



UNIVERSITY OF NAIROBI
SCHOOL OF COMPUTING
MASTER OF SCIENCE IN INFORMATION SYSTEMS

**ASSESSING CLOUD READINESS: A CASE OF NAIROBI COUNTY
GOVERNMENT**

BY

MULE JOSEPHINE KALEKYE

P56/61562/2013

Supervisor

Professor Elijah Omwenga

**A Project Report submitted to the School of Computing and Informatics in
Partial Fulfilment of the Requirements for the Award of a Master of
Science Degree in Information Systems at the University of Nairobi**

NOVEMBER, 2015

DECLARATION

This research is my original work and has not been presented for a degree in any other university.

Signature.....

Date.....

MULE JOSEPHINE KALEKYE

P56/61562/2013

APPROVAL BY THE SUPERVISOR:

This research project has been submitted for examination towards fulfilment for the award of a Master of Science degree in Information Systems with my approval as the university supervisor.

Signature.....

Date

PROFESSOR ELIJAH OMWENGA

DEDICATION

I dedicate my research to my family and friends. A special feeling of gratitude to my mother, Francisca Mule whose words of encouragement and push for tenacity rings in my ears. My brothers Daniel and Benjamin who have been a constant source of inspiration.

ACKNOWLEDGEMENT

I would like to thank my supervisor, Prof. Elijah Omwenga, for the patient guidance, encouragement and advice he has provided throughout my time as his student. I have been extremely lucky to have a supervisor who cared so much about my work, and who responded to my questions and queries so promptly.

And special thanks to my friends James and Victor for their support and encouragement during this process and for their pride in this accomplishment.

ABSTRACT

Cloud computing is an emerging technology that is being embraced by more and more organizations. It has been viewed as a way to increase the capacity or add capabilities dynamically without investing in new infrastructure, training new personnel, or licensing new software. A qualitative approach was adopted for this study. In order to gather information on the subject matter, questionnaires were used. The responses were fed into a cloud readiness assessment tool and score generated based on the questions. The score ranked the cloud readiness status as average at 65.4%. This is ranked as average based on the Business Software Alliance Global Cloud Computing Scorecard. Improving hardware readiness was identified as an area needing improvement. This can be achieved by obtaining a higher degree of virtualization and by willing to upgrade the current hardware and software infrastructure. Connectivity readiness was also identified as needing improvement. The study also found out that faster broadband connection with redundant capabilities can improve the score. The assessment computed a potential value of 70.4% that Nairobi County government could gain from the functionalities and flexibility of the cloud.

Keywords

Cloud computing

Cloud readiness

Assessment

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CHAPTER ONE

INTRODUCTION

1.0 Introduction

Cloud computing is a new technology that provides flexible and massive online computing power (Idris, Anuar Misron & Fauzi, 2014). Rathore, Jain and Kapoor (2014) record that Cloud computing provides many benefits over traditional infrastructure models where compute equipment is owned or leased and housed in a server room, data center, or collocation site, such as on-demand procurement, reduced cost, increased capability in terms of compute and storage, flexibility and application mobility.

This research study was aimed at assessing the cloud readiness status in Nairobi County with a specific focus on Nairobi County government. Omwansa, Waema & Omwenga (2014) observe that developing markets have opportunities to leap frog by adopting cloud computing technologies that result in many benefits, such as cost cutting and speed of processing. They further observe that Cloud computing in Kenya is fairly recent, with most organizations having adopted it in the year 2010 or 2011 thus implying that the impact of the technology is limited. A qualitative approach was adopted for this study. In order to gather information on the subject matter under study, apart from the desk research, questionnaires were used to collect data from the a sampled population within Nairobi County.

1.1 Background of Study

County governments are a devolved form of administration in Kenya. They were formed under the new Constitution that was promulgated on 27th August 2010 under Chapter Eleven – Devolved Government (The Constitution of Kenya). One of the Objectives of the devolved governments is to promote social and economic development and the provision of proximate, easily accessible services throughout Kenya (The Constitution of Kenya, 2010). To attain this objective service provision must be efficient. Gichoya (2005) suggests that government processes can be significantly improved by well-focused use of ICT to back improvements in efficiency, management effectiveness and eventually, the quality of services offered to citizens.

Subashini & Kavitha, (2011) define cloud computing as a way to increase the capacity or add capabilities dynamically without investing in new infrastructure, training new

personnel, or licensing new software. It extends Information Technology's (IT) existing capabilities. Cloud computing delivers an environmentally friendly, competitive, and efficient service. It uses only the necessary amount of server space and dramatically reduces commercial energy consumption. In addition to lowering a firm's carbon footprint, this also has significant and beneficial cost implications.

The integration of Cloud technology into service delivery can have a significant impact across multiple sectors. It can help deliver an efficient and continuous service, but it also has the capacity to reduce energy consumption and overhead costs. All of this translates into a more profitable and capable venture (Business Bee, ND).

1.2 Problem Statement

According to Eigema (2007), Service delivery is the government's key task. The best yardstick to measure government performance of good governance is through service delivery to the people. Abe & Monisola, (2014) in observing service delivery at the County Government Level in Nigeria records that the creation of County governments anywhere in the world stems from the need to facilitate development at the grassroots. The importance of local government is a function of its ability to generate a sense of belongingness, safety and satisfaction among its populace. He further observes that the need to improve local government service delivery cannot be overemphasized. Wyld (2009) argues that Cloud computing can easily deliver services that are common across government, such as accounting, procurement, and collaboration tools.

1.3 Research Objectives

The overall goal of this research was to explore and ascertain the level of cloud readiness in Nairobi County government.

The specific objectives are outlined below:

- To identify factors that contribute to the current status of cloud readiness in Nairobi County government.
- To propose ways to improve cloud readiness status in Nairobi County government.

1.4 Research Questions

This study has the following research questions:

- What is the cloud readiness status in Nairobi County?
- What are the factors that contribute to the current status of cloud readiness in Nairobi County government?
- What can the County government of Nairobi do to improve the cloud readiness status?

1.5 Scope of the Study

The research covered the responses of Nairobi County employees on the cloud readiness in Nairobi County. Only a sample of the population of Nairobi County employees was used as respondents.

1.6 Significance of the study

The findings of this research will contribute to an understanding of the level of cloud readiness in the Nairobi County government. The factors that contribute to the current status of cloud readiness and what can be done to improve the current status of cloud readiness will be discussed by this study. Therefore the research findings from this study will be of major significance to stake-holders in the county government system.

1.7 Limitations of the study

Time constraints were among the limitations experienced during this study. There are many facets of this phenomenon and there were many interesting stakeholders from which opinions on the cloud readiness in Nairobi County could be captured. Some of these stakeholders include the Ministry of Devolution officials, Ministry of ICT officials, the population receiving services from Nairobi County and many more. However, due to time constraints this study focused on the employees within the ICT department and heads of departments of Nairobi County and captured their perceptions on cloud readiness within Nairobi County government.

Respondents' cooperation was another limitation experienced in this study. A number of potential respondents refused to participate in this study as they felt that their responses get them into trouble with their supervisors. Although the researcher assured the respondents that the information given will be held in anonymity, a few potential respondents did not feel fully assured to take part in the study.

1.8 Assumptions

In this study, it was assumed that the variables of the study did not change in the course of the research period. It was also assumed that the sample chosen will be adequate to help assess and draw valid conclusions. Additionally, it is assumed that the instruments for data collection are valid and reliable. Lastly, it is assumed that the respondents were honest while giving the requested information.

CHAPTER TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.0 Introduction

Verdegem (2009) states that new information and communication technologies (ICT) offer the government new possibilities for providing citizens and businesses with better, more efficient services. Wyld (2010) notes that Cloud computing is an emerging concept. He further states that the basic idea of cloud computing is that computing will become location- and device-independent—meaning that it increasingly will not matter where information is housed nor where computation/processing is taking place. This enables computing tasks and information to be available anytime, anywhere from any device—so long as there is access to the internet. Sprecher (2000) suggests that the dilemma has been how governments can use the power of this ICT application to remake the way in which agencies provide services.

Gupta (2008) proposes that eGovernment initiatives all over the world endeavor to integrate Information and Communication Technologies (ICT) to transform delivery of government services to their stakeholders by improving quality of services, accountability and efficiency.

The emergence of information and communication technologies (ICTs), suggests that it is possible to improve efficiency of internal administration within government and to relocate government service from government offices to locations closer to the citizens (Gichoya, 2005). Carter (2005) recommends that ICT increases the convenience and accessibility of government services and information to citizens.

2.1 Cloud readiness in Kenya

The UNCTAD (2013) report stated that The Government of Kenya has developed data centre capacity for its own use as well as for public access in order to reduce costs for businesses and organizations that need to host data in-country. Such intervention is not uncontroversial, since government-owned data centers may compete with commercial businesses operated in the private sector (Research ICT Africa, 2013). The report further states that all large companies listed in the Nairobi Stock Exchange have started migrating some services to the cloud. Cloud adoption by SMEs is hampered by the lack of awareness and trust, high cost of broadband services and limited access to electricity. The UNCTAD report suggests that to raise awareness among citizens and

consumers, some e-government services in Kenya have been migrated to the cloud, and the Government has become one of the most significant cloud adopters in Kenya.

2.2 ICT in county governments

Green,(2013) suggests that decentralization aims to provide better quality services to citizens in the developing world. Griffin, Foster and Halpin (2013) record that successful introduction of new processes supported by ICT will make steps towards accomplishment of e-government. Weerakkody & Reddick, (2012) suggest that ICT has offered a better, faster and a more transparent way of delivering services to citizens and other stakeholders.

2.3 Benefits of cloud computing

Wyld(2009) states a number of benefits of cloud computing, including the potential for rapid scalability and deployment capabilities (providing just-in-time computing power and infrastructure). Decreased maintenance/upgrades is also a benefit of cloud computing. Improved resource utilization—elasticity, flexibility, efficiencies results as a use of cloud computing. Improved economies of scale, improved collaboration capabilities and an ability to engage in usage-based pricing making computing a variable expense, rather than a fixed capital cost with high overhead. Reduced information technology (IT) infrastructure needs - both up-front and support cost promote cloud computing. Capacity for on-demand infrastructure and computational power, Green-friendly - reduced environmental footprint and improved disaster recovery capabilities are gains of cloud computing.

2.4 County governments and performance

Abe & Monisola, (2014) recommend potential ways of improving service delivery in government which we discuss below.

Participation of the people in decision making – involving the populace in decision making helps in creating an environment where citizens feel that their opinion matters. It is easier for them to uphold decisions that they participated in making.

Transparency and accountability should be ensured if the available resources will be judiciously utilized. Avenues should be created for leaders to account for their stewardship.

The government at the grassroots should be sincere in meeting the needs of the people at the local level. Opportunity to serve at the grassroots should not be seen as a privilege to amass quick wealth but as privilege to serve.

Corruption must be stamped out of the system. Honest and people of proven integrity only should be given the privilege to serve at the grassroots.

Elections to local government posts should be free and fair from primary elections and should be handled by an Independent Electoral Commission. The practice of chosen caretaker committee to oversee the affairs at local level should be avoided. Leaders should be elected and made to be accountable to the electorate.

There is need to cultivate the culture of maintenance of local government projects. Any project to be carried out should be well monitored to ensure quality and durability of such projects.

Local governments should be given a free hand to carry out projects needed in their locality. Political interference and dictation should be avoided.

Improved service delivery cannot be achieved by employing a single solution. The above aspects if employed in addition to ICT cloud computing solution can go a long way in improving service delivery in Nairobi County.

2.5 Factors influencing service delivery in county governments

A report by the Rwandese Association of Local Government Authorities (2010) lists lack of staff; insufficient financial means; lack of database to facilitate planning, monitoring and evaluation; lack of motivation among staff due to low salaries, job instability and high work load; and means of transport and communication for supervision of activities as the most pressing factors influencing service delivery in Local Governments.

2.6 Importance of ICT to government

ICT presents a way for governments across the world to provide citizens, business and other government with convenient access to government services and opportunities of collaboration via Internet and wireless communication technology (Siau & Long, 2005). Nute (2002) records that systems reduce government institutions' costs through web based purchasing proposals eliminating "time-consuming administrative steps of

photocopying, folding, addressing and mailing bid packages”. This in essence will improve the procurement process which is one of the services offered or undertaken by county governments.

2.7 Inference (Cloud computing, and county governments)

County governments exist for the purpose of bringing services closer to the citizens of a country. The ability to deliver these services can be improved by use of ICT, with cloud computing in particular. The factors influencing service delivery play a major role in accessing the cloud readiness in Nairobi County government. These factors with their relations help to come up with the Conceptual framework that this study proposes.

2.8 Cloud Readiness Assessment Tools

Most of the available cloud assessment tools are driven by cloud providers. Therefore these tools are specifically designed to test customers that are interested to use the services of these providers. Some of these tools include the Microsoft Customer Assessment Tool for Private Cloud. Whereas it is an easy to use tool it is geared for customers that are interested in using the Microsoft cloud. The Cloud Assessment Tool provided by the Asia cloud computing association tests capabilities offered by different cloud providers to enable users to select the right cloud solution for the given requirement. As the aim of this study was to assess the level of Cloud readiness in Nairobi County government, the BSA Global Cloud Computing Scorecard was a better fit. The tool is not propelled by a cloud provider and is therefore thought to be impartial. The Scorecard tests the clients’ existing capabilities. It provides a detailed report with areas that need improvement, and what can be done to improve them.

2.9 Gaps observed in Literature Review based on this study

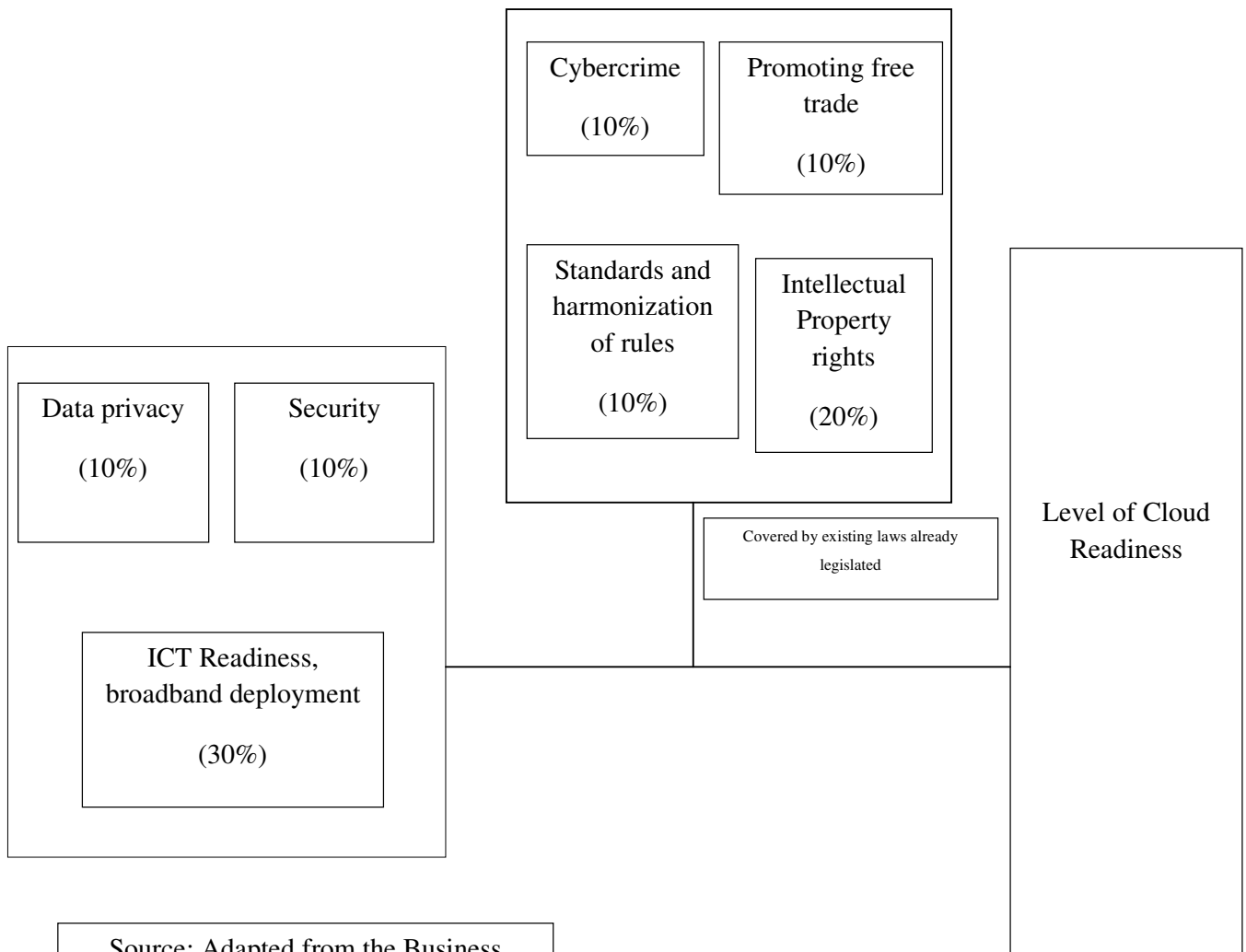
Whereas Verdegem(2009) suggests that ICT offers government new possibilities of achieving their mandate, there is no attempt to explicitly point at a specific ICT that will help in attaining these new possibilities. Carter(2005) and Weerakkody& Reddick(2012) concur that ICT offers a better and faster mechanism of delivering services. They do not however narrow down to a specific ICT application to facilitate this. Wyld (2009) points out that cloud computing as an application of ICT improves service delivery in government. Though he does not provide a way to assess the level of cloud readiness she states the benefits of cloud computing with a focus on government. The UNCTAD (2013) report agrees that Cloud computing is crucial in government with the BSA Global Cloud Computing Scorecard (2013) providing a methodology to assess cloud readiness. We

embarked to assess the cloud readiness status of the County government of Nairobi informed by this methodology.

Based on the methodology brought forward by the BSA Global Cloud Computing Scorecard (2013), we developed the conceptual framework below.

2.10 Conceptual Framework

Figure 1 – Conceptual framework



Source: Adapted from the Business Software Alliance – measuring cloud computing readiness

BSA. (2013). BSA Global Cloud Computing Scorecard developed a scorecard to measure cloud readiness that measures seven policy categories namely: Data privacy, Security, Cybercrime, Intellectual property rights, Support for industry-led standards and international harmonization of rules, Promoting free trade and ICT readiness, broadband deployment

Data Privacy

Questions in the Data Readiness section of the questionnaire are drawn from this section.

Cloud users will fully accept and adopt cloud computing only if they are confident that private information stored in the cloud, wherever in the world, will not be used or disclosed by the cloud provider in unexpected ways. National privacy regimes should be predictable and transparent and should avoid unnecessarily burdensome restrictions on cloud service providers such as registration requirements for data controllers and cross-border data transfers. Cloud providers should be encouraged to establish privacy policies that are appropriate for the particular cloud service they provide and the business model they use.

The weight for data privacy on the scorecard is 10%.

Security

Questions in the questionnaire in the Redundancy and Availability section and the Data readiness section are drawn from this section.

Consumers of cloud computing and other digital services (including both private-sector and government users) need assurance that cloud service providers understand and appropriately manage the security risks associated with storing their data and running their applications on cloud systems. This section of the Scorecard examines whether security criteria and the ongoing testing of security measures are the subject of regulation in each jurisdiction. The security section also examines electronic signature laws and Internet censorship or filtering requirements.

A number of countries have implemented Internet filtering or censorship regimes that may act as a barrier to the expansion of the digital economy and cloud computing. The key intention of the schemes is to address criminal conduct, including distribution of illegal material, particularly child pornography.

The weight for security on the scorecard is 10%.

Cybercrime

This section relies on the laws on the land, which are laws that exist formulated by the National government. Cybercrime and Computer Related Crimes Bill is the law that governs cybercrime in Kenya.

Because cloud computing involves the aggregation of massive amounts of data in large data centers, it creates new and highly tempting targets. As criminals turn their attention to these vaults of information, it will become increasingly challenging to protect such data centers from both physical and cyber-attacks. Governments should ensure that domestic laws provide an effective mechanism for law enforcement, and for cloud providers themselves, to combat unauthorized access to data stored in the cloud. This section examines these issues as well as rules relating to investigation and enforcement, including access to encrypted data and extraterritorial offenses.

The weight for cybercrime on the scorecard is 10%.

Intellectual Property Rights

This section is governed by rules that the National government has put in place. The laws that cover this area are listed below:

Main IP Laws: enacted by the Legislature

- Chapter 130 - The Copyright Act 2001 (2009)
- Chapter 506-Trade Marks Act (consolidated version 2007) (2007)
- The Seeds and Plant Varieties (Plant Breeder's Rights), Regulations, 1994 (2002)
- The Industrial Property Act, 2001 (2001)
- The Copyright (Amendment) Act (Act No. 9 of 1995) (1995)
- Chapter 326 - The Seeds and Plant Varieties Act (1991)
- The Trade Marks (Amendment) Act (Act No. 5 of 1994) (1984)
- The Trade Marks (Amendment) Act (Act No. 1 of 1984) (1984)

IP-related Laws: enacted by the Legislature

- The Competition Act No. 12 of 2010 (2011)

Providers of cloud computing and digital economy technologies and services, as with other highly innovative products, rely on a combination of patents, copyrights, trade secrets, and other forms of intellectual property protection. Thus, to encourage investments in cloud research and development, as well as infrastructure, IP laws must provide strong incentives for these investments and clear protection and vigorous enforcement against misappropriation and infringement. Online intermediaries should have incentives to behave responsibly, and they should enjoy safe harbors from liability when they do so.

The weight for intellectual property rights on the scorecard is 20%.

Support for industry-led standards and international harmonization of rules

This section is covered internationally. The Global Cloud computing Scorecard (2013) records that Kenya has done well in this area with score of 8.9.

Data portability and seamless use of interoperable applications are key considerations for cloud computing and digital economy applications. Consumers are demanding interoperability in the cloud computing space, and industry is working hard through standards development organizations and other international avenues to meet this demand. Government support of these efforts and the avoidance of technological mandates are important.

This section of the Scorecard examines whether or not governments encourage standards to be developed through voluntary, industry-led standards processes. This section also examines international harmonization of e-commerce rules, tariffs, and relevant trade rules.

The weight for this category on the scorecard is 10%.

Promoting Free Trade

This section is pegged on the National government with Kenya awarded a score of 8.5 by the Global Cloud computing Scorecard (2013).

Cloud services operate across national boundaries, and their success depends on access to regional and global markets. Restrictive policies that create actual or potential trade barriers will slow the evolution of cloud computing.

This section of the Scorecard examines and compares government procurement regimes and efforts to remove barriers to free trade, including countries' requirements and preferences for particular products.

The weight for this category on the scorecard is 10%.

Infrastructure (ICT Readiness, broadband deployment)

Questions in the questionnaire in the following sections were drawn from this area: Hardware Readiness, Connectivity Readiness, Software Readiness, Growth & Scalability, Mobility Readiness and Software & Expertise.

This section of the Scorecard examines and compares the infrastructure that is available in each country to support the digital economy and cloud computing. It is based on detailed comparative statistics on a range of important ICT indicators, including the presence of a national broadband plan, a country's International Connectivity Score and International Internet Bandwidth. In addition, the Scorecard includes statistics on the number of subscribers for various services, reflecting the importance (and growth) of mobile broadband subscriptions.

The weight for this category on the scorecard is 30%.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

The main objective of this study is to gather the views and perceptions of the sampled population to assess the cloud readiness in Nairobi County. This chapter therefore, provides an overview of the nature of research undertaken, sample size and sampling technique adopted. In addition, the chapter describes the research tool used.

3.1 Nature of Research

This research study explores the views and perceptions among the sampled population with an aim to assess the status of cloud readiness in Nairobi County government. The descriptive research design was used for this study. Seeking to answer what the level of cloud readiness is in Nairobi County government. It also sought to find out what factors have contributed to the current status of cloud readiness and what can be done to improve the current status of cloud readiness.

3.2 Sampling and Sample Size

In defining the sampling procedures this research study employed purposeful random sampling. ICT department employees in the Nairobi County government were used as respondents in this study. Head of departments were also used as respondents.

A sample size was determined based on the population size – Nairobi county government has 10 departments (Education, ICT, Health, Public Service, Lands, Public works, Trade, Water, Finance and Agriculture). There are 45 permanent employees in the ICT department of Nairobi County. Mugenda and Mugenda (2003) indicated a sample size of 10% or 20% will be sufficient for a study. 35 employees in the ICT department were used as respondents which are 77.78%, in addition to the 10 heads of departments to make 45 returned questionnaires.

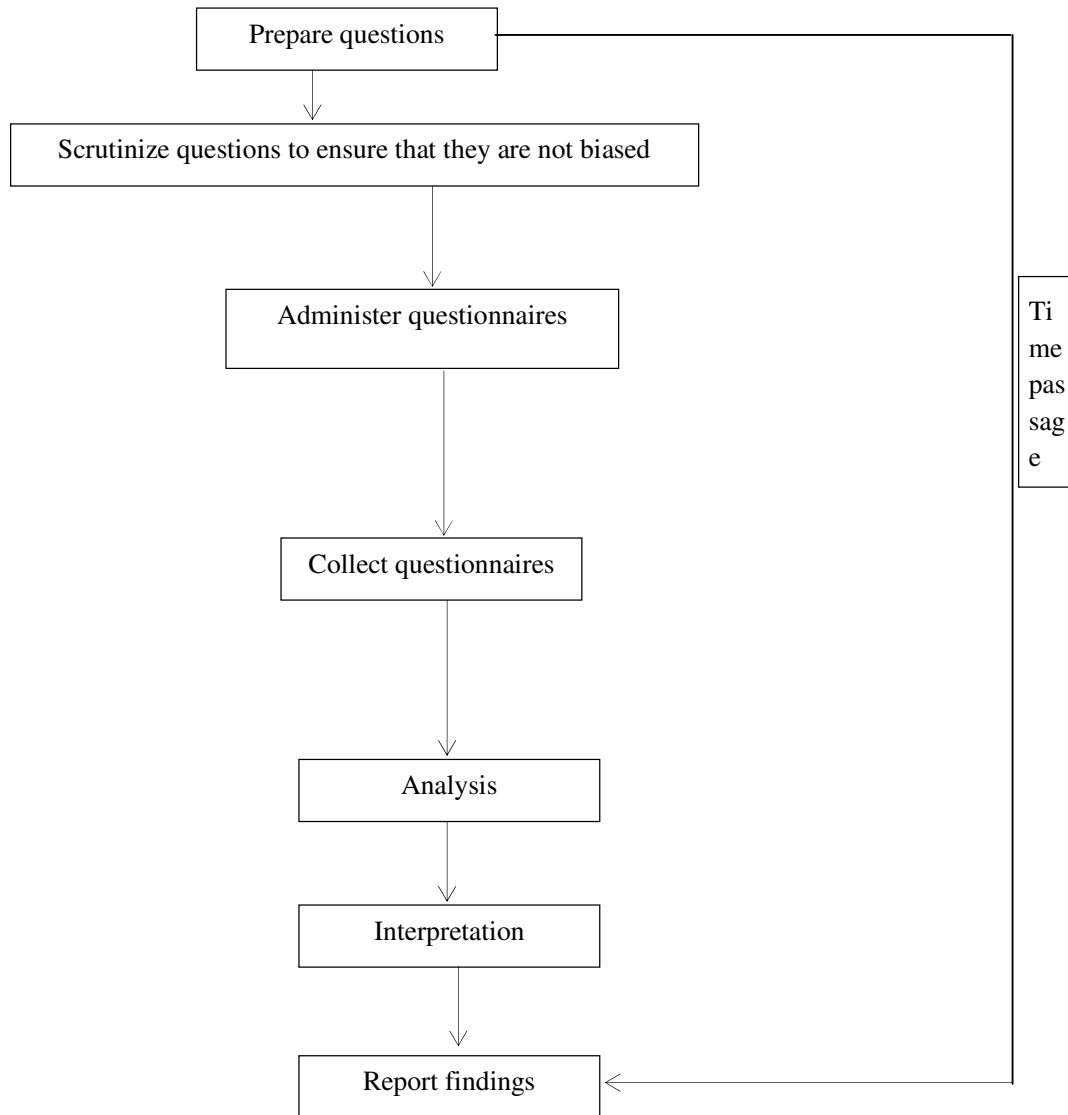
3.3 Data Collection

The research combines data collection techniques such as questionnaires and document and text analysis as suggested by Darke et al, (1998). The questionnaires (attached Appendix II) had closed ended questions with multiple choice responses.

3.4 Procedure of Data Collection

The sample population was drawn from the ICT department of Nairobi County government and heads of the 10 departments within Nairobi County. The questionnaires were picked two weeks after they were distributed to the respondents.

Figure 2 – Procedure of data collection



(Source: Compiled by author)

Questions were prepared and then scrutinized to ensure that they were not biased. The questionnaires were then administered to the respondents. After the questionnaires were collected the responses were analyzed. The responses were fed into an online cloud readiness assessment tool. Scores based on the various questions were calculated by the cloud readiness assessment tool. The results are discussed in Chapter four.

3.5 Ethical considerations

Behi, (1994) suggests that there are ethical issues when dealing with human subjects like confidentiality, dignity, benefit-to-risk ratio and informed consent. During the study participants got a full explanation of the research area. Any issues of privacy or anonymity were spelt out and respected at all times. Some respondents expressed fears of being quoted and consequently 'punished' by Nairobi County management if their responses did not paint the County government in good light. Such respondents felt more comfortable when they realized that questionnaires guarantee their anonymity.

3.6 Data Analysis

Miles & Huberman, (1984); Cavaye, (1996) stated that data analysis can be difficult given that qualitative data analysis methods are not as well established as quantitative methods, and the volume and variety of data collected may make analysis time-consuming. In light of this, on collection of the qualitative data derived from the questionnaires, careful analysis was done (both manually and utilizing a cloud readiness assessment tool).

The tool calculated the score based on the responses provided.

3.7 Limitations of the methodology

Research quality is heavily dependent on the individual skills of the researcher and more easily influenced by the researcher's personal biases and idiosyncrasies. To tackle this during this research all questions in the questionnaires were scrutinized to ensure that they were not biased.

The researcher's presence during data gathering, which is often unavoidable in qualitative research, can affect the subjects' responses. – During this research a deliberate effort was made to ensure that respondents were at ease. All information that was collected from respondents was collected voluntarily.

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSION

4.0 Introduction

The methodology described in the previous chapter provided the baseline for data-gathering. In this chapter, the presentation of data is systematically linked to the format of the self-developed questionnaire attached in the appendix. This chapter shall discuss the findings obtained from the primary instrument used in the study. In order to simplify the discussions, the researcher provided tables and graphs that summarize the collective reactions of the respondents.

This chapter presents the results of the research analysis. Structured data collection was aimed at determining:

- The level of awareness of cloud computing among employees of Nairobi County.
- Use of ICT in service delivery in Nairobi County.
- The perception on how well defined the services of Nairobi County are.

4.1 Description of the sample

As stated from the first chapter, the goal of the study is to assess the cloud readiness status in Nairobi County government. Data was collected using questionnaires. The questionnaires were delivered by hand to the respondents.

The sample was purposively selected from the entire population. The sample size then consisted of 55 respondents, although 10 questionnaires were not returned, thus reducing the number of returned questionnaires to 45. The respondents were males and females of different ages.

4.2 Question analysis

Hardware readiness

Response from questionnaires:

Table 4.1 – Question 2.1

Number of Servers	Response	Percent
1 to 3	-	0%
4 to 10	-	0%
10 to 20	-	0%
More than 20	45	100%
Over 100	-	0%

Nairobi County government has more than 20 servers according to 100% of the respondents.

Table 4.2 – Question 2.2

Are Servers Virtualized	Response	Percent
No	-	0%
Some of the servers are virtualized	35	77.78%
Most of the servers are virtualized	10	22.22%
All servers are virtualized	-	-

77.78% of the respondents felt that some of the servers are virtualized as compared to 22.22% that felt that most of the servers were virtualized. This shows that atleast some servers are virtualized.

Question 2.3

Table 4.3 – Question 2.3

Location of Servers	Response	Percent
In a room in our organization's facility	8	17.78%
In a room dedicated for servers in our organization's facility	35	77.78%
Hosted with an external partner	2	4.44%
Distributed over different locations	-	-

It was established that there is a server room within the Nairobi County government facility where servers are stored according to 77.78% of the respondents.

Question 2.4

Table 4.4 – Question 2.4

What kind of computers do you have and how does the county government use them?	Response	Percent
Mainly laptops, used everywhere	-	-
Mainly stationary clients located in a central office (if the clients	38	84.44%

are laptops but also stationary check this box)		
Mainly stationary clients located in employee's homes or across different locations	5	11.11%
Half of the clients are stationary, half are laptops (also used outside the office)	2	4.44%

84.44% of the respondents suggested that most of the computers in the county government are stationary. This could be because most of the services are done within the county government premises.

Question 2.5

Table 4.5 – Question 2.5

What is the average age of your server and storage hardware / technology platform?	Response	Percent
Less than 1 year old	-	-
1-2 years	-	
1-3 years	1	2.22%
1-4 years	2	4.44%
2-4 years	5	11.11%
All over 3 years	37	82.22%

Majority of the respondents (82.22%) averaged the age of the technology platform as above 3 years.

Question 2.6

Table 4.6 – Question 2.6

Do you plan to upgrade your server's operating systems to support new technologies?	Response	Percent
Yes, we are still on Windows Server 2003	3	6.67%
Yes, we are on Windows Server 2008 or 2008 R2 but want Windows Server 2012	-	-
We have a mixed environment (and might upgrade when migrating to the cloud)	40	88.89%
We are using the most current operating	-	-

systems and don't need to upgrade		
We are running an old operating system, but would like to keep the existing setup	2	4.44%

The server operating system environment is mixed, with respondents indicating they might upgrade when they migrate to the cloud.

Figure 3 – Score on Hardware Readiness



The total score can be improved by optimizing the hardware component. This can be achieved by obtaining a higher degree of virtualization and by being willing to upgrade current hardware and software.

Q 2.2 Before moving to the cloud, one should improve the degree of virtualization because virtualized systems can be easily transferred to a cloud provider. The organization can decide to build a new server from scratch when moving to the cloud, but that requires more effort and is more cost intensive. There are also tools on the market, for instance the VMware vCenter Converter, that help to convert a physical system into a virtualized one.

Q 2.5 Having an old infrastructure can be a driver to migrate to the cloud instead of modernizing and reinvesting in new hard- and software. Still, it can be more troublesome to join the cloud having old and outdated hardware than with a more recent infrastructure. Prepare enough time to migrate / renew your applications and servers.

Connectivity readiness

Table 4.7 – Question 3.1

How are you connected to the internet?	Response	Percent
Slow Internet < 20Mbit/s	40	88.89%
Normal speed with fast DSL or fiber, up to 60 Mbit/s	5	11.11%
Fast Internet access (fiber connection) up to 100Mbit/s	-	-
Backbone connection faster than 100Mbit/s	-	-

No Internet connection available	-	
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Majority of the respondents felt that the internet connection is slow within the Nairobi County government premises. Internet speed determines how fast an organization is able to send and receive files/documents.

Question 3.2

Table 4.8 – Question 3.2

How fast do you need to access documents?	Response	Percent
Seamless, should load immediately	3	6.67%
Fast	41	91.11%
Normal (short delay)	1	2.22%
Relatively slow (delay of a couple of seconds)	-	-

There was an agreement that documents need to be accessed fast as speed of service dispensation is dependent on speed of document retrieval.

Question 3.3

Table 4.9 – Question 3.3

Do you have Mobile Internet Access?	Response	Percent
We have phones with data plans and they can be connected to the computers	-	-
We have special SIM-Cards in our laptops with data plans	-	-
We use public and open Wi-Fi networks	45	100%
No, we don't use internet when we are on the road	-	-

There many public and open Wi-Fi in the city, 100% of the respondents agreed that this is what is used in Mobile Internet Access.

Question 3.4

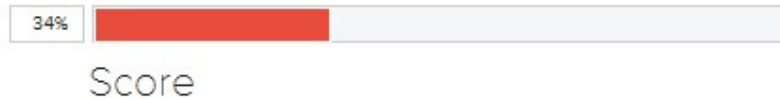
Table 4.10 – Question 3.4

Availability of your broadband network?	Response	Percent
We have redundant internet access with two providers	-	-
We have one internet connection but with a UTMS/EDGE extension (as backup)	-	-

We have only one internet connection	45	100%
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Only a single internet connection exists according to 100% of the respondents.

Figure 4 – Score on Connectivity Readiness



If requirements towards access speed are lowered or purchase of a faster broadband connection with redundant capabilities is made, this score can be enhanced.

Q 3.1 To use the cloud efficiently, a fast internet access is required. The faster the speed, the better the overall performance will be.

Q 3.2 To attain seamless or very fast access to data, the organization should consider using virtual desktops that run in the cloud provider’s data center. This way the organization would only access the client with a RDP protocol and would need less bandwidth because the data would never leave the cloud provider’s data center and would pass directly from the servers to the virtual desktop. Another alternative would be to use a local caching device that stores the most used data at your location and replicates it with the servers in the background. It does not have the same effect as cloud mirroring, but it is still very fast for most of your data requests.

Q 3.4 The likelihood that at some point the organization will experience an internet outage is quite high; in fact it is inevitable. Even if a cloud provider guarantees 99.999% uptime for your servers, if the internet connection breaks down, you can no longer access the servers. Having a backup connection in place is a smart move, especially when relying on a cloud based service, therefore, it is a huge factor when determining cloud readiness.

Software readiness

Table 4.11 – Question 4.1

Do you use branch specific software?	Response	Percent
Yes, and it runs on our server	45	100%
Yes, but it runs on each client individually (no server connection)	-	-
Yes, but it is old and can only run under	-	-

certain systems and configurations		
Yes, but it is hosted in the cloud	-	-
No, we use mainly standard office applications	-	-

There are branch specific software's that run in the Nairobi County servers according to 100% of the respondents.

Question 4.2

Table 4.12 – Question 4.2

What kind of software do you mainly use?	Response	Percent
Graphic intense Software Like CAD, Video Editing, Rendering (and option b)	-	-
Office Suites, Email, Accounting Tools, Inventory, CRM, simple GUI (data as text)	40	88.89%
Specialized software from a manufacturer that needs frequent updates (and option b)	-	-
Our own customized software (and option b)	-	-
Mixed, all and/or none of the cases listed above	5	11.11%

The soft wares used mainly are Office Suites, Email, Accounting Tools, Inventory, CRM, and simple GUI according to 88.89% of the respondents.

Question 4.3

Table 4.13 – Question 4.3

What operating systems do you use?	Response	Percent
Microsoft Windows Servers	40	88.89%
Unix Servers	-	-
Both	5	11.11%

Microsoft Windows Servers is the operating system used on the servers at the Nairobi County government.

Question 4.4

Table 4.14 – Question 4.4

What client operating system(s) do you use?	Response	Percent
Microsoft Windows XP or Vista	40	88.89%
Microsoft Windows 7	2	4.44%
Microsoft Windows 8	1	2.22%
Mixed Windows Environment	-	-
Mac (Apple) / Unix	-	-
Mixed	2	4.44%

The client environment is mostly Microsoft based, with Windows XP/Vista being the most used client operating system.

Figure 5 – Score on Software Readiness



The software and application score is adequate, it communicates cloud compatibility.

Data readiness

Table 4.15 – Question 5.1

How do you backup your data?	Response	Percent
We use an external hard drive and save it manually	-	-
We have the backup jobs automated	42	93.33%
Microsoft Windows 8	-	-
We don't backup, each user is responsible for their own backup	-	-
We use "dropbox" or another cloud based service to backup important data	3	6.67%

A backup system is existent, with backup jobs automated, according to 93.33% of the respondents.

Question 5.2

Table 4.16 – Question 5.2

Are internal data access policies and file access rights in place?	Response	Percent
We have no access rights defined for our data, everyone can see everything	-	-
We use Microsoft NTFS (Windows file	42	93.33%

permissions) to set file access rights		
Confidential data is stored locally by each employee	-	-
A bit of everything	3	6.67%

There is a system of file permissions, different access right permissions for different rights.

Question 5.3

Table 4.17 – Question 5.3

How confidential is your data?	Response	Percent
Low, we have nothing to hide	-	-
Normal, our data should remain within the company	1	2.22%
High, our data can only be accessed by company employees and authorized partners	42	93.33%
Ultra high, we need to know who accesses what at what time	2	4.44%

There is an agreement that data held in Nairobi County government is confidential.

Question 5.4

Table 4.18 – Question 5.4

Data location?	Response	Percent
Our data can reside anywhere in the world as long as we can access it and it's safety and security is guaranteed	40	88.89%
Our data must reside in the country where our company is located	-	-
Our data must be stored in our company's facilities	5	11.11%

Data can be held anywhere as long as it is accessible and safety and security is guaranteed.

Question 5.5

Table 4.19 – Question 5.5

Where is your company's data stored?	Response	Percent
Distributed on various computers and laptops	-	-
Centrally stored on a server	5	11.11%
External hard disks	-	-
Centrally stored on a SAN, NAS, or other storage solutions	3	6.67%
A bit of everything	37	82.22%

Data is stored in different storage locations, with a majority indicating that data is held in Nairobi County government servers.

Question 5.6

Table 4.20 – Question 5.6

How much data does Nairobi County government store?	Response	Percent
Less than 100 GB	-	-
Less than 500 GB	-	-
Less than 2 TB	5	11.11%
More than 2 TB	40	88.89%
More than 50 TB	-	-

Data stored by Nairobi County government is more than 2TB according to 88.89% of the respondents.

Question 5.7

Table 4.21 – Question 5.7

What kind of documents do you normally use?	Response	Percent
Standard office documents (<5MB)	3	6.67%
All kinds of documents (5-50 MB)	40	88.89%
Large files (25 - 200MB)	2	4.44%
Videos and high resolution images, or CAD renderings (>200MB)	-	-

The documents used in Nairobi County government are diverse thus a majority of the respondents indicated ‘All kinds of documents’.

Figure 6 – Score on Data Readiness



The data readiness score is very good making it simple to migrate the organization’s data to the cloud.

Growth & scalability

Table 4.22 – Question 6.1

What would you forecast the growth of your company to be over the next 3	Response	Percent
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years?		
Constant, we don't plan to expand	-	-
We need to be able to flexibly expand our infrastructure	40	88.89%
We have predicted a rapid growth rate and, therefore, we need to be flexible	5	11.11%
Decreasing	-	-

Future growth might not be easy to forecast but respondents signified the need for flexibility in expansion of infrastructure.

Table 4.23 – Question 6.2

	Response	Percent
How quickly do you need to expand infrastructure and deploy new servers and clients?		
Speed does not matter that much, normally we have a couple of months	5	11.11%
Within a month, we must be up and running	40	88.89%
Within a week	-	-
Within a day	-	-
Within hours	-	-

Expansion and deployment of new servers should be done within a month according to majority of the respondents.

Question 6.3

Table 4.24 – Question 6.3

	Response	Percent
How would you describe the degree of automation in your current IT-Infrastructure?		
Close to zero	-	-
Some task are automated 25%	37	82.22%
We try hard to automate as much as possible 50%	5	11.11%
High degree of automation > 75%	3	6.67%

There is an agreement that there is some degree of automation in the current IT Infrastructure, with majority of the respondents estimating the degree of automation at 25%.

Table 4.25 – Question 6.4

	Response	Percent
How would you describe the degree of standardization in your current IT-Infrastructure?		
Low, we don't have time for this < 25%	-	-

Little, we have some templates in place and some basic structure 25%	3	6.67%
Medium 50%	40	88.89%
High > 75%	2	4.44%

Standardization of current IT infrastructure was ranked as medium according to majority of the respondents (88.89%).

Table 4.26 – Question 6.5

	Response	Percent
Do you encounter occasional increased workloads on your servers? (during some periods of the year or on some specific days)		
Yes	45	100%
No	-	-

Figure 7 – Score on Growth & Scalability



This score shows that the organization is in the right path; the organization should continue the standardization and automation efforts.

Redundancy & availability

Table 4.27 – Question 7.1

	Response	Percent
Are you prepared for disaster recovery?		
Not at all	-	-
No, but we have the most important data stored at a different location	5	11.11%
Yes, we have our data synced to an alternate location within our company	40	88.89%
Yes, we have our data synced to an external provider	-	-

There seems to be an element of disaster recovery as 88.89% of the respondents indicated that data is synced at an alternate location within the organization.

Table 4.28 – Question 7.2

	Response	Percent
How critical is the availability of systems to your business?		
Not very important, we also function without technology	-	-
Medium, but not business threatening	-	-

Important, we need to access our data daily	40	88.89%
Existence is dependent on technology, we cannot function without our systems	5	11.11%

Data is accessed daily and therefore its availability is important for business according to 88.89% of the respondents.

Table 4.29 – Question 7.3

	Response	Percent
Do you have automated monitoring tools in place to alert you about the availability of services?		
No	-	-
Yes, we have some monitoring tools, but not centrally managed	40	88.89%
Yes, have an extensive monitoring tool in place	5	11.11%

A monitoring tool to alert on availability of services is available though not centrally managed according to 88.89% of the respondents.

Table 4.30 – Question 7.4

	Response	Percent
Do you use software that has a special demand for high-availability?		
No, if the Software fails we can get along without it for a little while	-	-
Low, software outages should not exceed 1 day	2	4.44%
Medium, software outages should not exceed 4 hours (during business hours)	41	91.11%
High, software outages should be reduced to the max (0-tolerance)	2	4.44%

There is need for medium to high-availability of software, which can be increased by migrating to the cloud.

Figure 8 – Score on Redundancy & Availability



The organization is well prepared and the availability requirements are ideal for the cloud.

Mobility readiness

Table 4.31 – Question 8.1

When and where do you access your data?	Response	Percent
Anytime and anywhere when connected to the internet	38	84.44%
Anytime but mainly from the office	2	4.44%
Anytime but only from the office	2	4.44%
Anytime at home or at the office	3	6.67%

Table 4.32 – Question 8.2

When and where do you access your email?	Response	Percent
Anytime and anywhere when connected to the internet	38	84.44%
Anytime but only from the office	2	4.44%
Anytime at the office or at home	5	11.11%

Table 4.33 – Question 8.3

When and where do you access company specific software?	Response	Percent
Anytime and anywhere when connected to the internet	2	4.44%
Anytime but mainly from the office	38	84.44%
Anytime but only from the office	3	6.67%
Anytime at home or at the office	2	4.44%

Access to software is mostly in the office, with email and data access anywhere when connected to the internet.

Figure 9 – Score on Mobility Readiness



There is a need to access data from a remote location and, therefore, making use of cloud enabled services is an ideal choice.

Migrating to the cloud would add many benefits to the organizations' your redundancy and availability needs. The organization's computed "value benefit" score for this section is: (93.3%).

Sourcing & expertise

Table 4.34 – Question 9.1

	Response	Percent
Who manages your servers and IT-Infrastructure?		
We manage them ourselves (internal IT)	-	-
We have a third party company that manages the servers	-	-
Both	45	100%

100% of the respondents implied that management of the IT infrastructure is done both internally by the IT team and externally by a third party company.

Table 4.35 – Question 9.2

	Response	Percent
How would you describe knowledge about cloud computing and IT-Infrastructure management within your company?		
Weak	-	-
Basic knowledge and understanding	41	91.11%
Advanced technical skills and knowledge	2	4.44%
We have a strong knowledge and can manage most of it ourselves	2	4.44%

Knowledge about cloud computing and IT infrastructure management is ranked as basic according to 91.11% of the respondents.

Table 4.36 – Question 9.3

	Response	Percent
Does your organization need to free IT personnel for other projects?		
No	1	2.22%
IT-Personnel would appreciate freedom from certain regular tasks	5	11.11%
Yes, we would like to use them for new projects	39	86.67%

Respondents showed there is need to free IT personnel for other projects.

Table 4.37 – Question 9.4

	Response	Percent
How do employees react to changes in their working methods?		
They are flexible and would adapt over	3	6.67%

time		
They are accustomed to their routine and would take some time to change	2	4.44%
Most of them are not technological savvy and would have trouble changing	2	4.44%
A bit of everything	38	84.44%

Reaction to changes in working conditions is mixed with majority of the respondents implying a bit of everything, which ranges from flexible to trouble changing.

Figure 10 – Score on Sourcing & Expertise



The weight of this section in respect to the total score is average. Training the employees to be ready for new software and new technological possibilities is recommended in order to efficiently accomplish tasks and acquire the necessary internal knowledge of cloud technologies.

4.3 Discussion

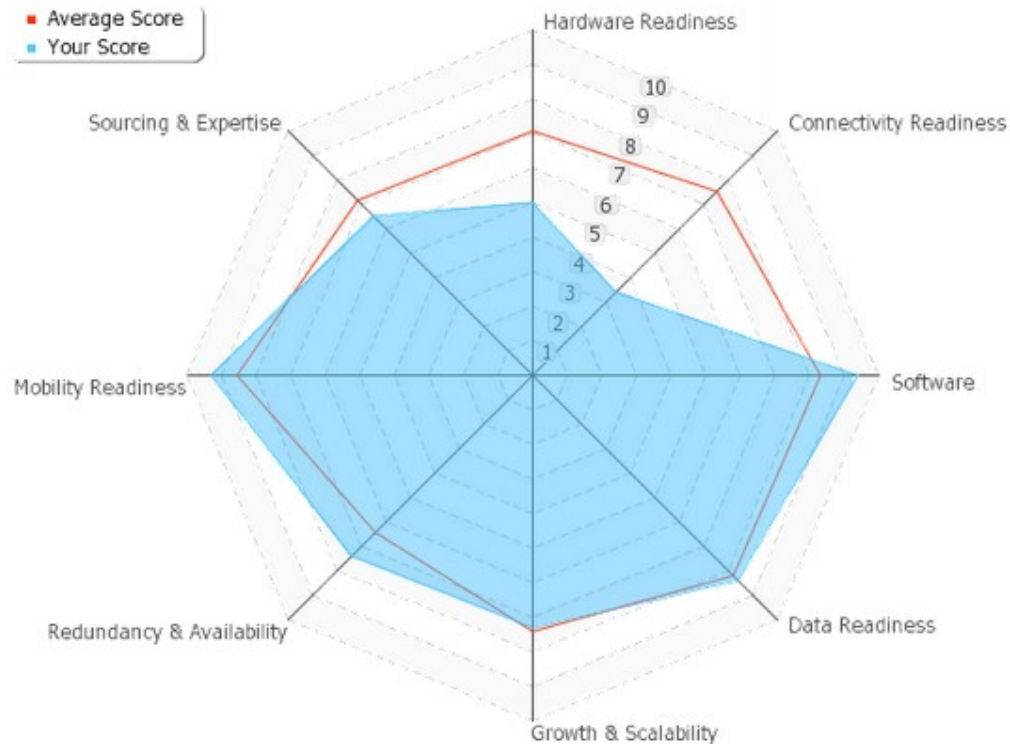
Each category was evaluated based on predefined weights set on each question and section.

Figure 11 – Total score assessed



The score for Nairobi County government is **average** based on the BSA Global Cloud computing Scorecard whose methodology was used for this study. This is demonstrated in the radar chart below:

Figure 12 – Cloud Readiness Radar Chart



The radar chart shows the score for Nairobi County across all areas that were tested in the questionnaire. Mobility Readiness, Redundancy and availability, growth and scalability, Data readiness and Software were areas that the score was high. Meaning that on these areas Nairobi County government is ready for cloud computing. Sourcing and Expertise, hardware Readiness and connectivity readiness had a low score. These areas require improvement. To improve on the area of Sourcing and Expertise, Nairobi County government can train the employees to be ready for new software and new technological possibilities in order to efficiently accomplish tasks and acquire the necessary internal knowledge of cloud technologies. The total score on Hardware Readiness can be improved by optimizing by obtaining a higher degree of virtualization and by being willing to upgrade current hardware and software. Finally on Connectivity readiness if requirements towards access speed are lowered or purchase of a faster broadband connection with redundant capabilities is made, this area can be improved.

Figure 13 – Value Gained



The assessment also computes a potential value (70.4%) that Nairobi County government could gain from the functionalities and flexibility of the cloud.

A cloud provider will mostly provide hardware as part of the service. These can be beneficial to Nairobi County government as it means the county does not need to invest in new hardware whose cost may be high. Redundancy and Availability and Growth and Scalability are benefits that emanate from cloud services, therefore Nairobi County will profit from the same.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND FURTHERWORK

5.0 Summary

The overall purpose of this study was to determine the cloud readiness status in Nairobi County government. To accomplish this goal, existing literature on this subject was reviewed and questionnaires were issued to employees of Nairobi County government. The responses were then fed into an online cloud readiness assessment tool. The scores were computed based on the varied weights of the questions as discussed in Chapter two.

The results show the level of cloud readiness in Nairobi County government answering the research questions raised at the beginning of this research process. The level of cloud readiness was 65.4%. This value is considered average based on the BSA global Cloud Computing scorecard.

The potential value that Nairobi County could gain from the functionalities and flexibility of the cloud shows that Nairobi County government could gain 70.4% by using cloud services. The areas that Nairobi County could gain in include Hardware, Redundancy and Availability and Growth and Scalability.

5.1 Conclusion

On successfully concluding the study, we found that there is a level of cloud readiness in Nairobi County government. The potential gain of using cloud services was also computed. Our conclusion can therefore be summarized as follows:

On the research question on the level of cloud readiness in Nairobi County government, the answer is 65.4%. Nairobi County government had a low score on Connectivity and Hardware Readiness. However, these are areas that it could gain greatly if it uses cloud services.

On the research question on factors contributing to current status of cloud readiness, Hardware Readiness, Connectivity Readiness and Sourcing and Expertise were areas in which Nairobi County performed poorly. Only some servers in Nairobi County are virtualized, given it is much simpler to move virtualized servers into the cloud than to start with physical servers, because all of the dependency clarifications and performance tests have already been completed. Often, problems are encountered with

external hardware, such as Dongles for specific software, which is not compatible with virtualized drivers, etc. Much more time and effort is necessary to migrate to the cloud if your servers are not virtualized.

On Connectivity Readiness the faster ones broadband connection is, the better the cloud experience will be. If servers are incorporated into the cloud, their computing requirements will be fulfilled by the cloud provider's hardware infrastructure and will, therefore, not be affected by the speed of the client's broadband connection. The speed at which the client will be able to send and receive files/documents will still be dependent on their broadband connection speed. It can be an advantage to have internal resources that manage company IT, and who also have the skills necessary to migrate to a cloud provider. Having resources present that can both assist and work internally to prepare for the migration is a valuable asset. These resources would have to be contracted which would in turn drive up costs.

On the research objective on ways to improve the level of cloud readiness in Nairobi County: The Hardware score can be improved by obtaining a higher degree of virtualization and by being willing to upgrade current hardware and software. The Connectivity Readiness mark can be improved if requirements towards access speed are lowered or purchase of a faster broadband connection with redundant capabilities is made. Sourcing and Expertise can be improved by training the employees to be ready for new software and new technological possibilities in order to efficiently accomplish tasks and acquire the necessary internal knowledge of cloud technologies.

5.2 Recommendations

Nairobi County government can greatly benefit by improving hardware readiness by obtaining a higher degree of virtualization of its servers. Nairobi County government can also consider upgrading the current hardware and software as a way of refining its hardware readiness. This could improve its cloud readiness score as observed in Chapter four on the analysis on the Hardware readiness section.

We also identified Connectivity readiness as an area needing improvement. To improve this area we recommend faster broadband connection with redundant capabilities. The faster ones broadband connection is, the better the cloud experience will be. If Nairobi

County government incorporate servers into the cloud, their computing requirements will be fulfilled by the cloud provider's hardware infrastructure and will, therefore, not be affected by the speed of Nairobi County's broadband connection. The speed at which the County will be able to send and receive files/documents will still be dependent on its broadband connection speed.

5.3 Further work

There are several areas for further development, for the work undertaken in this study. The respondents on this study were drawn from the IT department and from Heads of the various departments in Nairobi County government. It would be interesting to observe results from a wider pool of respondents. The respondents could even be drawn from stakeholders that receive services from Nairobi County government.

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APPENDIX I

Introduction Letter



UNIVERSITY OF NAIROBI
COLLEGE OF BIOLOGICAL AND PHYSICAL SCIENCES
SCHOOL OF COMPUTING AND INFORMATICS

Telephone: 4447870/ 4444919/4446544
Telegrams: "Varsity" Nairobi
Email: director-sci@uonbi.ac.ke

P. O. Box 30197
00100 GPO
Nairobi, Kenya

Our Ref: UON/SCI/MS/IS/2013

26 August 2015

To Whom It May Concern

Dear Sirs/Madam

RE: JOSEPHINE KALEKYE MULE- REG. NO. P56/61562/2013

The above named is a bona fide student pursuing a Master of Science in Information Systems degree at the School of Computing and Informatics, University of Nairobi. She is currently carrying out her research on the project entitled: "**Assessing Cloud Readiness: A Case of Nairobi County Government.**" Under the supervision of Prof. E. I. Omwenga.

We would be grateful if you could assist Ms. Mule as she gathers data for her research. If you have any queries about the exercise please do not hesitate to contact us. The information you provide will be solely for the project.

Yours faithfully

A handwritten signature in blue ink, appearing to be 'W. Okelo-Odongo'.

PROF. W. OKELO-ODONGO
DIRECTOR
SCHOOL OF COMPUTING & INFORMATICS



APPENDIX II

Questionnaire

General Questions

Information about the size and branch of Nairobi County government

1.1 What is the size of the organization?

- Small (1-9) Employees
- Medium (10 -50) Employees
- Medium-Large (50-250) Employees
- Large (250 - 2000) Employees
- Corporate (>2000) Employees
- Small (1-9) Employees

Hardware Readiness

State, location and age of servers, degree of virtualization

2.1 How many Servers / Systems do you have in place?

- 1 to 3
- 4 to 10
- 10 to 20
- More than 20
- Over 100

2.2 Are your servers virtualized?

- No
- Some of the servers are virtualized
- Most of the servers are virtualized
- All servers are virtualized

2.3 Where are your servers located?

- In a room in our organization's facility
- In a room dedicated for servers in our organization's facility
- Hosted with an external partner
- Distributed over different locations

2.4 What kind of computers do you have and how does the county government use them?

- Mainly laptops, used everywhere
- Mainly stationary clients located in a central office (if the clients are laptops but also stationary check this box)
- Mainly stationary clients located in employee's homes or across different locations
- Half of the clients are stationary, half are laptops (also used outside the office)

2.5 What is the average age of your server and storage hardware / technology platform?

- Less than 1 year old
- 1-2 years
- 1-3 years
- 1-4 years
- 2-4 years
- All over 3 years

- 2.6 Do you plan to upgrade your server's operating systems to support new technologies?
- Yes, we are still on Windows Server 2003
 - Yes, we are on Windows Server 2008 or 2008 R2 but want Windows Server 2012
 - We have a mixed environment (and might upgrade when migrating to the cloud)
 - We are using the most current operating systems and don't need to upgrade
 - We are running an old operating system, but would like to keep the existing setup

Connectivity Readiness

Current internet connection setup and usage

3.1 How are you connected to the internet?

- Slow Internet < 20Mbit/s
- Normal speed with fast DSL or fiber, up to 60 Mbit/s
- Fast Internet access (fiber connection) up to 100Mbit/s
- Backbone connection faster than 100Mbit/s
- No Internet connection available

3.2 How fast do you need to access documents?

- Seamless, should load immediately
- Fast
- Normal (short delay)
- Relatively slow (delay of a couple of seconds)

3.3 Do you have Mobile Internet Access?

- We have phones with data plans and they can be connected to the computers
- We have special SIM-Cards in our laptops with data plans
- We use public and open Wi-Fi networks
- No, we don't use internet when we are on the road

3.4 Availability of your broadband network?

- We have redundant internet access with two providers
- We have one internet connection but with a UTMS/EDGE extension (as backup)
- We have only one internet connection

Software Readiness

Current application usage and operating systems

4.1 Do you use branch specific software?

- Yes, and it runs on our server
- Yes, but it runs on each client individually (no server connection)
- Yes, but it is old and can only run under certain systems and configurations
- Yes, but it is hosted in the cloud
- No, we use mainly standard office applications

4.2 What kind of software do you mainly use?

- Graphic intense Software Like CAD, Video Editing, Rendering (and option b)
- Office Suites, Email, Accounting Tools, Inventory, CRM, simple GUI (data as text)
- Specialized software from a manufacturer that needs frequent updates (and option b)
- Our own customized software (and option b)
- Mixed, all and/or none of the cases listed above

4.3 What operating systems do you use?

- Microsoft Windows Servers
- Unix Servers
- Both

4.4 What client operating system(s) do you use?

- Microsoft Windows XP or Vista
- Microsoft Windows 7
- Microsoft Windows 8
- Mixed Windows Environment
- Mac (Apple) / Unix
- Mixed

Data Readiness

Data safety and security, data volume and location

5.1 How do you backup your data?

- We use an external hard drive and save it manually
- We have the backup jobs automated
- We don't backup, each user is responsible for their own backup
- We use "dropbox" or another cloud based service to backup important data

5.2 Are internal data access policies and file access rights in place?

- We have no access rights defined for our data, everyone can see everything
- We use Microsoft NTFS (Windows file permissions) to set file access rights
- Confidential data is stored locally by each employee
- A bit of everything

5.3 How confidential is your data?

- Low, we have nothing to hide
- Normal, our data should remain within the company
- High, our data can only be accessed by company employees and authorized partners
- Ultra high, we need to know who accesses what at what time

5.4 Data location?

- Our data can reside anywhere in the world as long as we can access it and it's safety and security is guaranteed
- Our data must reside in the country where our company is located
- Our data must be stored in our company's facilities

5.5 Where is the organization's data stored?

- Distributed on various computers and laptops
- Centrally stored on a server
- External hard disks
- Centrally stored on a SAN, NAS, or other storage solutions
- A bit of everything

5.6 How much data does Nairobi County government store?

- Less than 100 GB
- Less than 500 GB
- Less than 2 TB
- More than 2 TB
- More than 50 TB

5.7 What kind of documents do you normally use?

- Standard office documents (<5MB)
- All kinds of documents (5-50 MB)
- Large files (25 - 200MB)
- Videos and high resolution images, or CAD renderings (>200MB)

Growth & Scalability

Requirements concerning flexibility and scalability

6.1 What would you forecast the growth of Nairobi County government to be over the next 3 years?

- Constant, we don't plan to expand
- We need to be able to flexibly expand our infrastructure
- We have predicted a rapid growth rate and, therefore, we need to be flexible
- Decreasing

6.2 How quickly do you need to expand infrastructure and deploy new servers and clients?

- Speed does not matter that much, normally we have a couple of months
- Within a month, we must be up and running
- Within a week
- Within a day
- Within hours

6.3 How would you describe the degree of automation in your current IT-Infrastructure?

- Close to zero
- Some task are automated 25%
- We try hard to automate as much as possible 50%
- High degree of automation > 75%

6.4 How would you describe the degree of standardization in your current IT-Infrastructure?

- Low, we don't have time for this < 25%
- Little, we have some templates in place and some basic structure 25%
- Medium 50%
- High > 75%

6.5 Do you encounter occasional increased workloads on your servers? (during some periods of the year or on some specific days)

- Yes
- No

Redundancy & Availability

System availability and data redundancy

7.1 Are you prepared for disaster recovery?

- Not at all
- No, but we have the most important data stored at a different location
- Yes, we have our data synced to an alternate location within our company
- Yes, we have our data synced to an external provider

7.2 How critical is the availability of systems to your business?

- Not very important, we also function without technology
- Medium, but not business threatening
- Important, we need to access our data daily
- Existence is dependent on technology, we cannot function without our systems

7.3 Do you have automated monitoring tools in place to alert you about the availability of services?

- No
- Yes, we have some monitoring tools, but not centrally managed
- Yes, have an extensive monitoring tool in place

7.4 Do you use software that has a special demand for high-availability?

- No, if the Software fails we can get along without it for a little while
- Low, software outages should not exceed 1 day
- Medium, software outages should not exceed 4 hours (during business hours)
- High, software outages should be reduced to the max (0-tolerance)

Mobility Readiness

Mobile cloud usage requirements

8.1 When and where do you access your data?

- Anytime and anywhere when connected to the internet
- Anytime but mainly from the office
- Anytime but only from the office
- Anytime at home or at the office

8.2 When and where do you access your email?

- Anytime and anywhere when connected to the internet
- Anytime but only from the office
- Anytime at the office or at home

8.3 When and where do you access company specific software?

- Anytime and anywhere when connected to the internet
- Anytime but mainly from the office
- Anytime but only from the office
- Anytime at home or at the office

Sourcing & Expertise

Staff requirements and readiness of people

9.1 Who manages your servers and IT-Infrastructure?

- We manage them ourselves (internal IT)
- We have a third party company that manages the servers
- Both

9.2 How would you describe knowledge about cloud computing and IT-Infrastructure management within your company?

- Weak
- Basic knowledge and understanding
- Advanced technical skills and knowledge
- We have a strong knowledge and can manage most of it ourselves

9.3 Does your organization need to free IT personnel for other projects?

- No
- IT-Personnel would appreciate freedom from certain regular tasks
- Yes, we would like to use them for new projects

9.4 How do employees react to changes in their working methods?

- They are flexible and would adapt over time
- They are accustomed to their routine and would take some time to change
- Most of them are not technological savvy and would have trouble changing
- A bit of everything

APPENDIX III

Questionnaire background information

General questions

Information about the size and branch of Nairobi County government

Question 1.1

What is the size of the organization?

- Small (1-9) Employees
- Medium (10 -50) Employees
- Medium-Large (50-250) Employees
- Large (250 - 2000) Employees
- Corporate (>2000) Employees

Background Information: This is a general question to categorize the captured data by company size.

Hardware readiness

State, location and age of servers, degree of virtualization

Question 2.1

How many Servers / Systems do you have in place?

- 1 to 3
- 4 to 10
- 10 to 20
- More than 20
- Over 100

Background Information: The more servers an organization moves to the cloud the more the organization can benefit from economies of scale; however, each system is individual and brings its own unique requirements. Technically, this makes it is more challenging to bring a large amount of servers into the cloud.

Question 2.2

Are your servers virtualized?

- No
- Some of the servers are virtualized
- Most of the servers are virtualized
- All servers are virtualized

Background Information: It is much simpler to move virtualized servers into the cloud than to start with physical servers, because all of the dependency clarifications and performance tests have already been completed. Often, problems are encountered with external hardware, such as Dongles for specific software, which is not compatible with virtualized drivers, etc. Much more time and effort is necessary to migrate to the cloud if your servers are not virtualized.

Question 2.3

Where are your servers located?

- In a room in our organization's facility
- In a room dedicated for servers in our organization's facility
- Hosted with an external partner
- Distributed over different locations

Background Information: Depending where the servers are located, it can take more or less effort to migrate them to a cloud provider. Having them hosted at an external provider or distributed over different locations makes it slightly more complicated than servers which reside at a single location.

Question 2.4

What kind of computers do you have and how does the county government use them?

- Mainly laptops, used everywhere
- Mainly stationary clients located in a central office (if the clients are laptops but also stationary check this box)
- Mainly stationary clients located in employee's homes or across different locations
- Half of the clients are stationary, half are laptops (also used outside the office)

Background Information: Companies with predominantly mobile users most likely already have some solutions in place to access data remotely. Therefore, these companies are more cloud ready than one with only stationary clients that are connected to the in-house server. Nevertheless this factor does not add a lot of weight to cloud readiness.

Question 2.5

What is the average age of your server and storage hardware / technology platform?

- Less than 1 year old
- 1-2 years
- 1-3 years
- 1-4 years
- 2-4 years
- All over 3 years

Background Information: The more current an organization's IT infrastructure is, the higher its state of readiness will be, because new technologies are already in place and therefore can be merged faster and more conveniently to a cloud provider. The benefits however increase with the age of the hardware, because having old systems would require a reinvestment in new hardware, in which case it might be more cost effective to purchase new hardware and software directly with the cloud provider.

Question 2.6

Do you plan to upgrade your server's operating systems to support new technologies?

- Yes, we are still on Windows Server 2003
- Yes, we are on Windows Server 2008 or 2008 R2 but want Windows Server 2012
- We have a mixed environment (and might upgrade when migrating to the cloud)
- We are using the most current operating systems and don't need to upgrade
- We are running an old operating system, but would like to keep the existing setup

Background Information: Migrating to the cloud is also a great opportunity to update current operating systems unless you are already up-to-date and want to migrate directly with the present configuration.

Connectivity readiness

Current internet connection setup and usage

Question 3.1

How are you connected to the internet?

- Slow Internet < 20Mbit/s
- Normal speed with fast DSL or fiber, up to 60 Mbit/s

- Fast Internet access (fiber connection) up to 100Mbit/s
- Backbone connection faster than 100Mbit/s
- No Internet connection available

Background Information: The faster an organization's broadband connection is, the better the cloud experience will be. If you incorporate servers into the cloud, their computing requirements will be fulfilled by the cloud provider's hardware infrastructure and will, therefore, not be affected by the speed of your broadband connection. The speed at which an organization is able to send and receive files/documents will still be dependent on the organization's broadband connection speed.

Question 3.2

How fast do you need to access documents?

- Seamless, should load immediately
- Fast
- Normal (short delay)
- Relatively slow (delay of a couple of seconds)

Background Information: Storing data and servers at a remote location can cost time, because the performance to access data is less fast; therefore, a fast connection is helpful to retrieve data instantly. Still, there are multiple solutions that support off-site providers and increase data accessibility rates. If for instance an organization works with an application that runs on a remote server and can access data that is also stored on the remote server, the servers communicate with each other and the data does not need to be transferred to your current location. Accessing such data is instant. However, if an organization wanted to open a 20 MB Excel Sheet from a remote server folder, it can take up to a few seconds / minutes depending on the connection.

Question 3.3

Do you have Mobile Internet Access?

- We have phones with data plans and they can be connected to the computers
- We have special SIM-Cards in our laptops with data plans
- We use public and open Wi-Fi networks

- No, we don't use internet when we are on the road

Background Information: Supporting mobile internet access can strengthen the case for cloud computing because it allows one to access the company's data at any location. An example scenario would be a virtual desktop connected over mobile broadband allowing one to enter information into the companies CRM quickly and easily from anywhere. Syncing to the server is no longer needed, as the data is directly entered online.

Question 3.4

Availability of organizations' broadband network?

- We have redundant internet access with two providers
- We have one internet connection but with a UTMS/EDGE extension (as backup)
- We have only one internet connection

Background Information: When accessing servers and data at a remote location, a permanent, reliable broadband connection is obviously needed. This is extremely important for cloud readiness.

Software readiness

Current application usage and operating systems

Question 4.1

Do you use branch specific software?

- Yes, and it runs on our server
- Yes, but it runs on each client individually (no server connection)
- Yes, but it is old and can only run under certain systems and configurations
- Yes, but it is hosted in the cloud
- No, we use mainly standard office applications

Background Information: Depending on how branch specific software is used, the architecture of the infrastructure will vary. Some configurations being more cloud adaptable than others.

Question 4.2

What kind of software do you mainly use?

- Graphic intense Software Like CAD, Video Editing, Rendering (and option b)

- Office Suites, Email, Accounting Tools, Inventory, CRM, simple GUI (data as text)
- Specialized software from a manufacturer that needs frequent updates (and option b)
- Our own customized software (and option b)
- Mixed, all and/or none of the cases listed above

Background Information: Some types of software demand high levels of both graphical CPU and server performance; these types of software are not ideal for cloud usage, while other applications, like CRMs, Office Applications, Data Input / Output Applications are excellent.

Question 4.3

What operating systems do you use?

- Microsoft Windows Servers
- Unix Servers
- Both

Background Information: Both Unix and Windows Servers are almost entirely supported by cloud providers; however, Windows Servers are easier to manage and, in general, more IT technicians are familiar with how to operate them.

Question 4.4

What client operating system(s) do you use?

- Microsoft Windows XP or Vista
- Microsoft Windows 7
- Microsoft Windows 8
- Mixed Windows Environment
- Mac (Apple) / Unix
- Mixed

Background Information: The kind of client operating system one uses does not majorly impact cloud readiness, even though having a homogeneous set of clients does make integration and connection to the cloud far easier. Microsoft Clients offer facilitated functions so that they can be centrally managed and configured, enabling an organization to switch servers and deploy new settings and software in a much simpler and faster manner.

Data readiness

Data safety and security, data volume and location

Question 5.1

How do you backup your data?

- We use an external hard drive and save it manually
- We have the backup jobs automated
- We don't backup, each user is responsible for their own backup
- We use "dropbox" or another cloud based service to backup important data

Background Information: The way an organization backup's data does not directly influence cloud readiness, but it shows how structured the data is and whether or not processes are automated.

Question 5.2

Are internal data access policies and file access rights in place?

- We have no access rights defined for our data, everyone can see everything
- We use Microsoft NTFS (Windows file permissions) to set file access rights
- Confidential data is stored locally by each employee
- A bit of everything

Background Information: The way an organization sets data access policies factors in for the cloud readiness. Joining the cloud will provide a structured environment where data structure and access permissions will have to be defined.

Question 5.3

How confidential is your data?

- Low, we have nothing to hide
- Normal, our data should remain within the company
- High, our data can only be accessed by company employees and authorized partners
- Ultra high, we need to know who accesses what at what time

Background Information: This is a very critical question for cloud readiness. Security is generally very high in the cloud and often even better than in individual data centers. Nevertheless a lot of people fear of losing control over data.

Question 5.4

Data location?

- Our data can reside anywhere in the world as long as we can access it and it's safety and security is guaranteed
- Our data must reside in the country where our company is located
- Our data must be stored in our company's facilities

Background Information: It is difficult for cloud customers to determine where their data is stored and what happens to it because they lose direct control over physical servers, data location and security measures. Basically, the customer must trust the service provider. There are also many laws concerning data security which either permit or prohibit companies from moving data out of their data centers.

Question 5.5

Where is the organization's data stored?

- Distributed on various computers and laptops
- Centrally stored on a server
- External hard disks
- Centrally stored on a SAN, NAS, or other storage solutions
- A bit of everything

Background Information: Where an organization's data is stored does not directly affect cloud readiness, but it is an advantage if data is already stored at a central location. The more structured data is the better position an organization is in to migrate to the cloud.

Question 5.6

How much data does Nairobi County government store?

- Less than 100 GB
- Less than 500 GB
- Less than 2 TB
- More than 2 TB
- More than 50 TB

Background Information: The quantity of data an organization has should not be considered a hindrance because storage capacity is dynamic and can be expanded on premise. It does,

however, slightly affect cloud readiness due to the fact that the more data you have the longer it takes to transfer it and the harder it will be to migrate to another service provider (lock-in).

Question 5.7

What kind of documents do you normally use?

- Standard office documents (<5MB)
- All kinds of documents (5-50 MB)
- Large files (25 - 200MB)
- Videos and high resolution images, or CAD renderings (>200MB)

Background Information: This question can be seen as very critical for cloud readiness, specifically concerning access speed of files. Small files will not cause problems, but attempting to access large files can delay file-access speed for the end user. Nevertheless, there are solutions available in order to help minimize the problematic tendencies of accessing large files.

Growth & scalability

Requirements concerning flexibility and scalability

Question 6.1

What would you forecast the growth of Nairobi County government to be over the next 3 years?

- Constant, we don't plan to expand
- We need to be able to flexibly expand our infrastructure
- We have predicted a rapid growth rate and, therefore, we need to be flexible
- Decreasing

Background Information: Cloud computing enables new ways of deploying systems; it introduces a new level of elasticity and agility to scaling systems and acquiring resources on demand. Being flexible allows a company to react faster to changes.

Question 6.2

How quickly do you need to expand infrastructure and deploy new servers and clients?

- Speed does not matter that much, normally we have a couple of months
- Within a month, we must be up and running
- Within a week

- Within a day
- Within hours

Background Information: This question is less relevant to cloud readiness but instead assesses the value gained when having scalable systems in place.

Question 6.3

How would you describe the degree of automation in your current IT-Infrastructure?

- Close to zero
- Some task are automated 25%
- We try hard to automate as much as possible 50%
- High degree of automation > 75%

Background Information: A high degree of automation enables an organization to move faster and with less effort to the cloud. Cloud infrastructure will facilitate future automation possibilities for systems and reduce the amount of time needed to fulfill daily tasks executed by IT technicians.

Question 6.4

How would you describe the degree of standardization in your current IT-Infrastructure?

- Low, we don't have time for this < 25%
- Little, we have some templates in place and some basic structure 25%
- Medium 50%
- High > 75%

Background Information: A high degree of standardization facilitates the move to the cloud because many things are already defined and can be converted and adapted to the systems in the cloud. This means less specification work and less preparation time, which translates into a higher degree of cloud readiness.

Question 6.5

Do you encounter occasional increased workloads on your servers? (during some periods of the year or on some specific days)

- Yes
- No

Background Information: A virtualized infrastructure allows one to quickly allocate new resources and deploy new servers to balance and compensate for an increased workload.

Redundancy & availability

System availability and data redundancy

Question 7.1

Are you prepared for disaster recovery?

- Not at all
- No, but we have the most important data stored at a different location
- Yes, we have our data synced to an alternate location within our company
- Yes, we have our data synced to an external provider

Background Information: From the organization's perspective, business continuity and disaster recovery are very important.

Question 7.2

How critical is the availability of systems to your business?

- Not very important, we also function without technology
- Medium, but not business threatening
- Important, we need to access our data daily
- Existence is dependent on technology, we cannot function without our systems

Background Information: The less critical the availability of the systems, the easier it is to join a cloud provider. In surveys, CIOs stated that they were apprehensive concerning the availability of remote systems. Even though many cloud providers guarantee a very high degree of availability that many internally / private operated data centers cannot achieve.

Question 7.3

Do you have automated monitoring tools in place to alert you about the availability of services?

- No
- Yes, we have some monitoring tools, but not centrally managed
- Yes, have an extensive monitoring tool in place

Background Information: Good monitoring tools can help to measure data, uptime metrics, throughput, resource consumption and so forth. Having a good monitoring system in place

can give information regarding the potential requirements of joining the cloud and also an estimation of costs.

Question 7.4

Do you use software that has a special demand for high-availability?

- No, if the Software fails we can get along without it for a little while
- Low, software outages should not exceed 1 day
- Medium, software outages should not exceed 4 hours (during business hours)
- High, software outages should be reduced to the max (0-tolerance)

Background Information: The cloud can deliver high availability systems that are held redundant and can take over within under a second so that no system interruption will occur.

Mobility readiness

Mobile cloud usage requirements

Question 8.1

When and where do you access your data?

- Anytime and anywhere when connected to the internet
- Anytime but mainly from the office
- Anytime but only from the office
- Anytime at home or at the office

Question 8.2

When and where do you access your email?

- Anytime and anywhere when connected to the internet
- Anytime but only from the office
- Anytime at the office or at home

Question 8.3

When and where do you access company specific software?

- Anytime and anywhere when connected to the internet
- Anytime but mainly from the office
- Anytime but only from the office
- Anytime at home or at the office

Access to software is mostly in the office, with email and data access anywhere when connected to the internet.

Sourcing & expertise

Staff requirements and readiness of people

Question 9.1

Who manages your servers and IT-Infrastructure?

- We manage them ourselves (internal IT)
- We have a third party company that manages the servers
- Both

Background Information: It can be an advantage to have internal resources that manage organization IT, and who also have the skills necessary to migrate to the cloud provider. Having resources present that can both assist and work internally to prepare for the migration is a valuable asset. Otherwise, these resources would have to be contracted which would in turn drive up costs.

Question 9.2

How would you describe knowledge about cloud computing and IT-Infrastructure management within your company?

- Weak
- Basic knowledge and understanding
- Advanced technical skills and knowledge
- We have a strong knowledge and can manage most of it ourselves

Background Information: As we move up through the pyramid from the basic elements of infrastructure to the top layer of applications, the skills and necessary knowledge to build the components decreases. Each layer can be built upon the previous one even if one does not necessarily understand the layer beneath. An organization with limited infrastructure skills can, therefore, purchase Cloud services from a vendor and build their own unique platform upon that infrastructure.

Question 9.3

Does your organization need to free IT personnel for other projects?

- No

- IT-Personnel would appreciate freedom from certain regular tasks
- Yes, we would like to use them for new projects

Background Information: It is proven that virtualized and/or hosted infrastructures facilitate and reduce day to day tasks of IT staff.

Question 9.4

How do employees react to changes in their working methods?

- They are flexible and would adapt over time
- They are accustomed to their routine and would take some time to change
- Most of them are not technological savvy and would have trouble changing
- A bit of everything

Background Information: Changing the systems and transferring them from an internal data center to the cloud provider can go unnoticed by regular employees. However, the new functionalities of the system that add value to the business require employees to adapt. Often software upgrades are incorporated into a migration and users are forced to deflect.