CLOUD COMPUTING AND ORGANIZATION PERFORMANCE OF MANUFACTURING FIRMS IN NAIROBI

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DECLARATION

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

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This project paper has been submitted for examination with my approval as the university supervisor.

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ACKNOWLEDGEMENT

I am extremely thankful to the almighty God for granting me enough strength and courage to complete this enormous task. I’m also grateful to my supervisors Mr. Joel Lelei and Prof. Kate Litondo for their dedication as they guided me through this project.

DEDICATION

This project is dedicated to my parents whose support, sacrifice and commitment towards giving each and every one of us an education remains unrivalled.

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ACRONYMNS AND ABBREVIATIONS

ACL: Access Control Lists

CA: Communications Authority

CAPEX: Capital Expenditure

ERP: Enterprise Resource Planning

GDP: Gross Domestic Product

IDS: Intrusion Detection Systems

IPS: Intrusion Prevention Systems

ABSTRACT

This study aimed to determine the relationship between adoption of cloud computing and performance of manufacturing firms in Nairobi. The study had four objectives: to determine the extent of cloud adoption among manufacturing firms in Nairobi, to determine the relationship between cloud computing adoption and performance in manufacturing firms, to establish the opportunities that manufacturing firms could realize by adopting cloud computing and to establish the challenges that were hindering cloud adoption by manufacturing firms in Nairobi. A cross-section research design was used as the researcher aimed to determine extent of adoption of cloud computing at a particular point in time. The data collection method that was used was questionnaire method which was used to collect primary data. 58 firms were selected to be part of the study and a questionnaire was sent to 1 respondent in the firm. The study showed that 90 percent of the manufacturing firms in Nairobi used some form of cloud computing. The most popular cloud computing model was found to be SaaS which had a mean of 4.2857. Adoption of cloud computing was found to lead to reduced costs, enhanced quality of products and increased speed to market of new products and services. The opportunities that could be realized by firms when they adopted cloud computing were found to be increased data availability, flexibility in deployment of IT solutions and reduced operational costs. Challenges that were found to hinder cloud adoption included fear that cloud computing is insecure, lack of skilled personnel in cloud computing technologies and over regulation. The study found that there is correlation between performance and use of cloud computing. Further research could be done with a larger sample size to ensure that the results can be more easily generalized.

CHAPTER ONE: INTRODUCTION

1.1 Introduction

Manufacturing companies are facing many challenges including increased competition, rising costs of operations and increased complexity during expansion (Adeyeye, 2016). Cloud computing offers a way for organizations to overcome these challenges by enabling them to deploy IT solutions quickly and cost effectively. Cloud computing has become a key component of any organization's strategy. Lack of a proper cloud strategy will make an organization ineffective in executing its mandate.

Cloud can be defined as the use of a pool of interconnected computing systems to provide dynamically scalable services such as computing power, storage, applications etc. (Harris, 2012). Cloud is a metaphor which describes the internet as a space where computing has been pre-installed by a service provider and thus it exists for users to purchase and use for an agreed time (Kumar, 2012). Services are offered on a pay per use model. The user only pays for the services they have consumed in a particular period. This is different from the traditional computing model. Traditionally if a company wanted some computing power, they would purchase servers and host them on site. These servers would require power, cooling, network connectivity and physical security. After some time, the demand for computing resources would increase forcing the company to buy more servers. This all required a lot of capital expenditure (capex) as well as operating expenditure (opex) to keep everything running.

There are 3 main models used to provide cloud services. The first is Software as a service. In SaaS, an application if fully configured and the user does not have to do any additional setup (Hou, 2018). They can use it immediately. Access is usually via a web browser. Examples include Salesforce and Office 365. The second model of cloud computing is Platform as Service. PaaS is a model where cloud is used to provide a platform for users that enables them to develop and deploy applications (Gartner, 2017). The user has the freedom to build their own application which runs on top of the service provider's infrastructure. Examples of PaaS services include Stratos from Apache and google app engine. The third mode of providing cloud services is Infrastructure as a Service (IaaS). In IaaS, a user is given virtualized computing resources over the internet (Rouse, 2017). This model requires the most configuration from the user but it also offers the greatest flexibility in terms of the operating system the user can install as well as the applications they can

run. Examples include the Elastic Compute Cloud (EC2) from Amazon and Google Compute Engine. A user makes a choice on the model they desire based on the amount of flexibility they desire in terms of configuration.

The cloud can be private or public. In private cloud, compute resources are hosted in a client managed data center (White, 2015). All management and maintenance tasks are done by the client. Public cloud is different in that management tasks like power, cooling, network and computing resources are handled by the cloud service provider. The client is only responsible for their applications. One can also use a mix of public and private cloud which is known as hybrid cloud.

A direct relationship exists between cloud computing use and an organization's performance. Cloud computing can assist firms to improve their performance by reducing IT costs, making scaling IT solutions easier, enhanced data security and increase mobility of the workforce (Haas, 2014). IT costs are reduced because organizations do not need to maintain on site servers which require operational expenditure in terms of skilled personnel, power, cooling and networking costs. Scaling is also easy as services are offered on a pay per use model. One can scale up and down depending on demand. It is also easier to secure data in the cloud. Cloud providers provide low cost tools such as software-based firewalls that enable one to secure their data. Hardware appliances can be quite costly to acquire. The prohibitive prices may lead firms not to secure their data stored in on site data centers. Cloud computing also leads to increased workforce mobility as data can be accessed from anywhere. Employees do not need to work from the office. They can work from anywhere as long as they have an internet connection.

The barriers that hinder cloud adoption include need for a reliable internet connection, loss of control and need for skilled personnel. Operations can be grounded if there is an internet outage. Organizations do not have control of data center maintenance and they have to put in place business continuity measures to ensure an outage of cloud services will not affect them. A firm also need IT personnel who are skilled in managing cloud environments. A lack of cloud expertise can lead a firm to spend more that they need to because their cloud services have not been optimized. Services need to be optimized to ensure that a company is not paying for services they do not need.

1.2 Cloud Computing and Organization Performance

Manufacturing companies operate in a very competitive environment. Cloud computing can assist these firms to attain a competitive advantage. Businesses need to respond to competition by reducing their costs and offering innovative services.

Information systems value is defined as the impact of investment in information systems on the performance and capabilities of an economic entity (Schryen, 2012). Schryen further explained that the gains and losses an organization attains through implementation of information systems depends on the way the information system is exploited. The performance improvements that can be derived from cloud computing include productivity enhancement, increase in profitability, cost reduction and gaining a competitive advantage.

Firms can improve their performance in various departments by using cloud computing including Sales, IT and Finance (Douglas, 2012). Sales agents work in the field. They require a way of tracking a list of potential clients and engagements with clients. They also need to be able to make and record sales when they are out of the office. Thus, people working in sales can make use of SaaS. Applications such as Salesforce exist that can increase efficiency of sales agents enabling them to do all sales related activities from their web browser. IT can benefit by moving their servers to the cloud. It is costly to maintain on premises servers as they require power, cooling and network connectivity which are all expensive to acquire and maintain. Finance departments can also benefit from cloud computing. Accounting software can be costly to purchase. There are SaaS applications such as Zoho and Sage that are cost effective. They allow companies to purchase licenses according to their needs and they can scale up and down depending on demand.

Cloud computing helps firms to increase their efficiency, scalability and flexibility (Idris, 2016). According to Idris, cloud adoption led to Return on Investment and reduction in operational costs. He studied organizations before, during and after cloud adoption. Cloud adoption was found to have a positive impact on firm performance. Organizations in the study that had failed to adopt cloud were found to have high operational costs due to the high costs of maintaining a data center. It was also difficult for these organizations to scale their existing solutions due to the complexity of their data centers.

1.3 Manufacturing Firms in Nairobi

A manufacturing firm is any firm that uses raw materials to make a finished product (Fick, 2016). The product may be sold directly to consumers or to other manufacturing firms as

input to make another product. Manufacturing companies are very important to Kenya's economy. Kenya's economy is mainly dependent on agriculture and manufacturing companies are involved in every stage of the value chain from purchasing agricultural produce, processing it and distributing it to consumers. Industrialization is a key part of the country's development. According to a report done by the Kenya Association of Manufacturers in 2018, the industrial sector contributed to 16 percent of the country's GDP. The contribution of manufacturing companies to the GDP has remained consistent in the last decade. Industrial growth rate for 2018 stood at 3.1 percent (CIA World Factbook, 2011). Manufacturing companies contribute 11 percent of Kenya's per capita GDP (Kenya Association of Manufacturers, 2015). Kenya is rated 129 out of 185 countries as at 2018 by the World Bank in terms of ease of doing business. This ranking is based on the business environment and how it encourages firms to open and operate businesses.

The manufacturing sector employed 350,000 people which represents 13 percent of the total employment (Kenya Economic Survey, 2018). Moreover, another 1.4 million people are employed indirectly by manufacturing firms. In 2018, industrial exports stood at 4 billion shillings according to a report by Kenya Association of Manufacturers (KAM). These exports mainly comprised of vegetables products (50 percent), food beverages and tobacco (9 percent) and chemicals (8.5 percent). The Global Competitiveness Report of 2013 done by World Economic Forum ranked Kenya at position 68 out of 144 countries included in the report. In terms of sophistication of the production process Kenya was given a score of 3.6 out of 7.0 with 7.0 being the best score.

The performance of manufacturing firms is affected by high cost of doing business as well as competition from local and international firms (Mars Group Report, 2016). Manufacturing companies need to reduce their costs in order to become competitive locally and internationally. A large part of these costs is IT costs. Cloud computing offers a way for these companies to reduce their IT costs by moving to an opex model where IT costs are paid through small monthly subscriptions rather than the traditional capex model where servers need to be bought and hosted onsite.

Companies in Kenya have not yet fully adopted cloud computing but the environment is getting more conducive for adoption. The biggest obstacles in the way of adoption like access to high speed internet are slowly being cleared (Communications Authority of Kenya Report, 2018). According to the report by the Communications Authority of Kenya, there were 66,889 fixed internet subscriptions as at March 2019. The report goes on to say

there is a total of 4,655 Gbps of international bandwidth available from tier 1 providers like Seacom with only 1,149 Gbps of this being used (25 percent).

1.4 Research Problem

Manufacturing contributed 16 percent to Kenya's GDP (Kenya Association of Manufacturers, 2018). They thus contribute greatly to the economy. In order for them to not only survive but to thrive, they need to incorporate cloud computing in their organization strategy. A sound strategy is quintessential for an organization's success (Kauffman ,2005). Adoption rate of cloud among Kenyan organizations is still very low at 22% according to a Communications Authority report of 2017.

Several studies have been done on cloud computing. Cloud computing can help firms focus on their core business by offloading server maintenance to cloud service providers (Bamiah, 2012). Bamiah did a study to determine the effect of adopting cloud computing in the health sector in Malaysia. The study aimed to determine the opportunities that could be realized by using cloud in medical facilities. The study found that health institutions could improve information sharing among them by moving their data to the cloud. There is a direct relationship between adoption of cloud and performance in education institutions (Hussein, 2016). Hussein did a study in Egypt to determine how educational institutions can enhance their performance by using cloud computing. The study found that education institutions were able to reduce their costs by moving their servers to the cloud.

Most studies done outside Kenya cannot be applied locally due to differences in development. For cloud adoption to succeed, top management support is required (Nzoya, 2018). Nzoya did a study on drivers of cloud computing adoption among software development companies in Kenya. The study found that environmental factors such as increased competition affected firm's adoption of cloud computing. Organizations were found to consider risks such as unavailability of cloud resources and system performance before moving their systems to the cloud. The main drivers of cloud adoption in Kenya are cost reduction, enhancing performance and increased flexibility (Omwansa, 2015). Omwansa did research to investigate the current status of cloud computing in Nairobi and to establish its impact in the county. The study found that most institutions (39%) were using a private cloud compared to the 22% using public cloud due to security concerns.

The main barriers to adoption were found to be lack of adequate personnel skilled in cloud, perceived high costs of cloud and perceived insecurity of data stored in the cloud.

Manufacturing companies face many challenges that can be solved by cloud computing. They have IT costs due to hosting servers in onsite data centers, they incur high operational costs such as power, cooling and network connectivity and they cannot move quickly to roll out new IT solutions due to the complexity of the hardware in their data centers. Cloud is advantageous as deploying software in the cloud is easy since hardware is managed by the cloud service provider. Resources in the cloud can be accessed from anywhere. Data in the cloud is stored in geographically separated sites. A catastrophic failure in one site would not affect data availability. The reasons for slow uptake of cloud computing include lack of skilled personnel, desire by organizations to maintain the status quo and fear of exposing sensitive data in the public cloud (Kourik, 2011).

This study sought to fill in research gaps in previous studies. Wangechi (2017) did a study on cloud adoption and performance of SMEs in Nairobi. The study did not mention the opportunities that exist for organizations that exploit cloud. Kituku (2012) did a study on cloud adoption by firms listed on the NSE. This study focuses on a narrower target group of manufacturing companies in Kenya. Kigen (2001) did a study on use of IT to gain a competitive advantage by companies listed on the NSE. This study goes further to list cloud computing as the IT driver to assist manufacturing firms gain a competitive advantage.

This research sought to answer these questions. What percentage of manufacturing firms have adopted cloud computing? Which benefits can these companies enjoy by adopting cloud computing? What is the relationship between cloud computing and performance? Which are the main barriers to adoption among manufacturing institutions.

1.5 Research Objectives

1. To determine the extent of cloud adoption by manufacturing companies in Nairobi.
2. To determine the relationship between cloud adoption and performance of manufacturing firms in Nairobi
3. To establish the opportunities that manufacturing firms can exploit by adopting cloud computing.

4. To determine the challenges faced by manufacturing firms when adopting cloud computing.

1.6 Value of The Study

This research shall provide important to manufacturing firms to assist them survive in an extremely competitive environment. Porter (1985) said that a firm must have clear goals and strategies in order to build sustainable competitive advantage. He further stated that for a company to attain a competitive advantage, a company must have cost leadership, have a differentiated product and focus on their target market better than other firms. Cloud computing is the tool that manufacturing firms should use to attain competitive advantage.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Not enough research has been done in Kenya on the role played by cloud computing in enhancing the effectiveness of manufacturing firms in Kenya. Due to this, many of these companies do not fully understand the opportunities that exist in cloud adoption. Many

organizations have limited knowledge and understanding of cloud computing concepts (Ruxwana, 2014).

This chapter first aims to go through theories that explain why and how people adopt new technologies and then it summarizes previous studies on the topic of cloud adoption. This review delves into various theories that will guide the proposed research. Researchers are interested in knowing the factors that affect the adoption of new technologies like cloud computing. This knowledge assists product designers and innovators to design products that will gain widespread adoption. These products should be fit for use and fit for purpose. Numerous frameworks and models exist that explain user adoption of new technologies and this review aims to go through some of them. Acceptance is defined as the positive decision to use an innovation (Clarkson, 2004).

Moreover, this chapter goes through the concept of cloud adoption in terms of what it is and how companies are adopting cloud. It also defines the relationship between cloud computing adoption and organization performance as well as challenges faced when adopting cloud computing.

2.2 Theoretical Foundation of the Research

A theory is defined as a set of principles on which the practice of an activity is based (Kothari, 2003). This study is based on several theories of adoption.

2.2.1 Diffusion of Innovation Theory

The diffusion of innovation theory explains how users adopt new technology, how fast the technology is adopted and whether the technology succeeds in its aims or whether if fails to get widespread adoption (Rogers, 1962). Adoption is a resolution to start using an innovation such as a new technology as it is the best decision to improve a firm and rejection is the decision not to use the innovation (Mathers, 2003). Rogers defined diffusion as a process where a new innovation starts being used by a member of a group and gradually spreads through word of mouth and referrals.

The theory answers the following questions below: How do innovations spread, why do some innovations fail, what determines the success of an innovation and how can innovators increase the chances of success of their innovations. There are five different types of users of a new technology (Rodgers, 1962). Innovators are risk takers and they are the first users to start using a new technology. Their high tolerance for risk enables

them to use innovations that may end up failing. Early adopters follow innovators in adopting the technology. They are willing to change the traditional ways of doing things but are not as risk tolerant as the innovators. Early Majority adopt a technology after the innovators and early adopters have tried, tested and given positive reviews on the technology. They required adequate information to make a decision. Late majority are the people who approach new technology with a lot of caution and after a majority of people have already begun using the technology. They may not have enough financial resources to survive failure of a new innovation. They may also be individuals who like to maintain status quo and do not like change. Laggards adopt a new innovation last. They like to maintain traditional ways of doing things. They may adopt a technology when competitors have already developed a competitive advantage and have gained a large market share because of using the new technology.

In this research, the diffusion of innovation theory helps the researcher to understand how cloud computing adoption has spread among firms in Kenya. Adoption started with a few firms who were the innovators. In 2019, cloud computing is no longer an option for firms that seek to improve their IT operations. Even laggards by now have adopted cloud computing.

2.2.2 Theory of Reasoned Action (TRA)

It has its roots in psychological and sociological research but recently it is being used to explain individual's usage of new technology. According to the theory of Reasoned action (TRA), a person's actions will depend on their attitude and subjective norms (Fishbein & Ajzen, 1967) It can be expressed using the below mathematical expression.

Behavioral Intention = Attitude + Subjective Norms

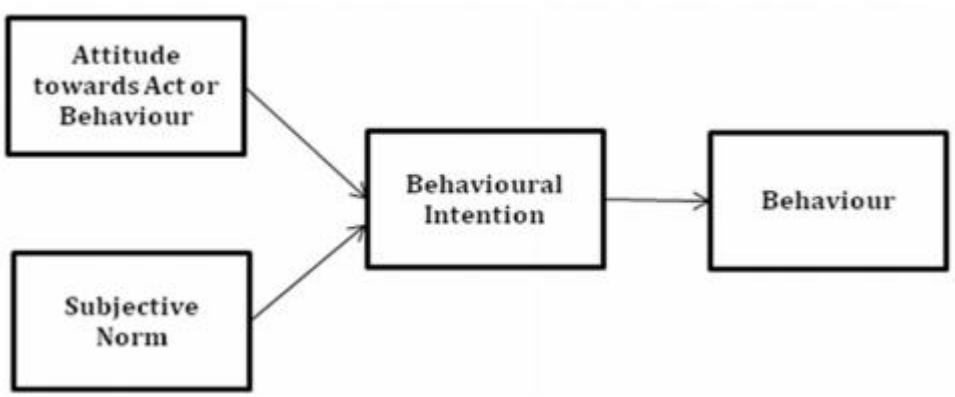

Figure 2.1: Theory of Reasoned Action (TRA)

As shown in Figure 2.1, TRA aims to predict how an individual will react to a new innovation based on their pre-existing attitudes and behaviors. Some people criticized this approach of using attitude to predict human behavior, saying that attitude alone was not enough to accurately predict human behavior. The Theory of Planned Behavior (TPB) and Reasoned Action Approach (RAA) were later developed to address these issues.

TRA aimed to understand an individual's behavior by examining their underlying motivation to perform an action. It states that a person's intentions are the main determinants of whether they will perform a certain action or not e.g. adopting a certain technology. Intention to perform a particular action will in all cases precede performance of the action (Fishbein, 1967). This is known as behavioral intention. It comes from the belief that performing a particular action results in a particular outcome that an individual's desire. TRA proposes that the stronger the inclination of a person to perform a particular action, the more likely an individual is to perform the action. Moreover, societal norms also play a big role. A person will perform an action if society will be happy with them for performing the act but they will be less likely to perform an action that society disapproves.

According to TRA, we can convince an individual to perform a particular action by: Strengthening the confidence in an attitude that supports the intended action, thus weakening belief in an attitude that opposes the intended action, creating a new attitude that supports the intended action and reminding the individual of an attitude that supports the intended action (Fishbein & Ajzen, 1967).

In this research, the theory of reasoned action helps the researcher to understand why firms decide to adopt or reject cloud computing. Firms with a positive attitude towards cloud computing believe that it is a useful technology that will help them achieve their goals. However, firms that believe cloud computing is insecure are less likely to adopt it.

2.2.3 Theory of Planned Behavior (TPB)

It is an improvement to the Theory of Reasoned Action. It states that Perceived Behavioral Control (PBC) in addition to attitude and subjective norms that had been proposed in the Theory of Reasoned Action also influences an individual's behavior (Ajzen,1985). TRA had proposed than an individual's actions are influenced by the pre-existing attitudes as well as societal norms. According to Ajzen, perceived behavioral control is an individual's

perception on the ease or difficulty of performing a particular action. TRA had been criticized to only depend on attitude to predict human behavior. TPB attempts to address this limitation as shown on Figure 2.2.

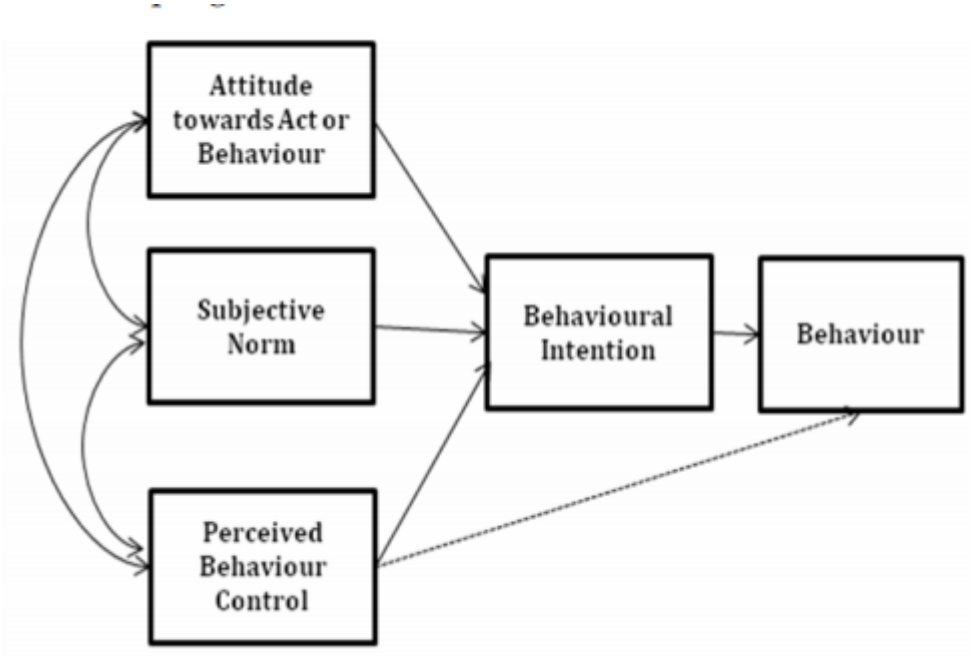

Figure 2.2: Theory of Planned Behavior (Ajzen, 1991)

According to TPB, an individual is more likely to perform an action they believe they have the expertise to do as compared to an action they believe to require skills they do not possess.

In this research, the theory of planned behavior assists the researcher understand why some firms adopt cloud computing while others reject it. According to perceived behavioral control, if the IT department believes that implementing cloud computing solutions is too complex, the firm is less likely to adopt cloud computing. Firms should invest in cloud training for their IT staff to ensure they do not miss out on the benefits.

2.2.4 Technology Acceptance Model (TAM)

TAM explains the user process of taking up and using a new innovation (Davis, 1989). It is an enhancement of the Theory of Reasoned Action (TRA). The acceptance of new technology is based on two factors: perceived usefulness and perceived ease of use. According to Fred Davis, perceived usefulness is concerned with how a user believes adopting a new technology will help improve their performance. Perceived ease of use is the degree to which a person believes that using a particular system would be free from

effort (Davis 1989). These two factors affect the inclination of users to use a new technology as shown in Figure 2.3.

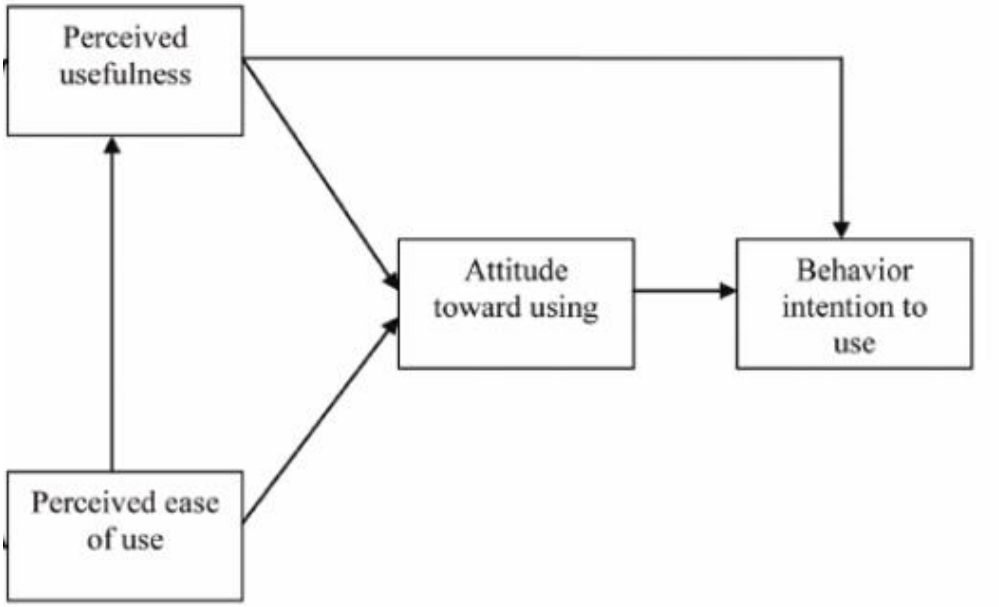

Figure 2.3: Technology Acceptance Model

In this research, the technology acceptance model helps the researcher to understand how perceptions influence cloud adoption. According to TAM, a firm will adopt cloud computing based on 2 factors. The firm will adopt cloud computing if they believe it easy to use and it provide benefits that will enhance the firm's operations.

2.3 Adoption of Cloud Computing

Firms have an option of adopting either one or several of the 3 cloud models, Iaas, Saas and PaaS. Their choice depends on factors such as level of flexibility required, where IaaS would provide the most flexibility in terms of choice of operating system as well as choice of applications. The choice would also depend on amount of configuration the firm wishes to perform, with SaaS requiring the least amount of configuration.

Larger companies are more likely to use cloud computing as compared to smaller firms (Lin, 2012). According to a study done by Lin, in Singapore, this is because larger firms face stiff competition and thus need to get a competitive advantage. The study done by Lin aimed to determine the extent of adoption of cloud computing in Singapore, the types of applications that were being run in the cloud, the payment models for cloud solutions and reasons for adoption or non-adoption. The firms were to be compared in terms of size, industry type, IT budgets and IT expertise. Firm size plays a significant role in the adoption

of technology innovations (Pang, 2008). The study also aimed to determine how the environment an organization operates in affects their adoption of cloud computing. A firm needs to continuously study the environment in which it operates it an readjust its strategies in order to survive (Porter, 1980). Pang saw that many firms that were using cloud were in the media and IT industry. The ones that had the lowest adoption were those in construction and engineering. In terms of firm size, large firms with more than 500 employees were found to have higher adoption rates than smaller firms. When firms were compared in terms of annual revenue, firms with large revenues above 10 million dollars were found to have adopted cloud more than firms with smaller revenues of less than 1 million dollars. The researcher concluded that adoption of cloud was still in its early stages in Singapore.

2.4 Cloud Computing Adoption and Organization Performance

An organization is an entity comprising of multiple people and which has a particular purpose (Bayazi, 2012). Organizations exist to generate value for its owners. Organization performance is considered one of the most important measures of success among listed companies (Roshwani, 2013). Use of cloud among organizations is key in enhancing efficiency of operations (Maleki, 2014).

Cloud computing has a huge effect on firm performance (Mirrazavi, 2016). Mirrazavi did a study on the effect of cloud computing technology on firm results. It was a case study on a company called Zarin Iran Porcelain Industries Company. The study had one main objective which was to study the effect of cloud computing on a firm's results. The study had 3 secondary objectives which were to study the effect of cloud computing on the financial results of a firm, on user satisfaction and on the operational efficiency of the firm. The study determined that cloud computing has a significant impact on organizational performance. It suggests that cloud computing should be used in the implementation of organization processes. The study also found that cloud computing had a material effect on the financial results of the Porcelain company. It suggests that outsourcing hosting services to cloud service providers could significantly reduce costs. The study also found that use of cloud computing led to increased user satisfaction as user requests could be served quickly. Lastly, the study found that use of cloud computing could enhance the internal efficiencies of the Porcelain company. Cloud could enhance process monitoring because data could be fed real time to cloud based systems and analyzed on the cloud to provide useful insights.

2.5 Opportunities of Cloud Computing Adoption

Firms can enjoy many benefits by adopting cloud computing (Haas, 2014). According to a study done by Haas, cloud computing can help organizations improve their performance by reducing IT costs, making scaling IT solutions easier, enhanced data security and increase mobility of the workforce. IT costs are reduced because organizations do not need to maintain on site servers which require operational expenditure in terms of skilled personnel, power, cooling and networking costs. Scaling is also easy as services are offered on a pay as you go model. A firm can scale up and down depending on demand. It is also easier to secure data in the cloud. Cloud providers provide low cost tools such as software-based firewalls that enable one to secure their data. Hardware appliances can be quite costly to acquire. The prohibitive prices may lead firms not to secure their data stored in on site data centers. Cloud computing also leads to increased workforce mobility as data can be accessed from anywhere. Employees do not need to work from the office. They can work from anywhere as long as they have an internet connection.

2.6 Challenges of Cloud Computing Adoption

Despite the rapid growth of cloud adoption in Kenya in recent years, there are challenges that still need to be overcome before companies in Kenya fully adopt cloud computing. Adoption rate is lower than that of developed countries. These challenges include the false perception that cloud is insecure, restrictive regulations of where personal data is stored and lack of adequate personnel who are skilled in cloud technologies.

Companies fear that hosting their data on the cloud due to security fears (Communications Authority of Kenya report, 2019). According to the report, 11.2 million cyber threats were detected between Jan and March 2019. 10.2 million were detected in the previous quarter indicating an increase of 10.1 percent as shown in Table 2.

Table 2: Cyber threats in Kenya 2019

Cyber Threat Events/Period	*Jan – Mar 2019*	*Oct – Dec 2018*
Malware	8,883,862	9,026,924
Web application attacks	1,222,237	737,289
Botnet/DDOS	1,133,893	453,371
System Misconfiguration	13,319	3,449
Online Abuse	265	158
Total	**11,253,576**	**10,221,191**

Source: National KE-CIRT/CC

Regulatory restrictions also hinder cloud adoption. Kenyan banks are regulated by the Central Bank of Kenya (CBK). CBK defines strict rules as to where and how user data is stored. Regulations need to be designed in such a manner that they ensure data is handled securely but also ensure that innovation is not stifled by over regulation (Hook, 2017).

There are 10 major factors that hinder cloud adoption (Durcevic, 2018). People fear that cloud is insecure. There is a lack of resources/expertise to implement and maintain cloud solutions. Government regulations restrict the growth of cloud. Banks are not allowed to store user data outside the country. There is a lack of a proper IT governance framework in organizations. Difficulty in complying with local data laws. It is complex to manage different cloud environments. Some cloud providers are unreliable. It is difficult and costly to build private clouds. Most organizations lack a robust cloud adoption strategy. Lastly, organizations find it difficult to migrate data to the cloud.

2.7 Conceptual Model

A conceptual model gives a visual representation of the variables of interest in a research. In this research, the conceptual model helps shows the relationship between the adoption of cloud computing and firm performance.

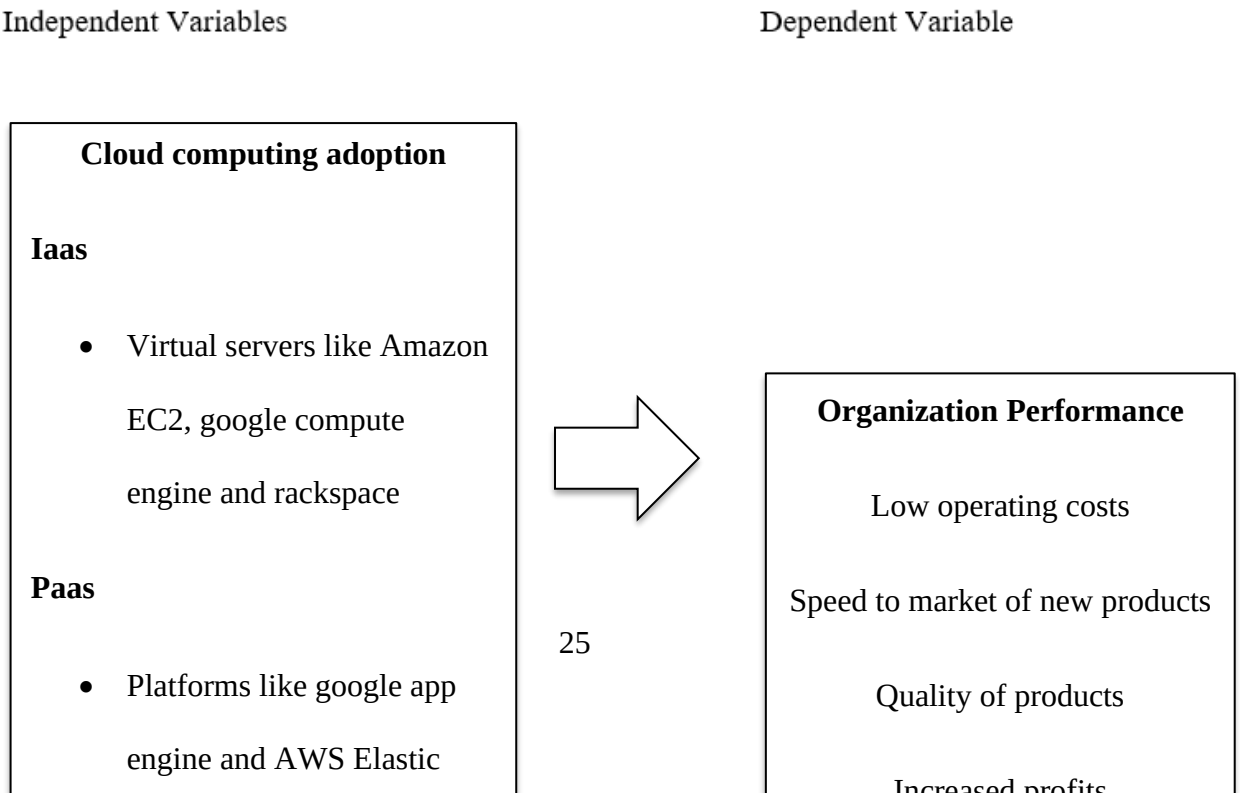

Figure 2.4: Conceptual Model

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

Research methodology are the specific procedures or techniques used to identify, select process and analyze information about a topic (Wilkinson, 2011). There are two main questions that this research methodology sought to answer. How the data was collected and how it was analyzed.

This study aimed to determine adoption rates of cloud computing by manufacturing institutions in Kenya and the factors that influence adoption or rejection. An appropriate research methodology was thus designed to collect required information and to analyze it in order to reveal actionable insights.

3.2 Research Design

A research design is a blueprint for collection, measurement and analysis of data (Russel, 2014). A cross-sectional research design was used in this study. A cross sectional study allows a researcher to analyze data from a population at a specific point in time (Marcus,

2015). This design was selected because it allowed the researcher to determine adoption rates of cloud computing at the time of the study.

3.3 Population

The population used in this study constituted all manufacturing companies in Kenya that are members of the Kenya Association of Manufacturers (KAM). According to the Kenya Association of Manufacturers, as at 2019, there are 1,100 member manufacturing firms (Appendix 1). KAM categorizes these companies into 14 sectors according to the activities these companies are involved in. These sectors are listed in the appendix.

3.4 Sample Design

The sampling technique used was stratified sampling which is a type of probability sampling. In probability sampling, every element in the population has an equal chance of selection to be part of the study. Stratified sampling was used because the technique allows the researcher to divide the population into subgroups (strata) based on a certain similarity and then select elements randomly from the strata. Manufacturing firms in Kenya are grouped into 14 sectors according to the items they produce. These 14 sectors are the strata (subgroups) from which the elements in the study will be chosen from.

A sample size of 58 firms was used. The following is the formula that was used to calculate sample size.

Sample Size = (Z-score)2 * StdDev*(1-StdDev) / (margin of error)2

A confidence level of 90 % was used corresponding to a Z score of 1.645. A safe standard deviation of 0.5 was used. The margin of error was +/- 10 %.

Sample Size = (1.645^2*0.25) / (0.1^2) = 58

From each firm, one individual was selected to take part in the study. This resulted in a total of 58 respondents. The employee that was selected was the IT manager as they were best fitted to know the cloud strategy of the firm. Questionnaires were administered to these respondents via email method.

3.5 Data Collection

This study used primary data. Data was collected using questionnaires. Questionnaires were administered to the respondents. The questions had both closed and open-ended questions to ensure a variety of data is collected. Email technique was used to distribute the questionnaires due to the large number of respondents that were involved. They were given ample time to fill the questionnaire. Responses were be required after one week.

3.6 Data Analysis

Data analysis was done once responses to the questionnaires were obtained and they are checked for completeness and consistency. Collected data was coded in order to reduce responses to a small number of classes. Coding is a way of indexing or categorizing the text in order to establish a framework of thematic ideas about it (Gibbs, 2007).

Collected data was tabulated for the purpose of statistical analysis. The researcher used mean and standard deviation. Once analysis is done, findings were compared to themes contained in the literature review. The data was interpreted with respect to the literature and objectives of the study. The findings were then be presented in chapter 5, summary conclusions and recommendations.

CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

The researcher also goes through the results or findings that were obtained after careful analysis. The findings are compared to the objectives of the study that were defined in chapter one. The research objectives were to investigate the extent of cloud adoption by manufacturing firms in Nairobi, to investigate the relationship between cloud adoption and performance, to determine the opportunities that could be realized by adopting cloud and to determine the challenges that firms face when adopting cloud.

Data was collected from 58 manufacturing firms in Nairobi with questionnaires issued to 58 employees of these firms.

Of the 58 questionnaires that were distributed to the target respondents, 40 were received back which represented a response rate of 69 percent. A response rate of fifty percent was determined to be adequate for statistical reporting (Mugenda, 2003). Of the 40 responses, 5 were incomplete. Thus 35 responses were used in this study. Descriptive statistics were used to analyze the data. Statistical methods such as relative frequencies, mean and standard deviation were used.

4.2 Respondents' Demographic Characteristics

The researcher aimed to investigate the demographic characteristics of the respondents who had been selected for the study. These demographics were in terms of age and gender. The researcher moreover sought to determine the characteristics of the firms under study in terms of number of employees they had, number of years they had been in operation and their annual revenues.

4.2.1 Gender

The researcher sought to find out the gender of the respondents. The results are shown in Table 4.1. Most respondents at 57% were found to be male.

Table 4.1: Respondents Gender

Gender	Frequency	Percentage
Male	15	43
Female	20	57
Total	**35**	**100**

4.2.2 Respondents' Age

The researcher aimed to get the age of the respondents. They were asked to indicate the age bracket they fell in. The results are shown in Table 4.2.

Table 4.2: Respondents ages

Age	No. of respondents	Percentage
30 years or less	15	43

31-40 years	10	29
41-50 years	5	14
Above 50 years	5	14
Total	**35**	**100**

The majority of respondents were found to be 30 years old or less at 43%. The second largest group of respondents were between 31 and 40 years old. 14% of the respondents were between 41 and 50 years and again 14% were above 50 years old.

4.2.3 Number of Employees

The researcher aimed to establish organization size using the number of employees. The respondents were asked to indicate how many employees their firm had. The results are shown in Table 4.3. 29% of the firms had 500 employees or less, 20% had between 501 and 1,000 employees, 22% had between 1,001 and 1,500 employees and 29% had more than 1,500 employees.

Table 4.3: Number of employees in respondents' firms

No. of employees	Number of respondents	Percentage
500 employees or less	10	29
501-1,000 employees	7	20
1,001-1,500 employees	8	22
Above 1,500 employees	10	29
Total	**35**	**100**

4.2.4 Years in Operation

The researcher sought to determine how long the manufacturing firms had been in operation in order to determine their maturity. The respondents were asked to indicate the number of years their firms had been in operation. The results are shown in Table 4.4.

Table 4.4: Number of years respondents' firms have been in operation

Years in operation	Number of respondents	Percentage
5 years or less	10	29
6-10 years	5	14
11-15 years	8	23
Above 15 years	12	34
Total	**35**	**100**

Most companies at 34% were 15 years old or more, 23% had been existence for between 11 and 15 years, 14% had been in existence for between 6 and 10 years and 29% had been in existence for 5 years or less.

4.2.5 Annual Firm Revenue

The study sought to determine firm size by looking at the annual firm revenue. Participants were asked to give annual firm revenue. The results are shown in Table 4.5. 14% of the firms had annual revenues of 100 million Kenya shillings or less. The majority at 34% had annual revenues of between 101 and 200 million. 26% had revenues of between 201 and 300 million and 26% had revenues above 300 million.

Table 4.5: Annual revenue of respondents' firms

Annual Revenue (kshs)	Number of respondents	Percentage
100 million or less	5	14
101-200 million	12	34
201-300 million	9	26
Above 300 million	9	26
Total	**35**	**100**

4.3 Extent of Cloud Computing Adoption Among Manufacturing Firms in Nairobi

The researcher sought to determine the adoption rate of adoption of various cloud computing models among manufacturing firms in Kenya. The respondents were asked to indicate the extent their firms had adopted the different models of cloud computing.

A 5-point scale was used. 1 indicated no extent, 2 indicated little extent, 3 indicated moderate extent, 4 indicated large extent and 5 indicated very large extent. The results are shown in Table 4.3.1. A mean of less than 1.5 means no extent, a mean between 1.5 and 2.5 means little extent, a mean between 2.5 and 3.5 means moderate extent, a mean between 3.5 and 4.5 means large extent and a mean of more than 4.5 means very large extent.

Table 4.6: Extent of respondent's adoption of various cloud computing models

Extent of Adoption	1	2	3	4	5	Mean	Standard Deviation
Software as a Service (SaaS)	0	2	3	13	17	4.2857	0.8599
Infrastructure as a Service (IaaS)	4	5	6	8	12	3.5429	1.4005
Platform as a Service (PaaS)	10	10	12	3	0	2.2286	0.9727

N=35

The results show that SaaS has the highest adoption rates among manufacturing firms in Nairobi with a mean of4.2857. This is followed by IaaS which has moderate adoption with a mean of 3.5429. Most manufacturing firms in Nairobi have not adopted PaaS as it has a low mean of 2.2286.

Moreover, the researcher also sought to determine the adoption rates of specific services within IaaS, SaaS and PaaS. The respondents were asked which Software as a Service applications their firms were using. The outcome is in Table 4.7.

Table 4.7: Extent of SaaS adoption

SaaS Application	Number of Respondents	Percentage
Salesforce	18	51
Sage	15	43
Office 365	20	57
Others	3	9

Office 365 was found to have the highest adoption with 57% of the surveyed firms using it. This was followed by Salesforce at 51% and Sage at 43%. 9% of the firms used other SaaS applications.

The respondents were asked which Infrastructure as a Service provider their firms were using. The results are shown in Table 4.8.

Table 4.8: Extent of SaaS adoption

IaaS Service	Number of Respondents	Percentage
AWS EC2	19	54
Google Compute Engine	5	14
Rackspace	2	6
Others	1	3

Most firms were found to be using AWS EC2 at 54% of the surveyed firms. Google compute engine follows at 14% and Rackspace at 6%. 3% use other IaaS providers.

The respondents were asked which PaaS service their firms were using. The results are shown in Table 4.9. Usage of PaaS among manufacturing firms in Nairobi was generally found to be low. 14% of the surveyed firms used AWS Elastic Beanstalk, 6% used google app engine and 3 percent used Heroku.

Table 4.9: Extent of PaaS adoption

PaaS Service	Number of Respondents	Percentage
Google App Engine	2	6
Heroku	1	3
AWS Elastic Beanstalk	5	14

Others	0	0

4.4 Cloud Computing Adoption and Organization Performance

The study sought to establish how cloud computing adoption affected firm performance. The respondents were asked to indicate the extent their firms had enhanced their performance due to their adoption of cloud computing.

A 5-point scale was used. 1 indicated no extent, 2 indicated little extent, 3 indicated moderate extent, 4 indicated large extent and 5 indicated very large extent. The results are shown in Table 4.4. A mean of less than 1.5 means no extent, a mean between 1.5 and 2.5 means little extent, a mean between 2.5 and 3.5 means moderate extent, a mean between 3.5 and 4.5 means large extent and a mean of more than 4.5 means very large extent.

Table 4.10: Cloud computing and organization performance

Performance Measure	**1**	**2**	**3**	**4**	**5**	**Mean**	**Standard Deviation**
Low operating costs	0	1	1	8	25	4.6286	0.6897
Speed to market of new products	0	1	7	7	20	4.3143	0.9
Quality of products	0	1	10	9	15	4.0857	0.9194
Increased profits	0	1	9	8	17	4.1667	0.9103
Reliability of IT services	0	1	6	22	6	3.9429	0.6835
Scalability of IT services	0	1	3	5	27	4.6111	0.7664
Data security	0	1	10	14	10	3.9429	0.8382
Others	0	1	20	5	9	3.6286	0.9103

N=35

As shown in Table 4.10, manufacturing firms realize the listed benefits when they adopt cloud computing. Most firms experienced lower operating costs when they adopted cloud computing. This effect had the highest mean at 4.6286.

4.5 Relationship Between Cloud Computing Adoption and Organization Performance

One of the objectives of the study were to determine the relationship between adoption of cloud computing adoption and performance of a firm. The researcher sought to find out to what extent a firm performed according to specified performance measures after adopting cloud computing. The researcher performed a regression analysis aiming to show the relationship between performance of a firm and extent of adoption of the 3 cloud computing models. The output of regression analysis are shown in Table 4.11, Table 4.12 and Table 4.13.

The researcher sought to analyze the relationship between adoption of various cloud computing models and the effect on performance of an organization in terms of annual revenue. A sample of 10 responses was selected to conduct a multiple linear regression. The dependent variable chosen was annual revenue of the firms in millions of shillings. The dependents variables were the extent of PaaS, SaaS and IaaS adoption by the firms which the respondents indicated on a scale of 1-5, with 1 meaning no extent and 5 meaning very large extent. A significance value of 0.05 was selected.

The estimated linear regression equation was used.

$$\hat{Y} = b_0 + b_1 X_1 + b_2 X_2 + \ldots + b_p X_p$$

Y is the estimated value of the dependent variable. b_0 is a constant. X_1 represents SaaS, X_2 represents IaaS and X_3 represents PaaS. In this study, Y was organization performance in terms of 6 performance measures which were operating costs, speed to market of new products, quality of products, increased profits, reliability of IT services, scalability of IT

services, data security and others. X1 was extent of adoption of SaaS. X2 was extent of adoption of IaaS. X3 was extent of adoption of PaaS.

4.5.1 Regression Statistics

The regression statistics results are shown in Table 4.11. The results show multiple R has a value of 0.8899. Multiple R is the correlation coefficient. A value of 1 would indicate a perfect positive relationship between the independent and dependent variables. Thus, the multiple R has a value of 0.8899 indicates a strong linear relationship between cloud computing adoption and firm performance. The R square value of 0.7919 shows that 79% of the variation in the dependent variable firm performance is caused by the independent dependent variables which are extent of Paas, Saas and IaaS adoption. The adjusted R square value of 0.6879 is similar to the R square but has been adjusted for the number of independent variables in the model which are 3. The standard error of the regression is 0.3172. This shows the average distance of the data points from the regression line. This means the data points are on average 0.3172 units away from the regression line. The data points are thus tightly fitted around the regression line which shows the model is able to accurately predict performance of a firm based on the extent of the firm's adoption of the 3 cloud computing models.

Table 4.11: Summary Statistics

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.8899
R Square	0.7920
Adjusted R Square	0.6880
Standard Error	0.3173
Observations	35.0000

4.5.2 Analysis of Variation

The Analysis of Variation (ANOVA) table gives us the significance of the overall model. The P value was found to be 0.0180 as shown in Table 4.12 which is below 0.05 thus showing that the overall model is significant.

Table 4.12: ANOVA

ANOVA					
	Df	*SS*	*MS*	*F*	*Significance F*
Regression	3.0000	0.2262	0.0754	0.0355	0.0181
Residual	31.0000	65.7738	2.1217		
Total	34.0000	66.0000			

4.5.3 Coefficients

The coefficients are shown in Table 4.13. The coefficient table shows that SaaS has a P value of 0.0024, which is below the significance value of 0.05. The researcher was thus able to reject the null hypothesis which states that the coefficient is equal to 0 and thus has no effect on the dependent variable. The extent of adoption of SaaS thus has an effect on firm performance. Similarly, IaaS has a P value of 0.0008 showing that the extent IaaS adoption has an effect on firm performance. PaaS however has a P value of 0.8140 which is greater than 0.05. We are thus unable to reject the null hypothesis meaning that according to this model, extent of PaaS adoption does not affect a firm's revenue. This independent variable was thus left out of the regression equation.

$Y = 1.3322 + 1.0407\ _{X1} + 0.0323\ X_2$

Table 4.13: Coefficients table

	Coeff	***Error***	***t Stat***	***P-value***	***Lower 95%***	***Upper 95%***	***Lower 95.0%***	***Upper 95.0%***
Intercept	1.33	1.12	2.97	0.00	1.04	5.62	1.04	5.62
SaaS	1.04	0.20	-0.21	0.00	0.00	0.36	-0.45	0.36
IaaS	0.03	0.20	-0.17	0.00	0.00	0.37	-0.43	0.37
PaaS	-0.04	0.16	-0.24	0.81	-0.36	0.28	-0.36	0.28

4.6 Opportunities of Cloud Computing Adoption

The researcher sought to determine which opportunities could be realized when manufacturing firms in Nairobi adopted cloud computing. The participants were requested to indicate the extent to which their firms had realized certain opportunities once their firms adopted cloud computing.

A 5-point scale was used. 1 indicated no extent, 2 indicated little extent, 3 indicated moderate extent, 4 indicated large extent and 5 indicated very large extent. The results are shown in table 12. A mean of less than 1.5 means no extent, a mean between 1.5 and 2.5 means little extent, a mean between 2.5 and 3.5 means moderate extent, a mean between 3.5 and 4.5 means large extent and a mean of more than 4.5 means very large extent.

Table 4.14: Opportunities of cloud adoption

Opportunity	**1**	**2**	**3**	**4**	**5**	**Mean**	**Standard Deviation**
Competitive advantage	3	2	5	10	15	3.9143	1.2689
Cost reduction	1	7	10	5	12	3.5714	1.2435
Operations efficiency	1	9	12	13	0	3.0571	0.8726
Scalability of IT resources	2	2	1	14	16	4.1429	1.1152
Quick recovery after a failure	2	1	14	16	2	3.4286	0.884
Flexibility in deployment of solutions	0	0	12	13	10	3.9429	0.8023
Ease of implementation of security controls	0	10	10	7	8	3.3714	1.1398
Others, specify and rate accordingly	10	12	8	5	0	2.2286	1.0314

N=35

All the opportunities except others had a mean of more than 3.0 as shown in Table 4.11. This means that the listed opportunities were indeed realized by manufacturing firms when they adopted cloud computing. Scalability of IT resources had the highest mean at 4.1429 and others had the lowest mean at 2.2286.

4.7 Challenges Facing Cloud Computing Adoption

The researcher sought to determine the challenges manufacturing firms in Nairobi were facing as they adopted cloud computing. The respondents were asked to indicate the extent to which their firms were facing certain challenges as they adopted cloud computing.

A 5-point scale was used. 1 indicated no extent, 2 indicated little extent, 3 indicated moderate extent, 4 indicated large extent and 5 indicated very large extent. The results are shown in table 12. A mean of less than 1.5 means no extent, a mean between 1.5 and 2.5 means little extent, a mean between 2.5 and 3.5 means moderate extent, a mean between 3.5 and 4.5 means large extent and a mean of more than 4.5 means very large extent.

Table 4.15: Challenges of cloud adoption

Challenge	**1**	**2**	**3**	**4**	**5**	**Mean**	**Standard Deviation**
Fear cloud is not secure	0	5	5	5	20	4.1429	1.1413
Complexity of implementation	0	5	12	13	5	3.5143	0.9194
Lack of skilled personnel	2	3	10	5	15	3.8	1.2556
Regulatory restrictions	15	5	10	4	1	2.1714	1.2001
Difficulty in migrating from on premises equipment to cloud	10	10	10	4	1	2.3143	1.1054
Cloud computing is still an	20	7	3	5	0	1.8	1.1061

immature technology							
High cost	5	7	18	5	0	2.6571	2.6571
Others, specify and rate accordingly	10	12	8	1	4	2.4889	1.1406

Challenges with means greater than 3.0 are the ones which firms were facing in cloud adoption. Table 4.15 showed that these were security, complexity and lack of skilled personnel to implement cloud computing technologies. Other challenges had means of less than 3 showing that manufacturing firms in Nairobi were not affected to a large extent by these challenges. These were high costs, immaturity of cloud computing technology, difficulty in data migration and regulatory restrictions.

4.8 Discussion of Findings

The objectives of the study were to determine the extent of cloud adoption among manufacturing firms in Nairobi, to establish the relationship between cloud computing adoption and organization performance, to determine which opportunities could be realized by adopting cloud computing and to determine the challenges manufacturing firms were facing as they adopted cloud.

In terms of extent of adoption, Software as a Service was found to be the most popular cloud computing model among manufacturing firms in Nairobi. SaaS is a low-cost service which requires minimal to no deployment effort which is why it has gained widespread adoption among manufacturing firms. IaaS is the second most popular model. PaaS has not been adopted widely. A possible reason is that manufacturing firms in Nairobi do not have adequate skilled personnel in cloud computing to enable them implement PaaS. 60% of the firms that have adopted cloud computing use the SaaS cloud computing model (Liu, 2012). According to the study done by Liu, this is because of its affordability, scalability and accessibility. The findings of this study are thus consistent with the study done by Liu in 2012. The most popular SaaS applications among manufacturing firms were found to be Office 365 which was used by 57% of the surveyed firms and Salesforce which was used by 51% of the firms. According to these results, firms were moving away from the on-premises versions of these applications to the cloud versions as they were more cost

effective and easier to scale. For IaaS, most of the surveyed firms at 54% were using Amazon's EC2 virtual machines. This was because EC2 was more cost effective compared to its competitors like Google Compute Engine and Microsoft Azure. Manufacturing firms need to keep their costs low in order to remain profitable in a highly competitive industry. PaaS was generally not popular and AWS beanstalk had the highest adoption at 14% of the surveyed firms. Training was needed to take advantage of this cloud computing model.

The study also sought to determine the relationship between cloud computing adoption and organization performance. Adoption of cloud computing was found to lead to enhanced performance among manufacturing firms. Performance was enhanced in terms of lower costs of operation, fast launch of new products and services to the market, increased quality of products, increase in profitability, easy scaling of IT resources and security of firm data. Regression analysis was done to analyze the relationship between the dependent variable organization performance and the independent variables which were the extent of firm adoption of the three cloud computing models, SaaS, IaaS and PaaS. The regression equation showed that organization performance was related to the firm's adoption of IaaS and Saas. Increased adoption led to a corresponding increase in the firm's performance. In Europe, extent of adoption of all 3 cloud computing models lead to enhanced firm performance (Fang, 2015). This is inconsistent with the findings of this study where only SaaS and IaaS were found to have an effect on firm performance. This can be attributed to a higher number of personnel skilled in cloud computing in Europe compared to Kenya. They are thus able to take full advantage of all 3 cloud computing models to enhance performance.

The research aimed to determine which opportunities manufacturing firms could realize by adopting cloud computing. The results showed that the opportunities that firms had realized included efficiency in operations, attaining a competitive advantage, scalability of IT resources, high availability, flexibility and ease of implementation of IT solutions. In India, adoption of cloud computing additionally led to increased mobility of the workforce as well as increased data security (HaaS, 2014). The study done by HaaS is consistent with this study as a majority of the benefits realized in India are also realized by manufacturing firms in Nairobi.

Lastly, the study intended to establish the challenges faced by manufacturing firms in their adoption journey. The results showed that the firms faced 3 main challenges: lack of skilled personnel in cloud computing, lack of knowledge of implementing security in the cloud

and complexity of implementing cloud solutions which is related to the challenge of lacking skilled personnel. The challenge of lack of skilled personnel is not experienced in London where 90% of the listed firms have adopted cloud computing (Specter, 2017). The results of this study are inconsistent with the study done by Specter as in Nairobi, lack of skilled personnel is a major challenge. This can be attributed to a difference in development in Nairobi as compared to London where cloud computing training is easily accessible.

There are various stages of adoption of a new innovation (Rodgers, 1962). According to the diffusion of innovation theory, there are innovators, early adopters, early majority, late majority and laggards. The results indicated cloud computing has gained widespread adoption among manufacturing firms in Nairobi. 90% of the surveyed firms use some form of cloud computing with SaaS applications being the most popular. Adoption has reached a point where even laggards are using cloud computing. It is no longer a new technology and has thus reached maturity. According to the Technology Acceptance Model Theory (TAM), users will adopt an innovation if they perceive the innovation is useful to them and it is easy to use. Cloud computing meets both criteria and has thus been adopted by firms in Nairobi.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter gives a summary of the research study, the conclusion the researcher came to as well as the recommendations that were given based on what was discovered during the study.

5.2 Summary of Findings

The objectives of the study were to determine the extent of cloud adoption among manufacturing firms in Nairobi, to establish the relationship between cloud computing adoption and organization performance, to determine which opportunities could be realized by adopting cloud computing and to determine the challenges manufacturing firms were facing as they adopted cloud.

32 of the 35 surveyed manufacturing firms in Nairobi (90 percent) surveyed in this study were found to have adopted some form of cloud computing technology. This shows that manufacturing firms have realized that cloud computing in not only important but is mandatory if they wish to survive in an extremely competitive environment. Manufacturing companies contribute 16% to Kenya's Gross Domestic Product (GDP) and thus their performance is very important. Cost reduction was found to be a key driver in cloud computing adoption. On a 5-point scale, cost reduction was found to have a mean of 3.5. SaaS was found to be the most popular cloud computing model. This is because of its affordability, scalability and accessibility. Most organizations were found to be using the cloud version of Microsoft Office suite called Office 365. Not only is it easy to deploy, it also cost effective compared to the onsite version. Firms are required to pay a small monthly or yearly subscription for the service. Moreover, firms do not have to incur capital expenditure to acquire servers or operational expenditure to maintain them.

The relationship between cloud computing and firm performance was investigated in this research. Regression analysis was done to model this relationship. The results showed that a linear relationship existed between cloud computing adoption and firm performance. Firm performance was the dependent variable. Firm performance was measured in terms of low operating costs, speed to market of new products, quality of products produced, increased profitability, reliability of IT services, scalability of IT services and data security. The independent variables were extent of adoption of SaaS, extent of adoption of IaaS and extent of adoption of PaaS. The results of the regression showed that the significant independent variables were extent of adoption of SaaS and PaaS.

The study sought to determine the opportunities that could be realized by manufacturing firms when they adopted cloud computing. Firms that adopted cloud computing were found to attain a competitive advantage. They were able to reduce their costs as cloud computing helped reduce both capital expenditure and operational expenditure. Operations efficiency was also enhanced as managing resources in the cloud is easier than managing on premises equipment. This is because hardware management is abstracted as it is provided by the cloud service provider. Firms also find it easier to scale their IT resources up and down ensuring no funds are wasted by purchasing more than is required or service delivery is affected by not having enough IT resources. Disaster recovery was also found to be easier as resources can be configured on different geographic locations to ensure resiliency in case of failure. Firms were also found to benefit from ease of deployment of solutions in the cloud.

This research also aimed to establish the issues manufacturing firms were facing which hindered their adoption of cloud. Firms feared that it is insecure and were thus reluctant to move sensitive data such as payroll data to the cloud. Many firms also lacked adequate skilled personnel in cloud computing. Due to this, the firms found implementing solutions in the cloud to be complex.

5.3 Conclusion of the Study

The research concluded cloud computing had gained widespread adoption among manufacturing firms in Nairobi with 90% of them using some form of cloud computing. Adoption has accelerated in recent years due to the need to increase efficiency and cut costs. Barriers to cloud adoptions such as cost effective and reliable internet connectivity

have been removed. The enabling environment for cloud computing, while not yet fully conducive was becoming friendlier to adoption of cloud services.

However, while uptake of cloud computing is growing, a majority of firms in Kenya are still not using cloud computing. The Communications Authority of Kenya found that most firms did not have a good plan for migrating their services to the cloud. Many firms that have not migrated to the cloud have not done so due to lack of skills. Research by the Kenya National Bureau of Statistics in 2016 showed that 37% of private firms in Kenya lacked knowledge on cloud computing. Firms need to invest in training their IT personnel on the use and benefits of cloud technologies. They could greatly improve service delivery if they moved their on-premises servers to the cloud and at the same time save on cost. Another hindrance to cloud adoption was found to be fear that data stored in the cloud was insecure. This is a wrong assumption though because data needs to be properly secured irrespective of where the data is stored. Data in the cloud is easier to secure because cloud providers have software-based tools like virtual firewalls which control access of data in the cloud.

5.4 Limitations of the Study

This research was constrained by both financial and non-financial limitations. There were limitations on time, scope and funding. Because of time limitations, the study could not focus on all manufacturing firms in Kenya and thus concentrated on manufacturing firms in Nairobi. A study of all manufacturing firms in Kenya could have produced results that could have been more easily generalized.

Similarly, due to resource limitations, stratified sampling technique was employed. Only 58 firms were selected for the study out of 1,100 manufacturing firms who were members of the Kenya Association of Manufacturers. If the researcher had more time and funds, a larger sample size would have been used.

5.5 Suggestions for Further Research

The research only concentrated on manufacturing firms in Nairobi. If a larger sample of manufacturing firms was used, the results could be more easily generalized across manufacturing firms.

The study could also include manufacturing firms in foreign countries. Each country operates in a different way and it would be interesting to observe the approach of foreign manufacturing firms in relation to technology and particularly to cloud computing.

A study could be done to investigate the relationship between performance of manufacturing firms in different countries and adoption of cloud computing.

REFERENCES

Ajzen, I. (1991). *The theory of planned behavior organizational behavior and human decision processes* (pp. 1-10). Ontario: Otago University Press.

Harris, S. (2012). *ICT adoption in small and medium enterprises: an empirical evidence of service sectors in Malaysia. International journal of business & management* (pp. 67-72). London: Macmillan Publishers.

Douglas, J. (2016). *Adoption factors and implementation strategies of on-premise and cloud-based ERP systems by SMEs in Thailand. Asean journal of management & innovation*. Retrieved August 8, 2019, from http.//journal.stamford.edu/index.php/ajmi/article/download/3

Bayazi, I. (2012). *Modeling use of enterprise resource planning systems: a path analytic study. European journal of information systems* (pp. 142-158). Dublin: Macmillan Publishers.

White, A. (2015). *Opportunities and risks of software-as-a-service, findings from a survey of IT executives. Decision support systems*, (pp. 23-25). Lisbon: Simon & Schuster.

Adeyeye, S. (2016). *Cloud computing may curb video game piracy*, (pp. 13-14). Rome: Simon & Schuster.

Haas, L. (2014). *Information technology: threats and opportunities for small and medium-sized enterprises. International journal of information management*, (pp. 323-325). New York: Pearson Education.

Fishbein, S., Ajzen, S. (1962). *The Reasoned Action Approach*. (pp. 523-530). New York: Houghton Mifflin Harcourt.

Ruxwana, E. (2014). *Model of adoption of technology in households: A baseline model test and extension incorporating household life cycle*. (pp 45-55). Bali: Cengage Learning.

Clarkson, F. (2004). *Cloud computing and emerging IT platforms: vision, hype, and reality for delivering computing as the 5th utility*. (pp 545-555). Sandton: Scholastic.

Kothari, G. (2003). *Organizing for radical product innovation: the overlooked role of willingness to cannibalize.* (pp 320-350). London: Oxford University Press.

Nzoya, C. (2018). *Initiation, adoption, and implementation of innovation: effects of context, organization, and leaders.* (pp 120-122). London: Kodansha.

Bamiah, B. (2012). *User acceptance of computer technology: a comparison of two theoretical models. Management science*. (pp 120-122). London: McGraw-Hill Education.

Kourik, D. (2011). *An ultimate guide to writing a dissertation in business studies: a step-by step assistance*. Retrieved July 11, 2019, from http://researchmethodology.net/researchphilosophy/interpretivism/

Hou, G. (2018, June 2). In-house versus in-cloud systems. A comparative study. Journal of enterprise resource planning studies. Retrieved June 26, 2019, from http://www.forbes.com/sites/alexanderhaislip/2014/01/14/india-cloud-opportunities/

White, H. (2015). *The Potential for Credit Scoring for SME Lending in Kenya, a strategy for small enterprise development in Nairobi*. (pp 567-568). Sydney: Harper Collins.

Brown, L. (2010, August 14*). Cloud computing's stormy future*. Retrieved September 23, 2019, from https.//hbr.org/2010/09/cloud-computings-stormy-future International Journal of Management and Commerce Innovations

Kagwe, O. (2017, March 1). Cloud computing to pick up pace in Kenya. Retrieved March 9, 2019, from http://www.capitalfm.co.ke/business/2017/08/why-smes-should-scale-up/

Kituku, K. M. (2012). *Adoption of cloud computing in Kenya by firms listed in the* NSE. (pp 120-122). Nairobi: Kariuki Publishers.

Kiveu, M. (2013). *Enhancing market access in SMEs in Kenya Using ICT*. (pp. 12-90). Nairobi: James Publishing.

Kourik, J. L. (2011). *Small and medium size enterprises (SME) deliberating cloud computing: a proposed approach*. (pp. 216-221). Pretoria: Quinn Publishing.

Rogers, H. (1962). *Diffusion of innovations*. (pp. 1216-1217). Sydney: Bill Publishing.

Idris, L. (2016). *A break in the clouds: towards a cloud definition*. (pp. 50-55). Bali: Hachette Livre.

Fick, A. (2016). Management of business challenges among small and micro enterprises in Nairobi, Kenya. *KCA journal of business management*, 2, 12-29.

Mirrazavi, K. (2012). *Cloud computing and software services: theory and techniques*. Buenos: Mc Graw Hill.

Durcevic, L. (2018). *Cloud computing and emerging IT platforms* (pp. 12-20). New York: Oxford University Press.

Wilkinson, G. (2011). *Sustaining IT Advantage: The Role of Structural Differences* (pp. 50-60). California: Oxford University Press.

Russel, G. (2014). *Capitalizing on Cloud: Preparing People and Processes for IT's Organizational Challenge* (pp. 90-95). Brussels: Harper Collins.

Gibbs, O. (2017). *Cloud Computing Issues and Impacts* (pp. 190-192). Lisbon: Hachette Livre Publishers.

Mugenda, M. (2003). *Technology: Benefits and Impacts* (pp. 10-13). Nairobi: Longhorn Publishers.

Liu, H. (2012). *Challenges for Adopting Cloud-Based Software as a Service (SaaS) in the Public Sector* (pp. 110-113). Sydney: Penguin Random House.

Fang, H. (2015). *The Cloud - Changing the Business Ecosystem* (pp. 55-57). Cairo: Macmillan Publishers.

Cheng, H. (2015*). Cloud computing: state-of-the-art and research challenges* (pp. 555-557). Shangai: Chin Wu Publishers.

Weiss, A. (2011). *Computing in the clouds - Where are we at with Cloud Computing?* (pp. 16-18). Rome: Hitachi Publishers.

Wozniak, T. (2009). *Cloud Basics – An Introduction to Cloud Computing* (pp. 116-118). New York: Mc Millan Publishers.

Rimal, I. (2005). *A Taxonomy, Survey, and Issues of Cloud Computing Ecosystems* (pp. 110-119). London: Springer.

Mahoney, I. (2018). *The resource-based view within the conversation of strategic management* (pp. 120-122). Cape Town: Simon & Schuster.

APPENDICES

APPENDIX 1: QUESTIONNAIRE

SECTION A: DEMOGRAPHIC INFORMATION

1. What is your age? (tick whichever is applicable)

   [ ] 30 or less years
   [ ] 31-40 years
   [ ] 41-50 years
   [ ] Above 50 years

2. What is your gender? tick whichever is applicable)

   [ ] Male
   [ ] Female

3. How many employees does your organization have? tick whichever is applicable)

   [ ] 1-500
   [ ] 501-1000
   [ ] 1,001 – 1,500
   [ ] Above 1,500

4. How old is your firm? tick whichever is applicable)

   [ ] 5 or less
   [ ] 6-10
   [ ] 11-15
   [ ] Above 15

5. How many years of experience do you have? tick whichever is applicable)
   [ ] 5 or less
   [ ] 6-10
   [ ] 11-15
   [ ] Above 15

6. What is the annual revenue of your organization (million Kenya shillings) ? tick whichever is applicable)

   [ ] 100 or less
   [ ] 101-200
   [ ] 201-300
   [ ] Above 300

7. Does your organization provide training opportunities in new technologies? tick whichever is applicable)

   [ ] yes
   [ ] no

8. What is your job position? ……..

SECTION B: EXTENT OF CLOUD ADOPTION

1. To what extent does your organization use each of the following cloud models?

Indicate the extent using a five-point scale, where: 1= **No extent 2 = Little Extent 3 = Moderate Extent 4 = Large Extent and 5= Very Large Extent.** Tick accordingly.

Cloud Computing Models	**1 – No extent**	**2 - Little extent**	**3 - Moderate extent**	**4 - Large Extent**	**5 - Very Large extent**
Infrastructure as a Service					
Software as a Service					
Platform as a Service					

2. Does your organization use the following SaaS applications? (tick whichever is applicable)
   [ ] Salesforce
   [ ] Sage
   [ ] Office 365
   [ ] Other, specify _____

3. Does your organization use the following PaaS applications? applications (tick whichever is applicable)
   [ ] Google app engine
   [ ] AWS Elastic Beanstalk
   [ ] Heroku
   [ ] Other, specify _____

4. Does your organization use the following IaaS applications? applications (tick whichever is applicable)
   [ ] AWS EC2
   [ ] Google Compute Engine
   [ ] Rackspace

[ ] Other, specify _____

SECTION C: CLOUD ADOPTION AND ORGANIZATION PERFORMANCE

Indicate the extent to which your organization has performed according to the following performance measures. Indicate the extent using a five-point scale, where: 1= No extent 2 = Little Extent 3 = Moderate Extent 4 = Large Extent and 5= Very Large Extent. Tick accordingly.

Performance Measure	**1 – No extent**	**2 - Little extent**	**3 - Moderate extent**	**4 - Large Extent**	**5 - Very Large extent**
Low operating costs					
Speed to market of new products					
Quality of products					
Increased profits					
Reliability of IT services					
Scalability of IT services					
Data security					
Others, specify and rate accordingly					

Indicate the extent to which your organization's performance in terms of annual revenue has been affected by adoption of the 3 cloud computing models. Indicate the extent using a five-point scale, where: 1= No extent 2 = Little Extent 3 = Moderate Extent 4 = Large Extent and 5= Very Large Extent. Tick accordingly.

Cloud Computing Models	**1 – No extent**	**2 - Little extent**	**3 - Moderate extent**	**4 - Large Extent**	**5 - Very Large extent**
Infrastructure as a Service					
Software as a Service					
Platform as a Service					

SECTION D: OPPORTUNITIES OF CLOUD ADOPTION

To what extent do you expect the following opportunities to be realized with cloud adoption in your organization? Indicate the extent using a five-point scale, where: 1= No extent 2 = Little Extent 3 = Moderate Extent 4 = Large Extent and 5= Very Large Extent. Tick accordingly.

Opportunities	**1 – No extent**	**2 - Little extent**	**3 - Moderate extent**	**4 - Large Extent**	**5 - Very Large extent**
Competitive advantage					
Cost reduction					
Operations efficiency					
Scalability of IT resources					

Quick recovery after a failure					
Flexibility in deployment of solutions					
Ease of implementation of security controls					
Others, specify and rate accordingly					

SECTION E: CHALLENGES HINDERING CLOUD ADOPTION

To what extent does your organization face the following challenges in cloud computing adoption? Indicate the extent using a five-point scale, where: 1= No extent 1 2 = Little Extent 3 = Moderate Extent 4 = Large Extent and 5= Very Large Extent. Tick

Challenges	**1 – No extent**	**2 - Little extent**	**3 - Moderate extent**	**4 - Large Extent**	**5 - Very Large extent**
Fear cloud is not secure					
Complexity of implementation					
Lack of skilled personnel					
Regulatory restrictions					
Difficulty in migrating from					

on premises equipment to cloud					
Cloud computing is still an immature technology					
High cost					
Others, specify and rate accordingly					