UNIVERSITY OF NAIROBI

SCHOOL OF COMPUTING AND INFORMATICS

TECHNOLOGY ACCEPTANCE OF CLOUD COMPUTING IN ICT DEPARTMENTS OF THE KENYA GOVERNMENT MINISTRIES

BY

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DECLARATION

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

Signed ………………………… **Date** …………………….

Richard Mwaura Kiarie

P56/70628/2007

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

Signed ………………………… **Date** …………………….

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DEDICATION

To my wife Sarah, Children Kiarie, Kaara and Njeri for their love and support my, father Mwalimu Eliud Kiarie for his love, encouragement, prayers and unending support to this day, to my beloved departed mum the late Mwalimu Elizabeth Njeri Kiarie for making me who I am today and my entire family and friends for their support.

God bless you all

For my departed mother

Mwalimu Elizabeth Njeri Kiarie

who went to be with the Lord on

8th October 2008

when I was pursuing this course.

Your wise counsel and mentorship will forever remain in my heart and

I shall always endeavor to be the

Son you would have wished me to be.

ABSTRACT

Cloud computing is associated with a new paradigm for the provision of computing infrastructure and services. It represents a shift away from computing as a product that is purchased, to computing that is delivered as a service to consumers over the Internet from large scale data centers or ‘clouds’. Clouds provide an infrastructure for easily usable, scalable, virtually accessible and adjustable IT resources that need not be owned by an entity but can be delivered as a service over the Internet. The cloud concept eliminates the need to install and run middleware and applications on users own computer by providing Infrastructure, Platform and Services to users, thus easing the tasks of software and hardware maintenance and support.

The project aimed to understand both the positive and negative factors that can significantly explain Kenya government ICT officers’ acceptance intention and use behavior for cloud computing. The project empirically validated a modified unified theory of acceptance and use of technology (UTAUT) model by adding a “Cloud Risk” construct in the Kenyan government ministries context to determine the effect of negative influences in the acceptance and use of the cloud computing paradigm. Data was collected from a questionnaires distributed to ICT officers in selected government ministries. The partial least squares (PLS) technique of the structural equation model (SEM) was used to evaluate the causal model and the reliability and validity of the model was examined using confirmatory factor analysis (CFA). The new construct of Cloud Risks (CR), was found to have a significant factor affecting ICT officers’ behavioral intention.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CC	Cloud Computing
CSP	Cloud Service Provider
IAAS	Infrastructure as a Service
ICT	Information and Communication Technology
IT	Information Technology
NIST	National Institute of Science and Technology
PAAS	Platform as a Service
PLS	Partial Least Squares
SAAS	Software as a Service
SEM	Structural Equation Modelling
SLA	Service Level Agreement
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Cloud Computing is the latest effort in delivering computing resources as a service. The US National Institute of Standards and Technology (NIST) published a working definition that captured the commonly agreed aspects of cloud computing (Mell and Grance, 2009). This definition describes cloud computing as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. Cloud computing offers its benefits through three types of service or delivery models namely infrastructure-as-a-service (IaaS), platform-as-a-service (PaaS) and software-as-a-Service (SaaS). It also delivers its service through four deployment models namely; public cloud, private cloud, community cloud and hybrid cloud (Mell et al, 2009).

Clouds provide an infrastructure for scalable and adjustable resources such as hardware, development platforms and or services to be virtually accessible and easily usable. Moreover this dynamic nature makes possible the reconfiguration and optimum utilization of such resources. The provider of this pool of resources also guarantees the utilization of these resources by employing customized Service Level Agreements (SLA). A pay per use model is typically used to exploit the resources. Cloud Computing is a departure from computing as a product that is owned to computing as a service that is delivered over the internet from large scale data centers or clouds. The Organizations, instead of investing in internally managed ICT infrastructure, simply rent or pay per use for resources managed and owned by a third party. Cloud services based on cloud computing can free an organization from the burden of having to develop and maintain large-scale IT systems; therefore, the organization can focus on its core business processes and implement the supporting applications to deliver the competitive advantages (Feuerlicht, 2010).

Cloud computing is not simply about technological improvement of data centers but a fundamental change on how IT is provisioned and used (Creger, 2009). Government ministries can benefit from Cloud computing solutions in several areas such as data hosting services, cloud platforms, applications running on the web and infrastructure. The ministries can save costs and time by eliminating ICT related problems and allow them to take advantage of emerging technologies.

1.1.1 An Overview of Cloud Computing

The NIST has identified five essential characteristics of cloud computing (Plummer et al., 2009). These are; On-demand-Self Service where a client can unilaterally provision computing capabilities, such as server time and network storage as needed automatically, without requiring human interaction with each service's provider; Broad network Access where capabilities are accessible over the network and accessed through standard mechanisms that promote use by internet ready devices (e.g., mobile phones, laptops, and PDAs); Multi-tenanted (Resource Pooling) where the provider's computing resources are pooled to be shared by multiple consumers in a multi-tenant model and such resources can be dynamically assigned and reassigned according to consumer demand; Rapid Elasticity where capabilities can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out, and rapidly released to quickly scale in and finally there is Measured Service characteristic where resource usage must be monitored, controlled, and reported which provides transparency for both the provider and consumer of the utilized service.

The NIST has also identified three service or delivery models (Mell et al., 2009). These are Cloud Software as a Service (SaaS) where the applications or software are stored by the provider and accessed from the network by the client who pays for the services consumed with the provider controlling the underlying hardware, platform and the application; Cloud Platform as a Service (PaaS) where the provider manages the infrastructure and the Operating systems with the client deploying onto the cloud infrastructure, consumer-created or acquired applications created using programming languages and tools supported by the provider and; Cloud Infrastructure as a Service (IaaS) where the provider controls the hardware while the client has control over the operating systems and applications that ran on that infrastructure.

In addition, cloud computing has the following four deployment models (Mell et al, 2009), Private Cloud where the cloud infrastructure, which may be managed by an organization or a third party, is operated solely for an organization; Community

Cloud; where the cloud infrastructure, which may be managed by an organization or third parties, is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations); Public Cloud where the cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services and Hybrid Cloud where the cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability.

The adoption of cloud computing in enterprise environment is non-trivial and is a multi-faceted problem. A number of authors have focused on cloud computing, but these works have mostly focused on technical problems and little has been written about the research challenges for cloud computing from an enterprise or organizational perspective (Khajeh-Hosseini, et al, 2011). Research in this field appeared to be split into two distinct viewpoints. One investigates the technical issues that arise when building and providing clouds and the other looks at implications of cloud computing on enterprises and users (Illango, 2010).

Large organizations are inherently complex and for cloud computing to deliver real value to the enterprise rather than simply be a platform for simple tasks such as application testing or running product demos, the issues around migrating application systems to the cloud and satisfying the requirements of key system stakeholders have to be explored. These stakeholders include technical, project, operations and financial managers as well as the engineers who are going to be developing and supporting the individual systems (Khajeh-Hosseini, et al, 2011). In the Government, ICT officers have a significant influence in ICT selection, deployment and use in the government and their acceptance of the cloud computing paradigm is crucial for promoting widespread adoption of the concept.

Currently the typical enterprise IT department is not used to a utility billing model across shared infrastructures; resource sharing across such infrastructures requires a certain level of cultural and organizational process maturity, and the move towards cloud computing will require significant changes to business processes and organizational boundaries (Fellows, 2008). Therefore, users need to consider the benefits, risks and the effects of cloud computing on their organizations and usage-practices in order to make decisions about its adoption and use: the potential for reduced costs could be just one of the persuasively significant benefits of cloud computing (Khajeh-Hosseini, et al, 2011)..

Nicky et al, (2012) examined the technology acceptance of cloud computing by analyzing empirical data from 100 CIOs and IT managers from stock indexed companies in Germany using factor analysis. The outcomes indicated that user acceptance of cloud computing can be explained and predicted by various non monetary variables concerning social influence and cognitive instrumental process. In particular, factors such as image, job relevance and perceived usefulness play an important role in cloud computing acceptance. Kai-Chieh Hu, et al (2012) explored the antecedents of behavioral intentions for cloud computing service based on UTAUT model. The findings indicated that network externalities have significant influence on performance and effort expectancy.

Adoption and implementation of a new innovation requires effort from both the individual and the organization. Adoption is the key stone which contributes to a wide use of the technology in an organization. Understanding the user adoption of new technologies, and the ability to use this information in the implementation process, can improve the use of new technologies in an organization. The adoption of a new technology is not a simple process: it includes many factors which influence the intention to use and different phases of the user experiences.

1.1.2 The ICT Function of the Government

There are various cadres of ICT officers in the government with different responsibilities. The scheme of service for ICT officers created several positions with ICT officer III being the lowest rank and on the other end, Secretary of ICT who has an advisory role to the government on the ICT policy to pursue.

ICT personnel play a central role in technology selection, evaluation, maintenance, support and training wherever they are deployed. ICT units at the ministry level are usually headed by an Assistant Director or a Principal ICT officer. Their duties include planning, monitoring and evaluating program activities; ensuring ICT goals and objectives are met; approving of ICT standards for application; liaising with users to ensure that information processing needs are met; reviewing and evaluating feasibility studies and reports for implementation; management and coordination of the unit; Supervising ICT officers; providing assistance in the development of ICT strategic plans; ensuring that ICT projects are completed within the planned time and budget; ensuring that procedures and standards are adhered to; liaising with heads of Department in the Ministries/Departments in developing and implementing change management initiatives; ensuring that officers are adequately trained; drawing up the budget for the ICT unit; and procurement of ICT equipments and services (GOK ICT Scheme of Service, 2007). The organization structure of the ICT function in government is depicted in Figure 1.

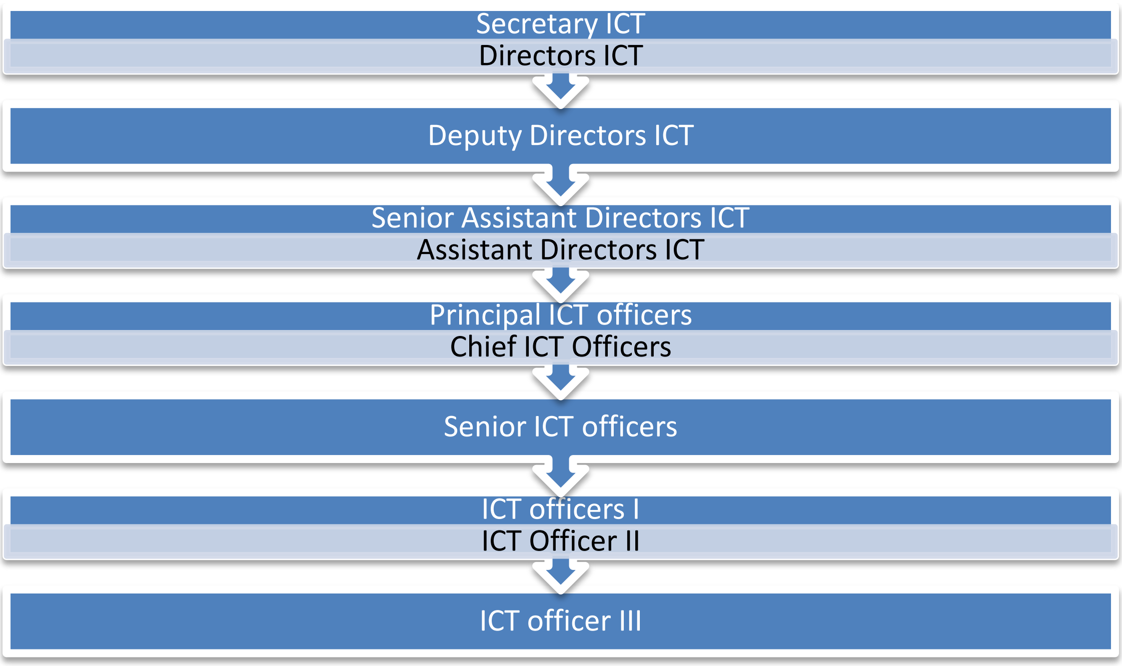

Figure 1: Organization Structure of ICT for GOK

The proliferation of inexpensive computing infrastructure has become an essential element of running the affairs of Ministries in the Kenya Government. For efficient and effective governance and public administration, it is imperative that an organization is supported by modern information technology. In practice, however, effective use of information technology and successful development of information systems in public sector are not easy. Government organizations face great levels of uncertainty in developing and providing e-Government services because of the complexity of the technology, deeply entrenched organizational routines, and great diversity in the acceptance of technology by individuals. E-Government requires much more than technical wizardry for developing and operating successful online services (Gant, 2008). "… *Government's current Information Technology (IT) environment is characterized by low asset utilization, a fragmented demand for resources, duplicative systems, environments which are difficult to manage, and long procurement lead times. These inefficiencies negatively impact the … Government's ability to serve the … public*. (Kundra, 2011, p1)

Government ministries should consider adopting the cloud computing paradigm. Cloud Computing is increasingly being considered as a technology that has the potential of changing how the Internet and the information systems are presently operated and used (Sharif, 2010). Cloud computing has the potential of radically changing how information services are provisioned in the government to make them more cost effective, efficient and easier to manage.

1.2 Statement of the problem

According to a recent survey (KPMG, 2010), government organizations and financial institutions are relatively reluctant to use cloud computing services. Compared to the private sector, the public sector still trails in adoption of cloud computing. Moreover, global public-sector cloud computing adoption remains more in the investigative stages than in actual deployments, whereas the private sector seems more willing to invest in and deploy the technology (Montalbano, 2011).

While existing research on cloud computing has been undertaken from the service-providers "perspective", there is need for further research that focuses on the organizational users "perspective" (Clarke, 2010; Svantesson and Clarke, 2010). While cloud computing is an emerging phenomenon, there is paucity of research concerning the perceived risks that affect the adoption intentions of prospective organizational adopters. In order to ascertain the organizational issues associated with adoption of cloud computing in the ministries, the following research problem is presented: "***What factors explain the technology acceptance of cloud computing model by ICT personnel in the Kenyan government Ministries?"***

1.3 Research Objectives

The main objective of this study was to analyze the adoption of an emerging computing paradigm called cloud computing and get empirical evidence of its acceptance by ICT officers in Kenya government ministries. The study was conducted from ICT personnel's point of view to determine the factors that explain the acceptance of cloud computing paradigm among ICT staff in the Kenya government Ministries.

We derived the factors of acceptance from a modified version of the common Unified Theory of Acceptance and Use of Technology (UTAUT) Model by Venkatesh et al. (2003) and reviewed the ability of transferring the factors of UTAUT to the cloud computing technology by empirical research:

1.4 Specific Objectives

i. Determine the effect of Performance Expectancy on the behavior intention to use cloud computing
ii. Determine the effect of Effort Expectancy on the behavior intention to use cloud computing
iii. Determine the effect of Social Influence on the behavior intention to use cloud computing
iv. Determine the influence of Cloud Risks on the behavior intention to use cloud computing
v. Determine the effect of Facilitating Conditions on the use behavior to cloud computing

1.5 Research questions

The following research questions were posed:

i. What influence does Performance Expectancy has on the behavior intention to use cloud computing?
ii. What influence does Effort Expectancy has on the behavior intention to use cloud computing?

iii. What influence does Social influence has on the behavior intention to use cloud computing
iv. What influence does Cloud Risks have on the behavior intention to use cloud computing
v. What influence does Facilitating Conditions have on the use behavior to cloud computing

1.6 Significance of the study

The findings of the study will be of great importance to the Government's ICT function as it provides information to management across the entire spectrum of the organizations on factors that can lead to acceptance or cause hindrance to cloud computing paradigm. It contributes new knowledge and forms an appropriate framework upon which introduction of new technology such as cloud computing may be planned and implemented in future at the individual ministries.

Researchers and academia will gain insight into understanding issues that may influence acceptance of cloud computing in other similar organizations. It will contribute to the ever increasing literature on Cloud Computing technology acceptance and its challenges.

Practitioners in technology adoption management will benefit from the study by having an important reference to a practical case on technology acceptance that highlights important aspects of accepting new technologies and perceived risks that may hinder acceptance which can help them borrow those practices that will guarantee success and avoid those that can be obstacles to realization of the deployment of new technology.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

Cloud Computing is associated with a new paradigm for the provision of computing infrastructure. The future of computing lies in cloud computing, whose major goal is reducing the cost of IT services while increasing processing throughput, reliability, availability, and flexibility and decreasing processing time (Hayes, 2008). Goscinski and Brock (2010) indicated that computing resources hosted within the cloud can perform in many roles such as database services, virtual servers, service workflows or configurations of distributed computing systems.

We first review the various frameworks that can be used to study the problem. Afterwards we explain the basis of the Unified Theory of Acceptance and Use of Technology (UTAUT) Model; it includes a description of the different factors given by the model and the interdependencies between these factors to explain the acceptance of a new technology. Later we give an overview about cloud computing by defining this term out of an unstructured literature review. We then reproduce benefits and risks of cloud computing from research literature. Finally we present our conceptual framework.

2.1. Technology Adoption Frameworks

Many competing theoretical models have been proposed and adopted in the research of user acceptance and adoption of information technology innovation, each with a different focus and tested in different contexts and countries. This section will examine a number of frameworks that have been used in Information Systems research. It will give a concise description of the theory, and then examine the main dependent construct(s) /variable(s), the main independent construct(s) / factors, and finally the level of analysis. The Applicability of the theory to analyzing the problem on hand will then be done. Finally the basis for selecting our framework will be given.

2.1.1. Delone and McLean IS Success Model

The model sought to understand and measure IS success and was introduced in 1992 by William H. DeLone and Ephraim R. McLean. The authors classified the factors for success for IS into six major categories after reviewing the various different measures that had been in IS literature to evaluate IS success. They showed the interdependencies between different success categories by creating a measuring model which was multidimensional (Delone and McLean, 1992) as depicted as in Figure 2.

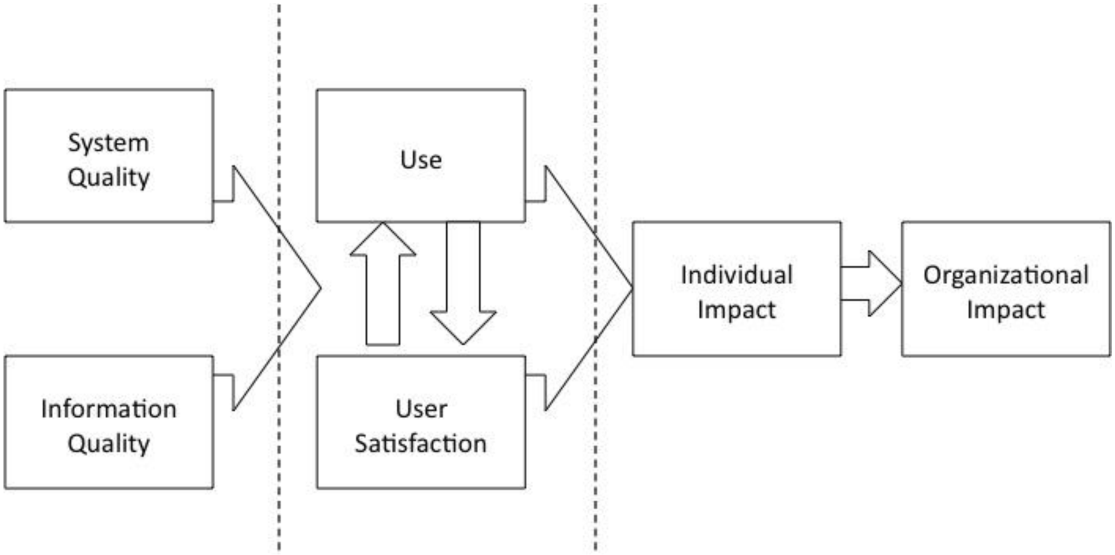

Figure 2: Delone and Mclean IS Success Schematic of the Theory Diagram/Schematic of the Theory

The diagram shows two independent constructs namely systems quality and information quality that have an effect on both use and user satisfaction. The measure of the information processing system itself is depicted by *Systems quality* while the output is measured by *Information Quality.* Every information system generates information targeted to specific recipients. Those who receive and use the information and their response to such use is measured by *Use and User Satisfaction* respectively. The recipient's behavior may be from affected from the use of the system and this is measured by *Individual impact* whereas the effect on the performance of the organization arising out of the system is measured by Organizational *Impact*.

After publication of the original model, Delone and Mclean evaluated many contributions to it, and proposed an updated IS model for IS success (DeLone and McLean 2002, 2003).

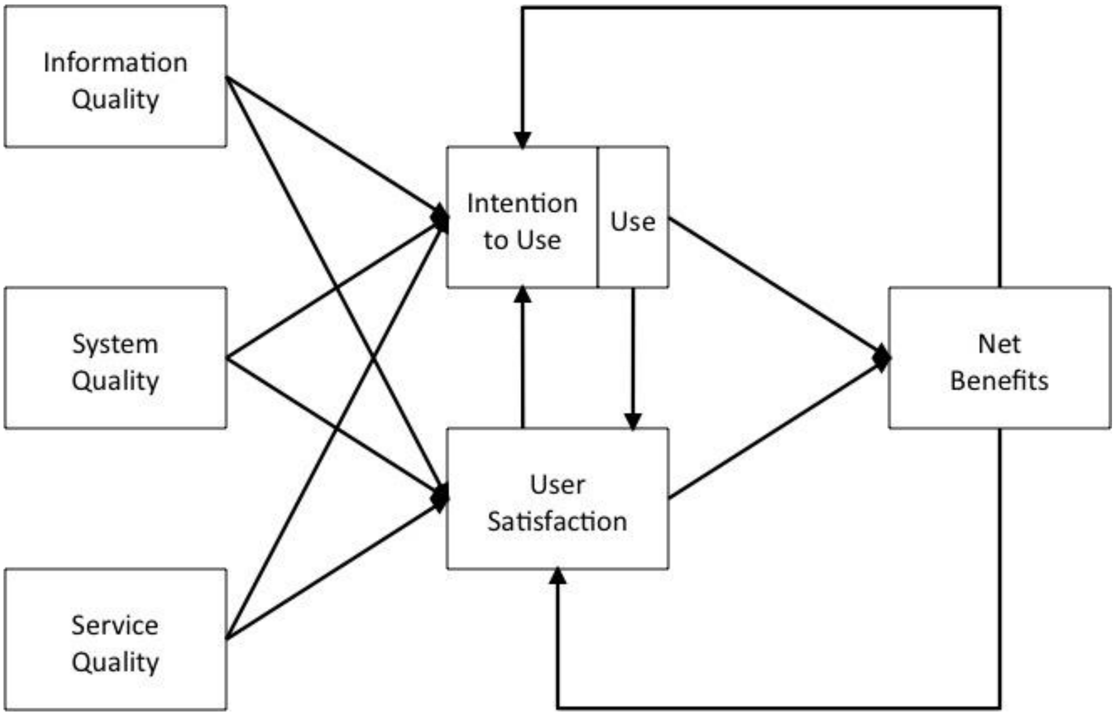

Figure 3: Delone and Mclean Updated Model (2003)

Dependent Constructs – Net benefits, user satisfaction, intention to use

Independent Constructs – Service quality, System quality, Information Quality

The model according, to Delone and Mclean (2003), was to be analyzed at both the organizational and individual levels of analysis. This means that if a particular information system is used, there are expected benefits that will arise from it which can be both positive and negative which can influence user satisfaction and consequently further use of the information system. A user will decide to use a particular system based on his/her perception on the quality of information obtained from the system, the quality of the system itself and quality of service offered by the system. These three factors may influence the intention to use or actual use of the system. They also influence the user satisfaction if the user decides to use the system. This can be depicted in Figure 3.

The model is used to analyze the success of an information system and not the tools or approaches for providing such systems. Cloud Computing is a tool/approach to providing Information Services in an organization. The model can therefore not be appropriate for studying the problem on hand.

2.1.2. Diffusion of Innovations (DOI) Theory

Individuals adopt innovations to different degrees. According to Rogers (1995), the willingness to adopt innovation can be segmented into five categories. These are innovators who are seen as educated, venturesome, and with, multiple info sources, Early adopters who are perceived as popular, social leaders, and, educated; Early majority who are perceived to have many social contacts that are informal; Late majority seen to belong to lower socio-economic status and are usually skeptical; and Laggards who are noted to fear getting into debt and rely on neighbors and friends as main information sources. These can be depicted in Figure 4.

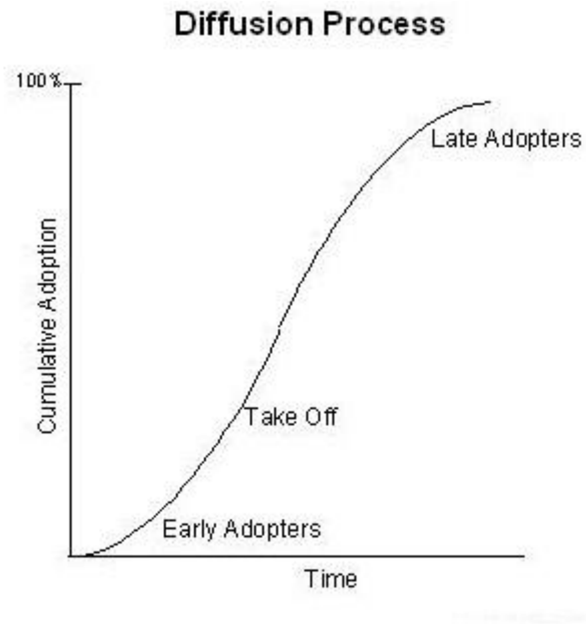

Figure 4: Diffusion Process for Innovation. Source Rogers (1995)

The adoption of innovations rate, as indicated in Figure 4 above, is influenced by five factors: namely relative advantage, trialability, compatibility, observability, which are positively correlated and complexity that is negatively correlated with the adoption rate (Rogers, 1995).

The five factors for innovation by Rogers were later expanded into eight with scales used to operationalize them validated in a study by Moore and Benbasat (1991). The eight factors that influence the adoption of IT were relative advantage, voluntariness, image, compatibility, ease of use, visibility, result demonstrability, and trialability (Moore and Benbasat, 1991). A generalized model arising from Diffusion of

Innovation Model has been developed showing that Relative Advantage (Perceived Need), Technical Complexity (Ease of Use) and Technical compatibility are the important antecedents to IS implementation success (Adoption and Infusion) (Bradford and Florin, 2003; Crum et. al., 1996) as shown in the figure 5.

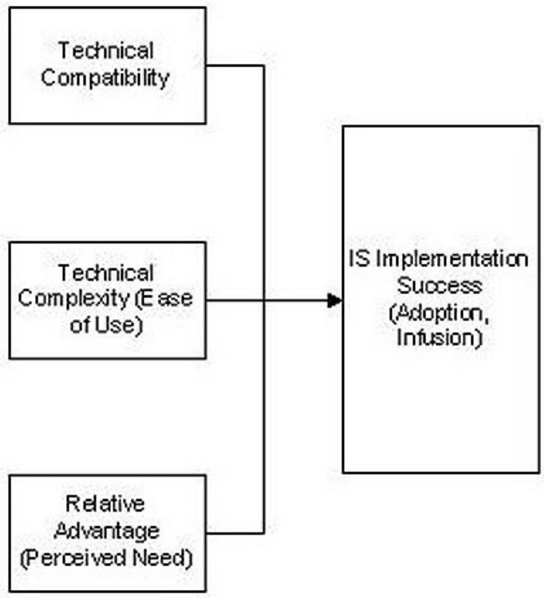

Figure 5: Diffusion of Innovation (Extended) – Source Crum et al (1996)

The model, in the context of this study can be useful in determining why some individuals would be quick to adapt new technologies. However, cloud computing is a radical departure from the traditional methods of providing information services in an organization. This model may not fully address what may influence individual ICT officers to depart from the current mode of provisioning of IT services to cloud based solutions.

2.1.3. Task Technology Fit (TTF)

The model posits that Utilization of Technology and its Impact on Performance depend on how the Technology and the Task on Hand fit together. This means that a user may be having a particular task that they wish to carry out and can only be successful if the technology available is appropriate for that task. If there is a mismatch, then either the technology will not be utilized or may adversely affect the performance. Task-technology fit (TTF) theory holds that IT is more likely to have a positive impact on individual performance and be used if the capabilities of the IT match the tasks that the user must perform (Goodhue and Thompson, 1995). Goodhue and Thompson (1995) developed a measure of task-technology fit that consists of 8 factors: quality, locatability, authorization, compatibility, ease of use/training, production timeliness, systems reliability, and relationship with users. Goodhue and Thompson (1995) found the TTF measure, in conjunction with utilization, to be a significant predictor of user reports of improved job performance and effectiveness that was attributable to their use of the system under investigation. This can be depicted by Figure 6

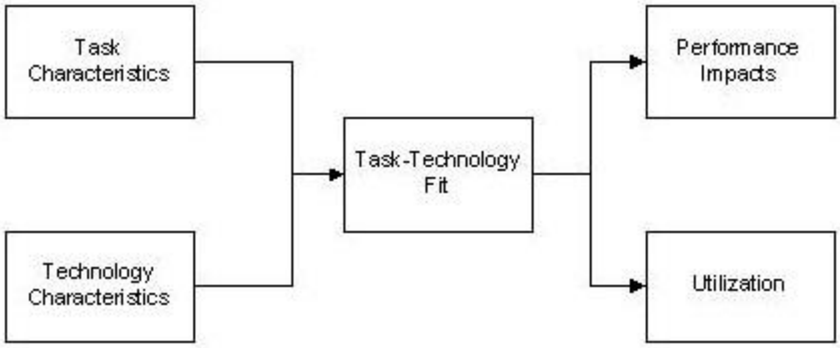

Figure 6: Task Technology Fit Framework, Source Goodhue and Thompson (1995)

In the context of this study, we can examine the various tasks that ICT officers perform in the government and the technology available such as cloud computing. If there is a good match, then there is likelihood of adopting the technology and also improve the performance of ICT officers. However, due to the diverse tasks carried out by the officers, this model was not found to be appropriate in addressing the problem statement.

2.1.4. Technology Organization Environment Framework (TOE)

This theory posits that there are three factors that influence the adoption of technology in an organization. These are Environmental Factors, Organizational factors and the technology factors. These three elements present "*both constraints and opportunities for technological innovation*" (Tornatzky and Fleisher 1990, p. 154). The level of analysis is organizational.

The organizational factors depict the characteristics and resources of the organization that can influence the adoption of technology these include size, communication processes, formal and management structures, human resources and the amount of free resources available. The technology factors are its availability and characteristics for both equipment and processes. The External Environmental factors are industry characteristics and market structure, technology support infrastructure and government regulation (Tornatzky and Fleisher 1990). This can be depicted by Figure 7

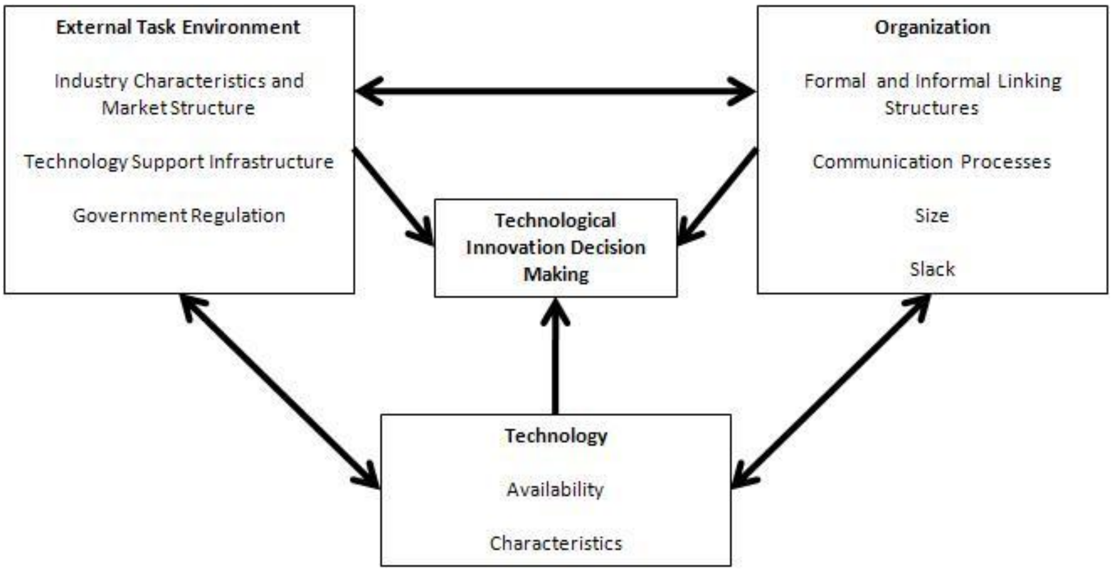

Figure 7: TOE Framework

This theory was not found appropriate in this study since its level of analysis was the organization whereas our focus was the individual ICT officer.

2.1.5. Theory of Reasoned Action (TRA)

TRA posits that individual behavior is driven by behavioral intentions where behavioral intentions are a function of an individual's attitude toward the behavior and subjective norms surrounding the performance of the behavior (Fishbein and Ajzen, 1975). One of the independent constructs is subjective norm, which is defined as a perception the individual has on people that are important to them on whether to perform the behavior. The other independent variable is attitude towards behavior which is individual’s feelings that can be both positive and negative about performing a behavior which is determined through and evaluations of one’s belief on the consequences of performing a particular behavior and the desirability of the outcomes. Behavioral intention is the dependent construct. This can be depicted diagrammatically in figure 8:

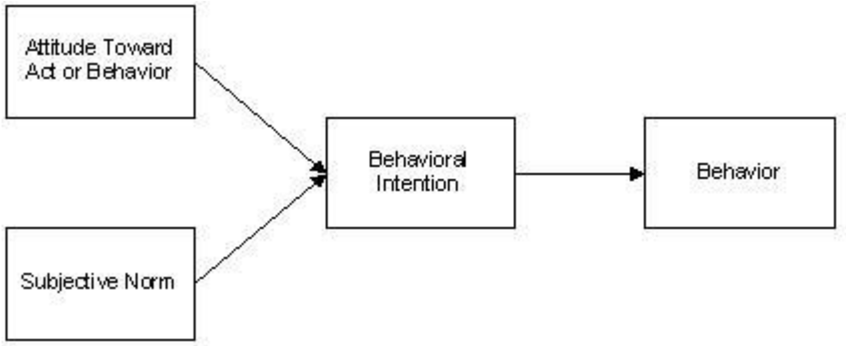

Figure 8: Theory of Reasoned Action

Dependent Constructs – Behavioral intention

Independent constructs – Attitude toward behavior, Subjective Norm

An important limitation of the model is the assumption of freedom to act without limitation after someone has formed the intention to act which in practice, is constrained by factors such as limited ability, time, environmental or organizational limits, and unconscious habits (Ajzen, 1991). In the current study, ICT officers may form the intention to adopt cloud computing concept but the government policy may prevent them from acting.

2.1.6. Theory of Planned Behavior (TPB)

The theory of planned behavior attempts to resolve the limitation of freedom to act in the Theory of Reasoned Action. Ajzen (1991) posits that individual behavior is driven by behavioral intentions where behavioral intentions are a function of an individual's attitude toward the behavior, the subjective norms surrounding the performance of the behavior, and the individual's perception of the ease with which the behavior can be performed (behavioral control) as depicted in figure 9.

Attitude toward behavior, like in the theory of reasoned action, is an individual’s own assessment on consequences and desirability of performing a particular behavior, while subjective norm is the perception the individual has on people who are important to him on whether the behavior should be performed. The perceived difficulty of performing a behavior is defined as Behavioral control. Although

Ajzen(1991) has suggested that the link between behavior and behavioral control outlined in the model should be between behavior and actual behavioral control rather than perceived behavioral control, the difficulty of assessing actual control has led to the use of perceived control as a proxy.

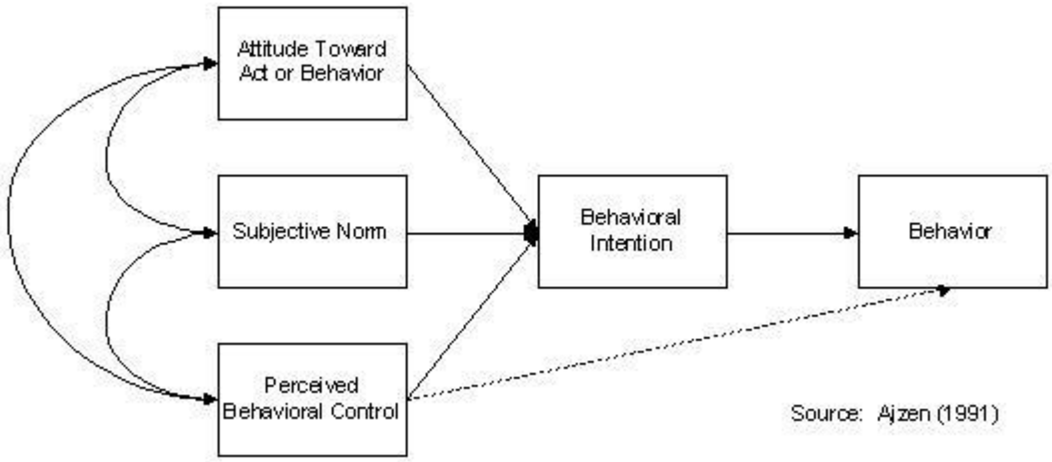

Figure 9: Theory of Planned Behavior

Dependent Constructs: behavioral intention, behavior

Independent Constructs: Attitude towards behavior, Subjective Norm, Perceived Behavioral control

2.1.7. Technology Acceptance Model (TAM)

Technology Acceptance Model (TAM), shown in Figure 10 (Davis 1989, Davis et al. 1989) is one of the implementing theories that is most used and cited. This model posits that two independent factors namely perceived ease of use and perceived usefulness have an influence on a dependent construct called intention to use and ultimately the usage behavior. Venkatesh et al. (2003, p. 428) explain that “TAM was designed to predict information technology acceptance and usage on the job.” In the Technology Acceptance Model, the fundamental factors that influence ICT officers' attitudes towards using cloud computing and intended use are Perceived Usefulness and Perceived Ease of Use. Perceived Usefulness is how a user feels that the innovation contributes to make the work more effective and improves the results. Perceived Ease of Use measures the effort the user has to exert to use the system. They are both influenced by external variables. Venkatesh and Davis (2000) extended the model with explanations on what contributes to Perceived Usefulness and Perceived Ease of Use. The new model is called TAM 2 (Venkatesh and Davis 2000, Chuttur 2009).

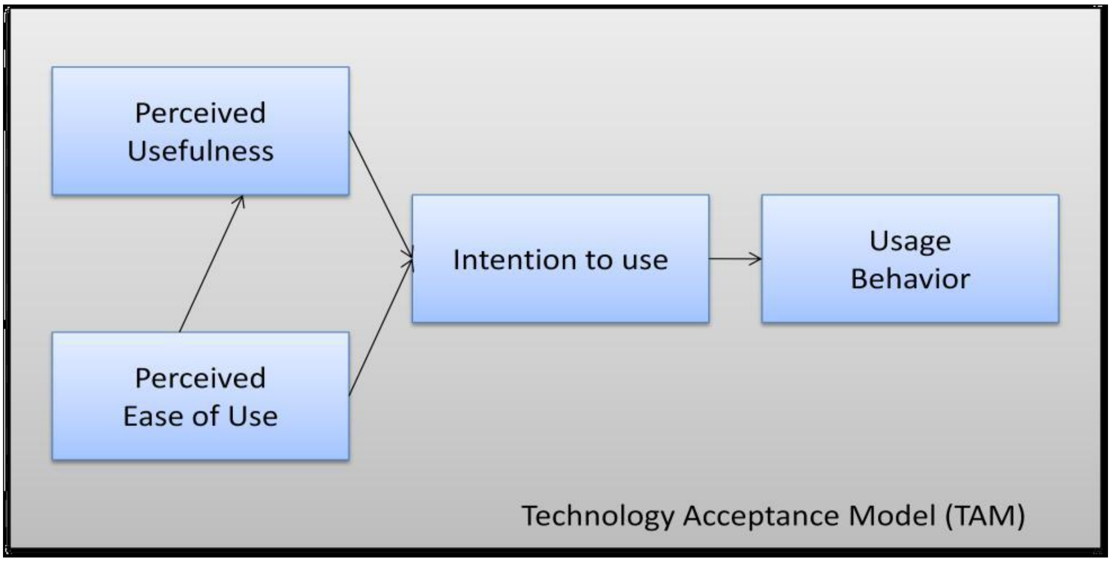

Figure 10: Technology Acceptance Model (TAM) Venkatesh and Davis 2000, p 188)

Dependent Constructs – Intention to use, Usage Behavior

Independent Constructs – Perceived Usefulness, Perceived Ease of Use

TAM 2 is the extended version of the technology acceptance model, proposed by Venkatesh and Davis (2000). The model is extended with factors that affect both Perceived Usefulness and Perceived Ease of Use. The factors that influence the perceived usefulness are Result Demonstrability, Output quality, Job relevance, Image and Subjective Norm. Subjective Norm is moderated by two factors namely Experience and voluntariness.

Subjective Norm is defined as a person's perception that most people who are important to him think he should or should not perform the behavior in question (Fishbein, 1975). This may include one's superiors, co-workers, professional colleagues, friends and even family. Image is the "degree to which use of an innovation is perceived to enhance one's status in one's social system" (Moore, 1991). Therefore, Image can be seen as what an individual feels that he is portraying to others by using a particular technology.

Voluntariness is the perception by the user on whether the use of technology is mandatory or otherwise. Job relevance explains the user's perception on the fit between the technology and the task in terms of supportiveness in the achievement of goals. The indicator of the technologies in performing regular work tasks well is reflected by Output Quality, while the last factor Result Demonstrability is an indicator of the results of the system to signify how useful a technology is. Without any existing demonstrable positive results from the technology, the user might have doubts about the usefulness of the technology and how the technology can be used. Venkatesh and Davis (2000) state that implementing an effective system can lead to failure if the Perceived Usefulness cannot be demonstrated. The diagrammatic representation of TAM 2 is as in Figure 11.

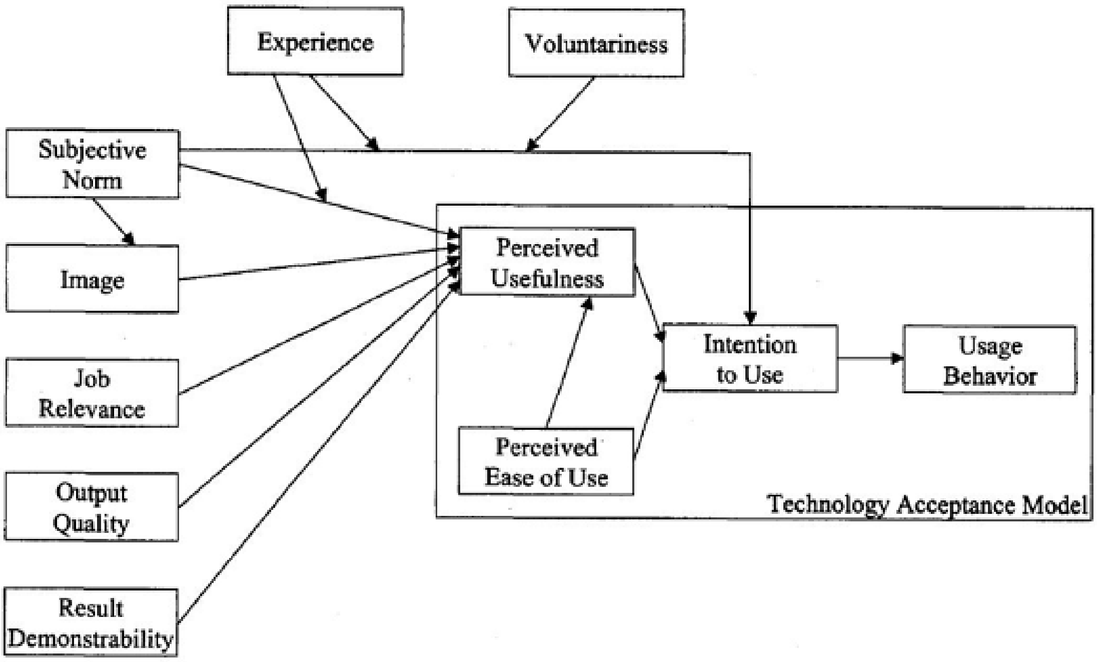

Figure 11: TAM 2 - Factors influencing Perceived Usefulness (Venkatesh and Davis 2000, p. 188)

2.1.8. UTAUT Model

Venkatesh et al. (2003) proposed The Unified Theory of Acceptance and Use of Technology (UTAUT) (depicted in figure 12) which compared and combined eight previous adoption theories through empirical studies; the Theory of Reasoned Action, Technology Acceptance Model (TAM1 and TAM2), Motivational Model, Theory of Planned Behavior, Combined TAM and TPB, Model of PC Utilization, Innovation Diffusion Theory, and Social Cognitive Theory. UTAUT is used in this study in the analysis of the gathered data.

In the UTAUT model the independent constructs are Performance Expectance, Effort Expectancy, Social Influence which have a direct influence on behavioral intention while the other independent construct Facilitating Conditions has direct influence on the actual use behavior of the system.

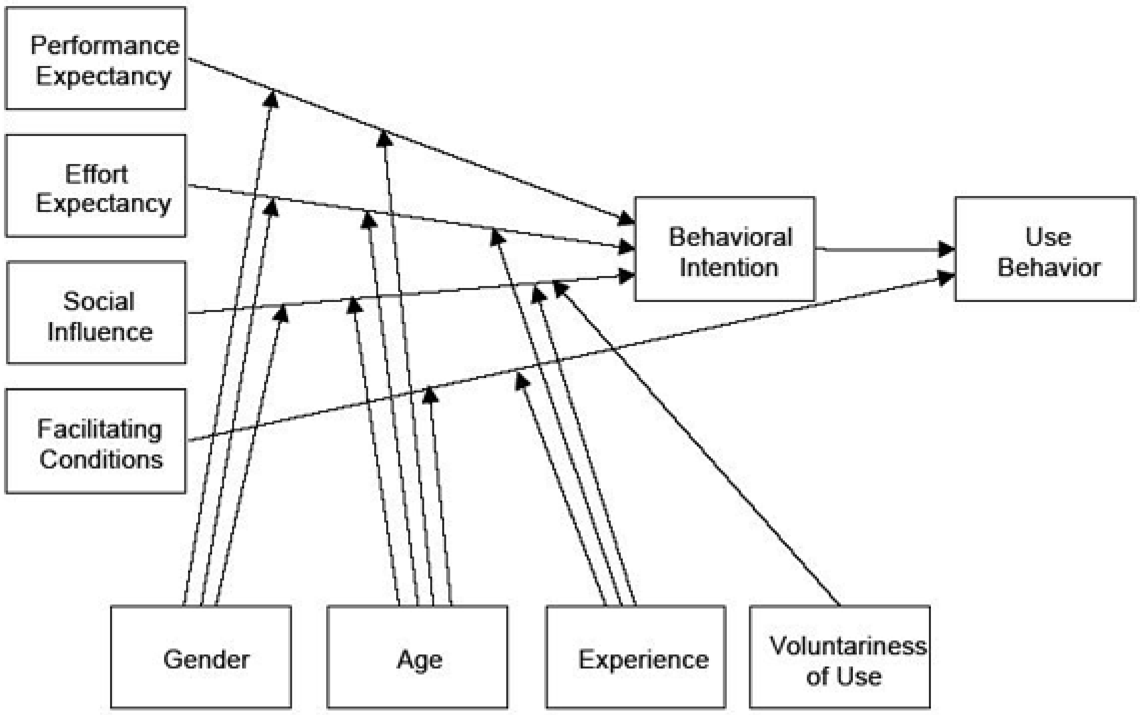

Figure 12 UTAUT Model (Venkatesh et al. 2003, p. 447)

Dependent Constructs – Behavioral Intention, Use Behavior

Independent Constructs – Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions

Moderating Variables – Gender, Age, Experience, Voluntariness of use

Venkatesh et al. (2003) defined Performance Expectancy as perception the individual has that the system will improve job performance which he argued was the most influential factor on behavioral intention. Effort Expectancy reflects the amount of time and degree of effort individuals think will be spent using the system. Social Influence is what the user considers others to think of a system while Facilitating Conditions includes the equipment and other infrastructure that are necessary to use the system. This is the model that was used in this study.

2.2. Cloud Computing

Although the term cloud computing is new, its concepts are not new. Cloud computing borrows terms and concepts from other computing paradigms such as utility computing, grid computing, service oriented architecture among others (Luis et al., 2008, Buyya et al., 2008). Cloud computing, or the use of Internet-based technologies to conduct business, is recognized as an important area for IT innovation and investment (Armbrust et al., 2010; Goscinski and Brock, 2010; Tuncay, 2010). Cloud computing has spread out through the main areas related to information systems and technologies, such as operating systems, application software and technological solutions for firms (Armbrust et al., 2010).

Cloud Computing has been defined as a type of “parallel and distributed system consisting of a collection of interconnected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements established through negotiation between the service provider and consumers” (Buyya et al., 2008, p. 6).

“Cloud computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services. The services themselves have long been referred to as Software as a Service (SaaS). The datacenter hardware and software is what we will call a Cloud. When a Cloud is made available in a pay-as-you-go manner to the general public, we call it a Public Cloud; the service being sold is Utility Computing. We use the term Private Cloud to refer to internal datacenters of a business or other organization, not made available to the general public. Thus, Cloud Computing is the sum of SaaS and Utility Computing, but does not include Private Clouds” (Armbrust et al. 2010, p50). They especially perceive the following aspects as new: (1) the illusion of infinite computing capacity available on demand, (2) the elimination of up-front commitment to resources on the side of the cloud user, and (3) The usage-bound pricing for computing resources on a short-term basis (Armbrust et al. 2010).

Another definition is as follows: “clouds are a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically reconfigured to adjust to a variable load (scale), allowing also for an optimum resource utilization. This pool of resources is typically exploited by a pay-per-use model in which guarantees are offered by the Infrastructure Provider by means of customized SLAs" (Luis et al. 2009, p51).

Although there are many definitions of cloud computing, such as the ones above, the US National Institute of Standards and Technology (NIST) has published a working definition that has captured the commonly agreed aspects of cloud computing (Mell and Grance, 2009). This definition describes cloud computing as a model for enabling convenient, on demand network access to a shared pool of configurable network resources (e.g. network, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (Mell et al, 2009). According to NIST, this cloud model promotes availability and is composed of five essential characteristics (Plummer et al, 2009) these are on demand self service, broad network access, resource pooling (Multi-tenancy), rapid elasticity and measured service.

Most authors agree that Cloud Computing spans around application services, infrastructure, scalability and internet or network. In addition, many authors mention pay-per-use models and virtualization, however, this is considered a fundamental prerequisite (Armbrust et al. 2010) and is thus not explicitly mentioned by many authors.

In this project we have adopted the definition of Cloud Computing as given by NIST summarizing it as an emerging ICT concept that involves transferring the provisioning of ICT services from within the organization to third parties. The 3rd party will provide services on demand that have expandable resource scalability, with little or no upfront costs.

2.2.1. Opportunities for Cloud Computing

Cloud computing provides a scalable online environment which facilitates the ability to handle an increased volume of work without impacting on the performance of the system. Cloud computing also offers significant computing capability and economy of scale that might not otherwise be affordable to businesses, especially small departments that may not have the financial and human resources to invest in IT infrastructure. Cisco IBSG (2009) examined some of the benefits of cloud computing which are summarized in table 1

Table 1: Benefits of Cloud Computing: Source Cisco IBSG 2009

BENEFIT	COMMENT
Cost Savings	Organizations need not own computing infrastructure, or have large IT staff but simply pay only for the services they use.
Ease of Implementation	Without the need to purchase hardware, software licenses, or implementation services, an organization can implement cloud computing rapidly.
Flexibility	Cloud computing can increase mobility of staff by allowing them to access business information and applications from a wider range of locations and/or devices.
Scalability	Organizations can add and subtract capacity as the network load dictates.
Access to Top-End IT Capabilities	Particularly for smaller organizations, cloud computing can allow access to hardware, software, and IT staff of a caliber far beyond that which they can attract and/or afford for themselves.
Redeployment of IT Staff	By reducing or doing away with constant server updates and other computing issues, and eliminating expenditures of time and money on application development, organizations may be able to concentrate at least some of their IT staff on higher-value tasks.
Focusing on Core Competencies	Cloud computing may make it much easier to reduce or shed unnecessary technical functions, allowing organizations to concentrate their efforts on issues central to their mission

A major attraction of cloud services is access to computing power at affordable costs. Organizations can provide unique services using large-scale resources from cloud service providers and add or remove capacity from their IT infrastructure to meet peak or fluctuating service demands while paying only for the actual capacity used

(Sotomayor et al. 2009) on a ‘pay-as-you-go’ economic model. IDC (2008) did a research on the top cloud benefits that are summarized in figure 13

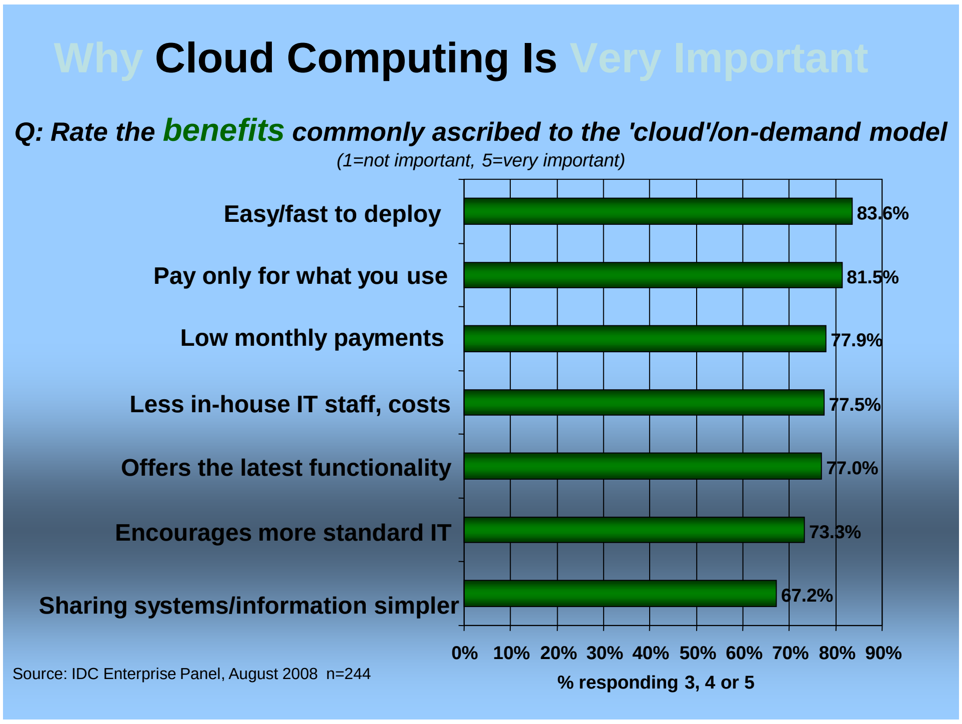

Figure 13: Why Cloud Computing is Very Important: Source IDC 2008

Advantages of using cloud services can also go beyond cost savings as cloud computing allows clients to avoid the expense and time-consuming task of installing and maintaining hardware infrastructure and software applications; and allow for the rapid provisioning and use of services to clients by optimizing their IT infrastructure (Lewin, 2009).

2.2.2. Cloud computing challenges

The adoption of cloud computing is an emerging challenge that enterprises face as popularity of this approach rises. The drawback of this paradigm is far from straight forward because the suitability of the cloud for many classes of systems is unknown.

Among the major issues raised are technological issues, economic issues such as utility billing model of cloud computing, security, legal and privacy issues, organizational challenges and political issues (Khajeh-Hosseini, et al, 2010). The technological and political issues are beyond the scope of this project but security challenges will be highlighted before addressing the major risks associated with the use of this paradigm.

IDC (2008) did a research on the top cloud computing issues that are summarized in figure 14. According to Grance et al (2010), security is still a major issue in cloud computing. Security is always a major factor for ICT establishments, more so with Cloud Computing multi-tenancy models. It is necessary to address the number of challenges that affects security in the cloud. This will enable organizations policy makers to have trust in the new paradigm. The three fundamental tenets of information security are confidentiality, integrity, and availability (CIA). Confidentiality is the prevention of the intentional or unintentional unauthorized disclosure of contents. Integrity is the guarantee that the message sent is the message received and that the message is not intentionally or unintentional altered. Availability ensures that connectivity is accessible when needed, allowing authorized users to access the network or systems (Ronald L. Krutz, Russell Dean Vines, 2010).

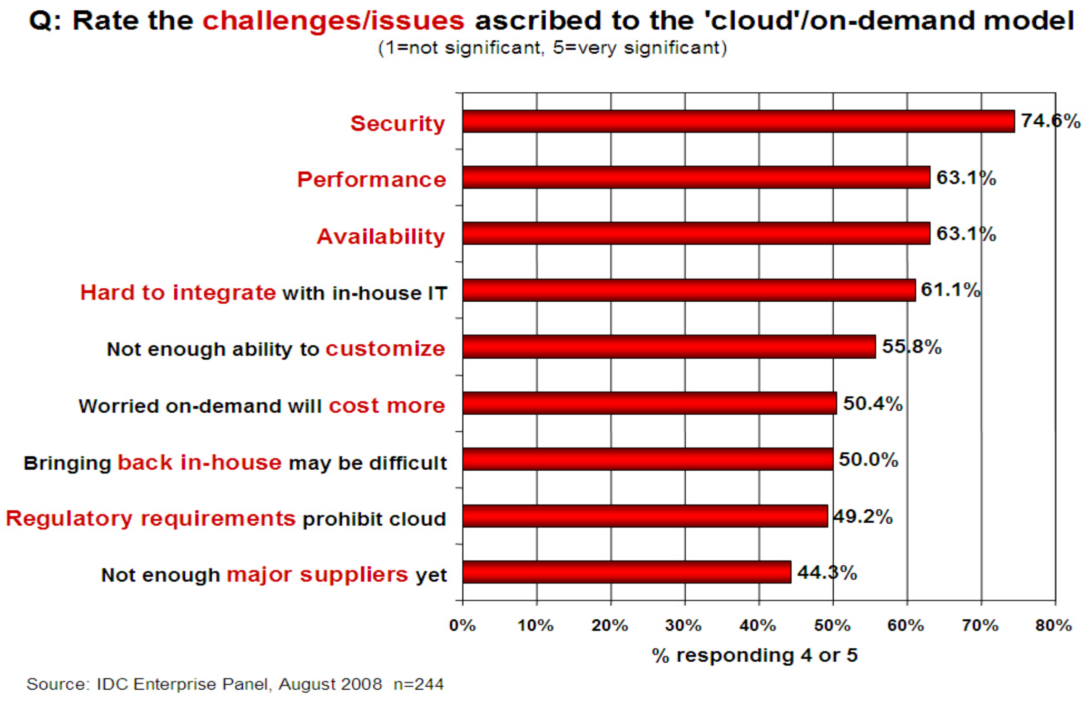

Figure 14: Cloud Computing Issues (Source IDC 2008)

2.2.3. Cloud Risks

The introduction of any new technology to an organization brings many risks associated with its implementation and use. Introducing the cloud environment in an organization as vast and complex as the government exacerbates the intricacies and potential risks enormously. Implementing a cloud computing platform incurs different risks than dedicated data agency data centers (Paquette, 2010).

Risk is defined as the possible impact of an event on an organization's assets and the corresponding expected and unexpected consequences that occur as a result (Levin and Schneider, 1997; Stoneburner, Goguen, and Feringa, 2002). In measurable terms, risk is a statistical measure that encapsulates the consequence of a loss by the chance of its occurrence (Crouhy, Galai, and Mark, 2006). A managerial perspective of risk in IT outsourcing associates risks with "danger or hazard" perceptions that can result in negative outcomes (March and Shapira, 1987). In this study we adopt the managerial perspective of risk. This choice is a useful proposition, particularly given the emerging nature of cloud computing and its pertinence to managers.

There is widespread agreement in the literature that even in established relationships between organizations, risks might exists on whether partners have the intention or will to, in fact, act appropriately as specified in IT outsourcing SLAs (Cullen and Willcocks, 2003; Liang, et al., 2005). These risks can erode relationships and potentially increase costs for both providers and their clients (Rousseau, et al., 1998) and may operate in cloud computing contexts as well (Paquette, Jaeger, and Wilson, 2010). In an emerging area such as cloud computing, prospective adopting organizations may find it challenging to easily and clearly associate risk with well-understood or widely-accepted cost structures (Paquette et al., 2010).

Closely related to risk is the notion of risk management. In cloud settings, risk management is the process of developing risk-adjusted strategies that attempt to balance opportunities that cloud computing offers with likely positive and negative consequences of taking advantage of them (Crouhy et al., 2006; Straub and Welke, 1998). That is, risk management can help deal with the consequences of "*modification, destruction, theft, or lack of availability of computer assets such as* *hardware, software data and services*" (Straub and Welke, 1998, p. 442) that are likely to occur in cloud settings.

In cloud computing contexts where sensitive data is held and operations are carried out outside organizational boundaries, risk can increase substantially as client organizations can expose themselves to failure risk or opportunism from their cloud providers (McCutcheon and Stuart, 2000). Examples include computer misuse, disaster, violation of access privileges and restrictions, intellectual property theft, data loss or damage (Paquette et al., 2010). Consequently, clients may want strong guarantees that cloud providers will not opportunistically share their data with others or that the computing resources that the providers offer will be reliable and impenetrable to illicit hacking activities from both outsiders and even cloud co-tenants. While risk management can be complex and ensuing outcomes or consequences not necessarily precise, identifying cloud computing risks is the first step that can allow these risks to be managed and mitigated (Paquette et al., 2010).

In this section a brief dissection of some of the sources of the perceived threats resulting into trepidation is done. The most common threats (Alcade et al, (2009), Andert et al., (2002), Armbrust et al., (2010), Catteddu and Hogben, (2009), Chow et al., (2009), ENISA (2009), Paquette, (2010), Troshani et al (2011))are described :

i. **Vendor Lock-In and Lack of Standards**: Lack of standards makes it difficult to develop applications that are compatible with multiple vendors. In addition, proprietary tools offered with cloud solutions that work only within the CSP's specific solution architecture make it difficult for the customer to migrate from one provider to another or back to an in-house IT environment. This introduces dependency on a particular CP for service provision and may create a monopoly situation by locking a Ministry into a single source (Paquette, et al, 2010).

ii. **Loss of Governance / Control**. Migration to cloud environments entails ceding control of computing capabilities and resources to cloud providers which can be seen as dependency that can adversely affect clients' ability to control service delivery and quality. Additionally, cloud providers may outsource specialized functions which can extend client dependency to third parties thereby potentially complicating both coordination chains and recourse to remedies in cases of non-compliance with SLA specifications (Troshani, 2011).

iii. **Cloud Provider Viability**. If the vendor goes out of business, faces bankruptcy, terminates their services, or is subsumed by another vendor, the custody, safety and availability of the data it had stored may be in question (Paquette, 2010).

iv. **Security and Privacy Issues in the Cloud.** If information in the clouds were to be compromised from internal and external sources, sensitive government data may easily be placed at risk. Due to multi-tenancy, a physical device may house multiple clients and it is important to ensure that each separate customer's data remains segregated so that no data bleeding occurs across virtual servers. To further complicate the issue, a single file or data storage area may be distributed among multiple physical servers over several countries; this may distribute the risk of a single point of failure, but creates multiple possible points for intrusion (Paquette et al, 2010).

v. **Availability.** Outages can and do occur in the clouds and can be unexpected and costly to a customer. The cloud's reserve capacity is not transparent, and data on this subject are not made public by major cloud providers due to competitive reasons.(Paquette et al, 2010)

vi. **Malicious activity.** According to Troshani et al (2010), Cloud resources can be susceptible to malicious activity by i) cloud provider insiders, and ii) outsiders or hackers. The first type of malicious activity concerns situations whereby individuals can abuse their high privilege roles e.g. system administrators, security providers, etc in their capacity as cloud provider employees. The second type of malicious activity concerns hacking by outsiders on cloud resources that attempt threats, such as, malicious probes, scans, and network mapping. According to CSA (2009), there is often little or no visibility into the hiring standards and practices of cloud employees. The level of access granted could enable an adversary to harvest confidential data or gain control of cloud activities (CSA, 2009). Malicious activities can potentially lead to loss of data integrity, confidentiality, and availability, potentially leading to economic loss, diminished customer trust, and damaged organizational reputation.

vii. **Inadequate technical support**. Most CSPs operate self-service type support and provide administrative functions enabling cloud clients to apply self-fixes that may be perceived to be inadequate. Inadequate helpdesk support is perceived to adversely impact the productivity of cloud users (Troshani, 2011), especially where the CSP operates in a time zone different from that of the client.

viii. **Limited expertise** While cloud providers can offer various computing capabilities and resources, clients also require adequately skilled human resources that can manage the interface between themselves and their cloud providers. There is currently limited expertise available including knowledge, experience, and skills, in managing cloud provider relationships (Troshani et al, 2011).

ix. **Compliance risk**. A significant concern in implementing the cloud into the government, especially when system security is a very high priority, is the issue of compliance. In-house IT developers and contractors who develop, deploy, and manage government systems are subject to the same compliance regulations. Investment in achieving certification (e.g., industry standard or regulatory requirements) may be put at risk by migration to the cloud, firstly, if the CP cannot provide evidence of their own compliance with the relevant requirements and secondly, if the CP does not permit audit by the cloud customer. In certain cases, it also means that using a public cloud infrastructure implies that certain kinds of compliance cannot be achieved.(Paquette et al, 2010, ENISA 2009)

x. **Foreign legislation impact risk**. The cloud environment spans the world. Access may also be subject to the conventions and laws of the country in which servers are housed. If the vendor's servers span multiple countries, data access and distribution may very well be subject to the privacy laws and precepts of the host country that do not synch well with local regulations (Jaeger, Lin, Grimes and Simmons, 2009). Cloud services used by clients will, as a consequence, be subject to the host countries' legislation. This is considered to be highly risky, particularly when host countries' legislation changes frequently, is unpredictable, is not enforced consistently, is inconsistent with or does not adhere by international agreements. Corollary issues include scenarios whereby cloud providers are subpoenaed by law enforcement organizations where hardware can be confiscated for e-discovery purposes (Troshani, 2011). These situations can potentially result in confidentiality breaches, data leakage, and economic losses for cloud clients.

In addition to these risks, certain characteristics of cloud computing may give rise to other less apparent challenge that warrant evaluation. Many of the risks highlighted here are not likely to be mitigated by contractual clauses with a CSP. Consequently, mitigation solutions may need to be implemented outside of the immediate cloud solution provided by the CSP

2.3 Conceptual Framework for the Research

Cloud computing service is a relatively new area, and there has not been much research discussing cloud computing using UTAUT (Kai-Chieh Hu et,al, 2012*)*. Since integrating cloud computing system or providing cloud computing services is now considered necessary for business these days, it is crucial for businesses to predict information technology acceptance and usage, and to know how people respond to new and unfamiliar information technology. As UTAUT model has integrated previous eight models and can explain the variance in usage intentions, and from previous studies, this study believes that UTAUT can be used to explore the user's adoption intention of cloud computing.

We have chosen the proven theory model Unified Theory of Technology Acceptance and Use of Technology Model (UTAUT) described by Venkatesh and Davis (2003) to create an information theoretical background for the survey on cloud computing technology acceptance in the government. The UTAUT Model which has a high level of abstractions and lower number of factors validates statements about why people use certain technologies and can be used both for explanations and forecasts.

The authors acknowledged a limitation of content validity due to measurement procedures and recommended that future research should be targeted at more fully developing and validating appropriate scales for each of the constructs with emphasis on content validity and revalidating or extending UTAUT with the new measures (Venkatesh et al., 2003).

In this study, the UTAUT model was employed as the base model to study user acceptance of cloud computing in order to further validate the model and enhance our understanding of the user adoption behavior. However, UTAUT mainly focuses on the positive user acceptance behavior. Several researchers have identified several missing factors of the user adoption behavior that can negatively affect the user acceptance of new technology. As described, security and privacy risk are some of the key negative factors that cause the slow growth rate of user acceptance. Therefore it is safe to extend the UTAUT model to suit the study. We have extended the study by including a new construct “Cloud Risks”. Cloud Risk (CR) was used as a new construct to reflect the several risk concerns in the acceptance of Cloud Computing.

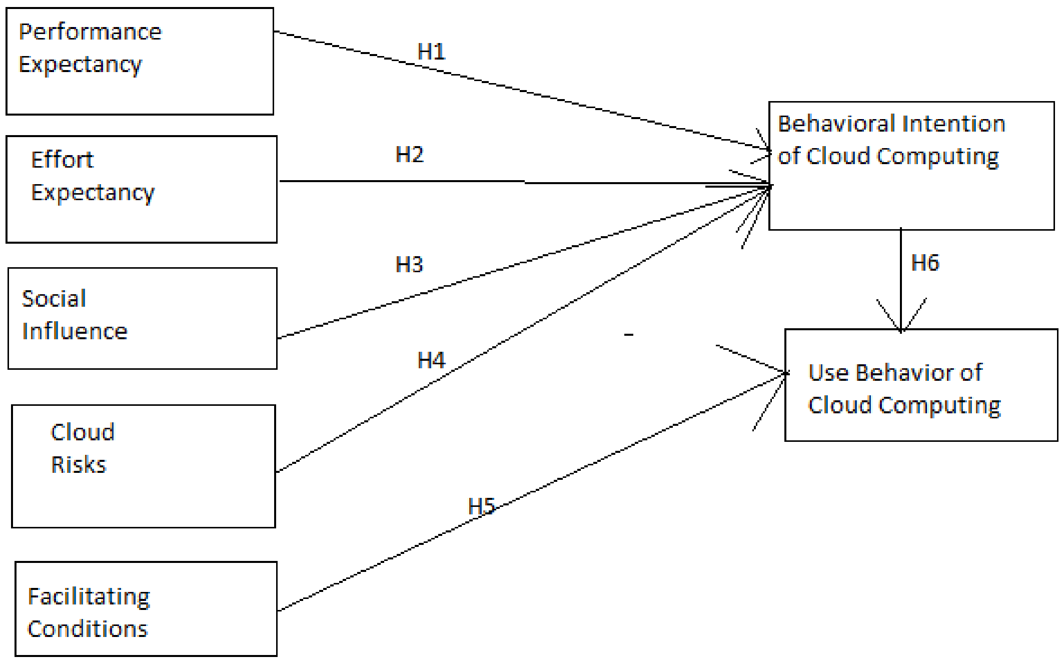

Figure 15: The Conceptual Framework

The first three independent are variables in Figure 15 (Performance Expectancy, Effort Expectancy, and Social Influence) are the concluded determinants of Behavioral Intention of cloud computing. The fourth independent variable of Facilitating Conditions and the Behavioral Intention are the determinants of Use Behavior. The lines are used to present the dependency relationships. The final independent variable of Cloud Risks is added to explore and analyze the potential influence on Behavioral Intention of cloud computing. The solid lines are used to present the mainly examined relationship between Cloud risks and behavioral intention.

In this study, we were interested in testing the direct influence of the main constructs of the basic UTAUT model. The effect of the moderating variables, though important, was not taken into account. However, this is noted as a recommendation for future research.

Several hypotheses are postulated as follows:

H1. Performance Expectancy has a positive influence on the behavioral intention towards adopting cloud computing.

H2. Effort Expectancy has a positive influence on the behavioral intention towards adopting cloud computing.

H3. Social Influence has a positive influence on the behavioral intention towards adopting cloud computing.

H4. Cloud Risks has a **negative** influence on the behavioral intention towards adopting cloud computing.

H5. Facilitating Conditions have a positive influence on the use behavior towards adopting cloud computing.

H6. Behavioral intention has positive influence towards use behavior in cloud computing.

Performance expectancy (PE), which is similar to the concept of perceived usefulness in TAM, is the extent to which an individual believes that using the system will gain benefits or enhance job performance. The performance expectancy construct should have positive influence on the behavioral intention of an individual on using a new technology. This is our first hypothesis.

Effort Expectancy (EE), which is similar to Perceived Ease of Use in TAM, is perception of the extent of expended effort in using the system. It generally believes that people would use a new technology if they find it easy to use. This is our second hypothesis.

Social influence (SI) is equivalent to subjective norm TAM2 in which an individual perceives that important others believe the person should use the new technology. For the proposed model, the third hypothesis (H3) states that *Social Influence has a positive influence on the behavioral intention towards adopting cloud computing*.

Facilitating Conditions (FC) is defined as the degree of believing in the existence of the technical and organizational infrastructure to support the usage of a new technology. Unlike other constructs, facilitating conditions should have a direct influence on the actual usage of the new technology. The UTAUT model stated that facilitating conditions have a positive influence on the actual usage instead of behavioral intention.

Cloud Risks (CR) is the degree to which an individual believes and worries about the potential risks and subsequent loss aroused from the use of the system. The construct extends the original UTAUT model to explore, analyze and critically assess the negative influence factors on the adoption model of cloud computing. The proposed model of this study is going to explore the impact of Cloud Risks; hence, the fourth hypothesis (H4) is defined as *Cloud Risks has a negative influence on the behavioral intention towards adopting Cloud computing.*

To conclude the research model and hypotheses, the first three (H1-H3) and the last (H5andH6) hypotheses are designed to verify and validate the proposed model. If results of the study match with the original UTAUT model, the structure of the proposed model can be considered as the valid extension of the UTAUT model. As explained, there is a limitation of this research to measure and understand the actual use behavior of the studied subjects.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter presents the procedures that were used in conducting the study. It is organized into the following sub-headings: research design, locale of the study, target populations, sampling technique, research instrument, data collection procedures and sources and data analysis techniques.

3.2 Research Design

The research design used in this research was a survey and is descriptive in nature. According to Kerlinger (1979) this is a systematic empirical enquiry in which the researcher does not have direct control of the independent variables because their manifestations have already occurred or because they are inherently not manipulatable. Descriptive research design is selected for the study because it is not possible to manipulate the variables of the study. The study is investigating the factors that can influence the acceptance of cloud computing technology by ICT officers in the government Ministries.

The research questions were designed with reference to the published questions for the survey research of the UTAUT model. Surveys are used to gather systematically factual information necessary for decision making. This is an efficient method of collecting descriptive data regarding current practices, conditions and preliminary information for generating research questions (Ogula, 1998).

3.3 Locale of the Study and Target Population

Kenya has a total of 42 Ministries and all of them are headquartered in Nairobi despite serving the nation countrywide. In fact they are concentrated in a narrow set of building either at the city center or the community at Upper Hill.

The target population in the study comprised of ICT officers in all the Ministries.

3.4 Sample and Sampling Procedures

In this study, purposive sampling was used to select government Ministries. Since most ICT officers were either on secondment from Government Information Technology Services (GITS) or Directorate of e-Government, a list was obtained that indicated ministries with a higher number of ICT officers which were then targeted for this research.

A paper based questionnaire was hand delivered to ICT departments in a sample of the ministries. The questionnaires were issued randomly to the officers who were present at the time of distribution. A total of 210 questionnaires were issued and 152 questionnaires were received giving a response rate of 152/210 = 72.4%. This response rate is consistent with rates in similar surveys in IS research (Mani et al, 2010). 9 questionnaires had invalid data and therefore could not proceed to analysis stage. The number questionnaires that were analyzed further were 143.

All the data in the questionnaire was pre-coded except designation. Codes were assigned for the 11 ICT positions in the government with 1 representing ICT officer III which is the lowest lever and 11 representing Secretary of ICT on the other end.

The sampled ministries were the following

Finance **(GITS)**	Local Government	Roads	Lands
Tourism	Co-operatives	Energy	Agriculture
Forestry and Wildlife	Public Works	Housing	Industrialization
Justice	Youth and Sports	Transport	Medical services
Nairobi Metropolitan	Water and Irrigation	Regional Devp.	Gender
Trade			

The bulk of the respondents were from the Ministry of Finance (Government Information Technology Services).

3.5 Research Instrument/Tool

The researcher used questionnaire for all the respondents. Gay (1996) explains that descriptive data are usually collected using questionnaire. Ogula (1998) has also positively identified questionnaires as instruments of data collection in descriptive research. The study employed one questionnaire for all ICT officers in various ministries. The questionnaire was structured to enable the researcher to get reasonable opinions on the stand of the various respondents on the cloud computing phenomena. Respondents were required to express their opinion on a Likert scale ranging from 1 to 5 (completely disagree to strongly agree).

The questionnaire had two sections. These are described as follows: The first section of the survey questionnaire aimed at understanding the respondent responsibility, their level of education and experience in ICT issues. This is important because personnel at different levels of management, with different level of involvement in IT decisions may have different understanding of technology and its impact to the Ministry. The second section of the survey questionnaire is aimed at understanding the drivers for adoption, such as Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Facilitating Conditions (FC) and the new construct Cloud Risk (CR) derived from the UTAUT model. The understanding of these factors from the practitioner's point of view is crucial. This allowed the researchers to analyses any changes in practitioners understanding of cloud computing and its benefits.

For the original constructs of Performance Expectancy (PE), Efficiency Expectancy (EE), Social Influence (SI), and Behavioral Intention (BI) of the UTAUT model, three to four questions are set for each of them. Since this research is to extend the well-established UTAUT model, there are ten questions related to the new construct of Cloud Risks (CR).

Table 2 : Construct Development

Variables	Definition	Items	Reference
Performance Expectancy (PE)	The degree to which an individual believes that using the system will gain benefits or enhance job performance	1. I expect additional benefits in the government by using cloud computing 2. Cloud computing would improve performance in my job. 3. Cloud computing can enhance effectiveness in my job. 4. I expect higher flexibility in our IT by using cloud computing	Davis, 1989; Davis *et al.* 1992; Venkatesh *et al.* 2003
Effort Expectancy (EE)	The degree of ease associated with the use of the system	5. Using cloud computing would not lead to technical difficulties in our IT department. 6. Cloud computing can integrate quite easily with our IT infrastructure. 7. It would not be time consuming for me to become skillful at using cloud computing 8. I would find cloud computing easy to use 9. Using cloud computing would not require a lot of mental effort	Davis, 1989; Thompson, *et al.* 1991; Moore and Benbasat, 1991; Venkatesh *et al.* 2003
Facilitating Conditions (FC)	The degree to which an individual believes that an organizational and technical infrastructure exists to support use of	10. I have the resources necessary to use cloud computing 11. I have the knowledge necessary to use cloud computing services. 12. Most cloud computing services are compatible with most other systems I use	Ajzen, 1991; Taylor and Todd, 1995; Thompson *et al.* 1991; Moore and Benbasat, 1991; Venkatesh *et*

	the system		*al.* 2003
Social Influence (SI)	The degree to which an individual perceives that important others believe he or she should use the new system	13. A specific person (or group) is available for assistance with cloud computing difficulties 14. People who influence my behavior think that I should use cloud computing 15. Experts who are important to me think that I should use cloud computing 16. People who are important to my career think that I should use cloud computing 17. I am expected to use cloud computing	Fishbein and Ajzen (1975), Moore and Benbasat (1991), Venkatesh *et al.* (2003), Lin and Zhang 2009
Behavioral Intention (BI)	The antecedent of behavior which served as indication of an individual's readiness to execute a particular behavior.	18. Assuming I can, I intend to use cloud computing 19. Given that I have access to cloud computing, I predict that I would use it. 20. I intend to use cloud computing 21. I am willing to recommend cloud computing to others	Fishbein and Ajzen, (1975), Venkatesh *et al.* 2003
Experience		22. I can describe the difference between the concepts of cloud computing and IT outsourcing 23. I have experience in using cloud computing 24. I know several cloud computing service providers and their services 25. I can distinguish between SAAS,	Fishbein and Ajzen, (1975), Venkatesh *et al.* 2003

		PAAS and IAAS	
Cloud Risks (CR)	The degree to which an individual believes and worries about the potential risks and subsequent loss aroused from the use of the system	26. I am worried that due to proprietary nature and lack of standards in the cloud I could be Locked-in to a particular cloud provider. 27. I am worried about Loss of control if I cede particular aspects of my IT to the clouds 28. I cannot ascertain the current and long term prospects of cloud providers 29. Using the cloud would expose us to security and privacy challenges 30. I am worried about the effect of outages on service delivery 31. I am worried that Cloud resources can be susceptible to malicious activity 32. I am worried that there is inadequate support from cloud providers due to self-service type support 33. I am worried there is limited expertise to support cloud services 34. I am concerned on how to comply and enforce standards when we migrate to the cloud 35. I am worried that foreign legislation may be inconsistent with local legislation.	IDC (2008), Alcade et al, 2009, Andert et al, 2002, Armbrust et al, 2010, Catteddu and Hogben, 2009, Chow et al, 2009, ENISA 2009, Paquette, 2010, Troshani et al 2011

The full questionnaire can be seen appendix 2

3.6 Validity of Instruments

Validity refers to the degree to which results obtained from the analysis of the data actually represents the phenomena under study. In order to test the validity of the instruments, questionnaires were first scrutinized and approved by the university supervisor. The researcher later carried out pre-test of the instruments by piloting in two ministries in the area of study that did not form part of the study. The Ministries piloted were Special Programmes and Immigration.

The pre-test results showed some questions were not clear to the respondents. Some terms in the piloted questionnaire were rather ambiguous and led to wrong interpretations. After piloting, the ambiguous questions were corrected and the questionnaires given back to the same respondents. This was done to determine whether the instrument would yield the needed data.

3.7 Reliability of Instruments

The internal consistency reliabilities of the summated scale variables were tested with Cronbach's Alpha coefficient (α), that should not, according to recommendations, be below 0.70 (Nunnally, 1994). The items with insufficient loadings were not included in the summated scale variables in order to increase consistency

3.8 Data Analysis

Collected data was first edited to remove errors then coded before being entered into computer software SPSS for quantitative analysis. Data was analyzed according to descriptive information following the research questions. Descriptive statistical analysis was employed, as it enabled the researcher to reduce, summarize, organize, evaluate and interpret the numeric information. Descriptive statistics are used because they are easy to analyze and convenient for the researcher and the study. These took the forms of percentages and means and frequency distribution. The findings were presented by use of tables, bar graphs, mean, frequencies and percentages.

The central constructs of the UTAUT (PE, EE, SI, FC, CR, XP, BI), excluding the use of cloud computing (UB) were formed by using confirmatory factor analysis (CFA)

The statements in the questionnaire used were based on some previously conducted tests of the UTAUT as well as on research relating to the adoption and use of technology and cloud computing (Venkatesh, 2003). The variables were measured with 5-point scales for all model components (which differed from the 7-point scales in the original UTAUT; a 5-point scale proved to be more robust for the type of survey we carried out), in which 1 equaled the negative end (fully disagree) and 5 the positive end of the scale (fully agree).

The data analysis of this research was conducted with SEM and PLS, using SmartPLS 2.0 software (Ringle, 2011). Structural Equation Modeling (SEM) is a family of statistical technique for testing and estimating causal relationships using a combination of statistical data and qualitative causal assumptions. SEM encourages confirmatory modeling that is suited to theory testing of the researched model. Partial Least Squares (PLS) is a second generation technique of SEM that enables researchers to answer a set of interrelated research questions by modeling the relationships among multiple independent and dependent constructs simultaneously (Gefen, 2000).

CHAPTER FOUR: DATA ANALYSIS, PRESENTATION AND FINDINGS

4.1. Introduction

This chapter contains analysis of the findings from the study. The data was collected by filling questionnaires that were sent to ICT officers in selected ministries. The data collected has been analyzed and interpreted in line with the objectives of this study based on the responses to the questions. Analysis has been carried out using statistical software and specialized software for carrying out Structural Equation Modelling (SEM) and Partial Least Squares (PLS).

4.2. Descriptive Analysis

Data was analyzed using Excel, SPSS 17 and SmartPLS. A sample profile of the data is as follows:

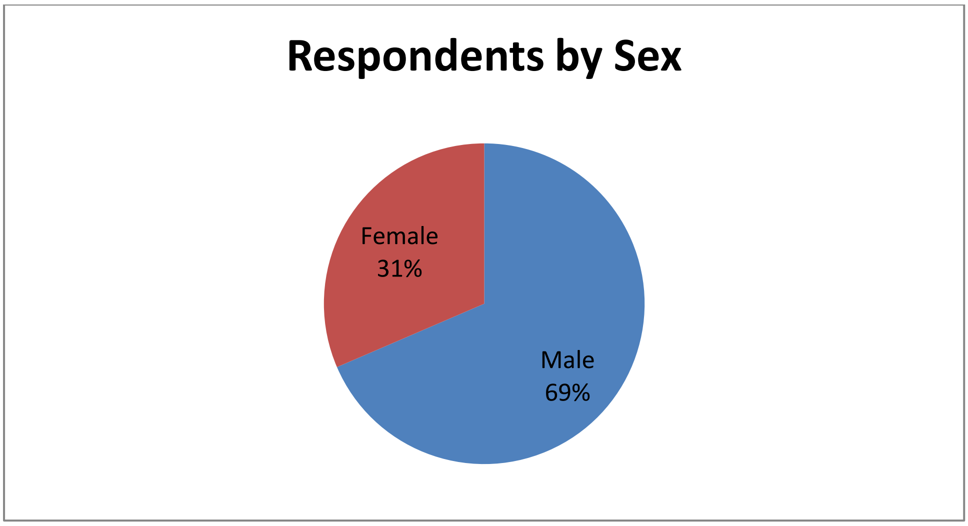

Figure 16: Number of respondents by sex

Table 3: Respondents by Sex

Sex	Number	Percentage	Average Age	Maximum Age	Minimum Age
Male	98	68.53%	39.69388	48	31
Female	45	31.47%	35	46	30
	143	100.00%			

The population comprised of both sexes with male having a higher proportion than the female sex. The average age for male was 39.6 while that for women was 35. The oldest respondent was 48 years and 35 years for male and female respectively. The youngest respondent was 31 and 30 years for male and female respectively as indicated in Table 3.

Table 4: Respondents by years of experience

	0-4 years	5-10 years	11-15 years	Over 15 years	Total
Male	0	35	42	21	98
Female	8	17	19	1	45
Total	8	52	61	22	143

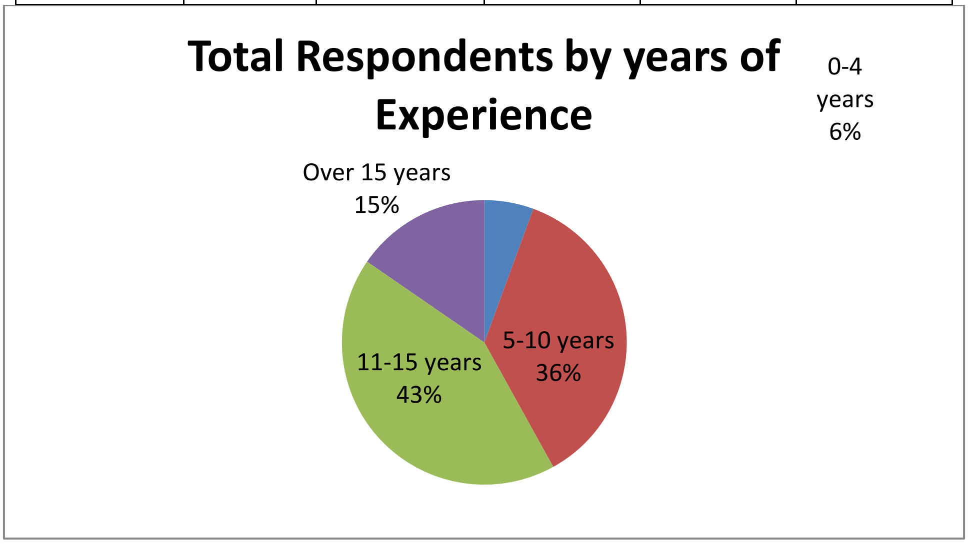

Figure 17: Respondents by Years of Experience

Majority of respondents had 11-15 years of services as shown in figures 17-19.

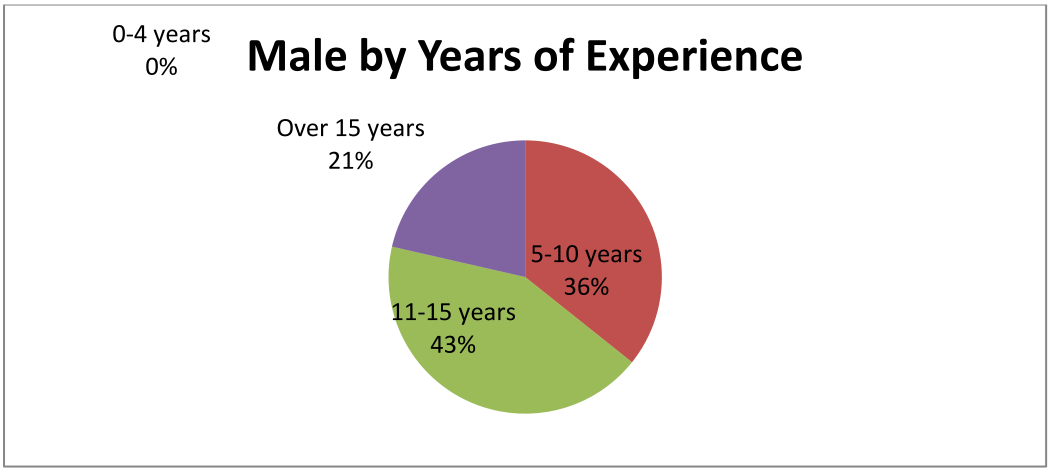

Figure 18: Male Respondents by Years of Experience

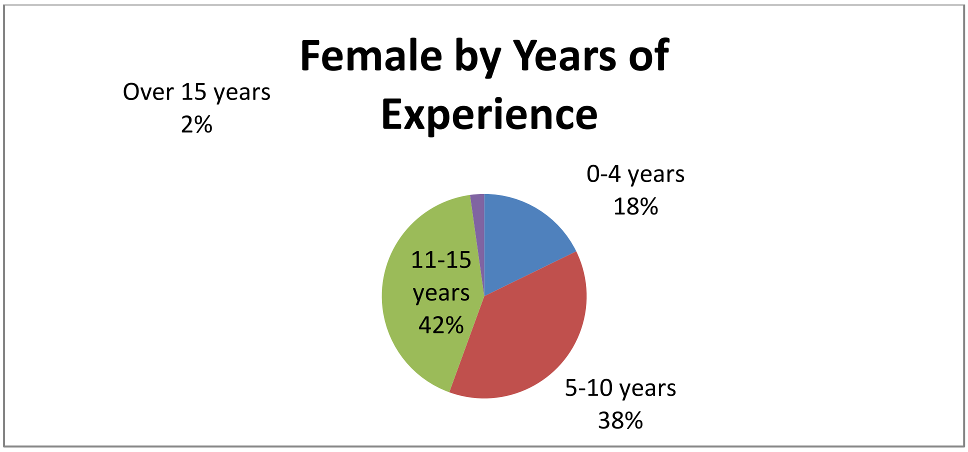

Figure 19: Female Respondents by Years of Experience

Table 5: Respondents by Designation

Designation	Male	Female	Total
1. Information Communication Technology Officer III	4	5	9
2. Information Communication Technology Officer II	15	11	26
3. Information Communication Technology Officer I	24	8	32
4. Senior Information Communication Technology Officer	21	7	28
5. Chief Information Communication Technology Officer	14	5	19
6. Principal Information Communication Technology Officer	11	4	15
7. Assistant Director, Information Communication Technology	8	5	13
8. Senior Assistant Director, Information Communication Technology	1	0	1
9. Deputy Director, Information Communication Technology	0	0	0
10. Director, Information Communication Technology	0	0	0
11. Secretary, Information Communication Technology	0	0	0
Total	98	45	143

The majority of the respondents were in the middle cadre of the service (i.e. Job Group J-M) as indicated in Table 5. The absence of respondents at higher levels was due to the reason that the questionnaires were administered to Ministries. The Secretary of ICT who heads e-government is based at the Cabinet office together with the directors. Heads of ICT in a ministry are usually at the level of assistant Director or Principal ICT officer.

Males were the dominant sex of respondents by designation as indicated in figure 20. This is consistent with the gender distribution of the respondents indicated earlier.

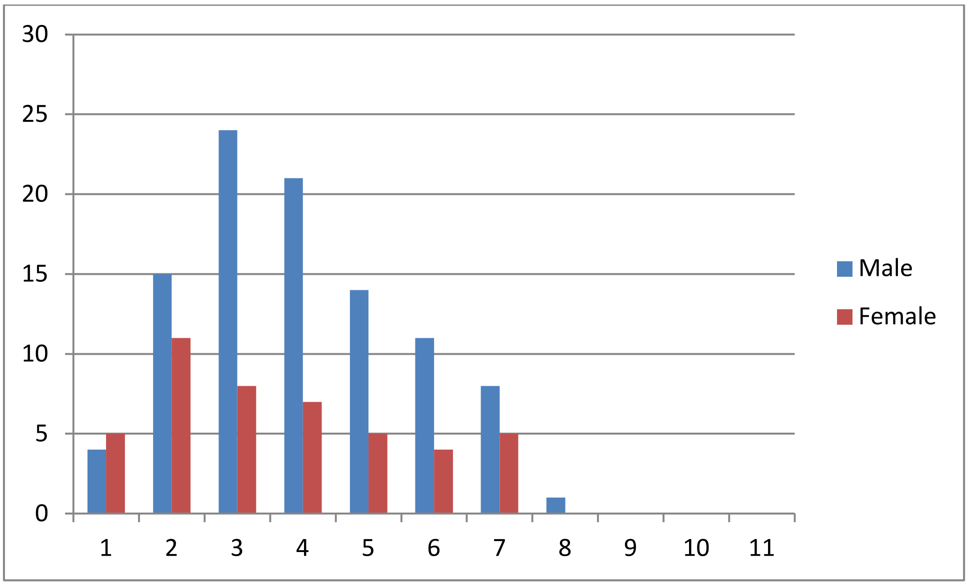

Figure 20: Respondents Designation by Gender

Table 6: Respondents by Qualification

Respondents by Qualifications	Male	Female	Total
Masters in Computing Field	13	10	23
Graduate in Computing Field	81	35	116
Diploma in Computing Field	4	0	4
Certificate in Computing Field	0	0	0
Degree in Non Computing Field	0	0	0
Other (Please Specify)	0	0	0
Total	98	45	143

Table 6 shows that all the respondents had qualifications in computing. The majority were graduates in a computing discipline. This was expected since the study targeted a particular professional arm of the government. It also gave credibility to the responses since all of them were conversant with the subject matter.

Table 7: Knowledge of cloud issues by sex

	Male	Female	Total
Not Conversant	0	6	6
Moderately Conversant	87	31	118
Very Conversant	11	8	19
Total	98	45	143

In addition to the qualifications, the researcher sought to find out the degree of knowledge by the respondents on cloud issues. The results are depicted in Table 7. The majority of the respondents had good knowledge on cloud computing concepts. Only 6 respondents indicated that they had little knowledge on the subject matter. The understanding on cloud issues is depicted in figures 21and 22.

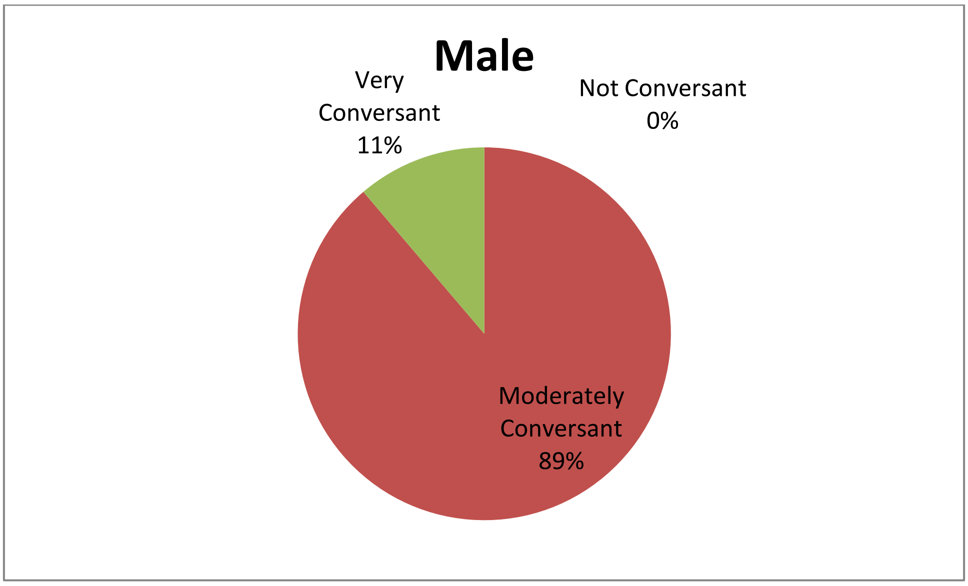

Figure 21: Knowledge of Cloud Issues- Male

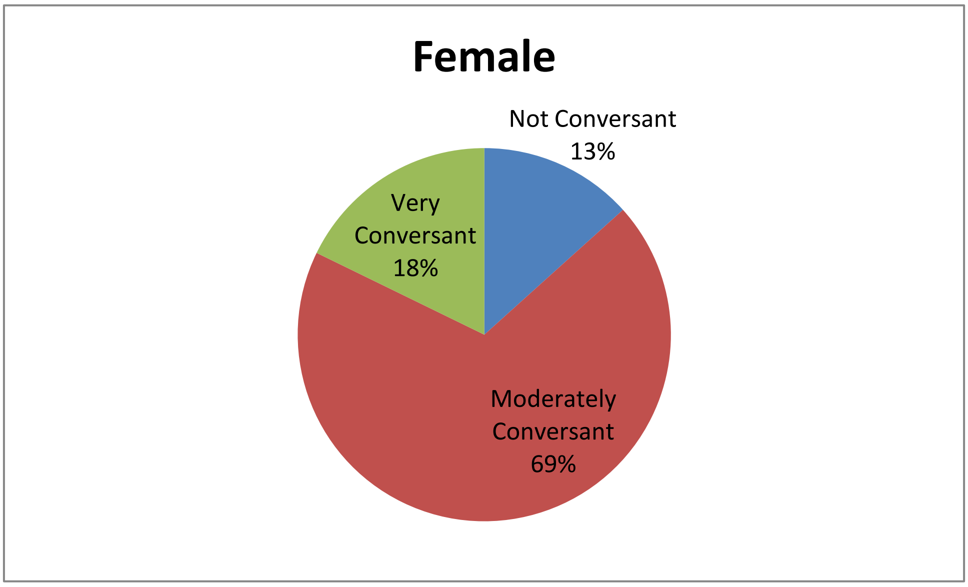

Figure 22: Female Respondents Knowledge of Cloud Issues

4.3.Factor Analysis

We applied confirmatory factor analysis to reduce the large item sets to their underlying variables from the UTAUT model. In contrast to the common exploratory factor analysis, confirmatory analysis is an applied statistical method in the social sciences to confirm proposed structures in variable sets (Field, 2009). All variables were examined regarding their usability for factor analysis. In addition several tests were included to confirm the quality of the sample. Scientific literature has many views on whether a sample is adequate or not. Recent research on simulated data points out that sample size is not a concern if factor loadings of at least 4 items are greater than 0.6. (Nicky et al, 2012)

When using factor analysis, the consistency of the questionnaire should be checked with Cronbach's α which should be greater than 0.7. When factor loadings and CA delivered reasonable results, the extracted factor was used in our research model. The data analysis of this research was conducted with PLS, using SmartPLS.

4.3.1. Initial Factor Analysis

The following tables show the results of the Initial analysis. Experience, Sex and Age as moderating variables had been included in the questionnaire but no analysis on their influence was carried out as indicated earlier since the researcher was interested in the direct influence of the constructs in the basic UTAUT model

Table 8: Initial Factor Analysis – Basic UTAUT model

	AVE	Composite Reliability	R Square	Cronbachs Alpha	Communality	Redundancy
BI	0.783801	0.935240	0.356159	0.906756	0.783800	0.062467
EE	0.755461	0.939085		0.923378	0.755461	
FC	0.916998	0.970686		0.954299	0.916998	
PE	0.553573	0.829996		0.729868	0.553573	
SI	0.598161	0.881083		0.834592	0.598160	
UB	1.000000	1.000000	0.491765	1.000000	1.000000	0.158560

The Cronbach alpha of all the factors was above 0.7 which indicated the reliability of the results. The cross loadings for the Basic UTAUT model are shown in Table 9.

Table 9: Factor Loadings (basic UTAUT Model)

	BI	EE	FC	PE	SI	UB
BI1	0.908988	0.439063	0.208120	0.389044	0.512993	0.491223
BI2	0.787532	0.329901	0.044582	0.358537	0.559540	0.192691
BI3	0.901514	0.419707	0.149640	0.469752	0.554681	0.325356
BI4	0.935954	0.354938	0.146395	0.356406	0.470490	0.406955
EE1	0.292582	0.801171	0.558949	0.496582	0.527348	0.419689
EE2	0.265886	0.869265	0.562607	0.617969	0.482630	0.432870
EE3	0.587155	0.897517	0.546098	0.600023	0.674015	0.448316
EE4	0.255292	0.860651	0.562527	0.603284	0.449051	0.419571
EE5	0.280048	0.912990	0.533458	0.489946	0.468907	0.385072
FC1	0.127867	0.630104	0.979000	0.530185	0.281221	0.622277
FC2	0.117963	0.611537	0.976217	0.503948	0.264788	0.609110
FC3	0.219330	0.570533	0.916271	0.495034	0.388866	0.571243
PE1	0.281957	0.424233	0.491176	0.689336	0.458093	0.544761
PE2	0.260335	0.533917	0.458067	0.827949	0.654900	0.389062
PE3	0.277574	0.436778	0.144830	0.609405	0.479445	0.334788
PE4	0.443355	0.527604	0.463194	0.825975	0.508953	0.424841
SI1	0.459925	0.456645	0.142146	0.535437	0.809723	0.114914
SI2	0.482638	0.574577	0.386481	0.651131	0.851617	0.495807
SI3	0.295725	0.464567	0.140850	0.520933	0.748175	0.144051
SI4	0.364194	0.602972	0.377857	0.543704	0.706823	0.255196
SI5	0.577156	0.381296	0.199805	0.458725	0.741982	0.355778
UB	0.408793	0.487815	0.627914	0.567217	0.374492	1.000000

The main constructs are indicated in Table 9 by the columns and each of the responses to a construct is indicated by the row. For example PE column will show the construct Performance Expectancy while PE1 will record the response to the first question under the performance expectancy construct. Table 9 shows own loadings of the constructs which are in bold. They are all above 0.60 and higher than the cross loadings with other measures. Therefore the model was a reliable one.

Path analysis is shown in Figure 23. It shows that the paths for all the constructs in the basic UTAUT model are positive. This validates the UTAUT model in investigating the problem.

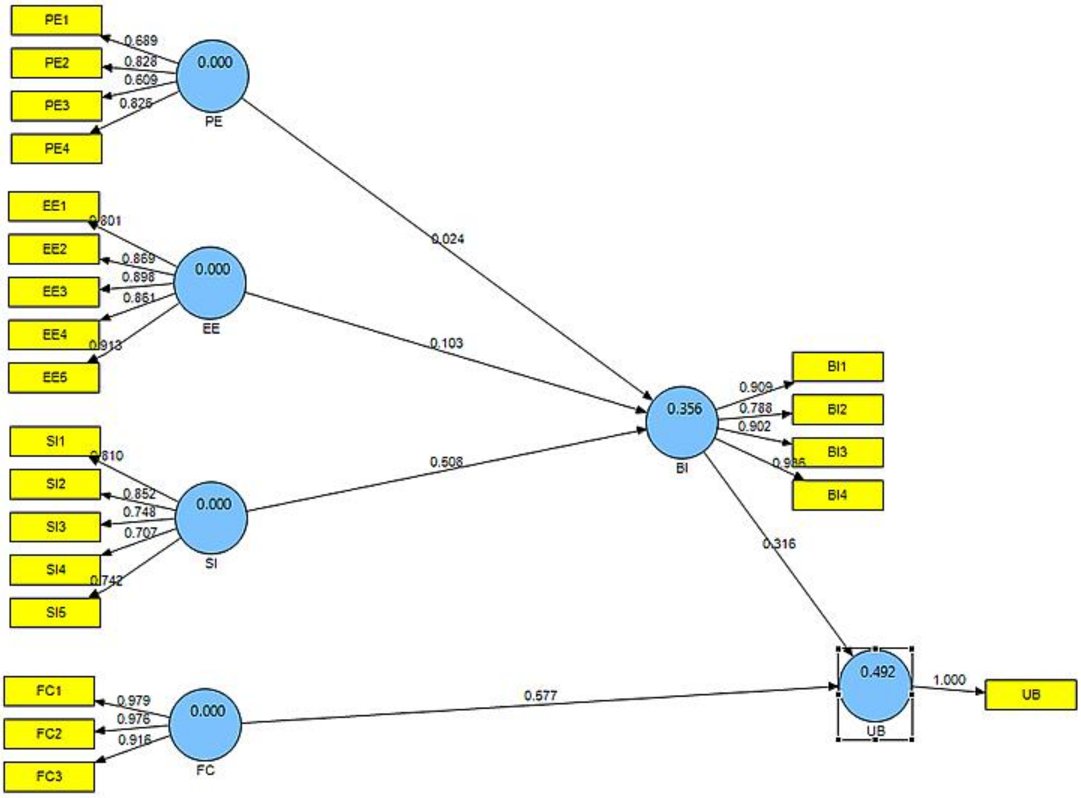

Figure 23: Path Analysis Basic UTAUT Model

The total effects of the basic UTAUT model are shown in Table 10. The total Effect of Behavior Intention (BI) on Use Behavior (UB) is 0.316, PE on BI is 0.024, EE on BI is 0.103 and SI on BI is 0.508. Facilitating Conditions, according to the UTAUT model has direct effect on the Use Behavior and according to our model this was 0.577

Table 10: Total Effects Basic UTAUT model

	BI	EE	FC	PE	SI	UB
BI						0.316317
EE	0.103485					0.032734
FC						0.577239
PE	0.024007					0.007594
SI	0.508329					0.160793
UB						

Table 11: Results of the Factor Analysis of the Basic UTAUT model

Factor	Items	Loading	CA
Performance Expectancy (PE)	I expect additional benefits in the government by using cloud computing	.689	.730
	Cloud computing would improve performance in my job.	.828	
	Cloud computing can enhance effectiveness in my job.	.609	
	I expect higher flexibility in our IT by using cloud computing	.826	
Effort Expectancy (EE)	Using cloud computing would not lead to technical difficulties in our IT department.	.801	.923
	Cloud computing can integrate quite easily with our IT infrastructure.	.869	
	It would not be time consuming for me to become skillful at using cloud computing	.898	
	I would find cloud computing easy to use	.860	
	Using cloud computing would not require a lot of mental effort	.913	
Facilitating Conditions	I have the resources necessary to use cloud computing	.979	.954
	I have the knowledge necessary to use CC services.	.976	
	Most cloud computing services are compatible with most other systems I use	.916	
Social Influence	A specific person (or group) is available for assistance with cloud computing difficulties	.810	.835
	People who influence my behavior think that I should use cloud computing	.852	
	Experts who are important to me think that I should use cloud computing	.748	
	People who are important to my career think that I should use cloud computing	.707	
	I am expected to use cloud computing	.742	
Behavioral Intention (BI)	Assuming I can, I intend to use cloud computing	.909	.907
	Given that I have access to cloud computing, I predict that I would use it.	.787	
	I intend to use cloud computing	.902	
	I am willing to recommend cloud computing to others	.936	

The results of the factor analysis are shown in the above table. PE had a CA of .730, EE had .923, FC had .954, SI had .835, and BI .907.

Since the Cronbach's alpha for all the constructs of the basic UTAUT model were all above 0.7 then it can be concluded the model is reliable and valid for studying the problem.

4.3.2. Factor Analysis of the Extended UTAUT Model

The results of the final factor analysis after including the extended construct Cloud Risks (CR) were as follows

Table 12: Extended Constructs Overview

	AVE	Composite Reliability	R Square	Cronbachs Alpha	Communality	Redundancy
BI	0.783808	0.935251	0.367275	0.906756	0.783808	-0.121232
CR	0.752235	0.968056		0.963624	0.752235	
EE	0.755531	0.939106		0.923378	0.755530	
FC	0.916998	0.970686		0.954299	0.916998	
PE	0.553553	0.829979		0.729868	0.553553	
SI	0.598250	0.881124		0.834592	0.598249	
UB	1.000000	1.000000	0.491254	1.000000	1.000000	0.157748

Table 13: Latent Variable Correlations of the Extended UTAUT Model

	BI	CR	EE	FC	PE	SI	UB
BI	1.000000						
CR	0.371856	1.000000					
EE	0.439242	0.747858	1.000000				
FC	0.159810	0.652379	0.631361	1.000000			
PE	0.445902	0.662204	0.649350	0.532407	1.000000		
SI	0.590880	0.667882	0.629706	0.323285	0.696541	1.000000	
UB	0.407757	0.625166	0.487811	0.627914	0.567104	0.374252	1.000000

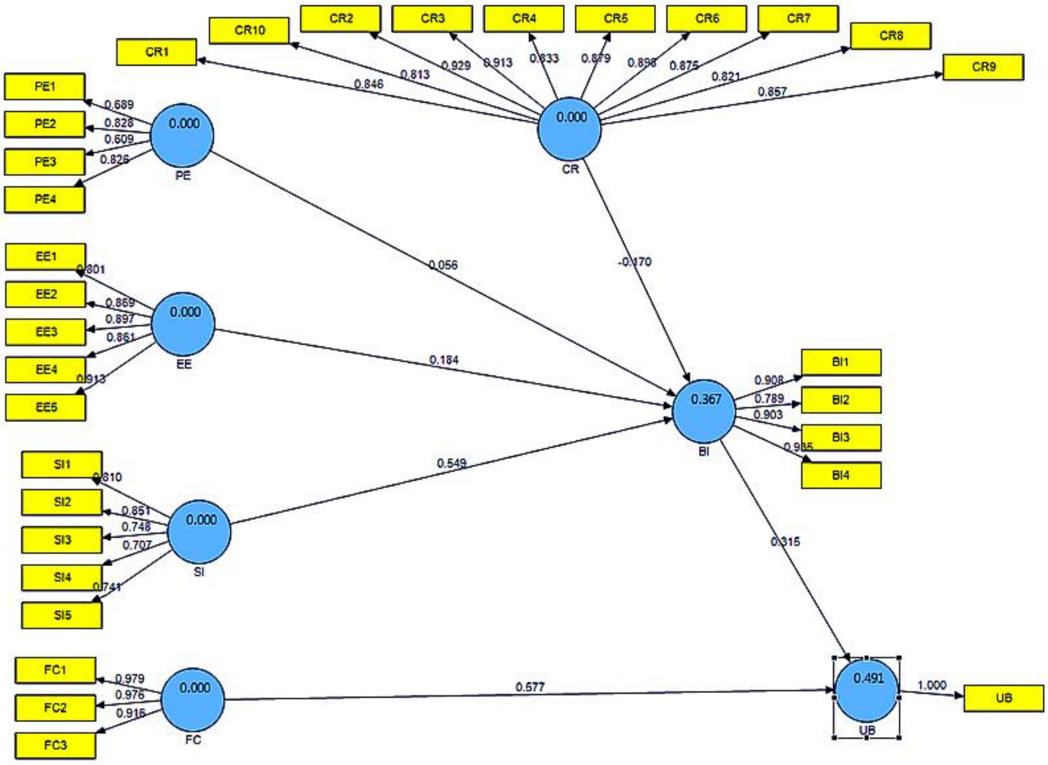

Figure 24: Path Analysis of the extended Model

The Cronbach Alpha of all the constructs in the extended model was above 0.7 as shown in Table 12. The path analysis in figure 24 shows the effect of each of the constructs on the dependent variable.

Cloud Risks (CR) total effect on Behavior Intention is -0.170

Performance Expectancy (PE) total effect on Behavior Intention is 0.056

Effort Expectancy (EE) total effect on Behavior Intention is 0.184

Social Influence (SI) total effect on Behavior Intention is 0.549

Behavior Intention (BI) effect on Use Behavior is 0.315

Facilitating Conditions (FC) effect on Use Behavior is 0.577

Cloud Risks extends the basic UTAUT model and according to our hypothesis has a negative effect on Behavior Intention which has been confirmed by the model.

Table 14: Cross Loadings of the Extended Model

	BI	CR	EE	FC	PE	SI	UB
BI1	0.907700	0.368517	0.438916	0.208120	0.389038	0.512736	0.491223
BI2	0.789154	0.279806	0.329831	0.044582	0.358577	0.559542	0.192691
BI3	0.902578	0.323302	0.419655	0.149640	0.469803	0.554644	0.325356
BI4	0.934826	0.337757	0.354828	0.146395	0.356385	0.470239	0.406955
CR1	0.344707	0.846049	0.722796	0.464030	0.559774	0.555027	0.442466
CR10	0.461598	0.813088	0.767699	0.603239	0.586078	0.473822	0.570701
CR2	0.275656	0.929192	0.641943	0.654477	0.653504	0.600179	0.603850
CR3	0.292973	0.912595	0.627260	0.648069	0.508387	0.553902	0.609821
CR4	0.210336	0.832848	0.538893	0.581000	0.621402	0.531783	0.632020
CR5	0.249974	0.879326	0.577635	0.586235	0.452391	0.511425	0.572864
CR6	0.237202	0.898448	0.606129	0.477077	0.550835	0.695151	0.446320
CR7	0.336295	0.874773	0.596042	0.572702	0.576948	0.641893	0.603262
CR8	0.210327	0.821369	0.599148	0.412564	0.637503	0.561785	0.426772
CR9	0.391415	0.857481	0.646496	0.579835	0.580828	0.666497	0.486513
EE1	0.292429	0.688837	0.801014	0.558949	0.496542	0.527337	0.419689
EE2	0.266515	0.623489	0.869481	0.562607	0.618030	0.482750	0.432870
EE3	0.587108	0.653398	0.897377	0.546098	0.600007	0.674069	0.448316
EE4	0.255902	0.622359	0.860877	0.562527	0.603335	0.449213	0.419571
EE5	0.280150	0.671271	0.913039	0.533458	0.489945	0.469073	0.385072
FC1	0.127404	0.653650	0.630113	0.979000	0.530112	0.281232	0.622277
FC2	0.117595	0.636542	0.611542	0.976217	0.503871	0.264806	0.609110
FC3	0.219035	0.581789	0.570536	0.916271	0.495075	0.388787	0.571243
PE1	0.281826	0.549988	0.424175	0.491176	0.689000	0.458024	0.544761
PE2	0.260875	0.619591	0.533985	0.458067	0.828004	0.655029	0.389062
PE3	0.277865	0.497115	0.436847	0.144830	0.609370	0.479373	0.334788
PE4	0.444276	0.387253	0.527635	0.463194	0.826177	0.509032	0.424841
SI1	0.461331	0.533034	0.456630	0.142146	0.535465	0.809993	0.114914
SI2	0.482737	0.710227	0.574491	0.386481	0.651079	0.851465	0.495807
SI3	0.296681	0.430056	0.464492	0.140850	0.520913	0.748453	0.144051
SI4	0.365660	0.475939	0.602945	0.377857	0.543800	0.707232	0.255196
SI5	0.576955	0.416776	0.381203	0.199805	0.458696	0.741493	0.355778
UB	0.407757	0.625166	0.487811	0.627914	0.567104	0.374252	1.000000

4.4. Evaluation of the Conceptual Model

In this study, both the calculated Cronbach's alpha correlations and composite reliability coefficients are all above 0.7 as shown in the corresponding columns of the Tables above, which indicates the statistical reliability of the internal consistency of the measures. For the measures of the studied Cloud Risks, the figures are higher than the other measures and all above 0.8, which indicates the higher reliability of the extended construct.

Construct validity can be determined by two indicators. In PLS, two indicators are considered: (1) the own-loadings are higher than the cross-loading; (2) the square root of each construct's Average Variance Extracted (AVE) is larger than its correlations with other constructs. Table 14 shows the Cross-loadings between the constructs and the measures. The bolded figures are own-loadings of the constructs. They are all above 0.60 and higher than the cross-loading with other measures. It can be concluded that the construct validity of this research can fulfill the statistical quality criteria.

A partial least squares analysis was carried out on the data. According to the path coefficients, **performance expectancy (PE)**, **efficient expectancy (EE),** and **social influence (SI)** have significant and near positive effects on behavioral intention (BI) since the coefficients are **0.056, 0.184**, and **0.549**. They match with the original UTAUT model. The new construct of **Cloud Risks (CR)** has significant negative effect on the behavioral intention of cloud computing acceptance because of the **negative value (-0.170)** of the coefficient. Since the weights of the path coefficients are near, it statistically indicates that the proposed model is a valid extension of the UTAUT model and the cloud risks (CR) represents a negative factor of the model for the measurement of Cloud computing acceptance.

CHAPTER 5: FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary, conclusions and recommendations of the findings of the study. It also highlights the limitations of the study and recommendations for further research, policy and practice. The summary is drawn from the findings and data analysis, conclusions are guided by the objectives and recommendations gathered from respondents.

5.2 Summary

This research sought to validate extended UTAUT in Cloud Computing Adoption in the government context. The structural model of the proposed model was analyzed by the PLS method with the help of SmartPLS software. The general applicability of a structural model depends on the reliability and validity of the modeling results. The constructs under study were 6 i.e. Performance Expectance (PE), Effort Expectance (EE), Social Influence (SI), Facilitating Conditions (FC), Cloud Risks (CR) and Behavior Intention (BI). Use Behavior was not being directly tested and we used a dummy item for it. The required minimal sample size of PLS is at least 10 times the number of constructs for IS research (Gefen, 2000). The research had 6 constructs requiring a minimum of (6x10= 60) responses as a minimum. This research had 143 responses which were good for PLS analysis.

Reliability and validity of the proposed model was assessed by internal consistency (reliability), convergent validity and discriminant validity. All test results were found to be satisfactory. The primary objective of PLS is the maximization of variance explained in all dependent constructs, which can be measured by R2 values of structural models. The R2 of BI is 0.367 while that of UB is 0.49. All the relationships between the latent constructs in the structural model are significant ($p<0.001$). This results the crucial requirement for reliability and validity of the structural model.

The proposed model is extended from UTAUT which consists of well established theories and approaches of user acceptance of new IS. The original UTAUT model includes the positive factors that can significantly explain user intention and use behaviors of IS. The proposed model with extension of a new construct Cloud Risk (CR) introduced the negative factor that significantly explains the negative user acceptance (or user rejection) of cloud computing acceptance. The concluded model indicated that the new construct of Cloud Risk is an important factor in cloud computing acceptance amongst ICT officers in the government.

5.3 Key Findings

The model had six constructs namely Cloud Risks (CR), Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Behavior Intention (BI) and Facilitating Conditions (FC). According to the model, CR, PE, EE and SI had an effect on Behavior Intention (BI) while FC and BI were the direct predictors of actual use of Cloud Computing.

The results for each of the constructs in the model are discussed below.

a) Facilitating Conditions

The results indicated two direct predictors of actual use of cloud computing, namely Behavior Intention (BI) and Facilitating Conditions (FC). Of the two, facilitating conditions were found to be a stronger predictor compared to BI. In facilitating conditions, respondents were asked on three items namely, whether they have resources to use cloud computing, secondly if they have knowledge to use cloud computing and thirdly whether cloud computing us compatible with most other systems they use. Since most of them are knowledgeable in ICT, the results were hardly surprising. Most of them use a form of SAAS such as email, others develop web applications and just require a platform (PAAS) and some systems reside on web servers (IAAS). Therefore facilitating conditions would be a stronger indicator than BI since computers and internet are easily available to the ICT officers. The significant of FC on actual usage suggest that more people would use Cloud Computing if given access to reliable internet and computers. In other words it indicates that the current use of cloud computing is still restricted by the poor reliability and low bandwidth of internet connectivity. As faster internet speeds become available cheaply such as the roll out of the Fiber Optic cable and +3G networks, there is likely to be an increased adoption of cloud computing not only among the government users but in the general populace.

b) Behavior Intention

This was the second predictor of actual use behavior of cloud computing. In this construct, respondents were asked four questions firstly whether they intend to use cloud computing, secondly, given access to cloud computing, whether they predict that they would use it, thirdly, if they actually intend to use cloud computing and finally, whether they are willing to recommend cloud computing to others.

The effect of BI on use behavior was 0.315 which was lower than facilitating conditions. BI in turn was dependent on Performance Expectancy, Effort Expectancy and Social Influence. The results indicate that the intention to use the new technology would greatly depend on the three factors PE, EE and SI. The respondents being technically knowledgeable had the capacity of evaluating any technology vis-à-vis the nature of their work and decide if it can make a difference in their performance. The effect of the independent constructs on Behavior intention is examined in paragraphs c-e.

c) Performance Expectancy

Performance Expectance (PE) was found to be a direct predictor of BI. However, its influence from path analysis was comparatively low, at 0.056. This suggests that ICT officers do not perceive increased change in performance by moving to the clouds. Respondents were asked on four items namely whether they accept additional benefits from use of cloud computing, secondly whether cloud computing would improve performance in their jobs, thirdly whether Cloud computing would enhance effectiveness in their jobs and finally whether they expect higher flexibility in their IT departments by the use of cloud computing. Since all respondents have strong ICT background and expertise, they could perceive cloud computing as an intrusion to the systems they have developed over time or wish to develop in future. There is less glory in implementing a solution from other parties while they could do it internally. It also indicates that they are contented with their current performance levels and see marginal improvement in performance or effectiveness by adopting cloud computing. It also implies that practitioners and vendors should focus on increasing the usefulness and innovativeness of services offered in the clouds.

d) Effort Expectancy

Effort Expectancy (EE) was also found to be a significant predictor of BI for cloud computing, with a path loading of 0.184. Five items were posed to the respondents namely whether using cloud computing would not lead to technical difficulties in our IT department, secondly if CC can integrate quite easily with existing IT infrastructure, thirdly whether it would be time consuming for me to become skillful at using cloud computing, fourthly, if respondent would find cloud computing easy to use and finally whether using CC requires a lot of mental effort. Again, being skilled people, it was not anticipated that anybody would have difficulties in a cloud computing environment. Providers of CC services should therefore come up with solutions that do not depart drastically from what the officers currently use. It would also mean that migration to the cloud computing should be structured and incremental. Officers can first be trained, compatible equipment procured in stages, and migration to cloud services carried out gradually.

e) Social Influence

Social influence (SI) with a path loading of 0.549 was the strongest predictor for BI. There were 5 data items, on which respondents were required to respond to, namely, whether there was specific person (or group) available for assistance with cloud computing difficulties, secondly, whether people who influence the respondents behavior think that s/he should use cloud computing, thirdly if experts who are important to the respondent think that s/he should use cloud computing, fourthly if people who are important to their career think that they should use cloud computing and finally whether they were expected to use cloud computing. The results indicate that SI can play a significance influence in adoption of cloud computing in the government sector. Firstly, the government needs to set up a help desk that can help ICT officers with cloud computing problems. Secondly, senior ICT officers should press for adoption of cloud computing, thirdly, professional forums should address the misgivings officers have with cloud computing, fourthly, performance contracts should be pegged to the adoption of cloud computing and finally policy makers should make it certain that they expect use of cloud computing in the Ministries.

f) **Cloud Risks**

Cloud Risks had an expected negative influence on BI (-0.171). Cloud Risks are the misgivings and apprehensions that ICT officers have on cloud computing. The respondents were asked on 10 items including security and privacy breaches, malicious activity, vendor lock-in, viability of provider, foreign legislation impact, inadequate expertise, capacity and support. All these can negatively influence the adoption of cloud computing. Although recent reports indicate that clouds are relatively more secure than traditional data centers (Paquette et al, 2010), most ICT officers feel that there is still unmitigated risks in the use of cloud services. Cloud providers need to address all these concerns and give assurance that clouds are better alternatives than in-house systems.

5.4 Conclusion

In this project we have studied the factors affecting the intention to use cloud computing by testing the UTAUT. The research sought to validate UTAUT in cloud computing context. The results showed two direct predictors of actual use of cloud computing amongst ICT officers in government, namely behavior intention and facilitating conditions. Of the two, facilitating conditions were found to be a stronger predictor compared to behavioral intention. This could partly indicate that ICT officer’s use of cloud computing tend to be a kind of involuntary and natural activity. It therefore means that more ICT officers will use cloud computing if given access to reliable internet connectivity and infrastructure.

From the results in the former sections, it can be concluded, with certain limitations, that technology acceptance of cloud computing can be described by UTAUT model and our extended model. The proposed research model combined both the positive and negative constructs that may influence the behavioral intention and use behavior of users. Further study and analysis will need to be carried out in order to ensure the validity of the results and enhance the rigorousness of the enhanced acceptance model.

The results from our study can show that in accordance with Koehler et al (2010), decisions towards the usage of cloud computing is not necessarily made for monetary reasons. Facilitating conditions, Performance Expectancy, Effort Expectancy and Social Influence all have a major impact in the decision to accept cloud computing.

5.5 Recommendations and Further Research

Although the study was conducted among ICT officers in the Kenyan public sector, the data can be useful to other sectors in order to validate the acceptance model. Furthermore, this study reveals additional factors that may influence technology acceptance. The factors are believed to be applicable to the user acceptance of general IS because security and privacy breaches, information leak, inadequate support, capacity and expertise, malicious activity, loss of intellectual property and lock-in are general issues of information systems and obstacles of user acceptance. The applicability of Cloud Risks warrants further exploration and research.

The research model did not consider the influence of the moderating variables of the UTAUT model namely Age, Sex, Experience and Voluntariness to Use. It would be necessary to consider their influence in future studies.

5.6 Limitations

As in all other studies, this one had some limitations. Firstly, the sample size in this study is not enough to generalize the opinions of all ICT officers in the government. Secondly, we did not analyze the impact of the sex, age and voluntariness to use moderators which cannot be controlled. The sample structure of this research may attribute sampling bias. Selection of sample was judgmental instead of random.

Thirdly, the research was conducted among ICT officers. These are relatively more knowledgeable in IT issues than their counterparts in the wider civil service. However, major policy decisions are made by other people who may not necessarily be skilled in ICT issues. Their opinions may not necessarily correspond to the findings in this project. It may therefore be difficult to generalize the findings to civil servant users from other Non-ICT backgrounds. Future research should focus more on the users who actively make policy decisions in the civil service regardless of their ICT backgrounds.

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APPENDICES

Appendix A: Questionnaires for ICT officers

This survey questionnaire on Cloud Computing acceptance, aims to identifying the main factors that will drive ICT officers in the government ministries to accept this paradigm. It will also identify the strong factors that will make the ICT officers reluctant to adopt cloud computing.

Section A (Participant Information)

The intent of this section is to obtain some information about individuals who respond to this survey. Information gathered about participants will be treated confidentially, and only group data will be reported as an outcome of this research. If the respondent is interested in the results of findings, they should respond with 1 for question 1 and provide a valid email address at the end of this questionnaire.

1. Are you interested in results of findings	1. Yes 2. No
2. Designation of the Respondent	
3. Age	
4. Gender	1. Male 2. Female
5. Experience in ICT field	1. 0-4 years 2. 5-10 years 3. 11-15 years 4. Over 15 year
6. Role of respondent in ICT matters in the government	1. Formulating Policy on ICT infrastructure, budget and procurement 2. Developing and Deploying Software 3. Network administration

	4. Technical support and Maintenance 5. User support and help desk 6. Others (Specify)
7. What is your level of education?	1. Masters in Computing 2. Graduate in computing 3. Diploma in computing 4. Certificate in computing 5. Degree in non-computing 6. Other (Please Specify)
8. How conversant are you with cloud computing issues?	1. Not conversant 2. Moderately conversant 3. Very conversant
9. Are you Currently using Cloud Hardware as a Service(HAAS)	1. Yes 2. No
10. Are you currently using Cloud Platform as a Service (PAAS)	1. Yes 2. No
11. Are you currently using Cloud Software as a Service (SAAS)	1. Yes 2. No

Section B: Cloud Computing

In this section Cloud Computing can be summarized as an emerging ICT concept that involves transferring the provisioning of ICT services from within the government to third parties. The 3rd party will provide services on demand that have expandable resource scalability, with little or no upfront costs.

Please circle the appropriate number to indicate the level of your agreement or disagreement with the following statements on a scale of 1 to 5, where 1 = completely disagree, 2 = somewhat disagree, 3 = neutral (neither disagree nor agree), 4 = somewhat agree, 5= completely agree

Items	**Response**

12. I expect additional benefits in the government by using cloud computing	1	2	3	4	5
13. Cloud computing would improve performance in my job.	1	2	3	4	5
14. Cloud computing can enhance effectiveness in my job.	1	2	3	4	5
15. I expect higher flexibility in our IT by using cloud computing	1	2	3	4	5
16. Using cloud computing would not lead to technical difficulties in our IT department.	1	2	3	4	5
17. Cloud computing can integrate quite easily with our IT infrastructure.	1	2	3	4	5
18. It would not be time consuming for me to become skillful at using cloud computing	1	2	3	4	5
19. I would find cloud computing easy to use	1	2	3	4	5
20. Using cloud computing would not require a lot of mental effort	1	2	3	4	5
21. I have the resources necessary to use cloud computing	1	2	3	4	5
22. I have the knowledge necessary to use cloud computing services.	1	2	3	4	5
23. Most cloud computing services are compatible with most other systems I use	1	2	3	4	5
24. A specific person (or group) is available for assistance with cloud computing difficulties	1	2	3	4	5
25. People who influence my behavior think that I should	1	2	3	4	5

use cloud computing	
26. Experts who are important to me think that I should use cloud computing	1 2 3 4 5
27. People who are important to my career think that I should use cloud computing	1 2 3 4 5
28. I am expected to use cloud computing	1 2 3 4 5
29. Assuming I can, I intend to use cloud computing	1 2 3 4 5
30. Given that I have access to cloud computing, I predict that I would use it.	1 2 3 4 5
31. I intend to use cloud computing	1 2 3 4 5
32. I am willing to recommend cloud computing to others	1 2 3 4 5
33. I can describe the difference between the concepts of cloud computing and IT outsourcing	1 2 3 4 5
34. I have experience in using cloud computing	1 2 3 4 5
35. I know several cloud computing service providers and their services	1 2 3 4 5
36. I can distinguish between SAAS, PAAS and IAAS	1 2 3 4 5
37. I am worried that Cloud resources can be susceptible to malicious activity	1 2 3 4 5
38. I am worried that data transit may increase exposure to eavesdropping threats	1 2 3 4 5
39. I am worried that there is inadequate support from cloud providers due to self-service type support	1 2 3 4 5

40. I am worried that there is inadequate data storage and retrieval in the clouds.	1	2	3	4	5
41. I am worried there is limited expertise to support cloud services	1	2	3	4	5
42. I am worried that I could have Lock-in risk from a cloud provider	1	2	3	4	5
43. I am worried that Intellectual property (IP)may be lost if I use the cloud	1	2	3	4	5
44. I am worried that there could be Security and privacy breaches risk.	1	2	3	4	5
45. I am worried about Loss of control.	1	2	3	4	5
46. I am worried that foreign legislation may be inconsistent with local legislation	1	2	3	4	5

Thank you very much

Appendix B: List of Government Ministries 2012

1. Ministry of State for Defence
2. Ministry of State for Provincial Administration and Internal Security
3. Ministry of State for Special Programmes
4. Office of the Prime Minister
5. Ministry of State for Planning, National Develoment and Vision 2030
6. Ministry of State for Public Service
7. Office of the Vice President & Ministry of Home Affairs
8. Ministry of State for National Heritage and Culture
9. Ministry of State for Immigration and Registration of Persons
10. Ministry of State for Development of Nothern Kenya & other Arid Lands
11. Office of the Deputy Prime Minister and Ministry of Finance
12. Office of the Deputy Prime Minister and Ministry of Local Government
13. Ministry of Agriculture
14. Ministry of Co-operatives Development
15. Ministry of East African Community
16. Ministry of Education
17. Ministry of Energy
18. Ministry of Environment and Mineral Resources
19. Ministry of Fisheries Development
20. Ministry of Foreign Affairs
21. Ministry of Forestry and Wildlife
22. Ministry of Gender and Children Affairs
23. Ministry of Higher Education, Science Technology
24. Ministry of Housing
25. Ministry of Industrialization
26. Ministry of Information and Communication
27. Ministry of Justice, National Cohesion and Constitutional Affairs
28. Ministry of Labour
29. Ministry of Lands
30. Ministry of Livestock Development
31. Ministry of Medical Services
32. Ministry of Nairobi Metropolitan Development
33. Ministry of Public Health and Sanitation
34. Ministry of Public Works
35. Ministry of Regional Development Authorities
36. Ministry of Roads
37. Ministry of Tourism
38. Ministry of Trade
39. Ministry of Transport
40. Ministry of Water and Irrigation
41. Ministry of Youth and Sports
42. Office of the Attorney General - State Law Office