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# Performance expectancy as a determinant for cloud computing acceptance in Kenyan Public Universities

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**Abstract**
Cloud Computing is interrelated with a new perception for the provision of computing infrastructure and other services. It provides an infrastructure that is scalable, usable, virtually accessible and adjustable Information Technology resources that need not be owned by an individual but can be delivered as a service over the Internet. This paper discusses the effect of Performance Expectancy on the acceptance to use Cloud Computing within public universities in Kenya. Mixed method research was used with Purposive and Stratified sampling being used to select the sample population and the sample size was 181 respondents from four public universities which were arrived at by using proportional allocation method. Questionnaires and interviews were used to capture data. The study established factors such as Performance Expectance to be a direct predictor of acceptability of cloud computing, migration to the cloud computing should be structured and incremental and more people would use Cloud Computing if given access to reliable internet and computers.

**Keywords:** Cloud computing, performance expectancy, virtualizing

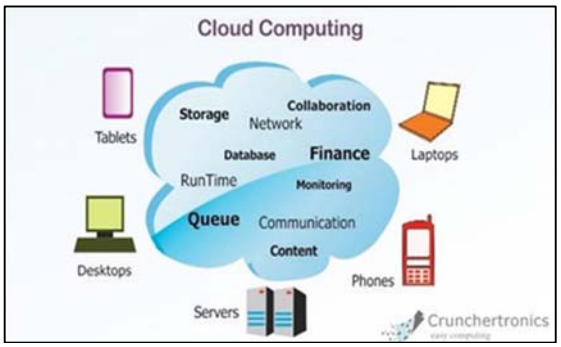
## 1. Introduction

### 1.1 Background Information

Information Technology has become one of the key areas in an organization for it to succeed. The organization can communicate faster, store huge amount of data in a more effective and reliable way. The communication within an organization has been boosted through computer network. There have been network services since the intervention of Internet in the year 1970's Martin, (2014) [20]. This has facilitated intensive online transactions.

Cloud Computing services are accessible once payment is done through subscription. As a consequence, there is no need of anymore worries for a machine running the application as the supplier of the service is now taking care of it. There is no devolution to time and resources needed to develop and maintain the application used with the concept of virtualization. Serves could be utilized more effectively. Applications and other IT infrastructure are independent thus allowing servers to be easily shared by many applications that are running virtually. Virtualization of application involves packaging the application bit with everything needed to run e.g. operating system, database etc.

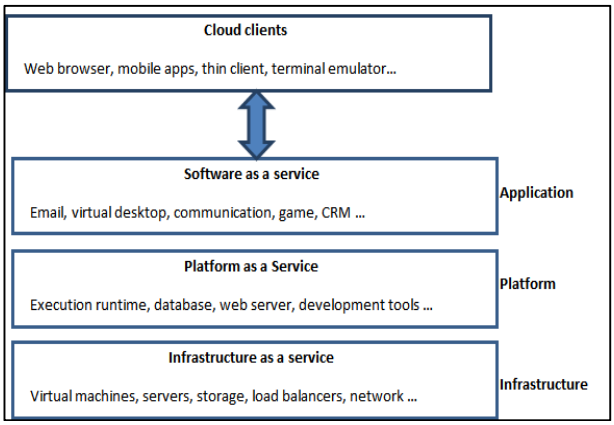
According to Armbrust (2010) [1], virtualization application can run anywhere thus not needed to run in a data center or in an application provider's center. Virtualization application can also run in the cloud. Cloud Computing is currently being seen as the newest effort in providing computing resources as a service. The National Institute of Standards and Technology (NIST) in the US published a functioning definition that summarized the generally agreed aspects of Cloud Computing. According to Mell and Grance (2009a) [21], Cloud Computing is described as a model for enabling universal, convenient, and on-demand network access so as to share a pool of configurable computing resources such as applications, networks, storage, servers, and services that can be quickly provisioned and released with minimal service provider interaction and management effort as shown in Figure 1.




**Source:** Adopted from

**Fig 1:** Cloud Computing (Tronics, 2014)

Cloud Computing offers its advantages through three types of services; infrastructure-as-a-service (IaaS), platform-as-a-service (PaaS) and software-as-a-Service (SaaS) (Mell *et al*, 2009) [21, 22]. The Cloud Computing services are charged based on the amount of used computing resources according to Hamid, Bryan, and Sharad, (2009) [12] therefore marking it very convenient to users. This feature of pay per use is one of the things that distinguish Cloud Computing from traditional IT service especially the today's IT as shown in Figure 2.

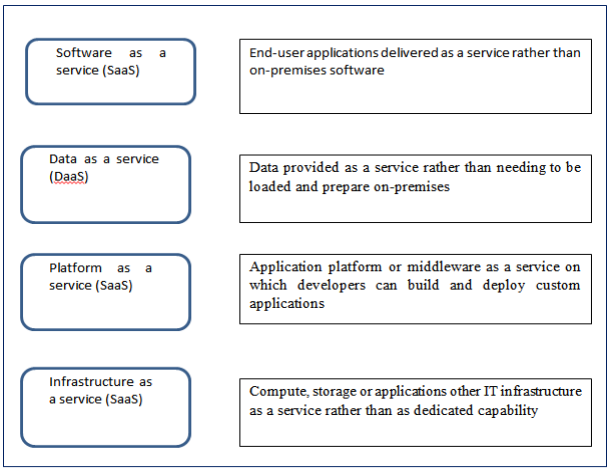



Source: Adopted from

**Fig 2:** Services being offered by the cloud (Stackpole, 2012)

Cloud computing is quickly emerging as a technology trend. Almost every industry that provides or consumes software, hardware, and infrastructure can leverage. Although there are several variations on the explanation of cloud computing, some basic views characterize this emerging environment. According to Kouyoumjian (2010) [16], Cloud computing furnishes technological capabilities commonly maintained off-premise that are delivered on demand as a service via the Internet. Since a third party owns and manages public cloud services, consumers of these services do not own assets in the cloud model but pay for them on a per-use basis. In essence, they are renting the physical infrastructure and applications within a shared architecture. Cloud offerings can range from data storage to end-user Web applications to other focused computing services. One critical difference between traditional and cloud computing is the scalable and elastic nature cloud computing provides. Instead of a static system architecture, cloud computing supports the ability to dynamically scale up and quickly scale down, offering cloud consumers high reliability, quick response times, and the flexibility to handle traffic fluctuations and demand. Cloud computing also supports multi-tenancy, providing systems configured in such a way that they can be pooled to be shared by many organizations or individuals. Virtualization technology allows cloud vendors to convert one server into many virtual machines, thereby eliminating client-server computing with single-purpose systems. This maximizes hardware capacity and allows customers to leverage economies of scale.

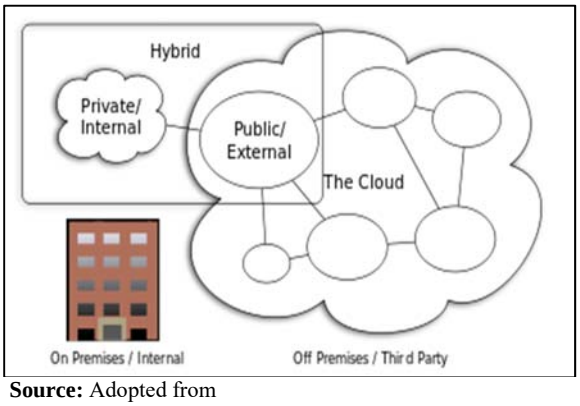
Three core options comprise the service model within the cloud computing environment are shown in Figure 3.




**Source:** Adopted from

**Fig 3:** Cloud Computing Service Model (Kouyoumjian, 2010) [16]

Armbrust (2010) [1], describes Cloud Computing as an innovative and advanced technology that virtualizes its services over the Internet. Depending on its architecture, Cloud Computing is divided into three deployment models namely: private/internal clouds – they provide data and other process and are managed within an organization without any restriction on the network band width or security exposure; public / external clouds – provide their resources on self-service over the Internet from an offsite third party provider; hybrid clouds – is an environment that consists of multiple internal and external Cloud Computing solution as depicted in Figure 4.




**Source:** Adopted from

**Fig 4:** Types of cloud deployment models (Tronics, 2014)

Cloud Computing is not all about technological improvement of data centers but also the fundamental change on how IT is established and used (Creger, 2009) [6-7]. The universities in Kenya can benefit from Cloud Computing solutions through data hosting services, applications running on the web, cloud platforms, and infrastructure. The universities will save on costs and time by reducing ICT related problems and allowing them to take advantage of the evolving technologies.

Despite Cloud Computing services being thought of being useful in advancing the academic research and administrative task (Nabil, 2010) [26], it has not been popular as it is anticipated in most universities in Kenya. Thus the purpose of this research study therefore was to develop a Cloud Computing acceptance framework for universities in Kenya that will assist in improving the acceptance of the Cloud Computing in these universities. Unified Theory of Acceptance and Use of Technology (UTAUT) was used for exploring the knowledge needed.

### 1.2 Statement of the problem

Cloud Computing can be used to improve the education standards, as well as saving the cost of purchasing both the hardware and software because all the services can be offered online. There are few universities in Kenya that have accepted and adopted Cloud Computing. According to Chan (2009) [4], universities in Kenya are relatively reluctant to use Cloud Computing services compared to other universities in East Africa. The number of universities that have accepted Cloud Computing is less than expected. This study therefore investigated performance expectancy as determinants for Cloud Computing acceptance in public universities in Kenya.

## 2. Cloud Computing

The future of computing may be presumed that it will rely on Cloud Computing, whose main objective is to reduce the cost of Information Technology services while increasing processing throughput, availability, reliability, and flexibility as well as decreasing processing time.

Computing resources that are hosted in the cloud can perform many roles such as virtual servers, configurations of distributed computing systems, database services or service workflows.

Although Cloud Computing is a new term, its concept is not new. Cloud Computing is recognized as an important area for IT innovation and investment (Armbrust *et al*., 2010; Goscinski & Brock, 2010; Tuncay, 2010) [1].

According to Armbrust *et al*. (2010) [1], Cloud Computing has extended through the main areas related to information technologies and systems such as application software, operating systems and technological solutions for firms.

Cloud Computing consists of a group 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).

Cloud Computing refers to the applications delivered as services over the Internet as well as the hardware and systems software in the data centers that provide those services. The services being referred are Software as a Service (SaaS), data center hardware and software. When a Cloud is made available by subscription to the general public, we refer to it as a Public Cloud; the service being sold is Utility Computing. Private Cloud refers to internal datacenters of an organization that is not made available to the general public. Therefore, Cloud Computing is the sum of SaaS and utility computing, but does not include Private Clouds (Armbrust *et al*., 2010) [1].

According to Mell & Grance (2009b) [22], 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. 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.

Most authors agree that Cloud Computing extents around application infrastructure, services, scalability and Internet or network. Many authors have mentioned pay-per-use models and virtualization, however, this is considered a fundamental prerequisite (Armbrust *et al*. 2010) [1] and is thus not clearly mentioned by many authors.

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

### 2.1 Benefits of Cloud Computing

In many organizations today, the role of the chief information officer has shifted in a way that makes Cloud Computing very difficult to ignore. Today's organizations are no longer exclusively responsible for the management of IT, but now for supporting business growth by driving innovation in effort to build a strategic advantage as well as reducing costs (LaManna, 2013) [17].

#### 2.1.1 Business Benefits of Cloud Computing

Business benefits are the outcome of an action or decision that contributes towards meeting single or multiple business objectives. This is where business people evaluate investments and actions in terms of expected cost and benefit outcomes. (Schmidt, 2014) [31]

**i. Reduces the cost of infrastructure investment**

If you have to build a large-scale system it may cost a fortune to invest in buildings, physical security, hardware (racks, servers, routers, backup power supplies), hardware management (power management, cooling), and operations personnel.

The high upfront costs for the project would typically require several rounds of management approvals before the project could start. Now, with utility style Cloud Computing, there is no permanent cost or startup cost (Varia, 2011) [38].

**ii. Just-in-time Infrastructure**

By deploying applications in-the-cloud with just-in-time self-provisioning, you don't need to worry about pre-procuring for large-scale systems. This increases responsiveness, while lowering the risk as well as the operational cost because you scale only as you grow and only pay for what you use(Varia, 2011) [38].

**iii. More efficient resource utilization**

System administrators usually worry about procuring hardware (when they run out of capacity) and higher infrastructure utilization (when they have excess and idle capacity). With the cloud, they can manage resources more effectively and efficiently by having the applications request and relinquish resources on demand.

**iv. Usage-based costing**

With utility-style pricing, you are billed only for the infrastructure that has already been used. You are not paying for what has been allocated thus adding a new aspect to cost savings. You can see immediate cost savings (sometimes as

early as your next month's bill) when you deploy an optimization patch to update your cloud application. For example, if a caching layer can reduce your data requests by 70%, the savings begin to accrue immediately and you see the reward right in the next bill(Varia, 2011) [38].

**v. Reduced time to market**

Parallelization is one ways to speed up processing. If one compute or data-intensive job that can run in parallel takes 500 hours to process on one machine, with cloud architectures it would be possible to spawn and launch 500 instances and process the same job in one hour. Having an elastic infrastructure provides the application the ability to exploit parallelization in a cost-effective manner thus reducing time for marketing (Varia, 2011) [38].

### 2.1.2 Technical Benefits of Cloud Computing

There are a number of *technological advantages* of cloud computing to organization. They include:

**i. Automation**

You can create repeatable build and deployment systems by leveraging programmable infrastructure automatically.

**ii. Auto-scaling**

You can scale your applications up and down to match your unexpected demand without any human intervention. Auto-scaling encourages automation and drives more efficiency.

**iii. Proactive Scaling**

Scale your application up and down to meet your anticipated demand with proper planning and understanding of your traffic patterns so that you keep your costs low while scaling.

**iv. More Resourceful Development lifecycle**

Production of systems may be easily to clone for use as development and test on the environments.

**v. Improved Testability**

Never run out of hardware for testing. At every stage during the development processes inject and automate testing. You can issue out an instant test lab with pre-configured environments only for the duration testing phase.

**vi. Disaster Recovery and Business survivability**

The cloud provides a lower cost option for maintaining a fleet of data recovery servers and data storage.

**vii. "Overflow" the traffic to the cloud**

With a few clicking and effective load balancing tactics, you can create a complete overflow-proof application by routing excess traffic to the cloud.

### 2.2 The effects of private cloud on acceptance of Cloud Computing

According to Lock (2012) [19], when economic times are tough there is always pressure on budgets in every area of organization operations. In fact justifying any spend at all has become subject to ever more intense scrutiny and in IT this has been reflected by vendors proclaiming IT budgets are being "slashed" and that IT must "do more with less".

### 2.2.1 The impact of private cloud on IT service delivery

Private cloud systems depend upon the sharing of computing resources amongst multiple IT services combined with the notion that such resources can be rapidly adjusted to ensure users obtain the levels of service quality they require to do their jobs. Indeed, the combination of active management and shared resources are major factors that transform a standard virtualized infrastructure into a private cloud. But moving towards the large scale use of private cloud poses a range of technical, process and financial challenges that it's important to be aware of. The most straightforward to address concerns the requirement for new tools that enable management and administration of the combined server, storage, networking and application resources in a seamless manor.

According to Lock (2012) [19], pulling things together across previously separate domains, private clouds, by their very nature, are also designed to be dynamically managed to ensure each IT service receives the resources needed to deliver specified levels of service as circumstances and usage vary. This will in turn necessitate using tools to monitor the service levels delivered, even including user experience. It will also become desirable, if not a necessity, to report to business users on the service levels being delivered, if only to ensure that everyone is aware that they are not being disadvantaged by the sharing of resources with other business units. Beyond tooling, keeping a private cloud functioning smoothly typically also requires IT departments to modify, perhaps drastically, many of the operational procedures and processes in place today. For some organizations this may well mean taking steps to combine different teams, for example the storage, server and networking groups, into new units combining all the skill sets.

### 2.2.2 Security Zones

In private cloud, resources of different types and sensitivity levels should be located in separate security zones (Stawowski, 2007) [34].

Private Clouds seem to be more secure than public Clouds because of how there infrastructure are designed. They give the organization more control over their policies and security.

According to NIST, the internal private Cloud is more suitable deployment models that offer an organization greater oversight and authority over security and privacy, and better limit the types of tenants that share platform resources, reducing exposure in the event of a failure or configuration error in a control.

According to Milian (2012) [23], private Clouds typically would suffer from perimeter complacency; thinking that because it is on the internal network, it must be secure; the Internet and viruses are still present. So, caution and security standards should not be lowered just because it is private. Moreover, the private Cloud requires that to have total control overall layers of the stack, which includes any traditional network perimeter security you might want to have in place.

In a private Cloud model, the Cloud services are not typically exposed to the general Internet users and remote access to private Cloud hosted resources is enabled through mechanisms used in traditional data centers. Private Cloud Computing typically uses virtualization technologies to increase hardware utilization and to abstract compute, memory, network, and storage component from Private Cloud consumers (Thomas, 2011) [36]

**Higher performance**

According to Caufield (2013) [3], private cloud is deployed inside the firewall on an organization's intranet, which means that transfer rates are dramatically increased versus using the Internet. In addition that, there's no worry of slow page access times that may happen with using a public cloud service. A private cloud is within an organizations intranet; this means access speeds are higher.

**Deeper compliance**

Sarbanes Oxley, PCI DSS and HIPAA compliance that data may be delivered through a public cloud service deployment, but sometimes the data may not be as detailed or customizable. Because the hardware, storage and network configuration is dedicated to a single client, compliance data is much easier to attain.

**Customizable**

Hardware performance, network performance, and storage performance can be specified and customized in the private cloud since it's owned by the company.

**Scalability**

Depending upon the software solution used and deployment architecture, scaling might be less fluid than public cloud. Between solutions like file cloud provide excellent scaling as good as public cloud.

**2.3 Cloud Computing use in Universities**

The University of California at Berkeley, found out Cloud Computing to be appealing to use in one of their courses. The focus was exclusively on the developing and deploying of Software as a Service application. These was Helped by a donation from the Amazon Web Services. University of California was able to shift its course from locally owned infrastructure to the cloud. One of the major reasons for doing so was that it had the ability to acquire a vast amount of servers that was needed for the course in a matter of a few minutes (Armbrust, 2010) [1].

Cloud Computing has been made less expensive and more accessible, making many users to set up and customize their own systems while investigators can be able to analyze their data in a greater depth than it was previously attain, thus making it possible for them to learn more about the systems they are studying (Nabil, 2010) [26].

Cloud Computing providers' like Google and IBM are aggressively promoting Cloud Computing as a tool for research. A research conducted by Google and IBM in 2007 announced a Cloud Computing university initiative that was designed to improve the knowledge of computer science students' in performing highly parallel computing practices so as to address the emerging pattern of large-scale distributed computing.

The National Science Foundation (NSF) in the year 2009 awarded approximately $5 million in grants to 14 universities through its Cluster Exploratory (CLuE) program. This helped in facilitate their involvement in the IBM/Google initiative which was to provide computing infrastructure to leading-edge research projects that could help us understand our planet, our bodies and many other issues.

There is a number of increasing educational establishments that are accepting Cloud Computing for economic reasons. Washington State University's School of Electrical Engineering and Computer Science (EECS) is one of those that have already adopted Cloud Computing. The EECS selected a cloud platform called vSphere 4 from VMware which is the leading provider of the virtualization technology as it was searching for the best platform that would support the move to Cloud Computing. This was a result of being faced by budget cuts related to the current economic conditions. The vSphere 4 platform accumulates and manages IT resources as a unified, flexible and a dynamic service that offers approximately limitless scalability, greater reliability as well as better performance than the traditional IT environment.

The EECS claim that Cloud Computing has enabled it to expand its services to faculty and students rather than slashing them back (DeCoufle, 2009) [8]. Schools appear to have accepted the idea of Cloud Computing.

Kentucky's Pike County district decided to rationalize costs by introducing Cloud Computing to its schools which had a population of 10,200 students. ICC Technology Partners, a subcontractor of IBM took the management of the platform. The schools used Cloud Computing to convert 1400 old computers many of which were sitting on the floor because they were ready for scrap, into a fully functioning VM. This was made possible because Cloud Computing eliminates the need for having a hard drive on the local computer.

In cloud environment, all processes take places at the server level and not locally at the desktop level. The desktop machine used becomes dumb terminal in that it will receive processing power as well as software that have been delivered from the server in the cloud. The major advantage of Cloud Computing for Pike County was having enough computers on the location to do computer-based for-motive assessment which had challenges in the past because they had limited number of desktop machines that were working (Erenben, 2009) [9].

The Pike County estimated that over a period of 5-year, the cost of ownership for the hosted virtual desktop solutions will be less than half the cost of supporting the desktops on-the ground. By hosting the desktops in the IBM's data center, the Pike County was able to avoid the additional cost for infrastructure and the staffing costs of controlling the servers (Lambert, 2009) [18].

Cloud Computing is also finding its way in British academia. A number of UK higher education institutions, such as the University of Glamorgan, the University of Aberdeen, the University of Westminster, Leeds Metropolitan University, the Royal College of Art (RCA) and the London University.

School of Oriental and African Studies (SOAS) have accepted Google Apps. The demand from students, many of whom were already discarding the untrustworthy in-house email systems because of the cost which was said to be the reason behind this move (Hicks, 2009) [13].

Some of African educational institutions have adopted Cloud Computing, because of their inadequate IT infrastructures and also their lack of ability to cope with the persistent cycle of in the upgrade of hardware and software due to the technology. Google has been very effective and successful in targeting the East African educational markets. For example, Google being the giant Cloud Computing service provider it has partnered with a number of East African educational establishments such as the Kigali Institute for Education, National University of Rwanda, Kigali Institute for Science and Technology, University of Mauritius, the University of Nairobi, Masinde Muliro University of Science and Technology, the Kenyan Methodist University and the United States International University so as to provide Google cloud services such as Google Calendar, Gmail, Google Talk and Google Spreadsheets and Google Docs to their students. These universities have also been helped by an existing World Bank grant in supporting bandwidth aid in universities (Wanjiku, 2009) [41].

Microsoft is also helping the Ethiopian government in rolling out 250,000 laptops to Ethiopian school teachers. These laptops will help the teachers in download the curriculum, keeping track of the academic records and safely transfer student data all through the education system, thus saving on

the cost of to build a support system of the hardware and software so as to connect them (Chan, 2009) [4].

The services use in Kenyan universities is Google cloud services such as Google Calendar, Gmail, Google Talk and Google Spreadsheets and Google Docs to their students. There are many services provided over the cloud apart from the few that are being offered through the three services offered (IaaS, SaaS and PaaS). The research studied why the universities that had accepted to use Cloud Computing were using only a few and it also studied why other universities were using the cloud services.

## 3. Methodology

### 3.1 Area of Study

The reason to why the study was based on public universities in Kenya is the ability of Cloud Computing to help Kenyan education, not only by reducing IT costs but also by making education more efficient than before. Cloud Computing is likely to be a very powerful (and empowering) tool for the advancement of education in this country.

#### 3.1.1 Sampling Technique

This study employed purposive and stratified sampling. Purposive sampling was used because the sample was taken from the IT department. The respondents from the selected universities were selected through Stratified sampling which was used to classify the users of Cloud Computing in Moi University, the University of Nairobi, Maseno University and Masinde Muliro University of Science and Technology to IT personals, managers, administrative staff, and student. This technique excludes members of the population who do not contribute to that purpose thus focus on particular characteristics of a population that were of interest, which best enabled to answer the research questions.

Homogeneous sampling is a type of purposive sampling technique that aimed to achieve a homogeneous sample; that is, a sample whose units involved the managers, IT personnel's, administrative staffs and students.

According to Ross (2002) [30], purposive sampling provide researcher with the justification to make generalizations from the sample that is being studied.

Purposive sampling was useful in this study because it provided a wide range of non-probability sampling techniques for the researcher to draw on.

The sample size was calculated at 95% confidence level, an alpha level of 0.05 which is margin of error of +/- 5% and. 5 as the standard of deviation which shows how much variance do the research expect in as responses.

The sample size for the study was 181 participants.

Managers were selected because they were the ones who come up with the final decisions on whether to accept or reject the new technology based on its advantages and disadvantages and in this case Cloud Computing is the new technology. The IT personnel were selected because they had the knowledge of what Cloud Computing was and they were the once who advised the managers on the technologies that was need in the university. Administration assistants and students were the people who used the technology that had been embraced in accomplishing their duties.

The sample size for the study was 181 participants to whom questionnaires were provided and interview schedule initiated. The sample size to be used in this study was arrived at by using proportional allocation method by Kothari (2009) [15] and consisted of; 4 homogeneous stratums comprised of 10 Managers, 97 IT personnel's, 21 Administration assistants and 212 students.

#### 3.1.2 Sample Size

The sample size comprised of 5 Managers, 52 IT personnel's, 11 Administration assistants and 113 students. This is depicted in Table3.1

**Table 3.1:** Sample size

| Study population | Target population | Sample size |
|---|---|---|
| Managers | 10 | 5 |
| IT personnel's | 97 | 52 |
| Administration assistants | 21 | 11 |
| students | 212 | 113 |
| Total | 340 | 181 |

### 3.2 Data Collection

The main research instruments that were used to collect data were questionnaires and interviews.

## 4. Data Analysis and Presentation

### 4.1 Demographic Information of the respondents

This subsection presents and discusses the demographic information of respondents as categorized by gender, age group, and experience in ICT field, designation and academic qualification.

#### 4.1.1 Respondents as categorized by gender

The study obtained information on the gender of the respondents, which has been presented in Table 4.2.

**Table 4.1:** Respondents by Gender

| Sex | Number | Percentage |
|---|---|---|
| Male | 154 | 85.1 |
| Female | 27 | 14.9 |
| | 181 | 100 |

A total of 181 participants completed questionnaires. This consisted of 85.1% (154) male and 14.9 % (27) female. It can be seen from Table 4.1 that majority of the respondents were male.

#### 4.1.2 Respondents categorized by age

Table 4.2 presents demographic information pertaining the age of the respondents. It was established that majority of the respondents were 18-25 years old. This formed 72.9% (132) of all respondents. It was noted that other age groups formed a small percent of the remaining respondents. This were age groups 34-41, 26-33, 42-50, and over 50 years old formed a percentage of 9.4% (17), 8.8% (16), 5.5% (10) and 3.3% (6) respectively.

**Table 4.2:** Age in years

| | Frequency | Percent (%) | Cumulative Percent |
|---|---|---|---|
| 18 - 25 years | 132 | 72.9 | 72.9 |
| 26 - 33 years | 16 | 8.8 | 81.8 |
| 34 - 41 years | 17 | 9.4 | 91.2 |
| 42 - 50 years | 10 | 5.5 | 96.7 |
| Over 50 year | 6 | 3.3 | 100.0 |
| Total | 181 | 100.0 | |

#### 4.1.3 Respondents categorized by years of experience in ICT field

Table 4.3 indicates the respondents experience in the field of ICT.

**Table 4.3:** Respondents by Years of Experience in ICT field

| | | | Experience in ICT field | | | | Total |
|---|---|---|---|---|---|---|---|
| | | | 0-4 years | 5-10 years | 11-15 years | Over 15 year | |
| Gender | Male | Count | 107 | 19 | 13 | 15 | 154 |
| | | % within Gender | 69.5% | 12.3% | 8.4% | 9.7% | 100.0% |
| | | % within Experience in ICT field | 85.6% | 76.0% | 92.9% | 88.2% | 85.1% |
| | Female | Count | 18 | 6 | 1 | 2 | 27 |
| | | % within Gender | 66.7% | 22.2% | 3.7% | 7.4% | 100.0% |
| | | % within Experience in ICT field | 14.4% | 24.0% | 7.1% | 11.8% | 14.9% |
| Total | | Count | 125 | 25 | 14 | 17 | 181 |
| | | % within Gender | 69.1% | 13.8% | 7.7% | 9.4% | 100.0% |
| | | % within Experience in ICT field | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

It was established that 69.5% (107), 12.3% (19), 8.4% (13) and 9.7% (15) of male had 0- 4, 5-10, 11-15 and over 15 years of experience respectively in the field of ICT. The study revealed that 66.7% (18), 22.2% (6), 3.7% (1) and 7.4% (2) of female respondents were found to have an experience of 0-4, 5-10, 11-15 and over 15 years respectively in the field of ICT. Respondents with 0-4 years of experience consisted of 85.6% (107) male and 14.4% (18) female. Respondents possessing 5-10 years of experience comprised of 76.09% (19) male and 24.0% (6) female. The study found out that within the experience bracket of 11-15 years, 92.9% (13) were male and 7.1% (1) was female while respondents with over 15 years of experience were 88.2% (15) were male and 11.8% (2) were female. Therefore a majority, 69.1% (125) had ICT experience of between 0-4 years while 13.8% (25), 7.7% (14) and 9.4% (17) had an ICT experience of between 5 -10 years, 11 - 15 years and over 15 years respectively.

### 4.1.4 Respondents categorized by Designation

The study established designation of the respondents by the roles they fulfill in ICT matters in the public universities that were studied. The finding on this is tabulated in Table 4.4. From the tabulated findings, it can be seen that majority 49.2% (87) were students these public universities. Among these students, 10.7% (19) were male while 5.6% (10) were female. Another designation was of respondents who were involved in formulating policy in ICT infrastructure, budget and procurement. This designation formed 16.4% (29) of the respondents. It comprised of 10.7% (19) male and 5.6% (10) female. Other designations were network administration, user support or help desk, technical support and maintenance, developing & deploying software and lecturer or teaching staff which had 11.3% (20), 8.5% (15), 5.6%(10), 5.1% (9) and 4.0% (7) respectively.

Network administration comprised of 10.7% (7) male and 0.6% (1) female. User support or help desk comprised of 7.9% (14) male and 0.6% (1) female. Technical support or help desk comprised of 3.4% (6) male and 2.3% (4) female. Respondents involved in developing and deploying software comprised of 4.5% (8) male and 0.6 (1) female while lecturers or teaching staff comprised of 4.0% (7) male and 0.0 (0) female.

**Table 4.4:** Respondents by Designation

| | | Gender | | Total |
|---|---|---|---|---|
| | | Male | Female | |
| Formulating Policy on ICT infrastructure, budget and procurement | Count | 19 | 10 | 29 |
| | % of Total | 10.7% | 5.6% | 16.4% |
| Developing and Deploying Software | Count | 8 | 1 | 9 |
| | % of Total | 4.5% | .6% | 5.1% |
| Network administration | Count | 19 | 1 | 20 |
| | % of Total | 10.7% | .6% | 11.3% |
| Technical support and Maintenance | Count | 6 | 4 | 10 |
| | % of Total | 3.4% | 2.3% | 5.6% |
| User support or help desk | Count | 14 | 1 | 15 |
| | % of Total | 7.9% | .6% | 8.5% |
| Lecturer or teaching staff | Count | 7 | 0 | 7 |
| | % of Total | 4.0% | .0% | 4.0% |
| Student | Count | 77 | 10 | 87 |
| | % of Total | 43.5% | 5.6% | 49.2% |
| Total | Count | 150 | 27 | 177 |
| | % of Total | 84.7% | 15.3% | 100.0% |

### 4.1.5 Respondents categorized by Qualification

The study established qualification of the respondents by their highest level of education in the public universities that were studied. The finding on this is tabulated in Table 4.5. From the tabulated findings, it can be seen that majority 34.8% (63) were Undergraduate students in these public universities. It comprised of 30.4% (55) male and 4.4% (8) female. This was expected since the study targeted a particular professional and students in public universities under study. It gave a credibility to the responses since all of the them were conversant with the subject matter., other Qualifications were Masters, Graduate, Diploma, Certificate in computing and Degree in non-computing which had 17.1%(31), 32.6%(59), 8.3%(15), 2.8%(5) and 4.4%(8) respectively.

Masters in computing comprised of 12.7% (23) male and 4.4% (8) female. Graduate in computing comprised of 29.3% (53) male and 3.3% (6) female. Diploma in computing comprised of 6.1% (11) male and 2.2% (4) female. Certificate in computing comprised of 2.8% (5) male and 0.0% (0) female. Degree in non-computing comprised of 3.9% (7) male and 0.6% (1) female

**Table 4.5:** Respondents by Qualification

| Level of education * Gender Cross tabulation | | | | | |
|---|---|---|---|---|---|
| | | | Gender | | Total |
| | | | Male | Female | |
| Level of education | Masters in computing | Count | 23 | 8 | 31 |
| | | % of Total | 12.7% | 4.4% | 17.1% |
| | Graduate in computing | Count | 53 | 6 | 59 |
| | | % of Total | 29.3% | 3.3% | 32.6% |
| | Diploma in computing | Count | 11 | 4 | 15 |
| | | % of Total | 6.1% | 2.2% | 8.3% |
| | Certificate in computing | Count | 5 | 0 | 5 |
| | | % of Total | 2.8% | .0% | 2.8% |
| | Degree in non-computing | Count | 7 | 1 | 8 |
| | | % of Total | 3.9% | .6% | 4.4% |
| | Undergraduate | Count | 55 | 8 | 63 |
| | | % of Total | 30.4% | 4.4% | 34.8% |
| Total | | Count | 154 | 27 | 181 |
| | | % of Total | 85.1% | 14.9% | 100.0% |

### 4.1.6 Respondents categorized by Knowledge in Cloud computing issues

The study sought to find out the degree of knowledge by the respondents on cloud issues. The finding on this is tabulated in Table 4.6. From the tabulated findings, it can be seen that majority 70.2% (127) were moderately conversant with cloud computing issues. It comprised of 60.8% (110) male and 9.4% (17) female. The majority of the respondents had good knowledge on cloud computing concepts. This was expected since the study targeted the IT department in public universities. Other categories were not conversant and Very conversant which had 12.2% (22) and 17.7 % (32) respectively.

Not conversant with cloud computing issues comprised of 7.7% (14) male and 4.4% (8) female. Moderately conversant with cloud computing issues comprised of 60.8% (110) male and 9.4% (17) female. Very conversant with cloud computing issues comprised of 16.6% (30) male and 1.1% (2) female.

**Table 4.6:** Knowledge in cloud issues by sex

| Conversant with Cloud Computing issues * Gender Cross tabulation | | | | |
|---|---|---|---|---|
| | | Gender | | Total |
| | | Male | Female | |
| Not conversant | Count | 14 | 8 | 22 |
| | % of Total | 7.7% | 4.4% | 12.2% |
| Moderately conversant | Count | 110 | 17 | 127 |
| | % of Total | 60.8% | 9.4% | 70.2% |
| Very conversant | Count | 30 | 2 | 32 |
| | % of Total | 16.6% | 1.1% | 17.7% |
| Total | Count | 154 | 27 | 181 |
| | % of Total | 85.1% | 14.9% | 100.0% |

### 4.2 Performance Expectancy as a determinant for cloud computing acceptance

The study sought to find out how the respondents perceived performance expectancy as a determinant for cloud computing acceptance in public universities. The results are shown in Table 4.7

**Table 4.7:** Performance Expectancy as a determinant

| | Completely disagree | Slightly disagree | Neutral | Slightly agree | Completely agree | Mean | Standard. Deviation |
|---|---|---|---|---|---|---|---|
| I believe there is additional benefits to the university by using Cloud Computing | 12 | | 16 | 44 | 109 | 4.31 | 1.098 |
| Cloud Computing improve performance in the job | 6 | 3 | 21 | 36 | 115 | 4.39 | 0.986 |
| Would Cloud Computing enhance effectiveness in my job or research | 3 | 8 | 14 | 30 | 126 | 4.48 | 0.934 |
| I anticipate higher flexibility in our IT by using Cloud Computing | 2 | 10 | 22 | 40 | 107 | 4.33 | 0.965 |
| Use of Cloud Computing would not lead to technical difficulties in our IT department in the university | 17 | 13 | 22 | 36 | 93 | 3.97 | 1.333 |
| Cloud Computing can integrate quite easily with our IT infrastructure | 8 | 8 | 8 | 72 | 25 | 4.20 | 1.026 |
| It would not be time consuming for me to become skillful at using cloud computing | 18 | 13 | 9 | 51 | 90 | 4.01 | 1.319 |
| I would find Cloud Computing easy to use | 4 | 24 | 13 | 45 | 90 | 4.10 | 1.155 |
| Using Cloud Computing would not require a lot of mental effort | 18 | 35 | 17 | 44 | 68 | 3.16 | 1.405 |
| There are necessary resources to use Cloud Computing | 9 | 16 | 21 | 45 | 90 | 4.06 | 1.191 |
| I have the knowledge that is required to use Cloud Computing services | 3 | 30 | 9 | 55 | 78 | 4.00 | 1.160 |
| Most cloud computing services are compatible with most other systems | 27 | 20 | 17 | 42 | 75 | 3.65 | 1.478 |
| A specific person or group is available for assistance with if any difficulty is encountered with Cloud Computing | 3 | 15 | 21 | 34 | 108 | 4.27 | 1.063 |
| People who influence my behavior think that I should use cloud computing | 2 | 5 | 36 | 30 | 108 | 4.31 | 0.956 |
| Experts who are significant to me think that I should use Cloud Computing | 8 | 13 | 19 | 38 | 113 | 4.35 | 1.036 |
| People who are important to my career think that I should use cloud computing | 9 | 5 | 10 | 39 | 117 | 4.39 | 1.059 |
| I am expected to use Cloud Computing | 15 | 21 | 23 | 42 | 80 | 3.83 | 1.327 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| As long as I have access to Cloud Computing, I predict that I would use it | 9 | 6 | 14 | 44 | 108 | 4.30 | 1.081 |
| I am willing to recommend Cloud Computing to others | 13 | 10 | 26 | 31 | 91 | 4.04 | 1.269 |
| I can describe the difference between the concepts of Cloud Computing, virtualization and IT outsourcing | 3 | 22 | 25 | 36 | 95 | 4.09 | 1.139 |
| I have experience in using cloud computing | 15 | 6 | 8 | 47 | 104 | 4.22 | 1.211 |
| I know of several Cloud Computing service providers and their services | 15 | 14 | 13 | 47 | 92 | 4.03 | 1.282 |
| I can differentiate between SAAS, PAAS and IAAS | 28 | 22 | 13 | 37 | 81 | 3.67 | 1.517 |

The findings of the study are indicated in Table 4.8. The scale used in the study was 1-completely disagree, 2- slightly disagree, 3- neutral (neither disagree nor agree), 4- slightly agree, 5-completely agree. The findings indicate that the respondents completely agreed that there were additional benefits to the university by using Cloud Computing as shown by a mean of 4.31, while they agreed that using Cloud Computing will improve job performance, Cloud Computing would enhance effectiveness in my job or research, anticipate higher flexibility in their IT, Use of Cloud Computing would not lead to technical difficulties in their IT department in the university, Cloud Computing could integrate quite easily with our IT infrastructure, It would not be time consuming become skillful at using cloud computing, Cloud Computing would be easy to use, using Cloud Computing would not require a lot of mental effort, There are necessary resources to use Cloud Computing, they have the knowledge that is required to use Cloud Computing services, Most cloud computing services are compatible with most other systems, A specific person or group is available for assistance with if any difficulty is encountered with Cloud Computing, People who influence their behavior think that I should use cloud computing, Experts who are significant to them think that I should use Cloud Computing, People who are important to their career think that I should use cloud computing, they expected to use Cloud Computing, As long as they have access to Cloud Computing, predict that they would use it, they are willing to recommend Cloud Computing to others, they can describe the difference between the concepts of Cloud Computing, virtualization and IT outsourcing, they have experience in using cloud computing, they know of several Cloud Computing service providers and their services and can differentiate between SAAS, PAAS and IAAS shown by means of 4.31, 4.39, 4.48, 4.33, 3.97, 4.20, 4.01, 4.10, 3.16, 4.06, 4.00, 3.65, 4.27, 4.31, 4.35, 4.39, 3.83, 4.30, 4.04, 4.09, 4.22, 4.03 and 3.67 with standard deviation of 1.098, 0.986, 0.934, 0.965, 1.333, 1.026, 1.319, 1.155, 1.405, 1.191, 1.160, 1.478, 1.063, 0.956, 1.036, 1.059, 1.327, 1.081, 1.269, 1.139, 1.211, 1.282, 1.517 respectively.

This indicates that majority of respondents strongly believed that there is additional benefits to the university by using Cloud Computing solutions, using Cloud Computing will improve job performance, enhance effectiveness in job or research, anticipate higher flexibility in their IT, use of Cloud Computing would not lead to technical difficulties in their IT department in the university, it would not be time consuming become skillful at using cloud computing, Cloud Computing would be easy to use, using Cloud Computing would not require a lot of mental effort, There are necessary resources to use Cloud Computing, they have the knowledge that is required to use Cloud Computing services, Most cloud computing services are compatible with most other systems, A specific person or group is available for assistance with if any difficulty is encountered with Cloud Computing, people who influence their behavior think that I should use cloud computing, Experts who are significant to them think that I should use Cloud Computing, People who are important to their career think that I should use cloud computing, they expected to use Cloud Computing, As long as they have access to Cloud Computing, predict that they would use it, they are willing to recommend Cloud Computing to others, they can describe the difference between the concepts of Cloud Computing, virtualization and IT outsourcing, they have experience in using cloud computing, they know of several Cloud Computing service providers and the services they offer and can differentiate between SAAS, PAAS and IAAS. The respondents also agreed that Cloud Computing could integrate quite easily with their IT infrastructure.

## 5. Findings, Summary, Conclusions And Recommendations

### 5.1 Key Findings

The UTAUT 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 study, Performance Expectancy had an effect on acceptability and the Behavior Intention to use cloud computing

#### 5.1.1 Performance Expectance (PE)

Performance Expectance was found to be a direct predictor of acceptability of cloud computing. However, its influence from path analysis was comparatively high, at 0.586. This suggests that students and ICT personnel's do perceive increased change in performance by moving to the clouds. Respondents were asked on several 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 most respondents had strong ICT background and some were 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.

They were also asked whether using cloud computing would not lead to technical difficulties in our IT department, secondly if cloud computing 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 Cloud Computing requires a lot of mental effort. Once again, being skilled people in ICT, it was not anticipated that anybody would have difficulties in a cloud computing environment. Providers of Cloud computing 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.

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 they should use cloud computing, thirdly if experts who are important to the respondent think that they 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 social influence can play a significance influence in adoption of cloud computing in the public universities in Kenya. Firstly, the public universities need to set up a help desk that can help students, ICT Personnel's and managers with cloud computing problems. Secondly, senior ICT personnel's should press for adoption of cloud computing, thirdly, professional forums should address the misgivings that the students and 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 public universities.

Under 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 since computers and internet is easily available to the ICT officers. The significant of facilitating conditions 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/+4G networks, there is likely to be an increased adoption of cloud computing not only among the public university users but in the general populace.

It also indicates that they are contented with their current performance levels and see marginal improvement in performance or effectiveness by accepting and adopting cloud computing.

It also implies that practitioners and vendors should focus on increasing the usefulness and innovativeness of services offered in the cloud computing.

### 5.2 Conclusion

More ICT officers will use cloud computing if given access to reliable internet connectivity and infrastructure

### 5.3 Acknowledgement

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