empirical and empirical sources, namely: literature reviews, focus-group interaction and semi-structured interviews. Furthermore, the researcher adopted the content-analysis method for the data analysis, which was used to identify themes, building categories, and for finding patterns.

1.7 Scope and limitations of the study

This study targeted on non-technological factors only that influence the adoption of cloud-computing technologies in a certain Provincial Government of South Africa. Therefore, the findings from this research are only applicable to the studied Provincial Government; and they exclude the technological component (hardware, software and communication equipments). Furthermore, this study investigated the readiness indicators from the government's perspective only, hence omitting possible external factors that could have had an impact on the cloud-computing adoption (for example, the availability of technical equipment and expertise of the supporting agencies, or the availability of the necessary treasury funding).

However, these limitations were not seen as factors that impacted on the integrity and findings of this study.

1.8 Contributions of this study

The main academic contribution of this study is a model – based on the suggestions from non-empirical research (the literature review) and the findings from empirical research, in the field-of-readiness indicators for the cloud-computing adoption in the studied South African Provincial Government. This model could be used by other academics and researchers to test and possibly develop it further, which could contribute to the body of knowledge in this field.

The application of this model, for testing the readiness of a particular Provincial Government for the adoption of the cloud-commuting technologies and services is seen as a practical contribution by this study. The recommendations given in this chapter could help managers of the studied Provincial Government in adequately preparing this institution for the benefits of these technologies.

1.9 Chapter outline

This research encompasses five chapters. In order to give the reader a guideline on the structure and content of each chapter, an outline is provided, together with a brief summary of each chapter.

Chapter 1: This is considered to be an introductory chapter, which provides a brief background to the study. This chapter includes the problem statement, the research questions, and the research objectives. Thereafter, the research methodology, the ethical considerations, as well as an overview of the findings, are provided in this chapter.

Chapter 2: This chapter elaborates on the literature review of the study, and provides an overview of what cloud computing is all about, the drivers and the challenges encountered with this innovative technology change. The main focus is on explaining what the readiness indicators are for cloud-computing adoption, in general.

Chapter 3: This chapter presents the research design and the methodology, which are used to carry out the study. The rationale for choosing the selected methodology is discussed. This is followed by explanations of the data collection and the data-analysis techniques that were implemented in this study.

Chapter 4: This chapter presents a detailed data analysis, as well as the findings of the study. The answers for research questions are provided as a conclusion to this chapter.

Chapter 5 concludes the entire study. It aims at the level to which the goals and objectives of the study were formulated. Some recommendations for future research are provided as well.

1.10 Chapter summary

This chapter has presented the background, the research problem, the questions and objectives, as well as the introductory approach to this study. This is followed by the explanation of the research scope and limitations. Finally, an outline of each chapter is provided.

In the following chapter (Chapter 2), a comprehensive analysis of the readiness indicators for a successful cloud-computing adoption are presented, as well as the characteristics, the benefits, the business models, and the service-deployment models of cloud computing are described.

CHAPTER 2: THE LITERATURE REVIEW

2.1 Introduction

This chapter reports on the literature review, which includes the background to cloud computing, more specifically, in terms of the characteristics, the business models, the deployment models, and the benefits of each model. It provides an overall understanding of what cloud computing is, and why its services attract organisations from both the private and the public sectors. This is followed by the identification, and an analysis of the readiness of non-technological indicators of cloud-computing adoption – with the emphasis on a specific Provincial Government in South Africa.

The relevant indicators were obtained from the pertinent literature published during the last five years – to ensure that the information is current and topical. Finally, this chapter ends with a conceptual research model for the empirical cloud-computing adoption testing in a selected government context.

2.2 Cloud computing

The idea of "cloud" existed long before Google's CEO Eric Schmidt used the word to describe the business model of providing services across the Internet in 2006 (cited in Zhang, Cheng & Boutaba, 2010). In 1997, Professor Ramnath Chellapa foresaw that the term "cloud computing" was going to be "*a new computing paradigm, where the boundaries of computing would be determined by economic rationale, rather than by technical limits alone.*"(cited in Shoshatari, 2013 and Hsu, Wang & Shieh, 2010).

The "*bandwagon effect*" brought about by cloud computing indicates that cloud computing is far more than just a merging of related technologies into one single term. It transcends the technical restrictions of computing, and opens up numerous economic possibilities for

businesses. Thus, the term is increasingly becoming popular. Infrastructure providers strive to provide more powerful and reliable cloud platforms. Service providers attempt to offer more vibrant and cost-efficient cloud services; and enterprises see the emerging computing paradigm as an innovative way to reshape their business models, in order to gain benefits (Zhang et al., 2010).

However, due to the fact that the term has been utilised mainly as a marketing term, a lack of any standard definition for cloud computing has led to the market hype: "*Cloud computing was simply a trap aimed at forcing more people to buy into locked, proprietary systems that would cost them more and more over time……It's a marketing hype campaign*", said Richard Stallman, the founder of the Free Software Foundation and creator of the computer operating system GNU(Johnson, 2008).

There is still no widely accepted uniform definition of cloud computing. The National Institute of Standards and Technology (NIST) (Mell & Grance, 2011) defines cloud computing as, *"a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort, or service-provider interaction".*

Figure 2.2 demonstrates the cloud-definition framework, as defined by NIST.

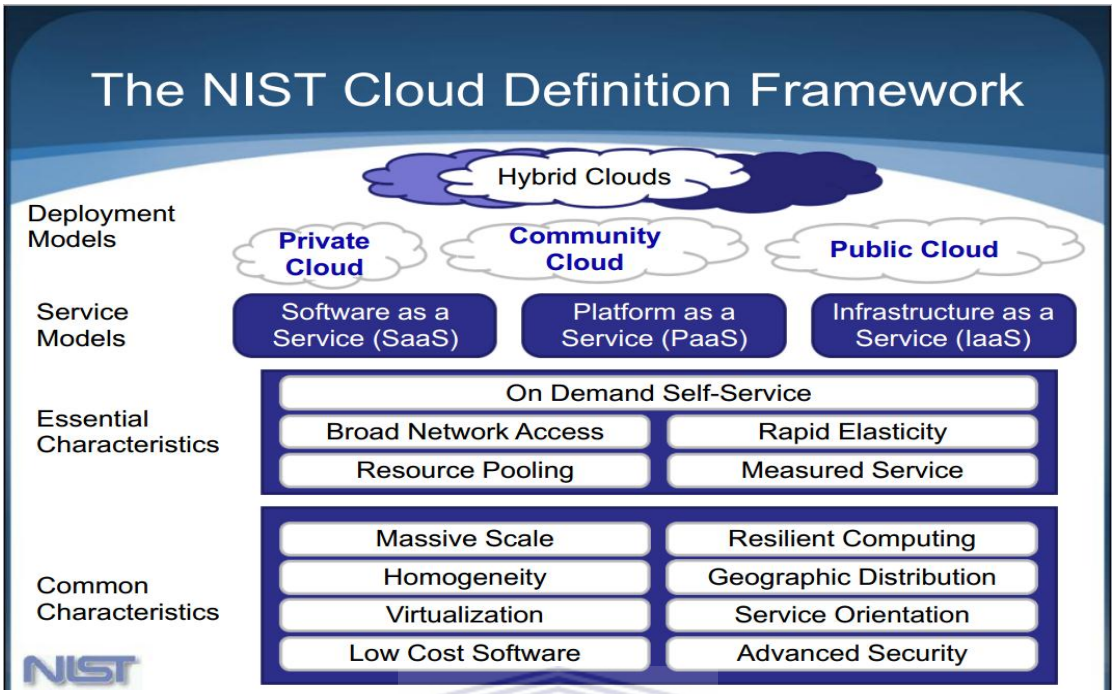


Figure 2-1 The NIST cloud-computing definition framework (Mell & Grance, 2009)

According to Gartner, cloud computing is "*a style of computing, where scalable and elastic IT-related capabilities are provided 'as a service' to customers using Internet Technologies*" (Gartner, 2010).

These different definitions of cloud computing indicate that people with different knowledge backgrounds and experiences have different understandings and perspectives on cloud computing – even as it continues to evolve and change over time (Martens et al., 2011). Table 2.1 lists a summary of the different cloud-computing definitions provided by Vaquero et al (2008).

Table 2-1 Cloud computing definitions (Vaquero et al., 2008)

Author	Year	Definition/Excerpt	Reference
M. Klems	2008	You can scale your infrastructure on demand within minutes or even seconds, instead of days or weeks, thereby avoiding under-utilization (idle servicers) and over-utilization (blue screen) of in-house resources…	(Geelan, 2009)
P. Gaw	2008	Using the internet to allow people to access technology-enabled services. Those services must be massively scalable…	(Geelan, 2009)

R. Buyya	2008	A cloud is a type of parallel and distributed system, consisting of a collection of interconnected and virtualised computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements established through negotiation between the service provider and the consumers.	(Buyya et al., 2008)
R. Cohen	2008	Cloud computing is one of those catch-all buzz words that tries to encompass a variety of aspects ranging from deployment, load balancing, provisioning, business model and architecture (like Web2.0). It's the next logical step in software (software10.0). For me, the simplest explanation for cloud computing is describing it as, internet-centric software…	(Geelan, 2009)
J. Kaplan	2008	A broad array of web-based services aimed at allowing users to obtain a wide range of functional capabilities on a 'pay-as-you-go' basis that previously required tremendous hardware/software investments and professional skills to acquire. Cloud computing is the realization of the earlier ideals of utility computing, without the technical complexities or complicated deployment worries…	(Geelan, 2009)
D. Gourlay	2008	…the next hype-term…building off the software models that virtualization enabled	(Geelan, 2009)
D. Edwards	2008	…what is possible when you leverage web-scale infrastructure (application and physical) in an on-demand way.	(Geelan, 2009)
B.de Haff	2008	…there really are only three types of services that are cloud-based: SaaS, PaaS, and cloud-computing Platforms. I am not sure being massively scalable is a requirement to fit into any one category.	(Geelan, 2009)
B. Kepes	2008	…put simply, cloud computing is the infrastructural paradigm shift that enables the ascension of SaaS… It is a broad array of web-based services aimed at allowing users to obtain a wide range of functional capabilities on a pay-as-you-go basis that previously required tremendous hardware/software investments and	(Geelan, 2009)

		professional skills to acquire.	
K. Sheynkman	2008	Clouds focused on making the hardware layer consumable as an on-demand compute and storage capacity. This is an important first step; but for companies to harness the power of the Cloud, complete application infrastructure needs to be easily configured, deployed, dynamically scaled and managed in these virtual hardware environments.	(Geelan, 2009)
O. Sultan	2008	…in a fully implemented Data Centre 3.0 environment, you can decide if an app is run locally (cook at home), in someone else's data centre resources (pantry is empty), or your having environmental /facilities issues (too hot to cook). In fact, with automation, a lot of this can be done with policy and real-time triggers…	(Geelan, 2009)
K. Hartig	2008	…really is accessing resources and services needed to perform functions with dynamically changing needs… is a virtualization of resources that maintain and manage themselves.	(Geelan, 2009)
J. Pritzker	2008	Clouds are vast resource pools with on-demand resource allocation…virtualized…and priced like utilities	(Geelan, 2009)
T. Doerksen	2008	Cloud computing is… the user-friendly version of Grid computing.	(Geelan, 2009)
T. von Eicken	2008	outsourced, pay-as-you-go, on-demand, somewhere in the Internet, etc.	(Geelan, 2009)
M. Sheedan	2008	…Cloud Pyramid to help differentiate the various Cloud offerings out there…Top: SaaS; Middle: PaaS; Bottom: IaaS.	(Geelan, 2009)
A. Ricadela	2008	…cloud computing projects are more powerful and crash-proof than Grid systems that have been developed – even in recent years	(Geelan, 2009)
I. Wladawsky Berger	2008	…they key thing we want to virtualize or hide from the user is complexity…all that software will be virtualized or hidden from us, and taken care of by systems and/or professionals that are somewhere else – out there in the Cloud	(Geelan, 2009)
B. Martin	2008	Cloud computing encompasses any subscription-based or pay-per-use service that, in real time over the Internet, extends IT's existing capabilities.	(Geelan, 2009)

R. Bragg	2008	The key concept behind the Cloud is Web application… a more developed and reliable Cloud. Many find it's now cheaper to migrate to the Web Cloud than to invest in their own server farm…it is a desktop for people without a computer.	(Bragg, 2008)
G. Gruman and E. Knorr	2008	Cloud is all about: SaaS…utility computing… Web Services…PaaS…Internet integration...commerce platforms…	(Gruman & Knorr, 2008)
P. McFedries	2008	Cloud computing, in which not just our data, but even our software resides within the Cloud, and we access everything – not only through our PCs – but also Cloud-friendly devices, such as smart phones, PDAs… the mega-computer enabled by virtualization and software as a service… This is utility computing powered by massive utility data centres.	(McFedries, 2008)

In summary, cloud computing, as the new computing paradigm, provides on-demand computing resources to consumers via the Internet. It requires little or no upfront costs for cloud-computing adopters, in terms of investment in IT equipment. Most importantly, cloud computing has the capability of offering expandable computing resources and data in an environment of constantly changing needs.

The following sub-section highlights the characteristics of cloud computing from the perspective of a comprehensive literature review.

2.2.1 Characteristics of cloud computing

Unlike other technical terms, cloud computing is not a new technology (Zhang et al., 2010); it simply leverages existing technologies, such as virtualisation and utility-based pricing, in a way to meet today's business requirements – both technically and economically. According to some authors (Vaquero et al., 2008; Mell and Grance, 2009; Shimba, 2010; Shoshatari, 2013), cloud computing has unique characteristics that distinguish it from other computing technologies:

Resource pooling

First of all, the architectural layer of cloud computing provides services to multiple providers; thus, any issues related to service performance and management are assigned to collaborative service providers. In addition, the infrastructure provider offers a shared-resource pooling to multiple resource users. Such dynamic resource assignment capability provides considerable flexibility to infrastructure providers for managing their own resource usage and operating costs (Zhang et al., 2010).

Broad network access

Cloud services are accessed via the internet. It enables users from different locations to access cloud services; hence, it enhances the mobility of the service. Moreover, many service providers have their data centres located at many locations around the globe – in order to achieve high network performance and localisation (Zhang et al., 2010).

On-demand self-service

One of the main reasons why cloud computing is of such great importance is that users are able to demand resources dynamically – without any prior notice, or human supervision. This makes a better resource utilisation environment for other users; moreover, the payment model associated with such a method helps to avoid unnecessary advanced expenditures. In addition, instead of having in-house infrastructures, users could avoid maintenance and upgrades on physical infrastructures and equipment.

Rapid elasticity

This characteristic allows resources and services to be expanded in correspondence with constantly changing needs. Such a capability ensures that the "actual need" can be met, therefore, in order to achieve increased efficiency.

Measured services

This characteristic provides transparency by adopting a metering mechanism to monitor, control and report the usage and services.

2.2.2 Business models of cloud computing

Cloud computing employs a service-driven business model (Zhang et al., 2010): every architectural layer within the cloud system can be offered as a service to the layer above. Generally, cloud computing has three business or service delivery models (Vaquero et al., 2008; Mell & Grance, 2009; Shimba, 2010; Shoshatari, 2013). These can be grouped into the following:

Infrastructure as a Service (IaaS)

The IaaS provider, who owns the cloud, offers on-demand provisioning of infrastructural resources. This aims to virtualise physical computer resources and hosting it online. This service-delivery model allows customers to deploy applications on the provided cloud infrastructures. However, customers do not have control of the infrastructure. But the cloud user may have control over the operating system, selected network components, storage units and software development application (Shimba, 2010 and Shoshatari, 2013).

An example of IaaS is Amazon C2.

Platform as a Service (PaaS)

This is the provision of an online platform, where SaaS providers offer dedicated resources to clients. PaaS provision includes operating system support and software development frameworks. Therefore, this service delivery model allows users to control their own created applications or software, but not the underlying cloud infrastructure. Examples of PaaS providers include: Google App Engine, Microsoft Windows Azure and Force.com

Software as a Service (SaaS)

This is a scalable provision of online applications via the Internet. Users do not need to instal programs and have access to these applications. They can simply demand such resources wherever and whenever they are needed. However, the clients do not have any control over the infrastructure on which the software is operating. Being the most common and cost efficient, cloud service simply means that clients do not need to be concerned with the maintenance and management of underlying infrastructure and operating systems, which are handled by the SaaS providers. Examples of SaaS providers are Salesforce.com. and Oracle CRM.

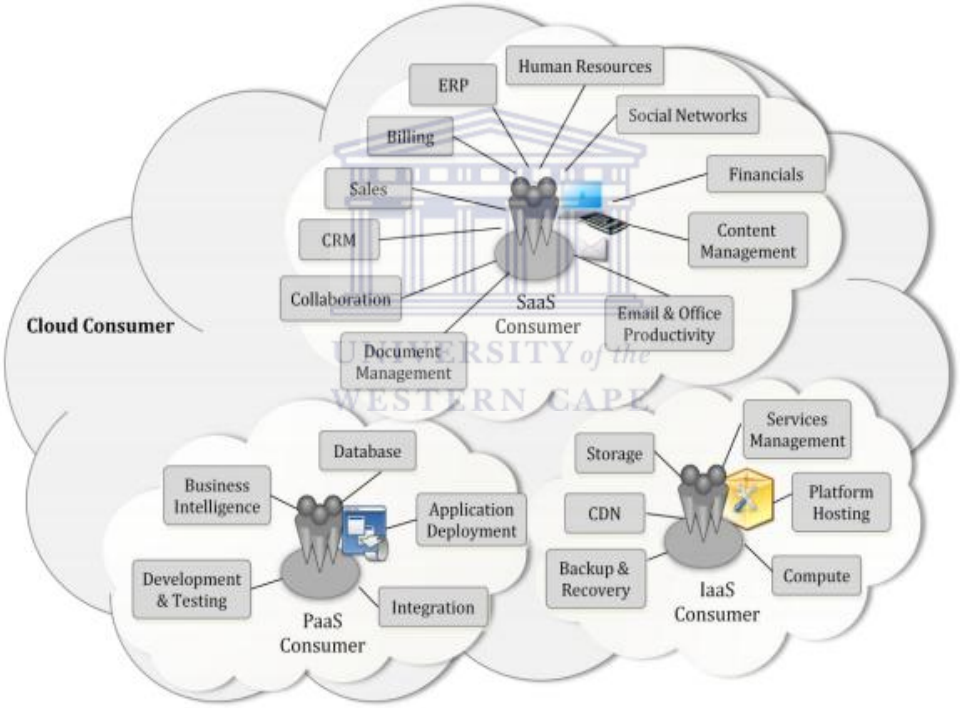


Figure 2-2 Example of the services available to a cloud consumer (Liu et al., 2011)

Figure 2.2 demonstrates some examples of cloud services available to cloud users. Each service scenario may vary, depending on the specific type of service each cloud user requests (Liu et al., 2011).

2.2.3 Service-deployment model of cloud computing

The way in which users use cloud services is known as deployment. There are four deployment models associated with cloud computing. These are based on the differences between how the exclusive the cloud resources are provided to a cloud consumer (Shimba, 2010; Liu et al., 2011; Mell & Grance, 2011; Shoshatari, 2013):

Public Cloud

A public cloud refers to the services offered to a diverse pool of clients over a public network. A public cloud is owned and managed by the cloud-service provider; therefore, such services provide users with the needed services – without any initial capital expenditure on the infrastructure; and this shifts the operating risks and costs to the providers (Zhang et al., 2010). On the other hand, users have limited control over their confidential data; networks and security are vulnerable to external attack.

Private Cloud

Private clouds allow organisations to gain control over the internal properties, as private clouds are designed and managed by a single organisation within a private network. They may be hosted on-premises or outsourced to an off-site company. Thus, a private cloud offers the highest degree of control over performance, security and compliance requirements (Zhang et al., 2010). However, it lacks some of the key featured benefits of a cloud service.

Hybrid Cloud

The hybrid cloud is a combination of cloud services, consisting of both public cloud and private cloud services. Hybrid clouds offer the combined flexibility of both cloud-deployment models. To be more specific, such a hybrid cloud retains sensitive data on the private cloud to allow visible control over data and security, while still providing the advantages of cost efficiency. However, a well-designed hybrid cloud requires careful analysis on how to split

the public and private cloud services, according to the types of data an organisation would require.

Community Cloud

This deployment model is adopted by several organisations that have shared interests or concerns, such as security, mission objectives and compliance policies. It may be managed on-premises or off-premises. Therefore, those organisations can benefit from the advantages of a private cloud, while avoiding extensive costs.

Table 2.2 illustrates the advantages and disadvantages of the various cloud-deployment models mentioned above.

Table 2-2: Comparison of cloud-computing deployment models (Shoshatari, 2013)

Deployment Model	Pros	Cons
Public Cloud	• Minimises the resource's wastage • Minimises the IT infrastructure cost	• Protection of sensitive data • Lower quality of service
Private Cloud	• Ensures security of sensitive data • High quality of service	• The high IT infrastructure cost • The high cost of managing and maintaining the infrastructure
Hybrid Cloud	• Better data protection	• Less cost efficient than public cloud
Community Cloud	• Minimises the IT infrastructure cost • Ensures security of sensitive data	• Less cost efficient than the public cloud

2.2.4 Benefits of cloud computing

New emerging technologies have always addressed the issues of previous technologies. According to Zhang et al., 2010, the emergence of cloud computing makes businesses aware of their economic efficiency – like never before. It supports organisations in maximising the

profit, while minimising unnecessary equipment costs and energy consumption through optimised utilisation. This sub-section depicts the benefits of adopting cloud computing. The overall benefits of cloud computing can be grouped into the following categories (Creeger, 2009; Kshetri, 2010; Shimba, 2010; Shoshatari, 2013):

Economic Advantages

Significant economic advantages could be achieved in two ways, in terms of capital expenditure (CapEx) and operating expenditure (OpeEx) on resources. Widespread use in virtualisation has reduced the upfront investments in a company's data centre and product development costs (Kshetri, 2010). In other words, cloud computing allows organisations to eliminate the initial capital-expenditure investments on infrastructure, and to focus more on core differentiating competencies. Virtualised data centres provided by the third party allow many companies to share the resources and purchasing power, while shifting maintenance costs and risks to the third party. A significant saving in disaster recovery could also be realised through using a virtual machine (VM).

Moreover, cloud-computing frees companies from planning for the unpredictable demands and its associated CapEx. In this way, companies can transform what was a high fixed cost into a lower variable one (Creeger, 2009).Therefore, this benefit provides the main incentive for both private and public sectors to move to cloud computing.

Flexibility

Cost savings are the advantage for using cloud computing in small-to-medium enterprises; while for large international enterprises, it makes good sense to avoid the hassle of setting up a basic infrastructure to run and support a fully deployed service. The era of hard-to-scale applications is becoming the past; the soaring demand can be met through the adoption of cloud computing services.

Improved collaboration

Universal access to cloud-computing resources enables flexible working collaborations, thereby increasing productivity. The key feature of being time-and-location independent also increases the collaboration of organisations or departments to share data and resources. Consequently, data consistency and integrity (Shoshatari, 2013) can be achieved between organisations or departments that share common concerns, thereby increasing the overall collaboration.

Automation and self-service

Cloud computing allows applications to run off-premises, which would require a higher degree of automation in the cloud. Self-service could be seen as the key feature of a cloud-computing service model. A higher level of automation enables IT departments to define user policies for automated platform and infrastructure services, with line-of-business owners developing applications on their own to meet those requirements (Creeger, 2009).

Value-added co-operation

A cloud platform creates a common application platform, which could be used to allow third parties to deploy services: either on behalf of the cloud owner to extend the services, or to operate individually.

2.3 Cloud computing in the e-Government context

E-government refers to an evolutionary way to provide government services via an Internet-based platform, in order to provide convenient services to the public in a user-friendly, transparent and efficient way. Most e-government services strive to promote the government services in the following domain: efficiency of the internal government affairs, Government-to-Government (G2G), Government-to-Business (G2B), and Government-to-Citizens (G2C) services (DPSA, 2001).

With the realisation of easily accessible Internet services and effectively functioning information systems, e-Government has gradually become the new form of government, as a single unit delivering improved government services to citizens, by utilising the support of modern Information and Communications Technologies (ICTs).

2.3.1 International government cloud (G-Cloud) adoptions

Since the introduction of cloud computing in the government context is closely linked to the concept of e-government, it might be useful to here give a definition of the latter:

E-government refers to electronic-government, sometimes known as digital government, or online government (Mvelase et al., 2013). E-government is designed and implemented as an integration of different related government departments, through national, provincial and local level of governments. It utilises innovative technologies and enhanced systems to improve the productivity of public affairs, to enhance the interactions between public sectors and citizens, and to increase the level of convenience to serve the citizens in a more efficient way (Mvelase et al., 2013).

In the above regard, the cloud-computing concept is taking place around the world for improving e-government performance. Some governments from developed countries have already started in the implementation of cloud computing, in pursuit of greater information and resource integration and sharing (Wyld, 2009). For example, the United Kingdom utilises the "G-Cloud" Programme (UK_G-Cloud, n.d.), which is described as a strategic priority (Wyld, 2010) – aimed at utilising the new technologies to deliver more efficient public services at a lower cost: "*Digital Britain is about giving the country the tolls to succeed and lead the way in the economy of the future*" said the Prime Minister, Gordon Brown (Wyld, 2009 & 2010).

The Japanese government uses the "Kasumigaseki Cloud" as a major cloud-based government initiative by the national government of Japan. It aims at developing a private

cloud environment amongst Japanese government departments to promote the standardisation and integration of IT resources (Wyld, 2009 & 2010). In addition, the Japanese government believes that adopting cloud computing is also going to contribute to the environmental-friendly operations. Furthermore, being part of a larger government project, Digital Japan Creation, Kasumigaseki Cloud also aims at spurring the economic development of Japan (Hoover, 2009).

In China, the cloud-computing based government developments remain at the regional level. The Yellow River Delta Cloud Computing Centre is located at the city of Dongying, where it is aiming to become a 'city of digital innovation' (Wyld, 2009& 2010). A cloud-computing centre has been built in the city of Wuxi, in collaboration with IBM, to offer cloud services to organisations in the "software park". The cities of Chengdu and Nanjing both enjoy the benefits of this initiative, and have built their cloud-computing centres as well (Sugon Information Industry Co. Ltd, n.d.).

In October, 2013, another cloud-computing centre was initiated in the Guizhou province of China (cntv.com, 2013). These initiatives aim to improve the city management and regional government services capacity (Sugon Information Industry Co. Ltd., n.d.).

In 2012, New Zealand's "cloud-first" government approach towards cloud computing was introduced by the Minister of Internal Affairs, the Hon. Chris. Tremain (DIA, 2012). It is currently undertaking a cloud-computing programme in an all-of-government direction. Desktop-as-a-Service (DaaS) and Office-Productivity-as-a-Service (OPaaS) (DIA, 2012) are proposed to achieve the overall productivity and collaboration on a government-wide scale.

All these examples suggest that the introduction of the cloud-computing technologies, and the concomitant services for making government's operations more efficient and effective equated to the right choice. This, in turn, confirms that the decision of the studied South

African Provincial government to introduce these technologies in its operations is both contemporary and beneficial.

2.3.2 Drivers of change

A revolutionary way of how technology is used in the public sector is the manner in which the new computing paradigm empowers massive changes, in terms of mindsets, operations and strategies. According to Brockman (cited in Wyld, 2009), drivers come from the growth of consumers' expectations; since it is these expectations that shape what can and what is expected to be done.

The current financial downturn, and the resulting financial tightness, together pose challenges to the ability of getting the best outcomes, by using the least amount of resources. The benefits brought about by cloud computing shed light on the financial downturn, as governments consistently look for solutions that involve cost savings (Wyld, 2009) and increased efficiency and effectiveness (KPMG, 2012), in terms of dealing with civil affairs with a broader digital inclusiveness of the citizenry.

The economic value of cloud computing is gradually being realised and perceived by the public sectors. With data applications stored on the cloud, it enables multiple users to collaborate on the same project (Wyld, 2009), regardless of their locations. Moreover, other advantages achieved by moving e-Government services onto the cloud platform include increased flexibility, improved levels of automation and employee mobility (Wyld, 2009).

As a whole, cloud computing frees government from building, maintaining and upgrading in-house infrastructures and technologies, and instead enables them to pay extensive attention to their key priorities (Microsoft, 2010):

- **Energy savings**: the cloud transition frees users from deploying excessive servers for the purpose of guarding against failures and meeting aggregating demand. This, in turn, reduces energy consumption and carbon emissions.

- **Financial savings**: cloud transition help governments diminish unnecessary IT spending without compromising the ability and performance of delivery-essential services.
- **Better service delivery to the citizens**: internally, cloud computing can improve the level of collaboration and co-ordination between different government departments. Externally, with optimised resources, government can better address issues, such as the never-ending queuing. Moreover, better interaction with the citizens is likely to be improved, by getting feedback from the citizens in a faster and easier way.

2.4 Government-Cloud Computing readiness analysis

The concept of cloud computing now has surfaced; and it is "spilling" its influence across various industries worldwide, and especially in the government operations – since the adoption of cloud computing services would help government to focus on mission-critical operations, and to reduce its overall IT costs. With governments of the USA, the UK, Canada, Australia, China, Japan and other countries already at different stages of cloud-computing adoption, it is becoming practically a must for the rest of the public sectors around the world.

However, any form of new technological solution brings multiple changes to businesses and society. Sometimes such changes challenge the routine capabilities for staff and the organisational environment: both technically and socially. Cloud computing definitely has the ability to affect the way we operate things now to a whole new level we could never have previously imagined.

Although cloud computing is a new trend in IT; and it is offering immense benefits, it is unfortunately not yet widely adopted. There are technical and socio-technical challenges that need to be addressed before adoption (Niazi & Mahmood, 2011). Depending on different environmental conditions, issues associated with the new computing paradigm, may hinder its adoption to some extent. Therefore, in order to realise and maximise the perceived benefits

of cloud computing, there is a need to develop a framework, of which a structured analysis can be drawn, in order to assess how cloud computing would affect the key abilities, processes and strategies within the public sector – and to the extensive effect that this may have in the future.

In this chapter, the focus has been on finding and assessing indicators, which may affect the cloud-computing adoption, with a background analysis of the African continent context, considering the unique opportunities and constraints, especially in the context of South Africa and its Provinces.

The reviewed literature suggests that the CC readiness indicators can be categorised into three sections, namely:

- ***Infrastructural*** indicators,
- ***Organisational*** indicators, and
- ***Environmental*** indicators.

Finally, this chapter has hosted a discussion on the frameworks and models that can be used for the government cloud-computing readiness assessment. The relationship of those indicators within the established model will be explained in the context of assessing the readiness of the studied Provincial Government for adopting the cloud-computing technologies.

2.4.1 Infrastructural indicators

New IT innovations are introduced, regardless of a country's economic developmental level. However, in order to implement new IT innovations successfully, a closer consideration needs to be taken of each country's economic condition, since this varies from one country to another. It is evident that national infrastructure condition reflects a country's economic level. Thus, the technology-related infrastructure (which here refers to electricity supply and ICT infrastructure) condition determines the wide adoption of cloud computing.

2.4.1.1 Electricity supply availability and reliability

In developing countries, the availability of electricity supply determines the extent of cloud-computing adoption in the public and the private sector. Especially in the context of e-government, this aims at bringing people together in a digital sense by, for example, engaging the rural citizens in a cloud-based government strategy. The electricity supply availability plays a vital role in serving the first step of the CC adoption, which remains one of the primary challenges in some parts of the studied Province, where there is a lack of any reliable electricity supply.

In addition, a lack of any ongoing electricity supply hinders the future adoption of cloud computing in general. In South Africa, the electricity is mainly generated by coal-fired power stations (about 90%), which sometimes present a challenge in consistently supplying electricity. This happens for various reasons – of which one was recently reported – too wet coal for use in the power plants[1].

Since 2005, South Africa has been suffering from load-shedding, which occurs when it becomes necessary to interrupt the electricity supply because the demand cannot be met (Biles, 2008). Major inconveniences were caused in various industries. In November 2013, Eskom admitted that there would be a possible gap in the power supply in 2014 (Jansen, 2013). Thus, the current energy outage situation in South Africa may seem to weaken the cloud-computing environment. For example, Data Centres, which are essential for introducing Cloud Computing, are currently consuming 1.5%-2% of all global electricity, and this is increasing at a rate of 12% per year.

[1]e.g. Eskom declares power emergency due to wet coal, source: www.moneyweb.co.za/moneyweb-south-africa/load-shedding-inevitable--etzinger

Moreover, the current technologies are still powered by coal, with over half of the companies rated relying on this resource for up to 50%, or even as much as 80%, of their energy needs (Greenpeace, 2011).

The International Telecommunication Union (ITU, 2012) also has indicated that an unreliable electricity supply is commonly seen on the African continent. Thus, the current power infrastructure situation in South Africa and the researched Province might have some impact on large-scaled cloud-computing adoption for the public sector in the short term.

An electricity outage, which would then cause an outage of the cloud-computing services, seems to be inevitable in those countries with an inconsistent electricity supply. This outage could be both temporary or permanent. In 2007, an electricity power outage caused a 4-hour downtime for the Server Beach datecenter (Maurice et al., 2012). Regionally, this may happen due to the electricity outage, which would lead to poor and unsatisfactory communication and data transaction between the client computer and the Web server in the cloud.

Here is another example: According to Smith (2012), a Virginia datecentre run by Amazon Web Services became unavaliable, due to the power blackout caused by an electrical storm that swept across the East Coast. Instagram, Netfix and Pinterest went down, as those companies rely on Amazon's virtual data servers.

In summary, it may be conluded that the reviewed literature reveals that a reliable electricity supply serves as the most fundamental prerequisite for cloud-computing adoption across various industries – as well as the government environment.

2.4.1.2 Broadband connectivity indicator

Cloud computing enables to sustain "work on the go", where and whenever you wish, with access to fast and reliable Internet speed and computing power (Wyld, 2010). Thus,

ubiquitous Internet access is the most essential factor in enabling cloud computing technologies (ITU, 2012). As the vital prerequisite in enabling the ultimate cloud services, the national ICT development level determines a wider adoption of innovative ICT services – from individuals to corporate companies and the public sector. With the implementation of several undersea cables, the South African telecommunications market is characterised by improving Internet connectivity and increasing uptake of mobile data services, as a result of high data demand and further reduction of the bandwidth costs.

However, poor quality of Internet service is often discovered – as a result of insufficient investment in the telecommunication networks (ITU, 2012), which causes inadequate speed of the Internet connections in many peri-urban and rural areas. Moreover, many remote areas are still not sufficiently covered with the telecommunication network infrastructures. This makes the majority of the rural population unable to gain access to the digital government services – in turn, inhibiting the realisation of the ultimate vision pertaining to the CC-based government services.

Hence, it is advisable that reliable fixed infrastructures, and high-speed networks that are supporting CC technologies, should be of a significant quality (ITU, 2012), if effective CC-based government services are to be accessible.

In the above regard, it seems that the ICT infrastructure situation in South Africa is improving, as, according to ITU (2012), out of 112 data centres on the African continent, 15 are established in South Africa: two new data centres have been established in Johannesburg and Cape Town. The significance of these data centres is that they all use the most up-to-date ICT infrastructure. Due to its growing broadband infrastructure and somewhat competitive pricing comparing to, for example, European countries, these centres may attract further investments and drive improvements on the telecommunications infrastructures. And this is crucial for the CC services (ITU, 2012).

In Africa, which is inevitably linked to the developments in South Africa, it is still at the stage of achieving pan-Africa interconnectivity via broadband networks (Kuada et al., 2012), coupled with several infrastructural constraints obstructing the overall ICT development. The costs associated with data transportation in and out of Africa are still relatively high, whereas intra-Africa rates seem to be more advantageous, in terms of costs. However, the unreliable electricity supply and the fixed networks make intra-Africa data transportation relatively affordable, but still unsatisfactory.

The literature review revealed that it may still take a while to see any leapfrogging in building data centres in Africa for a wider and successful utilisation of cloud computing.

Furthermore, taking into consideration risk management and security concerns, the private cloud is widely recommended to suit the purposes of the public administration. Moreover, when placing government services onto a cloud, compliance with local laws and policies is required. This means that the private government cloud must occur within the boundaries of its own country, in terms of data storage and processing. This also confirms the significance of reliable and efficient ICT infrastructure for enabling a government's CC-based services.

2.4.2 Organisational indicators

When a cloud adopter considers a cloud-computing solution, organisations should evaluate both operational and strategic feasibility, by comparing and analysing the potential benefits and possible vulnerabilities.

For example, the Federal Financial Institution Examination Council Agencies (2012) considered cloud computing to be a different form of outsourcing, since it possesses the same basic risk characteristics and risk remedy techniques as traditional forms of outsourcing. The major considerations, when adopting a cloud-computing solution, must impose on how to

improve organisational business efficiency and lower operational costs, while not compromising security and the overall service performance.

The ICT executives are likely to be confronted with the relatively same pros and cons when migrating to the cloud-computing technologies, as they did with the outsourcing strategy.

Generally, when introducing the CC technologies, the public sector (and other) organisations should consider both *strategic* and *operational* factors. These considerations are portrayed in the next two major sections.

2.4.2.1 Strategic business considerations

2.4.2.1.1 Strategy

Cloud-computing strategy is, according to the reviewed literature, "*the first step in the process of migrating towards cloud technologies, both within the public and [the] private sector*" (Kundra, 2011). According to Kundra (2011), the CC strategy should be designed to:

- Articulate the benefits, considerations, and trade-offs of cloud computing;
- Provide a decision framework and case examples to support government agencies in migrating towards cloud computing;
- Highlight cloud-computing implementation resources;
- Identify government activities and roles and responsibilities for catalysing cloud-computing adoption.

Generally, a cloud-computing adoption strategy includes the development of appropriate: (i) *Policies, (ii) principles, (iii) contract guidance, and (iv) knowledge sharing*. All these strategy elements should be included in a cloud-computing strategic framework, which should have the following (DFD, 2011):

- "Use of cloud computing " principles;
- Governance framework;
- Cloud-computing best-practice guidance;

- Risk-based service provision;
- Procurement guidance.

Furthermore, the cloud-computing strategy should include considerations regarding issues, such as: (i) *Security*, (ii) *privacy*, (iii) *portability*, and (iv) *service-provider certification*. It is suggested by the reviewed literature (e.g. DFD, 2011) that the strategic framework should be undertaken in collaboration with the cyber-security policies and the protective-security policies. In addition, the same source (DFD, 2011) suggests that the strategic framework should be: (i) risk-based, (ii) cost-effective, (iii) flexible and responsive, (iv) avoiding technology lock-in, and (v) effectively managed in regard to contract arrangements.

Summarising the literature review findings on cloud-computing strategic considerations, the provincial cloud-computing strategy is needed to lay the groundwork, and to foster the cloud-computing launch province-wide. A well-developed strategy is intended to accelerate the changes required to improve the IT operations and their performance.

2.4.2.1.2 Top-Management Support

When a new ICT innovation is introduced in a company, the employees are the first ones to react. This is because they are afraid of the possible impact of change that is brought about by the new ICT service. Frequently, employees are not comfortable with getting out of their current comfort zone, and making the effort to adapt to the new environment. Most importantly, certain ICT-related changes may cause possible change of the organisational structure, so employees may be afraid that these changes might affect their current benefits, power, and even job positions (Lam, 2011).

The negative attitude to the forthcoming change is likely to have an impact on the employees' productivity, thus inhibiting the full realisation of deployment and performance in cloud-computing services (Ragu-Nathan et al., 2004). Therefore, encouraging and maintaining a high level of motivation is essential in the process of implementing

cloud-computing technologies and service, which should be supported by the top management within the organisation.

On the other hand, with a highly skilled top-management committee, a positive climate and effective communications must be in place to support capable personnel, utilising adequate resources, to ensure successful system transformation and integration (Low et al., 2011; Swink 2000). Moreover, top management with a clear vision must contribute to the ultimate goal. This could significantly help the goal of introducing new technologies and services (Dhiman, 2010; Swink, 2000).

With the top-management leadership overseeing and monitoring the entire process of introducing new technologies, the process can be safeguarded when the complexity increases and issues arise. Thus, an experienced top-management committee is a critical success factor in supporting and ensuring the achievement of innovative ICT projects.

2.4.2.1.3 Human-Resource Strategy

Once the enterprise decides on migrating to the cloud-computing model, it is important to ensure that the organisation has suitable skills and motivation at the deployment stage. Ultimately, by adopting cutting-edge cloud-computing services, enterprises aim at creating a winning strategy. Thus, it is critical to have specialised right skills to form part of the core competencies in the organisation, in order to realise the maximum achievement of expected improvements (Lam, 2011).

This is also associated with rewarding high-performance employees, in order to create a satisfying and positive working environment.

The analysis of the reviewed literature on this topic suggests that all the stakeholders who are relevant in the transition of change of technology (i.e. migration to the CC technologies) should all be involved with the process. It is believed that nobody should be eliminated from

the process of introducing new technologies – be it vertically or horizontally – in the organisation. This is supported by the fact that the research done by ITU (2012) indicates that there is a lack of required skills in cloud-computing technology in Africa. In South Africa, there is currently a shortage of about 70,000 ICT professionals (Mitrovic et al., 2012). This calls for the need to emphasise the CC-related training and integrated programmes across the entire African continent.

The reviewed literature suggests the offering of different programmes to both high-level management and the staff. The ICT executives need to have a thorough understanding of the legal issues, the strategic alignment, and the complexity of the cloud-computing technologies and services, in order to be more flexible when confronting new governance challenges in the cloud-computing environment (ITU, 2012). Complexity is the degree to which using an innovation is perceived to be a difficult task.

A general consensus is that a complex innovation that requires greater technical skills and greater effort to implement would probably reduce the likelihood of adoption (Cooper & Zmud, 1990; Teo, Tan & Wei, 1995). This can also be applied to cloud computing, as the complexity of the underlying infrastructure can impact on the wider adoption of a cloud solution (Vouk, 2008). This, according to Vouk (2008), is a lesson learned from grid computing. Hence, ICT professionals are more likely to consider using cloud computing if the use thereof does not require more technical skills and greater efforts to implement (Lin & Chen, 2013) .

Employees, on the other hand, need to understand and possibly adjust their responsibilities, in order to effectively support the new corporate goals and objectives regarding the introduction of new technologies (Lam, 2011).

2.4.2.1.4 Vendor Management/Service Level of Agreement

Prior to accepting a partner with a cloud-service provider, organisations need to acquire a comprehensive examination of the service provider, in terms of its areas of specialties, capability, pricing, and most importantly, the Service Level of Agreements (SLAs). A Service Level Agreement (SLA) serves as a legal and mutual agreement between a customer and a service provider (Bollineni & Kumar, 2011).

It is important for the provider to have a solid understanding of the industry's legal and regulatory environment in which the organisation operates, so that the organisation's sensitive information and data (Federal Financial Institutions Examination Council, 2012) can be protected by the provider. In order to ensure that the SLAs are as detailed as possible, specifications must be given to the level of ownership, the location where the data and the back-ups are stored, as well as the format of the data (Federal Financial Institutions Examination Council, 2012).

Detailed requirements should be met for security protection, privacy, data and process integrity, service and system availability (Ernst&Young, 2011), in addition to the recovery plan.

Allowing cloud-service providers to have control over the organisation's data and applications, cloud-service users may feel insecure in trusting service providers, whereby they have limited or no transparency of the providers' infrastructures. Since the cloud market is still in its infant stage, an initial lack of experience in managing cloud-service providers is found amongst most organisations. There is also a trend in which a single business-process solution may require many applications provided by multiple providers. This increases the level of complexity to manage vendors. Moreover, in addition to a list of the precise requirements, signed off by both parties, there is a lack of other approaches to enforce such requirements (Ernst &Young, 2011).

There are certain critical issues when managing vendors in a cross-cloud environment. Sourcing is a lengthy process. It not only takes time for organisations to decide and shift certain data and processes onto the cloud; but it also requires a personnel shift from those with technical skills to those with people skills (Ernst & Young, 2011) for managing, communicating and negotiating different service contexts with multiple vendors.

In addition, organisations doubt that many offerings can be smoothly implemented over the long term, due to the nature of their complexity, in terms of service contexts, system integrity issues, regulation compliance, privacy and data security, the relatively immature cloud-market environment and cloud-service offerings etc. Moreover, organisations tend to move the business processes that are less risk-sensitive and non-critical. However, such conditions may change over time, as the cloud market evolves and becomes more mature. This further requires consistent strategic-sourcing revision. These factors should be taken into consideration when initially setting the SLA for both parties to co-operate in the long run.

With data security and privacy issues being the primary concerns and the most critical components, when it comes to migrating to cloud services, cloud-service users should specify the detailed responsibilities for legal and regulatory compliance with the cloud-service providers. Incidents should be reported in time, together with solutions. Business customers should also be notified in case of any breaches (Federal Financial Institutions Examination Council, 2012).

According to the ITU (2012), the following key aspects are to be addressed when negotiating and signing a SLA:

i. Network security
ii. Data-access authentication
iii. Data back-up
iv. Data and process interoperability

v. Regulatory issues associated with the location of data

vi. Data traceability

vii. Security incidents and a recovery plan

viii. Service interruption and a recovery plan

Furthermore, it requires a detailed description and explanation of each service within the various categories. SLAs should at least cover the following areas of concern:

Table 2-3 Areas of concern in SLA (Bollineni & Kumar, 2011)

Consideration	Description
Service Delivery	A detailed description is given of how services are delivered and what level of reliability is expected within a certain timeframe
Performance	Monitoring and measuring criteria are set to determine the performance of the service
Problem Management	A management description of identifying, solving and managing incidents during the service delivery and implementation process
Customer Duties	A detailed specification is given to explain the duties and responsibilities of the customers
Security	It is the most concerning feature, which specifies solutions to sensitive-security issues
Disaster Recovery	Solutions are given to ensure that the service can still operate continuously
Others	Warrant and service exclusions are addressed
Termination	It specifies the contract-termination conditions

Partnering with a good vendor, whose service is best suited to your requirements is the critical step in securing a mutually beneficial SLA for both parties. This requires a detailed company background check, service analysis, and customer feedback (Bollineni & Kumar, 2011). However, organisations may not always get what they expect from the SLA, especially when the SLA is created to protect a cloud-service provider more than the user.

Hidden costs may be discovered at a later stage; blurred responsibilities may lead to unsatisfactory service experience; vendor lock-in issues (Habib et al., 2010) may arise as a way for cloud providers to gain profits in the long run. These comprise the concerns that scholars and industry experts suggest need to be taken into careful consideration. Therefore, an agreed-upon, mutual and beneficial SLA is crucial for an effective level of co-operation.

2.4.2.2 Operational business considerations

2.4.2.2.1 Security

Data security

Moving data off-premises to the Cloud renders them generally vulnerable to potential security threats (Dhiman, 2010). Having a third-party process and storing your data and information could pose the risk of losing, misplacing, or someone gaining wrongful access to the data. Therefore, all of the potential issues related to data security, when adopting a cloud solution – with the appropriate precautions – need to be considered.

According to the Federal Financial Institution Examination (2012), There are three areas of consideration relating to data security: data classification, data segregation, and data recoverability. A cloud adopter needs to identify how sensitive the data are (public, confidential, or critical). When stored in the cloud, would the data be appropriately protected? Once the data have been placed in the cloud, would they, be accessible to other clients, who share the same cloud computing provider? If not, how restrictive is the data-access security that is in place to ensure the confidentiality of the client's data? Finally, are there appropriate disaster-recovery plans and business-continuity plans in place to respond to disasters and to ensure continued service?

Furthermore, the global nature of cloud computing determines that the data be stored remotely. They are vulnerable to complex legal acts, especially when the back-up data are stored in more than one location/country.

Data-Access Management

Physical transportation of the data may not be the only way that could lead to loss, damage or interception of the data, dishonest staff may overrun their responsibilities and duties (Kim et al., 2009); thus, the systems and the data are vulnerable to manipulation by unauthorised organisations and individuals. Currently, there are no technological barriers, which exist to prevent the unauthorised secondary usage of data (Pearson, 2012). The fear of losing control of one's own data would lead to the critical trust issue, when adopting cloud services.

A restrictive and effective identity-and-access-management system is crucial when accessing customer data, especially when utilising a multi-tenant cloud-deployment system (Federal Financial Institutions Examination Council, 2012). Security policies, practices and standards should be in place to ensure that a strict and appropriate level of data protection exists, and that such a system functions to allow only tenant's access to their own respective information and data.

Amazon Web Service employs a security authentication mechanism, which uses a digital-signature technique for message-authentication (Schreiber, 2011). Users can run their own customised image with a full-root access, and to have their own ingress firewall. Moreover, users also need to have a very granular and full-featured access control for each single-file host on S3 (Petkov, 2008). A signature of a special string has been developed by Amazon, as a canonical string. Such security mechanisms are based on symmetric cryptography, which requires a secret key (40 characters), and a public key (20 characters) (Schreiber, 2011).

In conclusion, in order to prevent any potential loss associated with security issues, users need to select a service provider, who can provide them with suitable context-dependent solutions. In achieving a better level of security, a thorough examination of the Service Level of Agreement (SLA) is necessary.

2.4.2.2.2 Trust

When embracing a new IT innovation, individuals and organisations have their subjective criteria and opinions of the new technology. Unlike security issues, trust lies in the eye of the beholder. It is a broader notion, since it reflects all the possible threats associated with cloud computing services. There are many aspects indicating that trust is based on balancing out the positive expectations of the implementation of cloud computing, as well as the possible vulnerabilities. Thus, the level of trust of cloud adopters could delay the process of launching and implementing cloud-computing services.

The perceived lack of reliability is determined by the availability and reachability of the cloud service (Habib et al., 2010; ITU, 2012). This, in turn, is determined by a number of factors, such as, a lack of speed, high bandwidth internet connection (Bollineni & Kumar, 2011) and control over computing resources, when sensitive data are stored remotely (Pearson, 2012). Additionally, there is the danger of network failure (Bollineni & Kumar, 2011) and server outage (Habib et al., 2010).

In assessing and deciding a cloud-computing service provider, the adopter's decision is based on a combination of both technical and non-technical mechanisms for trust consistency. This implies that if the level of cloud services is of a high standard, as it is advertised, its reputation should be trusted by a group of consumers and experts. Even though trust is determined within a certain period and within a special context, the degree of the trust level is unequal among cloud-service adopters, as recommendation factors may vary from one organisation to another (Li & Ping, 2009).

Reputation is perceived and rated to be the most obvious criterion, when consumers trust an online provider, with 28% of the interviewees stating that confidence in knowing who to choose to supply the service (Cloud Forum IP Ltd., 2011) is considered as one of the concerns affecting cloud-service adoption. The International Data Corporation (IDC) published a survey on cloud computing. According to the analysis of IDC's report (IDC

Executive, 2009), security remains the main concern, when adopting a cloud model; while service availability comes in second. As many as 83.3% of the interviewees agreed that, organisations are skeptical about whether or not the trade-offs between costs and benefits is worth the try. It is of high importance for cloud providers to provide a trusted platform (Furrier, 2009) and strict data-access control, as security and trust are critical factors affecting cloud-computing adoption.

According to Li and Ping (2009), a trust model was introduced; and its simulation experiment was tested in a simulated cloud platform. The results show that the proposed trust model can be established to measure the perceived trust degree between customers and service providers. However, there are many more reality issues that exist that are not yet included in this simulation model. Further research is still required.

2.4.2.2.3 Compatibility and interoperability

In the process of understanding cloud computing with its associated benefits and costs, businesses and organisations often find that compatibility is an essential factor for new technology adoption (Low et al., 2011). Compatibility refers to the degree to which cloud computing services fit into the business or organisation's operational needs and strategic goals. Compatibility is a critical enabler for applications to be able to move easily among different cloud-service providers, regardless of their locations, formats and operating systems.

Migrating IT processes to a cloud model is a lengthy process. Challenges may occur on whether or not a business' processes and data transactions are able to operate timeously and accurately on different IT systems (Ernst & Young, 2011). The biggest concern lies in how well the cloud-service providers' solution combines with the on-premise infrastructures, applications and the data of the customers. The true value of cloud computing is likely to be achieved, if the process is successful. Otherwise, the operation will be doomed to fail, if

operational and strategic alignment cannot be found between the users and the service providers.

On the other hand, with the emergence of numerous cloud-service providers, having multiple vendors available to develop a business solution is becoming the current trend. However, at the current cloud-services market, many existing issues limit the choice of incorporating such service solutions. This furthermore inhibits the ability of interoperating data and applications within a cross-clouds environment. Sometimes, one single business process requires a business solution that is jointly provided by multiple cloud-service providers (Ernst & Young, 2011). Thus interoperability issues arise, since different service providers may run on different infrastructural service providers' platforms.

Moreover, when shifting from one cloud-service provider to another, customers are hoping to be able to do so without considering the incompatibility amongst those service providers – and most importantly, without the concern of losing data or having a penalty, by doing so (ITU, 2012). This is the reason why the current cloud market has a lack of widely accepted standard, in terms of cloud-computing interoperability. Studies made by Pearson (2012) indicate that lacking a globally accepted standard may also lead to the vendor lock-in issue.

Therefore, standards need to be established in the cloud-service market, to clarify the platform, interface and the data format for all models of cloud-computing services. According to Wang et al. (2012), organisations such as the IEEE Standard Association have already been working on the interoperability standards. Parameswaran and Chaddha (2009) addressed the interoperability and standardization issues and discussed two approaches, namely: the Unified-Cloud Interface/Cloud Broker, and the Enterprise-Cloud Orchestration Platform/Orchestration Layer.

The fundamental concept behind these proposed approaches is to create a unified architecture layer, which serves as a single management platform to provide orchestration for both cloud users and multiple providers. Challenges associated with such an approach are identified as issues, such as service-level management, data volumes, and support that need to be taken into consideration.

2.4.2.2.4 Cost performance

Cost efficiency is featured as one of the benefits of cloud computing (Dhiman, 2010; ITU, 2012; Lam, 2011; Low et al., 2011). In an economic context, both private and public sectors are constantly looking for solutions to minimise their operating expenditures, while making the most out of their investments (ITU, 2012). The "pay as you go" model allows users to only pay for what they need, according to the requested time and volume of their own usage and consumption patterns, which frees organisations and businesses from investing heavily in internal resources.

However, transitioning to cloud is not a once-off mission. Additional and unexpected costs may be discovered during the migration. Moreover, it certainly cannot ensure perceived financial gains by solely depending on the provider. From maintaining on-premises data back-ups to performance management, organisations and businesses need to co-operate with the cloud-service providers to make sure the possible impacts brought by unexpected costs should not jeopardise the overall cost performance.

In other words, considering the development of cloud computing is still in its nascent stage, and lacking the requisite global standards. Users have uncertainties about handling data and processes to the provider; therefore preference is given to keep on-premise back-ups, monitoring tools, in-house expertise, secondary cloud services, and upgrades of bandwidth networks (Kim et al., 2009). However, additional costs are required to ensure business continuity; and the critical part is the ability to maintain an affordable cost structure.

By knowing all the tangible benefits associated with cloud-computing services, organisations should evaluate their own economic situations and business priorities, in order to reach a suitably customised conclusion (ITU, 2012; Dhiman, 2010), as different cloud models have their distinct aspects of achieving and maximising certain business needs.

Maximising the overall performance, while still aiming at cost efficiency requires continuous monitoring and good management.

2.4.3 Environmental indicators

There are other factors that could impact on the adoption of cloud computing within the government. This chapter depicts these factors, namely: regulation of the environment and the sustainability issue.

2.4.3.1 Regulation of the environment

Earlier it was mentioned that issues, such as security, interoperability, service reliability, data protection etc., hamper the trust of potential users, which may hinder the process of adopting cloud computing. This is due to the level of uncertainty of the trade-off between the cost and gains being quite high. The fundamental reason behind this is a lack of regulatory establishment in the cloud-computing environment nationally, and across borders. The development stage of related regulatory and legislatorial fields is still nascent. Thus, this issue could keep businesses from moving into the cloud.

With datacentres located everywhere around the world, issues around security and privacy of data and the location of data become the most paramount concern, when it comes to cloud-computing adoption. Therefore, this is a challenge in the context of regulation formulation. A lack of universally accepted standards also creates a barrier for cloud computing to flourish in the present era.

According to ITU (2012) and Kuada, Olesen and Henten (2012), the majority of African countries fall short of data-protection legislation, compared to other relatively "mature" cloud markets around the world. These have already formed strategic policies, or are in the process of finalising such policies. The dissatisfaction with the lack of data protection makes potential users insecure to hand over their personal information or intellectual proprieties to cloud-service providers. Thus, the trust issue becomes the barrier for cloud-service providers when introducing cutting-edge technology to organisations. It hinders any future access to cloud-computing services.

Currently, it is necessary to establish regulatory authorities in Africa. Standards should be agreed on amongst businesses, various industries and the public sector. Furthermore, compliance is required to ensure the legal protection of all parties involved. Government needs to take necessary action in making effective policies in the field of cloud computing to facilitate and accelerate the process of adoption across industries nationwide.

2.4.3.2 Sustainability

The energy consumption of data centres is consistently rising. This demand is driven by the increased IT centralisation and greater computing capacity (Paper & Continuity, n.d.). As much as $3.3 billion is spent on power costs for U.S. data centres annually (Paper & Continuity, n.d.); and according to Hamilton (2009), approximately 53% of the total operational expenditure of data centres is used for powering and cooling. According to Gartner (2007), 2% of the global carbon dioxide (CO_2) emissions is generated by the ICT industry alone.

This shows that fast server-computing performance is not necessarily accompanied by a better improvement in energy efficiency (Brill, 2007). The rising energy costs within the data centre have now drawn attention to the cloud-service provider, IT equipment suppliers, and almost every organisation. Government is also involved in making policies and regulations for this cost crisis, as such ongoing growth contributes to the carbon footprint. This calls for

sustainability awareness: for both the environment and future businesses. Thus, finding a solution for resolving the rapidly growing energy consumption should be raised as a key concern.

Service providers put more effort in their application performance; however, they should not neglect improving energy efficiency, more accurately, and being carbon efficient. Solutions should not only address the issue of high energy consumption, but also to decrease CO_2 emissions. Garg, Yeo and Buyya (2011) give an example: if cheap energy is used to generate cloud datacentres, such as coal, the release of CO_2 emissions would only increase under such circumstances. Therefore, as a whole, it is not environmentally sustainable. According to Eskom (Eskom n.d.), South Africa's sole electricity supplier, 90% of electricity is produced by using coal-fired stations.

Over 90 million tons of coal is used by Eskom per annum, as coal is the most convenient source of energy found in South Africa. Nevertheless, carbon efficiency is unlikely to be realised if cloud datacentres utilise coal-powered electricity in South Africa.

There is no doubt that cloud computing is an energy-efficient technique (Berl et al., 2010), despite the fact that they are the main power consumers (Brill, 2007). Policies should be made around true-cost justifications with sound examples to not only reduce the carbon footprint, but also to operate businesses effectively. Efficiency for more profit could drive the industry to do businesses differently, especially by being more environmentally sustainable.

Berl et al. (2009) suggested the need to develop a comprehensive approach towards an energy-efficient cloud environment, which takes into consideration both service providers and users. From the vendors' point of view, an energy-aware scheduling mechanism could be applied, and incorporated with the compromising of performance or cost reduction due to energy saving. In addition, how to map the workflow under the circumstances of reaching

both financial and energy savings is of great value, depending on the cloud offerings (PaaS, IaaS, or SaaS). Users may decide to choose a more energy-efficient service, or a more business-efficient service.

Garg et al. (2011) optimised the above-mentioned concept by proposing a Carbon-Aware Green-Cloud Architecture, together with a Carbon-Efficient Green Policy (CEGP) to aim at curbing carbon footprint by involving all the parties. It encourages and provides incentives to both service providers and users to embrace the "Green" concept when delivering and utilising the cloud services. They (Garg et al., 2011) also showed a 23% energy saving and a 25% carbon footprint reduction with their case-study experiment. With its promising improvement that has been approved, cloud vendors could adopt such an approach with their existing and potential users.

Both these approaches are suggested to encourage both vendors and users to use cloud service "wisely", in this case meaning "greener". However, the latter optimised the concept by involving a third party (Green Offer Directory and Carbon Emission Directory) to list green-cloud services and the corresponding energy-efficiency indicators. Therefore, it not only serves as a ranking technique for encouraging vendors to compete with whose cloud service is more "greener", but also allowing users to be able to make their choices by selecting a "greener" cloud vendor.

Such a harmonising environment could facilitate and contribute to a more carbon-efficient cloud-environment, as a whole.

The new computing paradigm requires energy-efficient solutions to not only reach its fullest promising business potential, but also to contribute to a better carbon efficiency.

2.5 Literature review summary

This chapter has provided a wide overview of the various concepts, including the characteristics of cloud computing, business models and service-delivery models of cloud computing, as well as the benefits of cloud computing. In addition, it has provided an extensive review of the literature pertaining to the possible readiness-indicators for cloud-computing adoption. There are three main readiness indicator contexts, namely, infrastructural and technological indicators, organisational indicators and environmental indicators.

Table 2-4 A research conceptual model of readiness indicators for e-Government cloud computing adoption (Source: Author)

Context	Factors	Sub-factors	References
Infrastructural indicators	Operational infrastructure	Electricity availability and reliability	Biles, 2008; Greenpeace, 2011; ITU, 2008; Kim. Lee. &Lee 2009; Maurice et al., 2012; Smith, 2012
		Broadband connectivity	Wyld, 2010; ITU, 2012; Kuda et al., 2012; Federal Financial Institution Examination Council Agencies, 2012
Organisational indicators	Strategic business considerations	Strategy	Kundra, 2011; DFD, 2011
		Top management support	Lam, 2011; Abadi, 2009; Furrier, 2009; Ragu-Nathan et al., 2004; Low et al., 2011; Swink, 2000; Dhiman, 2010
		Human resource strategy	Lam, 2011; ITU, 2012
		Vendor management/Service level of agreement	Bollineni & Kumar, 2011; Federal Financial Institution Examination Council Agencies, 2012; Ernst & Young, 2011; Habib et al., 2010.
	Operational business considerations	Security issues	Dhiman, 2010; Federal Financial Institution Examination Council Agencies, 2012; Kim et al., 2009; Pearson, 2012; Schreiber, 2011; Petkov, 2008; ITU, 2012
		Trust	Habib et al., 2010; Bollineni & Kumar, 2010; Pearson, 2012; IDC, 2009; Furrier, 2009; Li & Ping, 2009; ITU, 2012; Cloud Forum IP Ltd., 2011
		Compatibility and	Low et al., 2011; Ernst

		interoperability	&Young, 2011; ITU, 2012; Pearson, 2012; Wang et al., 2012; Parameswaran & Chaddha, 2009;
		Cost performance	Dhiman, 2010; ITU, 2012; Lam, 2011; Low et al., 2011; Kim et al., 2009
Environmental indicators	Regulation environment		ITU, 2012; Kuada et al., 2012
	Sustainability	Energy and carbon efficiency	Paper & Continuity, n.d; Hamilton, 2009; Gartner, 2007; Brill, 2007; Garg et al., 2011; Eskom, n.d.; Berl et al., 2010

Table 2.4 summarises the different readiness indicators of cloud-computing adoption, as discussed in the literature review section. The next chapter will present the research design and the research methodology adopted to examine the proposed research questions.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction to the chapter

The purpose of this chapter is to describe the research design and research methodology, which are used in the readiness assessment of cloud-computing adoption in a South African provincial government. The research question of this study was to investigate the state of readiness for moving e-Government into cloud computing in the infrastructural, organisational and environmental contexts of a Provincial Government in South Africa.

The chapter begins with stating the research assumptions and the research paradigms in sections 3.2 and 3.3. It first starts with discussions on the philosophical underpinnings, and in providing the rationale for the applicable paradigm that suits this particular study. This is followed by section 3.4, which explains the research design process adopted for this study. In section 3.5, different research methodologies are presented and discussed. Section 3.6 specifically discusses the case-study method that was selected for the study.

This is further followed by a discussion of the sampling design specified in section 3.7. Lastly, a further discussion is presented in sections 3.8, 3.9, 3.10 and 3.11, including the data collection and the analytical methods, as well as the research validity and the reliability issue, in addition to the ethical considerations.

3.2 The research assumptions

One of the critical decisions of research design is to identify a particular research paradigm, to best address the research questions, and to achieve the research aims. A paradigm functions as a blueprint that makes assumptions about a phenomenon; it defines certain questions to explore; and it identifies the correct approaches to address them (Glesne, 2011).

In this particular research study, three underlying philosophies are embedded, namely: Ontology, epistemology, and methodology. Ontology refers to an understanding of the nature of being, existence and reality (Glesne, 2011). Ontological analysis forms the knowledge base for a particular domain; and it conceptualises the underlying knowledge. In turn, a researcher might perceive and analyse the world, in order to establish certain propositions in that domain (Chandrasekaran, Josephson & Benjamins, 1999).

On the other hand, epistemology is characterised by what things ought to be. It is the theory of knowledge; and it questions what knowledge is, and how it can be acquired (Glesne, 2011). The instruments chosen, together with the design used for data collection and analysis, are important factors contributing to the definition of epistemology.

From these two elements of knowledge (Ontology and Epistemology), the methodology can be developed – either from the reality of the research, i.e. the laws of nature – or by a subjective perception of the knowledge.

Methodology refers to the formulation of the method used to achieve knowledge *via* the entire research process (Bryman, 2008). It is used to explore different types of methods or procedures, and to uncover the research assumptions.

In this particular study, the ontological questions refer to the state of readiness of moving e-Government into cloud computing in the infrastructural and technological, organisational and environmental contexts, and more specifically in a Provincial Government in South Africa. Considering the nature of the research question and the assumptions, a case-study method is chosen to acquire the knowledge of the studied subject, which helps to answer the epistemological question of what and how the state of indicators could affect the adoption of cloud computing in the government context.

3.3 The research paradigms

Philosophical assumptions are the cornerstone of quantitative and qualitative research methods, from which one proceeds with the 'valid' research, and one then ascertains compatible research methods (Myers 1997). Thus, in order to select an appropriate methodology, it is required to understand various research paradigms. In that regard, the three major research paradigms are: (i) Positivism, (ii) interpretivism, and (iii) critical research.

3.3.1 Positivism

The positivist perspective refers to the isolation of the existence of reality from the observer. It means that the researcher's role is detached from the reality s/he wishes to study (Glesne, 2011). The researcher controls the procedure, and validates the explanation of a particular phenomenon under certain circumstances, in order to better understand that phenomenon (Orlikowski & Baroudi 1989). Quantitative research methods are commonly used in positivist researchers' work, such as, surveys, field studies and experiments (Leedy & Ormrod, 2013).

Positivist research consists of obtaining the facts through testing theories, with the objective of establishing the underlying principles and laws, which determine the physical and social world (Bryman, 2008). Until such time that the enquiry can be proven, the theoretical assumptions hold no value. In this regard, the research must remain unbiased or objective. In conjunction with the positivist perspective, a case-study research can be conducted in a controlled environment, to provide efficient measurement of the outcome. This can be achieved by controlled observations, controlled deductions, replicability and generalizability (Glesne, 2011).

The experimental process provides for the alteration of certain factors concerned; however, this would not be possible in case-study research. The construction of theories can still be derived from this process and natural laws obtained or discovered through empirically evaluating and measuring the process (Yin, 1994).

Thus, in this study, the positivist paradigm does not fit with the research problem, since this research does not seek to identify any form of quantitative data, nor does it seek to test any variables.

Critical Research Paradigm – The basis of the critical theory paradigm involves the existence of multiple social realities and influences. The structure of this consists of groups contributing to the research (Johnson & Onwuegbuzie, 2004). Thus, the given result of knowledge is derived in a specific social-group reality. This encourages interactive participation between the researcher and the social group, and the knowledge is thus value-mediated, and hence seen as value-dependent (Hunt, 1991).

However, since this particular research is not looking for multiple realities, the critical research paradigm is not suitable for this study.

3.3.2 Interpretivism

Unlike positivist techniques, interpretive techniques allow researchers to apply their own values and assign their own meanings to the knowledge of reality, and in turn to draw concepts from within a particular context (Glesne, 2011). Therefore, the researcher's role is inseparable from the reality. Reality is based on belief systems and values that are unique to each individual, and whose definition is defined by the use of language, as well as different types of tools and literature. It can, therefore, be said that humans create their own reality associated with their own particular belief systems and values (Yin, 1994).

In an interpretivist research, the focus is on understanding the complex social and human variables within which the studied phenomenon is located. Since these variables are difficult to measure, the researcher proceeds with an intense inquiry process of understanding and analysing. The results acquired from the inquiry and the data-collection process, need to be

interpreted by the researcher. Thus, the researcher's individual values, beliefs and knowledge may well impact on the final understandings of the participants' account.

3.3.3 Locating the study within the interpretive paradigm

Each research study, has its own unique philosophical underpinning, and can employ a single, or multiple paradigms. The overall philosophical assumptions of this particular study fit the interpretive paradigm. The assessment of the readiness of cloud-computing adoption within a Provincial Government context is an examination of the government officials and employees' perception of the current cloud-computing environment and its readiness. Thus, the interpretive paradigm is selected as the best suited for eliciting the in-depth qualitative meaning.

Through interactive participation with the government employees, a series of issues and concerns of the current cloud-computing practices and environment were uncovered. In turn, the researcher sought to understand the underlying problem – by analysing the concerns – and reflecting the relevant attitudes associated with the cloud-computing adoption. Given the paradigm within which this research study is located, the employee's beliefs and perceptions had an impact on the knowledge of reality in this particular research. As such, the interpretive approach guided this researcher's process toward understanding such impact.

3.4 The research design

The research design is a logical approach, which serves as a link between the research question and the research process. It consists of research methods, data-collection activities and data-analysis techniques. It aims to achieve the ultimate goal which the researcher intends to attain – in order to address the research question (Mouton and Marais, 1996). According Yin (1994), the main components of a research design include: What is the research question of the study? What kind of data are required, and are available? How should one gather the applicable data? And how should one analyse the data?

The research goal of this study was to identify the readiness factors that influence a successful migration to cloud computing, and to assess the actual readiness of a provincial government in South Africa for this migration. In order to address the above research question, the researcher began with a comprehensive reading and analysis of the pertinent literature; this was followed by the selection of an applicable research methodology. In turn, this guided the data collection and data-analysis process.

The data collection was performed in two stages: Interviews and focus groups with the selected sample. Since it was an exploratory and explanatory study, the analysis of the raw data helped to identify the main themes, and to group them into categories. This provided the researcher with an insight into the underlying meanings of each pattern. These were identified in certain themes or categories. These then helped the researcher to determine the readiness indicators for cloud-computing adoption in the South African Provincial Government in this study. This was followed by the report writing, thereby completing this thesis.

The whole research design is presented in Figure 3.1 (below).

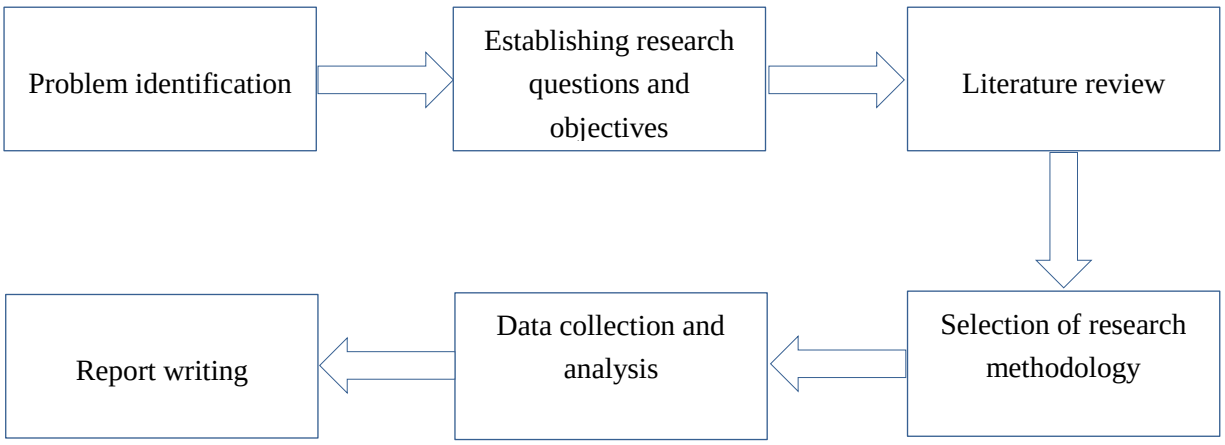


Figure 3-1 Research design steps (Source: Author)

3.5 The research methodology

The research methodology is considered to be an inquiry process, which goes beyond the underlying philosophical assumptions (Myers, 2009). The cornerstone of the research method lies in asking the right questions in the well-defined research scope. This encompasses making the right assumptions, structuring the research design, and collecting the data. There are two approaches commonly classified in research methodology: The quantitative and the qualitative methods (Fuchs & Hanning, 2001). In addition, a third method known as the mixed-method methodology is a combination of both quantitative and qualitative methods (Creswell, 2013).

3.5.1 Quantitative methodology

The quantitative methodology is also known as a positivist approach. It is designed to study the natural phenomenon in the natural-scientific field. In quantitative research methodology, there is only a single reality that exists; and this is perceived to be objective and positive. The researcher simply observes the world in an objective way. A hypothesis is required before the research process begins, in order to test, verify and establish any possible relationships between the measured variables – hence, it is deductive in nature. Survey methods, observations, experiments, and numerical modelling are used, as data-collection and analytical methods in quantitative research methodology, in order to generate statistical figures (Bryman, 2008; Leedy & Ormrod, 2013).

3.5.2 Qualitative methodology

Qualitative methodology is, on the other hand, known as an anti-positivist method; and it is inductive in nature. It is used to study social and cultural phenomena in the social science field. In qualitative methodology, there are multiple realities that could exist in any given context. The researcher engages his or her knowledge and values with the scenarios, in order to make sense of the participants' account through self-interpretation. Qualitative methodology includes the case-study approach, ethnography, grounded theory, action research and life history (Glense, 2008; Leedy & Ormrod, 2013).

Examples of the data-collection methods in qualitative methodology include questionnaires, interviews, observation and documents (Bryman, 2008; Myers, 2009).

In sum, both methodologies reflect different elements of the studied phenomenon. The qualitative approach is considered to be more exploratory and explanatory; while the quantitative approach is objective and definitive. The main difference between these two methodologies is the type of studied phenomenon that needs to be analysed. Therefore, this researcher selected the methodology that was determined by the type of research question asked, and the type of information required. In that regard, the qualitative methodology was selected for this study.

3.5.3 Rationale for a qualitative study

The main purpose of this study was to determine the readiness indicators that might influence cloud-computing adoption in a South Africa Provincial Government, and the extent of readiness shown by this government for could-computing adoption. The theoretical knowledge and models in this regard were discussed in the reviewed literature presented in Chapter 2.

In order to answer the research questions, and to meet the research objectives, this particular study required an appropriate research methodology that was able to explore and explain the readiness indicators affecting cloud-computing adoption in a government context. Especially from the employees' stance, this study sought to examine the current state of readiness of the Provincial Government for adopting cloud-computing technologies and the services supplied by these technologies. In addition, this study focused more on an evolving process, rather than on a definitive end-result.

Thus, it required an in-depth analysis and understanding that enabled the researcher to gain the insight and meanings of participants' account and behaviours. As such, this study adopted the case study as the particular method of choice.

3.6 The Case-Study strategy

A case-study method (CSM) is often referred as an idiographic research project (Leedy & Ormrod, 2013). It focuses on studying and investigating a social phenomenon (e.g. individual, organisation, event, activity, process) in all or most of its dynamics, and in a certain period of time (Christensen et al., 2011; Leedy & Ormrod, 2013). The purpose of adopting a case-study methodology is to understand the uniqueness and idiosyncrasy of the studied case in-depth (Huysamen, 1994).

Huysamen (1994) further advises that by utilising a case-study methodology, the researcher would be able to provide insights and meanings out of the "*recurring patterns and consistent regularities*" that were uncovered.

The case-study approach is often used in information systems, as the most widely used qualitative method (Orlikowski & Baroudi, 1991; Alavi & Carlson, 1992). Gerring (2004) defines a case study as, "*An intensive study of a single unit for the purpose of understanding a larger class of similar units*". In addition, Yin (1994) defines a case study as, "*An empirical inquiry used for investigating a phenomenon (existing within a defined time period) in a real-life environment, and in which the boundaries between the phenomenon and [the] environment are not clearly evident*". The CSM is particularly relevant in this study, since the main focus or interest in studying information systems in organisations "*has shifted to organisational rather than technical issues*" (Benbasat, Goldstein & Mead, 1987).

Table 3.1 represents the strengths and weakness of case-study method (Jabar, 2009).

Table 3-1 Strengths and weakness of CSM (Jabar, 2009)

Strength	Weakness
1. Excels in understanding complex issue or objects and can extend experience or add strength to what is already known through previous research.	2. Lack of control of variables.
3. Captures the local situation in greater detail, and with respect to more variables than is generally possible	2. Different interpretations by different people
4. Applicable to real-life, contemporary, human situations and its public accessibility through written reports.	3. Unintentional biases and omissions in the description due to intense exposure to the study
	4. Study of a small number of cases can offer no grounds for establishing reliability or generalisability of findings.
	5. Case study research is useful only as an exploratory tool.

However, in this study, where the aim was to explore the in-depth meanings of the researched phenomenon (i.e. governments' CC readiness) phenomenon, the strengths outlined in the above table outweigh the weaknesses of CSM. The use of CSM helped this researcher to understand the contextual condition, in which people attach their values and experiences to the studied phenomenon applicable to real-life, contemporary, human situations on the readiness to introduce the cloud-computing technologies and services in the studied provincial government.

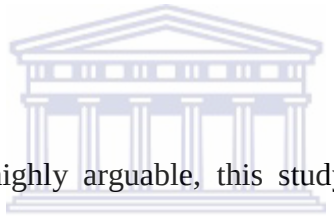
3.6.1 Categories of case studies

There are three categories mainly used in the case-study method, namely: The exploratory, the explanatory, and the descriptive (Tellis, 1997; Yin, 2003). Exploratory case studies are commonly used to establish research questions and hypotheses. This is undertaken in the early stage of the research process, where a phenomenon interests the researcher. Thereafter, it could serve as a starting point to guide the researcher in seeking further information about the identified phenomenon in a real-life context.

Explanatory case studies are often used in an attempt to explain a phenomenon when casual studies are undertaken. Descriptive case studies try to "*determine the appropriate classification of events*" (Acapens, 1990), in order to generalise certain values throughout the research process.

3.6.2 Limitations in the qualitative case-study method

Criticisms exist of the qualitative case-study method. First of all, case study is considered as being less rigorous than other methods, such as a survey (Kyburz-Graber, 2004), especially since the researcher's bias could impact on the results. Another criticism of case studies is that it is not easy to make generalisations out of a single case or multiple cases in this method. Therefore, qualitative methods, such as case studies, are seen to lack adequate precision and rigour.



Although these limitations are highly arguable, this study was acutely aware of its own limitations, while working to acquire substantive data.

In this study, the case-study method was adopted to investigate the extent of readiness for cloud-computing adoption in a South Africa Provincial Government. This was achieved through acquiring and analysing the perceptions of selected government officials and employees of cloud-computing adoption. Therefore, there is only a single case utilised in this study; and consequently, the findings are only applicable to the studied Provincial Government in South Africa. Additionally, based on the small sample size, the researcher is aware that the results may not entirely reflect the reality, from which the sample was drawn.

Despite the above limitations, this research gives conceptual and practical indications for measuring the readiness of the studied provincial government, and possibly other governments in a similar context. This study also provides some direction for future research,

including the possibility of testing the findings in this study in other contexts, which could then increase the generalizability of this study.

3.6.3 Case-study design in this research

Yin (1994) suggests that there are two types of case-study designs, namely: a single-case design, and multiple-case design. The choice of adopting one of these designs is based on the research question to be addressed. This study sought to assess the readiness of cloud-computing adoption in a South African Provincial Government; consequently, a single case study was the logical selection. A single-case study allows the researcher to understand a case or phenomenon within a unique context (i.e. the selected government), in order to study the phenomenon in some depth. It could also contribute to practice in other similar situations (Leedy & Ormrod, 2013).

One the other hand, multiple-case studies refer to when a researcher decides to use more than one case. The purpose of adopting this form of case study is to establish both similarities and distinctions among the selected cases, in order to predict similar or contrasting results (Yin, 1994). This can be done by testing the results of this study in similar contexts, which were beyond the scope of this research.

3.7 The sampling design

In order to appropriately represent the characteristics of the entire population for the purpose of the study, a process of sample selection is required. Samples are a collection of various entities chosen for the purpose of analysing their potential relevance to the research problem, which include "*objects, text materials, and audio-visual and electronic records*" (Leedy & Ormrod, 2013). The process of sample selections is referred as the sampling process. There are two broad categories of sampling: probability sampling and non-probability sampling. "*In probability sampling, it is assumed that the characteristics of the selected sample are approximately equal to the characteristics of the total population*". Whilst, in non-probability

sampling, there can be no guarantee that each criterion of the selected sample in the population will be sampled (Leedy & Ormrod, 2013).

In this study, the researcher adopted a purposive-sampling approach, in order to select a representative sample of the total population. By applying this method, the researcher selected the potential participants, according to the following criteria: (i) Working in the relevant department in charge of CC adoption; (ii) holding relevant IT positions at a division of the department in charge of CC adoption; (iii) having at least one year's experience in the current position. It was presumed that the people who had qualified for these three criteria would be able to provide a meaningful input.

3.8 The data collection

Secondary data (i.e. literature-review-based data) and empirical data were collected and presented in this study. In the literature review, the relevant information was obtained by identifying the potential relevance of the articles on the investigated topic. A variety of data were gathered and studied, which included sources from published studies (e.g. books, journals, and articles), media reports (e.g. newspapers, documents, reports) and internet-based documents.

Chapter 2 provided a comprehensive literature review of the important readiness indicators and theories in the cloud-computing adoption field. In turn, the findings of the literature review provide a theoretical model, which is then used to conduct the empirical research.

The empirical research of this particular study consists of a single case study, in which interviews were conducted to obtain the data from the studied organisation. A case study is used to provide an in-depth analysis of the studied phenomenon. There are many data-collection methods identified in the case-study research, such as, questionnaires, interviews, documents and textual analysis, observation, and archival records (Yin, 1994).

This study made use of documentary analysis and semi-structured interview data-collection methods.

The relevant cloud-computing-related documents were gathered and studied, in order to gain an overall understanding of the main concepts, theories and influencing factors of cloud-computing adoption. The findings extracted from such documents, in turn, contribute to the development of a future interview guide.

The interview method is seen as a sufficient approach to yield a considerable amount of useful and meaningful information. It is believed that it provides much richer information than questionnaire techniques, since it allows the researcher to ask and look for facts, feelings, motives, and behaviours (Leedy & Ormrod, 2013). A focus group interview is seen to be more informative than individually conducted interviews (Leedy & Ormrod, 2013), as the participants can inform and drive one another, to build a richer content of the studied topic.

A list of semi-structured questions was utilised to guide the interview process, which allowed for an open-structured discussion. The purpose of open-structured interviews was to lead respondents, so that they would be able to share diverse opinions on focal areas of the study. Thus, this data-collection method, coupled with the focus-group approach, was sufficient to collect rich data on the studied phenomenon. Thereafter, all interview data were recorded on audiotapes, and then transcribed onto paper.

In this study, a focus-group interview was also conducted. A focus group refers to conducting a group interview with several participants simultaneously. One of the strengths of conducting a focus group interview is that rich data can be generated through interactions within the group, as the participant are encouraged to talk to one another (Kritzinger, 1995). Since the majority of the participants are colleagues, they felt quite comfortable with sharing

ideas and knowledge, even sensitive issues, rather than having individual interviews with the researcher alone.

3.9 The data analysis

Data analysis involves putting in order what the researcher has read, seen and heard, in order to make sense of the data, and hence to answer the research question (Glesne, 2011). It enables a researcher to obtain valuable information from the raw data (Christensen, Johnson & Turner, 2011). The aim of conducting a qualitative data analysis is to discover meanings, themes and patterns in the semantic content.

The content-analysis technique approach was adopted to analyse the textual data transcribed from the interviews, and from the focus-group feedback. There were three analysis stages involved throughout the process. During the first stage, individual interviews were first transcribed. The researcher read and re-read all the interview transcripts, in order to make sense of the studied phenomenon perceived by the participants. This was then followed by an "open coding" (Strass and Corbin, 1990) approach to begin the data-analysis process, which was often utilised to create the descriptive categories.

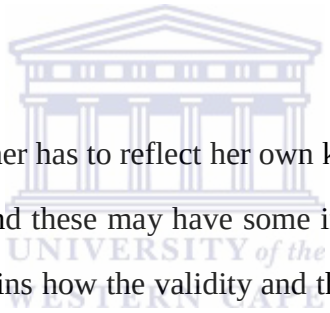
This initial process forms a preliminary framework for future data analysis. The output of this stage is to identify multi-dimensional themes, including those that surfaced from the interviews.

In the second stage, a detailed exploration of the semantic meanings was carried out, in which the information was grouped, according to the themes identified in stage one. The researcher integrated common issues and the themes identified amongst participants. The purpose of doing this was to look for the underlying meanings of each theme, and to make sense of the participants' accounts. The categorising process assisted the researcher to make comparisons

between the various patterns. The outcome of this stage is to discover patterns, in other words, what the data really mean.

In the final stage, the researcher should be able to identify and recognise the interconnections between the different categories or themes. Finally, an organisational model is produced to represent the final findings of the studied phenomenon.

The data-analysis process is considered to be time-consuming and complex (Leedy & Ormrod, 2013). It is an iterative and inductive process, where the input of each stage is generated from the output of the previous stage. Therefore, the researcher must possess the ability to accurately generate her understandings in a logical way, in order to see patterns and relationships.



In a qualitative study, the researcher has to reflect her own knowledge, perceptions and biases during the data-analysis stage. And these may have some impact on the interpretation of the data. Thus, the next section explains how the validity and the reliability of this research were achieved.

3.10 Research evaluation: trustworthiness, validity and reliability

Evaluating the accuracy of the qualitative findings is not easy. Since qualitative research is not based on standardised instruments, but is rather a matter of adopting a non-random sampling strategy. The qualitative researcher is more interested in understanding the meanings of a phenomenon, in a real-life context. However, there are strategies to enhance the trustworthiness of qualitative studies (Baxter & Jack, 2008).

Trustworthiness refers to the extent to which the data and the research results are valid and true. In qualitative research, there are four criteria used to establish the trustworthiness of the results: Credibility (this is analogous to internal validity); transferability (this is analogous to

external validity); dependability (this is analogous to reliability) and conformability (this is analogous to objectivity) (Guba & Lincoln, 1981; Krefting, 1991).

Credibility in qualitative research refers to how the research findings match reality. However, the reality in qualitative research refers to the people construct within social and cultural contexts. As in this study, the "reality" refers to the understanding of the participants' construct of cloud-computing adoption-readiness in a specific social context – a Provincial Government in South Africa. Therefore, in order to enhance the credibility of the qualitative research, Guba and Lincoln (1985) suggested that including members to check into the findings and ensure the results support conclusion, is considered to be "*the most critical technique for establishing credibility*".

Transferability refers to the extent that the findings of the study can apply to other populations or situations (Seale, 1999). Since researchers apply their subjectivity in qualitative research, as a key instrument; therefore, to ensure that transferability is considered to be a challenge. The strategy to address this issue is to provide detailed and in-depth information of the research methodology, and of the contexts, in order to provide the reader with rich information about the research; and to enable them to apply their own understanding to other similar settings with which they are familiar (Seale, 1999).

Dependability is analogous to reliability. It refers to the consistency and repeatability of the results when applying them in similar contexts (Miller, 1986). In other words, the emphasis is on describing the data-collection procedure. Achieving reliability in qualitative studies is considered to be problematic, since human behaviours, attitudes, and knowledge change – depending on various factors. This means that it is difficult to ensure consistency in other contexts, and in other time periods.

In order to ensure that the results are consistent with the data, Merriam (1998) suggests the use of multiple data-collection methods and analysis (triangulation), and to explain the procedure in detail. In this study, this was achieved by collecting the data from the interviewees and the focus group, and also comparing the analysis results from these two sets of data.

3.11 Ethical considerations

According to the University of the Western Cape, it is necessary to apply for ethical clearance compliance before the commencement of the data-collection process. The researcher first requested permission from the potential participants in the relevant division within the relevant department. This permission was granted via emails. The researcher provided comprehensive details of the research before any interviews were conducted. An interview guide was sent to the participants, to give them opportunity to withdraw from the research if they felt uncomfortable with the questions. The participants were informed that their personal information (e.g. names and contact details) would be kept confidential.

The researcher assured them that the provided information would only be used for the purpose of this particular research, and that the final results of this study would be available in the library of the University of the Western Cape.

3.12 Conclusion

This chapter began by elaborating on two research paradigms, namely: the positivist paradigm and the interpretivist paradigm, which are used to guide various research methods. According to the philosophical assumptions of this study, and based on the nature of the research problem and the questions, the researcher determined to adopt the interpretivist paradigm. Furthermore, based on the type of research question asked, and the type of data required, the researcher determined to use the qualitative research methodology to guide the

research process. In that regard, the Case-study Methodology was selected and used for the data collection and the subsequent analysis.

CHAPTER 4: CASE-STUDY FINDINGS AND DISCUSSION

4.1 Introduction

This chapter has used the conceptual model illustrated in Chapter 2, of which readiness indicators influence the process of e-government cloud-computing migration, as a guideline for the empirical study. In the data-collection process, the documents were analysed, and semi-structured interviews were conducted. Furthermore, themes were identified, categorised, and analysed, according to literature reviews and emerging categories from the empirical study, which were extracted by using a content-analysis technique. Finally, the findings are presented with relevant direct quotes in some areas.

4.2 Organisational characteristics

This study focuses on an assessment of cloud-computing adoption readiness in a South African provincial government, more specifically regarding e-government migration to a cloud-computing platform. Thus, the Department of the Premier was chosen as the investigated department. The main function of the Department of the Premier is to offer co-ordinated affairs at provincial level for the Premier, the Director-General, and other departments in the provincial government.

Furthermore, the Centre for e-Innovation (CE-I) was selected to be interviewed, as it provides ICT services to the provincial government.

4.3 Background of the participants

A total of six individual interviews and a focus group were conducted for this study. All the participants currently hold positions in the division of CE-I, the Department of the Premier. There is a fairly good mix of senior manager, middle-level manager, business analysts and

technical personnel amongst the interviewees. To preserve the confidentiality, each participant was given a code.

The table below illustrates a breakdown of all the participants, according to their positions held, the unit/division they work under, the number of years of experiences they have been working in their current positions.

Table 4-1 Background information of the participants (Source: Author)

Code	Unit/Division	Position	Years of experiences within the current position
A	CE-I	Project Manager	5
B	CE-I	Manager	14
C	CE-I	Technician	3
D	CE-I	Senior Manager	10
E	CE-I	Manager	6
F	CE-I	Manager	7
G	CE-I	Business Analyst	4
H	CE-I	Manager	8
I	CE-I	Project Manager	5
J	CE-I	Technician	3

The information provided indicates that all the chosen interviewees hold relevant positions in the department, thereby being qualified to contribute to the data-collection process. All the participants have had more than three years' experience in their current positions. This is an important issue, since the longer they have been working in their current positions, the more knowledge and insight they would have gained on the organisation. Consequently, the participants were able to share and discuss their understanding and opinions effectively. Therefore, their contributions to this study can be seen as valuable and pertinent.

The information gathered from the participants of various positions allowed the researcher to acquire an understanding of the readiness indicators from different angles. In other words, the inputs provided by the participants are considered to be comprehensive. Thus, if the

knowledge is well utilised, it could generate value for the organisation, and contribute to the cloud-computing strategy formulation in the near future.

4.4 The current state

During the interviews, there were few cloud-computing practices being adopted within the provincial government context, as indicated by the participant (Interviewee B): "*The only thing we get closer to cloud computing is the virtualisation; we have moved quite heavily into virtualisation, not everything, but a large portion*". This is indicative that a lack of strategy leads to insufficient organising and planning of cloud-computing adoption. There is no awareness of any concrete plan yet. The respondent (Interviewee A) further remarked: "*I think (to have a strategic plan to lead cloud adoption) is still a bit further down the road than where we were in the implementation of e-government*".

4.5 Cloud-Computing adoption readiness factors in the investigated province

This section of the study analyses the factors that enable cloud-computing adoption from the participants' angle. A number of readiness indicators have been generated from numerous literature sources, as discussed in Chapter 2. Amongst the indicators commonly discussed were the availability and reliability of electricity (e.g. Biles, 2008); broadband connectivity (e.g. Wyld, 2010); security (e.g. Dhiman, 2010); trust (e.g. Habib et al., 2010); compatibility and interoperability (e.g. Low et al., 2011); cost performance e.g. Dhiman, 2010); top-management support (e.g. Lam, 2011); human-resource strategy (e.g. Lam, 2011); vendor management/service level of agreement (e.g. Bollineni & Kumar, 2011); regulation (e.g. ITU, 2012); sustainability (e.g. Hamilton, 2009).

These readiness indicators are further grouped into three categories, namely: infrastructural indicators; organisational indicators; and environmental indicators.

In the following section, the findings are presented of the three categories mentioned above. Additionally, indicators that have emerged from the empirical study are also included.

4.5.1 Emerging concept: Attitudes towards cloud computing

Attitude refers to: "*A mindset or tendency to act in a particular way due to both an individual's experience and temperament"* (Pickens, 1998). Thus, it reflects the state of readiness of individuals, which is based on their experiences and other influences. This explains that participants with different positions, work experiences, and personalities hold different views on cloud-computing readiness in this particular provincial government in South Africa.

In order to acquire a brief understanding of the attitudes and awareness of cloud-computing adoption, the first question asked was: *What is the government's attitude towards cloud computing-adoption in government services?* The respondents gave diverse opinions based on their understanding of cloud computing and its associated potential benefits and possible threats.

Overall, the participants in both senior and middle-level management positions showed a positive attitude towards cloud-computing adoption in government services: "*There is definitely a desire to begin to adopt cloud, because the benefits that cloud-computing brings*". Another participant (Interviewee B) added "*…the fact that we can introduce new features quickly, and we can be more agile*".

However, there are some different opinions amongst employees towards cloud-computing adoption. Their perceptions of cloud computing services are that they are "*not very trustworthy*", especially when considering the issues, such as security and legislation. They feel that "*it is not secure to put your emails and information with somebody else*".

Some senior managers seemed to have a more comprehensive understanding than middle-level employees. It is indicative that the attitude has a strong link to security, trust and vendor-management issues, since these issues are shaped by their understanding and familiarity with cloud-computing services.

Some responses gathered from the interviews indicated that there was willingness to embrace cloud computing in the studied Government, "*…the government is taking a look at investing in cloud solutions in certain cases… we are in the exploration phrase of cloud computing*" said Interviewee A. However, "*…it is a cautious approach that people have to do research on, so that is the approach at the present time*" another participant (Interviewee C) added. It is indicative that a lack of overall strategic road map influences employees' attitude towards cloud-computing adoption within government services.

Furthermore, this could influence the launching and implementation of cloud computing, as one respondent (Interviewee E) stated: "*…people are just not sure about how to handle it*".

In summary, the primary themes that emerged from the interviews were: dubious attitudes and uncertainty. The interviews also showed that these two themes strongly influence one another. Furthermore, they are shaped by other readiness indicators, such as security, trust and skills. These issues will be discussed later. Another element attributed to various attitudes towards cloud-computing adoption is the complexity of cloud-computing adoption, especially in the government context, which deals with civil services and citizens' sensitive information.

It is also evident from the published literature that there are technical and socio-technical challenges that need to be addressed before adoption can be seriously considered (Niazi & Mahmood, 2011), since cloud-computing still remains an unfamiliar concept to businesses and some IT professionals (Lin & Chen, 2013).

To conclude this section, some respondents showed that there is an intention and willingness to introduce and implement cloud computing in the government context. While others raised concerns about the influence of various issues (e.g. broadband connectivity and security) that could impact on cloud-computing adoption. Those issues, however, gave the researcher a guideline to continuously seek and analyse the underlying interconnections of various readiness indicators.

4.5.2 Infrastructural indicators

4.5.2.1 Electricity availability and reliability

As discussed in Chapter 2, the literature reviews revealed that, electricity availability and reliability were highlighted as the most fundamental prerequisites in cloud-computing adoption. Especially when connecting all citizens in the field of e-government services nationwide. However, in South Africa, various industries have suffered from load-shedding, because the demand cannot be consistently met (Biles, 2008). Eskom, South Africa's state-owned utility, has declared many power outages; the most recent one happened in March 2014 at the time of this study.

Hence, from the future perspective of cloud computing-adoption, the unstable electricity supply situation in South Africa, could not only hinder the service reliability from the service provider's side, but also limit the accessibility from the citizens' perspective.

This particular electricity issue was confirmed by participants during the empirical investigation. Some participants stated that South Africa is still a developing country. Many people in developing countries lack reliable access to electricity, particularly in some rural areas. In that regard, one participant remarked: "*I think we have been stable for a number of years. I think supplying electricity to various areas could be a little bit of a problem. For example, places like Khayelitsha*".

In addition, some of the responses gathered from the participants on the state of current electricity supply indicated that there is a mismatch between the supply and the demand, due to years of underinvested energy infrastructures and distribution. Here is an illustration: "*…the electricity situation in South Africa with Eskom is unstable, meaning that we have power outages*" agreed Interviewee A; and this was confirmed by all the participants.

However, the possible effect of unreliable electricity supply is considered to be minor, when this is compared with other critical issues of cloud-computing adoption. For example, one participant (Interviewee E) stated: "*…yes, it will have an effect on us, but that would not stop us from going cloud*". On the other hand, some employees had a different point of view. They said that they would rather not rely on a local cloud, because of the electricity issue in South Africa. This is illustrated by Interviewee G: "*…the reason for not relying on a local cloud base is because of the electricity supply (situation in South Africa)*".

In general, the participants agreed on the electricity supply being an issue for future cloud-computing adoption, but the right solutions could overcome that, such as using in-house generators. It is also indicative that the situation of power outages could impact on the decision-making of choosing a local service provider, rather than an overseas one.

4.5.2.2 Broadband connectivity

A fast and reliable Internet access is considered to be the most important essential in enabling the cloud concept, as reviewed in literature reviews (e.g. ITU, 2012). However, in South Africa, the challenge of broadband has constrained digital readiness and development in both businesses and communities.

The empirical investigation on this topic was based on the literature review findings on the current broadband status in South Africa (section 2.2.1.2: Broadband Indicator): (i) Poor coverage; (ii) slowness; (iii) expensive to some lower-end markets; and (iv) availability.

These problems were indeed confirmed by the respondents in this study. For example, one respondent (Interviewee D) stated that, "*being a developing country, South Africa is still behind [the] first-world countries*". The same respondent maintained that the "*underlying causes*" and the country's diversity result in the absence of high-speed and high quality bandwidth.

The above is also confirmed by another respondent (Interviewee C), who said that "*…connectivity is the biggest constraint… if you don't have a good, reliable and fast connectivity, how can one ensure a reliable cloud-service delivery at all times?*"

The importance of the broadband connectivity for government cloud computing-based service delivery is also linked to the notion of "digital inclusion", particularly in deep rural areas, which continue to be an issue of connectivity, despite years of government broadband initiatives. This is illustrated by the response of Interviewee E, who is of the opinion that"*…even though, the government is rolling out the bandwidth aggressively, the coverage in some small towns and schools is not that great… service providers don't see any monetary value in that to go past, what we call, the mountains*".

It was further explained by Interviewee C that the affordability, especially when connecting the rural dwellers into the digital-government services, is directly related to the relatively high costs associated with bandwidth – hence, it is still a barrier for the lower-end market (i.e. previously disadvantaged communities).

As a possible effective remedy for the above issues, the participants mentioned the Department of Communications policy 2013, which aims to address the accessibility to broadband of a critical mass of South Africans, at an affordable price (DoC, 2013). All the participants demonstrated positive attitudes towards the implementation of this policy, and

believe that it would foster the process of cloud-computing adoption. In that regard, one participant (Interviewee D) remarked: "*The broadband initiative will open up the way so that we can make use of cloud computing*".

Furthermore, there is a belief that the initiative will focus on two different streams of the broadband – as explained by one participant (Interviewee D): "*The one focuses on community access, where they are making it available and supplying connectivity to communities. Then there is also the focus on business, to get better pricing for business to use broadband more effectively*".

In general, unreliable, slow and relatively expensive broadband connectivity was seen to be a constraint for future digital readiness and development. However, the government is in the position to shift the situation, and foster a mass digital inclusion by launching and implementing the 2014 broadband initiative. This would make cloud computing in the public sector appear more attractive.

4.5.3 Organisational indicators

4.5.3.1 Strategic business considerations

4.5.3.1.1 Strategy

During the investigation on this topic, all the participants demonstrated that they were either not aware of whether there is a strategy or not, or they were uncertain about what they knew. This indicates that there is uncertainty on the existence of the strategy at the strategic level; or the provincial government has no strategic plan to foster cloud-computing adoption. In addition, the respondents could not confirm whether there is a strategic plan rolled out, since this was not communicated to them.

Hence, it may be concluded that there is ineffectual communication between the strategic high-level management and the operational levels. As one participant (Interviewee A) remarked: "*I am not aware of that. At this point, we don't have any solid plans towards that*".

Furthermore, there is uncertainty on the choice of those cloud-computing models the government might select for adoption, as was suggested by the reviewed literature. Interviewee A further explained: "*...we haven't yet determined that we are going to adopt a private cloud, and whether, or not, we are going to build our own infrastructures*".

Since other respondents echoed the remarks of these cited the above, an overall impression regarding the CC strategy issue was that the cloud-computing strategy is absent at the provincial government level. This strongly indicates that this provincial government is not ready for the introduction of cloud computing. .

4.5.3.1.2 Top-Management support

The participants believed that a clear strategic vision is essential and critical in guiding any successful project: "*I believe that if there is an overall strategy and vision come from the top, and we will be able to start the following phases effectively*", stated one of the participants (Interviewee L). This clearly indicates that there was no concrete strategy available, when the interviews took place. This readiness indicator refers back to the strategy-readiness indicator.

Another reason why top management support is essential, as discussed in Chapter 2, was confirmed by the participant (Interviewee L). "*...people still come from the old age where they still want to own things, so it's a culture thing that needs to change; and it all takes time…so managers within the IT department must make decisions about cloud computing, and lead the employees through the entire implementation*".

The literature review revealed that employees are the first ones to react. This is because they are afraid of the possible impact of change that would be brought about by the new IT service. They are afraid of losing their current organisational status and belongings, which might, in turn, affect their overall attitudes and productivity. Thus, a strong leadership support is seen as the most important enabler in realising a successful deployment of IT solutions. The participants indicated that a positive organisational culture and effective top-to-bottom communications would be absolutely crucial. This requires top-management steering.

The impression of this researcher was that the participants were aware of the importance of top management's support. However, there were fewer discussions on this issue than of the other readiness indicators. The participants tended to have more priority concerns with other indicators, such as, broadband connection and security.

4.5.3.1.3 Skills shortage

There is evidence showing that a lack of cloud computing-related skills and competencies exists in the government. Although the participants were aware of those skill shortages, there was no human resource strategy in place to address this issue.

During the investigation of the necessary skills in a cloud-computing environment, a number of areas were mentioned and discussed by all the participants. For example, a participant (Interviewee A) stated that, "…*we don't have those engineers to run those private cloud infrastructures…and then when it comes to our sourcing as well, we are not very experienced with outsourcing*". This indicates that a lack of skills was perceived in terms of in-house technical skills and outsourcing skills.

It was further explained by another participant (Interviewee B), "*...from the technical resource angle, I don't think we have much skill in that area*". There is a need of skills in developing the cloud platform, and utilising the services that the cloud platform offers.

Moreover, administrative experience and skills are required as well, as one participant (Interviewee A) remarked, "*... if we were running a team that is managing a private cloud infrastructure and service, then they need to be skilled in administering that, and in maintaining the infrastructure*".

There was another area of expertise required in the cloud-computing environment: contract/SLA management. Most participants demonstrated their concerns regarding this skill. Here is an illustration, "*...you need to have the people with the relevant skills in place that understand this type of documentation to ensure that the correct principles of the cloud are going to be utilised*", said Interview H. With the emerging cloud-computing concept, an area comprising both legal and business-analytical expertise is essential. Negotiating skills and knowledge of the process are equally important.

The overall findings on this topic indicated that the participants were critically aware of the skill-shortage situation in the public sector. On the other hand, they were also aware that there was no human resource strategy, nor educational planning to address this shortage. This also shows that the government is not yet ready to embrace cloud computing.

4.5.3.1.4 Vendor management/Service-level agreement

The empirical investigation on this topic was based on the findings of the literature reviews. Prior to accepting a partnership with a cloud-service provider, organisations need to acquire a comprehensive examination of the service provider, in the form of a Service-Level Agreement (SLA). This forms a legal and mutual agreement between the customer and the service provider (Bollineni & Kumar, 2011).

During the interview process, all the participants demonstrated a high level of concern regarding this readiness indicator. All the SLA considerations were indeed confirmed by the respondents in this study. For example, one participant (Interviewee A) stated, "*A sufficient SLA should cover very specifically the data access, and who does what on the service…(and*

to address) security vulnerabilities". Interviewee B added that it was important to know "*…where the back-ups would be stored, (as well as the) disaster-recovery plan*". Interviewee D further addressed the vendor lock-in issue, "*…as you move from one service provider to another one, you need to make sure you are getting all your information out of that cloud*".

In addition, one participant (Interviewee E) demonstrated a strong interest in areas like, the certification of providers and contract renewal issues. Here is an illustration: "*I think a lot of work needs to be done on the certification of cloud providers and contracts for clouds*". This confirms what was discussed in Chapter 2: the technical and non-technical conditions may change over time, as the cloud market evolves to become more mature – hence, it requires consistent strategic-sourcing revision (section 2.2.2.2 Strategic Business Considerations: Vendor Management/Service Level of Agreement).

In summary, all the participants were aware that the main concerns when signing a SLA were, to ensure that the right level of service is guaranteed, and that the service provider is accountable for the provision of such services.

4.5.3.2 Operational business considerations

4.5.3.2.1 Security

The interview confirmed that security is considered to be the highest priority amongst all the adoption issues. The interviewees believed that having one's own data stored somewhere else, would render it vulnerable to the exposed environment, "*depending on what kind of information is hosted there, and the level of sensitiveness of the information*", said Interviewee A.

Furthermore, several considerations were highlighted amongst all the participants, such as, the type of legislation required, the conditions for storing sensitive data and the internet

surveillance issues. These were discussed in Chapter 2; and they will be further explained below.

One participant (Interviewee E) believed that much information is fact-centric. Such information would be safe to host in the cloud, as this "*...would alleviate a lot of internal internet traffic inside, because you are looking at 2 to 3 million hits per day, or maybe more*". Categorizing information and deciding what could be stored externally would determine the future financial strategy when implementing cloud-computing services. Thus, making critical decisions on what type of data can be stored externally or hosted outside of the border, and the local conditions, would be matters of great importance, in terms of data storage.

On the other hand, the participants agreed that necessary government policies should be in place to enforce a safe cloud environment for government-sensitive information across borders.

Moreover, some participants showed a high level of concern, with regard to data leakage under the multi-tenancy environment. "*How could you ensure your data are protected, when there could be a security breach, and a massive amount of information would be instantly available*", said Interviewee H. The participants agreed on the unauthorised secondary usage of data; and this was further explained by Interviewee J: "*Security issues are everywhere; you cannot even ensure your information is completely safe at any given time or condition, people are the ones behind technology*".

Hence, the participants demonstrated a strong need and a belief that a good SLA should cover all these issues specifically.

In general, it is clear that security remains the top priority concern at all times, especially when introducing a new or innovative technology. These issues should not stop the process of

embracing it, however. Government policies and an effective SLA should be in place to establish a standard; and to ensure the implementation. Some participants positively believe that once the public sector starts utilising cloud services, and people get used to how it functions, the adoption would become much easier. This is illustrated by the response of Interviewee H: "*…only when you have experienced it, then you will have a solid understanding and better strategy to address those issues, but again, I guess it is about trust*".

There is an evident linkage between security issue and trust. And this matter was confirmed by all the participants.

4.5.3.2.2 Trust

During the interviews, it became clear that trust is a reflection of participants' understanding and views on cloud computing. As discussed in Chapter 2, trust is a subjective criterion; and opinions varied towards the new technology (section 2.2.2.1 Operational Business Consideration: Trust).

Throughout the empirical investigation on this topic, the majority of the participants referred to their level of trust, based on their concerns with other readiness indicators. As discussed in the literature-review findings, the perceived lack of reliability is determined by the availability and reachability of the cloud service (Habib et al., 2010; ITU, 2012), which is determined by a number of other factors (section 2.2.2.1 Operational Business Consideration: Trust). This was confirmed by the respondents, as one participant (Interviewee K) indicated, "*…it's not that I don't trust cloud computing in general, the bandwidth issue and electricity supply we've discussed earlier worries me, because I don't know how it's going to work in South Africa, if we still have those unsolved issues*".

Interviewee H stated that "*...trust is a major psychological concern you cannot directly feel from your employees*". The challenge of this concern is that it cannot be physically managed

and controlled. It exists in individuals' minds, which would be difficult to influence. It was further explained by Interviewee J, "*It is about how they feel. It could be because of their beliefs, age, gender, and previous unsatisfactory experiences with similar scenarios*".

Moreover, some participants also indicated that the cloud market was still immature; "*…there are all kinds of service providers and practices there, of which do not have any guarantee on your data. Such levels of uncertainty raise concerns, especially when one deals with government data*" stated Interviewee A. It is clear that people were skeptical about whether or not government information would be kept safe. People's trust level is determined by all the possible vulnerabilities of cloud-computing services. In turn, their trust level could affect and shape their perceptions in adopting cloud-computing solutions – hence, this could hinder further launching and implementing strategies.

The other concern raised in the interviews was 'trust consistency', which was discussed in Chapter 2 as well. Trust is determined within a certain period, and within a special context. It was clear that the degree of the trust level was unequal among the cloud-service adopters (Li & Ping, 2009). The participants confirmed that because there are various service providers and practices out there, "*the competition must be fierce*", said Interviewee J.

Another participant (Interviewee H) further added: "*The market could evolve so quickly, and what if the service provider that we have contract with at that time, might lose its advantages within the market in the future? And we are locked in with the initial contract*". Thus, a careful evaluation of the chosen service provider should be made in advance; while the vendor lock-in issues need to be addressed as well.

In general, the trust level of employees in the public sector fundamentally would determine whether they are psychologically ready to embrace cloud-computing, or not. This is seen as an invisible soft issue that could possibly affect employees' attitudes and productivity –

hence, this needs to be addressed by top management. There is an evident linkage between trust, attitudes and top-management support.

4.5.3.2.3 Interoperability and compatibility

Chapter 2 highlighted the importance of interoperability and compatibility, and how these are important in the strategic alignment of business and technology.

During the interviews, the participants expressed the need to be able to transfer their data and applications between different service providers. As one participant (Interviewee A) put it, "*…we should be able to have that data out and transfer to another platform, if we need to*". Participants associated their understanding of interoperability and compatibility with vendor lock-in issues.

However, other perspectives on the interoperability and compatibility issues related to having a business solution involving multiple vendors, as discussed in literature reviews (section 2.2.2.1 Operational Business Considerations: Compatibility and Interoperability), was not mentioned, nor discussed by the participants. In other words, this makes the department's future focus limited to the standardization on data only.

4.5.3.2.4 Cost performance

As discussed in in Chapter 2, the literature review revealed that cost performance refers to being cost efficient, and achieving value-for-money. In other words, possible impacts brought by unexpected costs should not jeopardise the overall cost performance of cloud computing. Therefore, a careful balance between the benefits and the costs associated with a particular cloud-computing solution or service need to be borne in mind.

The participants agreed that balancing between benefits and costs was important in enabling an effective deployment of cloud computing in the public-sector environment. However, their views differed when different phases of cloud computing were in question. For example, interviewee A stated that: "*there are certain models of cloud computing that are cost-efficient;*

however, particularly when implementing a private cloud, it requires quite a heavy investment upfront". This indicates that a balance between benefits and costs is necessary; but this should be done before the initiative commences. As explained by this interviewee, the cost/benefits decisions should be based on how to weigh those benefits against the costs, in order to appropriately meet the government's operational and strategic needs.

Another interviewee (Interviewee D) pointed out that the process of cost/benefits assessment should be continuous – as suggested by the reviewed literature (section 2.2.2.1 Operational Business Considerations: Cost Performance). This interviewee illustrated his point by stating that the "pay-as-you-go" pricing model could enable government to scale up and down as they need, without incurring any up-front planning costs. It would also allow them to focus on their core competencies.

As one participant (Interviewee C) said, "*…you can adapt your hardware requirements; since they are centrally managed and you don't have to worry about your licensing and asset management and upgrades…we would then have more time and ability to create new stuff*".

Moreover, the participants also indicated that adopting cloud-computing solutions on a mass scale, especially in a national government context, could contribute to a significant cost reduction and standardisation. Here is an illustration: "*If it is a cloud that is hosted by the government IT agency, they will do it for all 9 provinces and they will do it for all government departments… that would be a big saving for us*" (Interviewee D).

Some participants also pointed out possible unexpected costs that may be incurred at a later stage during the cloud-computing implementation: "*Sometimes, we might find that the service might not work so, we must scale it down; and once we scale it down, we might have to purchase other services and that would obviously affect our cost implications*". Thus,

organisations should evaluate their own economic situations and business priorities continually, in order to reach a suitably customised conclusion (ITU 2012; Dhiman 2010).

As different cloud models have their distinct aspects of achieving and maximising business needs, taking full advantage of the overall performance, while still aiming at cost efficiency, requires continuous monitoring and management.

An overall impression of this researcher is that this topic of cost/benefit balancing and evaluation is not within the expertise of the interviewees – thus, not much detail could be reported here. This, however, does not make the findings in this section any less relevant.

4.5.4 Environmental indicators

4.5.4.1 Regulation

The regulation indicator discussed in Chapter 2 indicates that there is a paucity of international legal and regulatory standards within the cloud-computing environment. This lack of enforcement results in negative attitudes towards cloud-computing adoption.

However, during the empirical investigation of this topic, only a few discussions were made on international standards. One Participant (Interviewee E) stated: "*…Unfortunately, laws apply to certain countries; and I think there should be international laws that all the countries should be having the same conversation about cloud. So, the standard should be the same; and the laws that apply to clouds and service providers should be the same across the board"*.

The majority of participants paid attention to the national regulatory environment, more particularly, the national Information Technology (IT) agency. This was first mentioned in the first focus group discussion, as one participant (Interviewee J) stated, "*…we have to use the state IT agency for our IT services…this incurs more costs…introduces additional red*

tape". "*…they (the national IT agency) also want to provide cloud services to government, but for some reason it takes a long time to make this happen*", explained another participant (Interviewee G).

This clearly shows that the national IT agency is the key to having a successful or unsuccessful cloud-computing service adoption.

Another participant (Interviewee B) also mentioned the reason for such a lengthy service delivery: "*I am getting this distinct feeling that there is a different approach between the local IT Agency in the Western Cape and those national folks in Gauteng or Pretoria, also the difficulties of offering these services".* Furthermore, the participants have doubts on the capability of the national IT agency, in delivering timely and quality services. Here is an illustration, "*…I don't think some portions of IT Agency have the capacity to deliver… I don't think it has a lot of experience with providing cloud solutions, hosted-cloud solution,*" stated Interviewee B.

In that regard, Interviewee D remarked, "*…they lagged a little bit behind and service delivery was not what we expected it to be at that stage*".

In summary, the state-owned IT agency in South Africa poses difficulties for the public sector to embark on the implementation of cloud-computing services. The major issues discussed can be grouped into the following: (i) Time-consuming; (ii) incapability and lack of experiences; and (iii) red tape.

4.5.4.2 Sustainability

The sustainability issue (discussed in Chapter 2) demonstrates that the awareness of the "green computing" concept. This needs to be raised, among both cloud-computing users and service providers. This is because of the rising energy costs associated with increased IT

centralisation and greater computing capacity (section 2.2.3.2 Environmental Consideration: Sustainability).

During the empirical investigation process, the participants limited their discussions to how cloud computing enables energy-efficiency. As one participant (Interviewee A) stated, "*...when consolidating a lot of different applications onto a single-cloud platform, a reduction of services is likely, and the power consumption of it*". This indicates that the participants have the intention to contribute to energy savings by adopting cloud-computing services. In that regard, one participant (Interviewee D) mentioned, "*...I think we have an energy-scarce country; it (is) quite important to look where we can spare energy*".

Moreover, according to one participant, in addressing the power-consumption issue, a project called the "smart-metering project" took off in 2013. "*It aims at measuring the power usage and displaying this, to make employees aware of their power consumptions*" said Interviewee B. However, "*... not everyone is aware, but a communication gets sent out*", he explained further.

From the supplier's angle, one participant (Interviewee D) pointed out, "*...if you need to think greener, definitely use manufacturers who have a green policy, and who will buy back their service and refurbish it, or re-use the components in the technology*". It is clear that the government is aware of the green concept; but it is limited in the manufacturing angle. This indicates that there is a lack of knowledge and experience of 'green computing' amongst the participants. This could impact on their future cloud-computing adoption strategy with minor environmental considerations, not mentioning that 90% of electricity is produced by using coal-fired stations in South Africa.

In other words, carbon efficiency is unlikely to be achieved when cloud-computing services are implemented in the public sector.

An overall impression of this researcher is that the topic of sustainability was not a priority consideration among the interviewees. In other words, there were other strategic considerations that needed to first be addressed, in order to reach this particular stage. This, however, does not make the findings in this section any less relevant.

4.6 Conclusion: The answer to the research question

This section concludes the findings of this study by recapitulating answers to the main research question through the established sub-questions.

Firstly, the literature review was utilised, in order to answer the question regarding the characteristics of cloud computing; and it was found that cloud computing has unique characteristics that distinguish it from other computing technologies:

- *Resource pooling*, i.e. the infrastructure provider offers a shared-resource pooling to multiple-resource users.
- *Broad network access*, which essentially means that the cloud computing services are accessed via the internet.
- *On-demand self-service*, basically meaning that users are able to demand resources dynamically without prior notice or human supervision.
- *Rapid elasticity*, which is characterised by the possibility of the expansion of resources and services in correspondence with the constantly changing needs.
- *Measured services*, which is characterised by the transparency through adopting a metering mechanism to monitor, control and report the usage and services.

Furthermore, it was found that many countries worldwide have successfully introduced cloud-computing technologies in their operations. This confirms that the decision of the studied provincial government in South Africa to introduce these technologies is timely and potentially beneficial.

However, in order to fully utilise the unique characteristics of cloud computing in the researched provincial government, the next step was to explore the factors that influence an effective introduction of cloud computing in a government. This was the next sub-question in this study. The literature review elicited a number of factors in this regard:

Table 4-2 Literature review cloud computing readiness factors (Source: Author)

Context	Factors	Sub-factors	References
Infrastructural indicators	*Operational infrastructure*	Electricity availability and reliability	Biles, 2008; Greenpeace, 2011; ITU, 2008; Kim, Kim, Lee & Lee, 2009; Maurice et al., 2012; Smith, 2012
		Broadband connectivity	Wyld, 2010; ITU, 2012; Kuda et al., 2012; Federal Financial Institution Examination Council Agencies, 2012
Organisational indicators	*Strategic business considerations*	Strategy	Kundra, 2011; DFD, 2011
		Top management support	Lam, 2011; Abadi, 2009; Furrier, 2009; Ragu-Nathan et al., 2004; Low et al., 2011; Swink, 2000; Dhiman, 2010
		Human resource strategy	Lam, 2011; ITU, 2012
		Vendor management/Service level of agreement	Bollineni & Kumar, 2011; Federal Financial Institution Examination Council Agencies, 2012; Ernst&Young, 2011; Habib et al., 2010
	Operational business considerations	Security issues	Dhiman, 2010; Federal Financial Institution Examination Council Agencies, 2012; Kim et al., 2009; Pearson, 2012; Schreiber, 2011; Petkov, 2008; ITU, 2012

		Trust	Habib et al., 2010; Bollineni & Kumar, 2010; Pearson, 2012; IDC, 2009; Furrier, 2009; Li & Ping, 2009; ITU, 2012; Cloud Forum IP Ltd., 2011
		Compatibility and interoperability	Low et al., 2011; Ernst & Young, 2011; ITU, 2012; Pearson, 2012; Wang et al., 2012; Parameswaran & Chaddha, 2009;
		Cost performance	Dhiman ,2010; ITU, 2012; Lam, 2011; Low et al., 2011; Kim et al., 2009
Environmental indicators	*Regulation environment*		ITU, 2012; Kuada et al., 2012
	Sustainability	Energy and carbon efficiency	Paper & Continuity n.d., Hamilton, 2009; Gartner, 2007; Brill, 2007; Garg et al., 2011; Eskom, n.d.; Berl et al., 2010

These factors were organised into three logical groups: three main context-dependent groups of readiness factors:

- Infrastructural indicators,
- Organisational indicators, and
- Environmental indicators.

These indicators were subsequently tested in an empirical setting of the studied provincial government. This part of this research has indicated that the participants have confirmed the relevance of the identified-readiness indicators. However, the empirical investigation elicited another important factor, here labelled as "Attitudes". This factor relates to the overall attitude towards cloud-computing adoption as an emerging concept, which was first realised during the first focus-group discussion.

Emerging Indicator: Attitudes

The overall attitude towards cloud-computing adoption is an emerging concept, which was first discovered during the first focus-group discussion. When the researcher presented the research questions and the research objectives of the study, the participants demonstrated different attitudes both verbally and non-verbally. Hence, this prompted the idea to look for the possible relationship between people's attitudes towards cloud-computing adoption and the impact it has to embracing cloud computing.

The overall attitude towards cloud computing is that it is a "*complex issue*," as stated by one of the respondents. Senior and middle-level managements are positive about what cloud computing could bring to the organisation. However, other respondents also felt somewhat insecure about introducing the cloud-computing services, and how these would influence their jobs. This finding suggests that the negative attitude of employees could negatively affect the introduction of cloud computing in this provincial government.

Table 4.2 presents the empirically confirmed and revised (by adding an additional indicator) CC readiness indicators recommended as fundamental if cloud-computing adoption is to be successful in the studied Provincial government. All these factors are summarised below.

Table 4-3 The indicators of the final proposed cloud-computing adoption readiness model based on the study's outcome (Source: Author)

Context	Factors	Sub-factors
Infrastructural indicators	*Operational infrastructure*	Electricity availability and reliability
		Broadband connectivity
Organisational indicators	*Strategic business considerations*	Strategy
		Top management support
		Human resource strategy
		Vendor management/service level of agreement
	Operational Business Considerations	Security
		Trust
		Attitude
		Compatibility and interoperability
		Cost performance
Environmental indicators	*Regulation environment*	
	Sustainability	Energy and carbon efficiency

The last research question intended to seek the extent of readiness of a studied Provincial government for the readiness for adoption of the cloud-computing technologies and services. The following table provides a summarised overview of the actual readiness status of each indicator related to the researched Provincial Government.

Table 4-4 The extent of readiness of a studied Provincial Government for cloud-computing adoption (Source: Author)

Context	Factors	Sub-factors	Actual readiness Status
Infrastructural indicators	Operational infrastructure	Electricity availability and reliability	**Yes**
		Broadband connectivity	**No** (in progress)
Organisational indicators	Strategic business considerations	Strategy	**No**
		Top management support	**No**
		Human resource strategy	**No**
		Vendor management/SLA	**No**
	Operational business considerations	Security	**No**
		Trust	**Yes**
		Attitude	**Partially**
		Compatibility and interoperability	**No**
		Cost performance	**No**
Environmental Indicators	Regulation	Regulation	**No**
	Sustainability	Energy and carbon efficiency	**No**

The findings of this study indicate that the researched provincial government is not yet ready to embrace the cloud-computing technologies and services, since many indicators are marked by a *No*.

Apart from the Electricity supply factor, which is not seen as critical by the respondents in this study, and the Attitude factor, which is partly satisfactory, all other indicators suggest that this Provincial Government should address them if it aspires to successfully introduce the CC technologies and services.

Although the broadband Provincial strategy is in the operational phase, the introduction of the CC technologies and services would not be possible before the province-wide broadband connectivity has been completely rolled out.

Strategic issues, which include strategy, top-management support, human-resource strategy and, at the certain point, vendor management, are still to be addressed – before attempting to introduce the CC technologies and services. The same holds true for the operational issues of security, trust, attitude, compatibility and interoperability, and cost performance, which will follow the strategy operationalization.

The regulatory CC environment is also of the utmost importance for a successful adoption and operation of the CC services; but here it is not the responsibility of the provincial government. This is the realm of the National government, and the researched Provincial government could not have much influence on the current state of affairs in this area. However, it irrespectively impacts on an effective adoption of the CC technologies and services by the researched Provincial government. This similarly holds true for the ecological environmental concerns, which are mainly regulated at the national level. These concerns would influence the adoption of the CC technologies and services in the researched SA Province.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter concludes the entire research by revisiting the research objectives identified in Chapter 1. This is complemented by providing brief answers to the research questions, based on the findings and the results obtained in the previous chapter. Furthermore, it reports on contributions of this study, while also acknowledging some of the limitations. The recommendations for the studied Government in terms of cloud-computing adoption were given, as well as for some potential future research in the relevant field.

5.2 Research objectives revisited

The main objective in this study was to identify the readiness factors that influence successful migration to cloud-computing, and to assess the actual readiness of a provincial government in South Africa for this migration to occur. This main objective was reached by attaining the following sub-objectives:

- *To determine and explain the characteristics of Cloud-Computing*: This was attained by reviewing the modern literature and gaining a thorough understanding of these technologies.
- *To identify the factors that influence an effective introduction of the cloud-computing in a government environment*: This sub-objective was reached in two ways: (i) by reviewing the pertinent literature; by identifying a set of indicators; and (ii) by testing these indicators in the empirical setting of this study. This produced a final list of the CC readiness indicators, which was subsequently used to attain the last sub-objective:

- *To determine the extent of readiness of a studied Provincial government for the cloud-computing platform*: After attaining this objective, it was evident that the

studied Provincial Government was not yet ready for the introduction of the CC technologies, and for the services based on these technologies.

In order to become ready for the introduction of CC technologies, the following recommendations are suggested:

5.3 Recommendations

5.3.1 Infrastructural Indicators

Infrastructural and technological indicators refer to the level of readiness at the provincial level (tightly linked to the national level) and condition; since this determines the wider circumstances for the adoption of cloud-computing. As the literature review revealed, there are two indicators in this regard, namely: (i) The electricity supply availability and reliability; and (ii) broadband connectivity.

5.3.1.1 Electricity supply

Although this study showed that the electricity supply is rather stable in this province; it is still important to check the power supply in the rural areas that might use the CC-based government services. A lack of stable electricity supply might hinder future cloud-computing adoption in these areas of the studied province.

5.3.1.2 Broadband connectivity

Despite the years of government broadband initiatives, the broadband connectivity situation remains unsatisfactory. An unreliable, slow and relatively expensive broadband connectivity remains a constraint for any future digital readiness and development. With the launching of the 2014 broadband initiative in the studied province, it is likely that this situation might change in the near future.

5.3.2 Organisational Indicators

Organisational indicators intend to evaluate both the operational and the strategic feasibility of the cloud-computing solutions – this includes both: comparing and analysing potential

benefits and possible vulnerabilities. This readiness group of indicators is divided into two main categories:

- Operational business considerations, having the following indicators: (i) Security; (ii) trust; (iii) compatibility and interoperability; (iv) cost performance; and
- Strategic business operations, consisting of: (i) Strategy; (ii) top-management support; (iii) human-resource strategy; and (iv) vendor-management/SLA.

5.3.2.1 Strategic Business Consideration

5.3.2.1.1 Strategy

A strategy is seen as "*the first step in the process of migrating towards cloud technologies, both within the public and the private sector*" (Kundra, 2011). This lays the groundwork to foster the cloud-computing launch province-wide. An overall cloud-computing strategy is still lacking in the studied Government, which means that the introduction of CC technologies cannot be done in an organised, or strategic manner. A well-developed strategy is intended to accelerate those changes required to improve the IT operations and performance, in general – and the CC adoption in particular.

In this study, in addition to the overall government cloud-computing strategy, there are three areas of concern that need to be taken into consideration: (i) Top-management support; (ii) human-resources strategy; and (iii) vendor-management/service level of agreement.

5.3.2.1.2 Top-management support

When introducing a new or innovative technology (such as CC) into an organisation, employees react to the changes brought about by new technology. In turn, this could affect their work productivity, as a result of losing their current organisational status and positions. Therefore, encouraging and maintaining a high level of motivation is essential in the process of implementing cloud-computing technologies, and on these technology-based services. This needs to be supported by the top management in the studied government, as this is essential for a successful cloud-computing adoption.

5.3.2.1.3 Human-resource strategy

In order to accelerate the transition of changes required for cloud-computing adoption, a human resources (HR) strategy and related programmes are needed to address the complex cloud-computing-required skills in the organisation. Here, the empirical findings indicated that the CC-related skill shortage exists in the studied provincial government. Moreover, it was found that there was no the HR strategy in place at the studied Government. Hence, it is recommended that such a strategy be established, in order to secure the appropriate CC-related skills.

5.3.2.1.4 Vendor Management/Service level of Agreement

A mutually beneficial service level of agreement is essential to ensure that a proper level of services is guaranteed; and the service provider is accountable to provide such services. It is, however, evident that strategic management have not come to terms with any actual strategy or concept in contract management yet – despite the fact that the participants in this research demonstrated a good understanding of its importance and the issues that need to be addressed in a SLA. Thus, the SLA issues should be addressed at the appropriate time of the CC adoption.

5.3.2.2 Operational Business Consideration

5.3.2.2.1 Security

Security is considered to be the highest priority of all the cloud-computing adoption issues. The major concerns are associated with data access, data storage, and data management. The lack of regulations and the data-protection law enforcement makes cloud-computing services less attractive in the public sector, since this issue deals with sensitive government and civil information. Consequently, security issues must be addressed appropriately, and should make CC operations protected, in order not to hamper or hinder the cloud-computing adoption.

5.3.2.2.2 Trust

The uncertainty and the insecure feelings that people have about cloud computing are tightly linked to the concept of trust. The presence of trust (or otherwise) would affect the employees'

psychological readiness to embrace cloud computing, due to the various adoption issues (mentioned the above) and the implications. This is referred as the trust level, which comprises the subjective criteria or opinions towards new technology. This is seen by the participants in this study as an invisible soft issue that could possibly affect employees' attitudes and productivity, while adopting or using cloud-computing technologies. Thus, the role of the management structures of the studied government is to promote trust among its employees, in order to support an effective adoption of the CC technologies.

5.3.2.2.3 Emerging Indicator: Attitudes

The overall attitude towards cloud-computing adoption is an emerging concept, which was first discovered during the initial focus-group discussion. When the researcher presented the research questions and research objectives of the study, the participants demonstrated different attitudes: both verbally and non-verbally. Thus, this prompted the idea to look for the possible relationship between people's attitudes towards cloud-computing adoption and the impact it has on embracing cloud-computing.

Senior and middle-level managements are positive about what cloud computing could bring to the organisation. However, some of the other respondents felt somewhat insecure about introducing the cloud-computing services and how this would influence their jobs – hence, having a "mixed" attitude. This finding suggested that the negative attitudes of employees could negatively affect the introduction of cloud computing in this provincial government. Hence, this issue should be addressed together with the trust issues, in order not to jeopardise the adoption of the cloud-computing technologies in the studied Provincial Government.

5.3.2.2.4 Compatibility and Interoperability

Compatibility and interoperability issues refer to the degree to which cloud-computing services fit into the business or organisation's operational needs and strategic goals. It is a critical enabler for the data and the applications to be able to move easily among different cloud-service providers.

To draw conclusions from the findings, it is evident that there are no strategies, policies or principles in place yet to address the compatibility and interoperability issues. This could negatively affect future cloud-computing adoption in the studied government; therefore, these issues should be appropriately resolved if the adoption of the cloud-computing technologies is to be successful.

5.3.2.2.5 Cost Performance

Lastly, cloud-computing implementation is a continuous and costly process. It requires constant measuring and monitoring techniques. Thus, it is important to ensure that the possible impacts brought about by the unexpected costs should not jeopardise the overall cost performance. The awareness of such issues is evident amongst the participants; however, the studied provincial government has no strategy or other means to address this area of concern yet. This could certainly hamper future cloud-computing adoption; so it should be appropriately addressed.

5.3.3 Environmental Indicators

Environmental indicators focus on how the macro-environmental factors could influence the organisations' ability to adopt cloud-computing services in general. It covers the ***regulatory environment*** and ***sustainability*** indicators.

5.3.3.1.1 Regulatory environment

This study has revealed that here are some obstacles related to the regulatory-technology environment. This is due to a perception of the participants towards the incapability of State-owned IT agencies. The underlying cause remains unidentified, due to the confidentiality issue. Together with the lack of universal standards and commonly accepted laws to regulate the regional market, it is evident that this situation obstructs the effective adoption of cloud-computing in the studied Province.

5.3.3.1.2 Sustainability

The studied Provincial Government is still at the stage of taking a cautious approach to the adoption of the cloud-computing technologies, which *inter alia* includes an evaluation of the potential cost/benefits. However, the studied Government has not yet considered the

introduction of "green-computing" strategy into the cloud-computing adoption. Since the relevant literature suggests that it may have a negative impact on the environment, it is necessary for this Government to consider the "green" (sustainable) technology options.

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The detailed recommendations in this and all other recommendations are out of the scope of this study and would need to be addressed separately.

5.4 Contributions of this study

The contributions of this study are seen as twofold: academic and practical.

The main academic contribution of this study is a model, based on the suggestions from non-empirical research (literature review) and the findings from the empirical research, in the field of readiness indicators for cloud-computing adoption in the studied South African Provincial Government. This model could be used by other academics and researchers to test and possible develop it further, which might well contribute to the body of knowledge in this field.

Application of this model for testing of the readiness of a particular Provincial Government for the adaptation of the cloud-computing technologies and services is seen as a practical contribution of this study. The recommendations given in this chapter could help managers of the studied Provincial Government in adequately preparing this institution for acquiring the benefits of these technologies.

5.5 Limitations of this study

This study has targeted only the non-technological factors influencing the adoption of cloud-computing technologies. Therefore, the findings from this research are only applicable to the studied Provincial Government, and they exclude the technological component (hardware, software and communication equipment). Furthermore, this study has investigated

the readiness indicators from only the government's perspective, hence omitting any possible external factors that could have an impact on the cloud-computing adoption (i.e. the availability of technical equipment and expertise of the supporting agencies, or the availability of the treasury funding).

However, these limitations were not seen as factors that impacted on the integrity and findings of this study.

5.6 Recommendations for further research

It is recommended that future research be done in examining the cloud-computing service-providers' capabilities (i.e. specialised government agencies) to support the introduction and operations of these technologies in the provincial governments. This bears high significance, as there is no successful adoption of the CC technologies and services without the appropriate support from these (technological) specialised government agencies. It would be also relevant to explore the relationship between the non-technological adoption factors presented in this study and the "hard-core" technological (e.g. hardware, software, communication equipment) adoption factors.

On this note, more study needs to be done, in order to ascertain the successful cloud-computing adoption and deployment within the studied (and possibly similar) Provincial Government departments.

On the other hand, it would be beneficial to explore the readiness from the citizens of the studied Province for adopting and using the government-provided cloud-computing services.

It is also recommended to replicate this study in other South African provinces, in order to increase the generalisation of the findings of this study, and also to increase the reliability of the readiness indicators across various provincial governments.

5.7 Conclusion

This thesis reports on a study aimed at investigating and examining the readiness for cloud-computing adoption in a South Africa Provincial Government. The non-empirical data retrieved from the literature, together with the empirical findings, demonstrated that there are a wide variety of factors that impact on cloud-computing adoption in the studied Provincial Government.

Despite the benefits of cloud-computing technologies, it is recommended that government strategic decision-makers should take into consideration those factors, grouped in three main contexts, namely: The infrastructural indicators; the organisational indicators; and the environmental indicators. This study has provided the guidelines needed for such matters.

This study is now open to the practitioners and researchers to critique, amend or expand this research, which would benefit both government decision-makers and the academic world.

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APPENDICES

Appendix 1: Interview Guide

1. What is government's attitude towards cloud-computing adoption in government services?
2. Does the government have a plan to build a private cloud?
3. Would you consider the current electricity supply could have an impact on the government-cloud adoption?
4. Would it be a matter of concern, with regard to the current ICT level of development, if it were to have an impact on cloud-computing adoption?
5. What would be your concerns, with regard to security issues when migrating e-Government onto the cloud?
6. Do you trust cloud services, or are you confident in moving government services onto the cloud?
7. In the light of compatibility and interoperability, what would be your areas of concern?
8. What would be your areas of concern when choosing a cloud-service provider?
9. Would you consider cloud computing to be cost-efficient?
10. What kind of skills or competencies are you expecting from your employees in the cloud-computing environment?
11. Do you think necessary training is required for related positions when cloud computing is being introduced?
12. What would be your main concerns when signing a Service-Level Agreement?
13. How does the current regulation situation impact on cloud-computing adoption and development?
14. Do you believe that by utilising cloud computing, a reduction of energy consumption is likely? Why?
15. What are your suggestions on the contributions of "green computing" in cloud computing?