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Cloud Computing in Kenya

A 2013 Baseline Survey

University of Nairobi

School of Computing and Informatics (SCI) &

Computing for Development Lab (C4DLab)

Dr. Tonny K. Omwansa

Prof. Timothy M. Waema

Mr. Brian Omwenga

April 2014

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INTRODUCTION

Background

The increase in connectivity coupled by a growing size, variety and interrelations of data led to the introduction of larger infrastructures with capacity for dynamic load and access balancing. Amazon published internal data sources allowing customers to access and use them and the term ‘cloud’ was introduced to refer to the elasticity of infrastructure. The term ‘cloud’ however dates back to the 90s to refer to dynamic traffic switching to balance utilization within the telecoms infrastructure[8].Cloud computing concepts originate from other computing paradigms like utility computing, virtualization, parallel computing, grid computing and even service oriented architecture [2][5][14][15]some of which date back to early 1960s.

Organizations began to develop and adopt cloud, led by technology and innovation inclined companies. Many countries, led by the western nations have developed strategies to accelerate the uptake of cloud computing. Developing nations have a huge opportunity to exploit the power and benefits of these technologies provided the right frameworks and investments are in place. The rapid development and adoption of cloud computing has primarily been accelerated by the emerging computing technologies that enable reasonably priced use of computing systems and infrastructures as well as mass storage capabilities.

The possibility of outsourcing computing resources that have the potential to scale-on-demand with little or no up-front IT infrastructure investment costs makes cloud computing very attractive to organizations, particularly smaller entities [3][8].

Despite the numerous benefits that cloud computing promises, its adoption faces numerous challenges. Security implications, trust between providers and consumers, legal considerations, organizational setup and compliance requirements are some of the common research challenges [1] [2] [3].

Justification

Cloud computing has emerged in recent years [15] however not much research has been done in this area in developing countries. In many respects, developing markets have opportunities to leap frog by adopting modern technologies that result in many benefits,

such as cost cutting and speed of processing. Similar transformations have been observed in the uptake of mobile phones and mobile financial services in developing countries.

For these technologies to be implemented appropriately and adopted, several critical elements must be in place. Governments must put in place supportive legal and regulatory frameworks, suppliers must make the technology available, technical people must have the right skills and consumers must have the right knowledge and attitude.

Given the limited research at country level, more so in emerging markets, this research was proposed to investigate the status of cloud computing in Kenya, a developing nation that has demonstrated leadership in developing and adoption of appropriate technological innovations. The study digs deep to understand the circumstances, challenges, opportunities and limitations facing the country in her quest to exploit cloud computing technologies. In conclusion the report provides a set of recommendations that could spur the development of the sub-sector.

Research Objectives

The aim of the study was to provide an understanding of the current status and trends for cloud computing in Kenya from a number of perspectives, including adoption, impact and policy. Beyond the understanding, the research aimed at providing recommendations with specific interventions needed to spur the growth of the sub-sector.

To achieve this goal, the following objectives guided the study:

- Investigate the current status of cloud computing adoption in Kenya
- Establish the impact of cloud computing.
- Make recommendations through several outputs, including a white paper, academic paper and policy brief

Research Questions

The following are the research questions that guided the study:

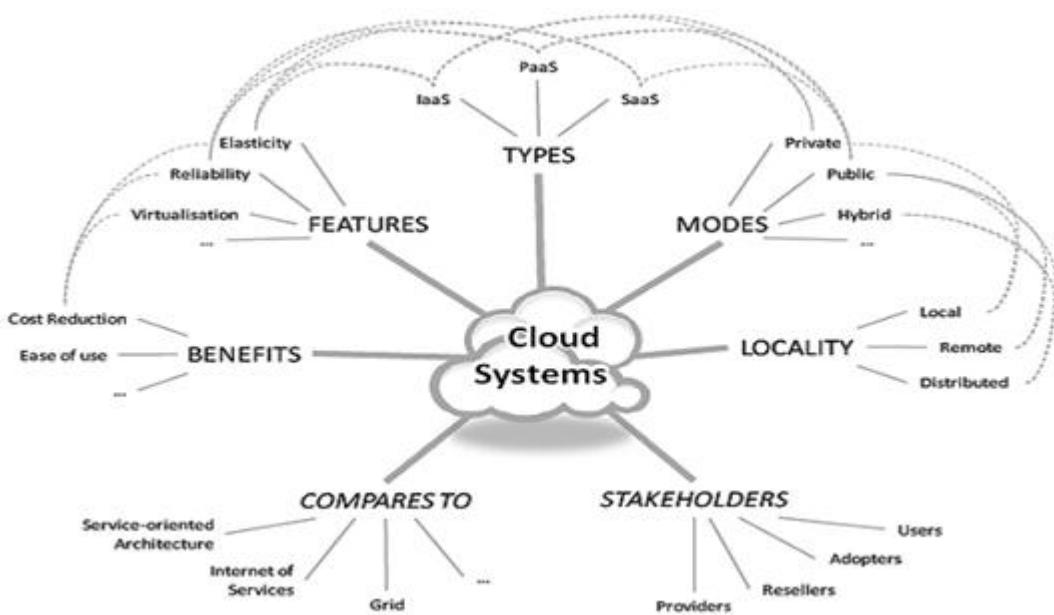
- What is the extent and characteristic of cloud computing adoption in Kenya?

- What are the perceived technical requirements and impacts of cloud computing in Kenya?
- What is the perceived and desired policy and regulatory requirement for cloud computing in Kenya that can facilitate maximum benefit of cloud technology?

Scope

The study was limited to institutions that have a physical presence in Nairobi, the capital city of Kenya. The focus on Nairobi was based on the fact that most organizations in Kenya have their headquarters in Nairobi which is the economic hub of East Africa. In addition, the budgetary allocation for the research project could not allow covering cities beyond Nairobi. There are various dimensions of analysing cloud computing, including stakeholders, types, modes, features and locality as summarized by the cloud computing systems model by Jeffrey & Neidecker-lutz (2009) [8]. The model was used as a basis for scoping and identifying key respondents in the study. Within the sample identified, there were providers, consumers and policy makers. The providers were grouped into Infrastructure as a Service (IaaS), Software as a Service (SaaS) and Platform as a Service (PaaS). Providers and consumers were also classified as either utilizing public or private clouds.

Figure 1: Model used as a basis for scoping [8]



REVIEW OF RELATED LITERATURE

Terminologies, Definitions and Cloud Computing Overview

'Cloud'

There are several definitions and interpretation of what cloud computing or simply the cloud is. We provide a selected few from literature. Jeffrey and Neidecker-Lutz define the cloud as '*an elastic execution environment of resources involving multiple stakeholders and providing a metered service at multiple granularities for a specified level of quality of service*' [8]. This provides a representative as opposed to complete definition. Buyya et al., 2008 [2] define the cloud as '*a type of parallel and distributed system consisting of collection of interconnected and virtualized computers that are dynamically provisioned and present as one or more unified computing resource based on service-level agreements established through negotiation between service provider and customer*' while Plummer et al., 2009[12] define cloud as '*a style of computing where scalable and elastic IT-related capabilities are provided as-a-service using Internet technologies to multiple external customers*'. The latter two provide a more academic view of the cloud. The National Institute of Standards and Technology (NIST) of the US department of commerce defines the cloud 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*'[11]. A generic definition states that the cloud is '*an emerging business model that delivers computing services over the internet in an elastic self-serviced, self-managed, cost-effective manner that guarantees quality of service*' [9].

The NIST proposes that cloud is composed of five essential characteristics, three service models, and four deployment models. Table 1 summarizes the NIST proposed essential elements. Beyond these characteristics, researchers have identified other characteristics that define cloud computing which include: massive scale, availability of computing and storage capabilities, use of virtualization technology, resilient computing, homogeneity and pay-as-you-go model [10] [14].

These characteristics, including the low (or no) upfront and low overheads, make cloud computing appropriate for organizations and governments.

Table 1: Essential elements of cloud computing (NIST)

Element	NIST description
On-demand self-service	A consumer can unilaterally request for provision of computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider
Broad network access	Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations)
Resource pooling	The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand.
Rapid elasticity	Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand.
Measured service	Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts).

With the elements of cloud computing highlighted in Table 1, a number of potential advantages have been identified in the literature. The United Nations Conference on Trade and Development (UNCTAD) identifies a number of potential advantages and disadvantages summarized in

Table 2.

Table 2: Potential Advantages and Disadvantages of Cloud Computing [13]

Potential Advantages	Potential Risks/Disadvantages
Reduced costs for rented IT hardware and software compared to costs for in-house equipment (cost advantages can be reaped through the economies of scope and scale of cloud solutions and from the shift from capital to operational expenditure)	Increased costs of communications (to telecommunication operators/ISPs)
Reduced cost of in-house IT management	Increased costs for data or service migration and integration
Enhanced elasticity of storage/processing capacity as required by fluctuations in demand	Reduced control over data and applications
Greater flexibility and mobility of access to data and services	Data security and privacy concerns
Immediate and cost-free upgrading of software	Unreliable services e.g. due to inadequate ICT or power infrastructure
Enhanced reliability/security of data and services	Risk of Vendor locking(limited interoperability and data portability) with providers in uncompetitive cloud markets

Cloud Service Delivery Model

Cloud Service Providers deliver cloud computing capabilities as one or a combination of three hierarchical service models:

- The infrastructure layer (Infrastructure as a Service, IaaS) where the customer is provided with a capability to access fundamental computing resources to deploy and run software, which can include operating systems and applications.
- The platform layer (Platform as a Service, PaaS) whereby a customer is provided with a capability to deploy onto the cloud infrastructure.
- The application layer (Software as a Service, SaaS) whereby a customer is able to use the provider's applications running on a cloud infrastructure.

Cloud Implementation Models

Any cloud system, whether IaaS, PaaS or SaaS can be implemented as a private cloud, public cloud, hybrid cloud or a community cloud. A private cloud is exclusively owned and delivered within an organization. However the management and operation may not always be within the organization. A public cloud provides services that can be accessed publicly through standard APIs over the Internet. A hybrid cloud is a mixed deployment model that utilizes both private and public infrastructures. In a community cloud implementation, multiple organizations who have common concerns (e.g. security, interests, and missions) share cloud infrastructures.

Within the implementation models, different organizations play different roles. Some act as providers, offering cloud services to consumers, others act as resellers who aggregate cloud services from providers to provide enhanced features or simply larger capacity for the customers. Vendors enhance their own services and capabilities by exploiting cloud platforms from cloud providers or cloud resellers while users or consumers directly make use of the cloud capabilities provided. Lastly, cloud tool providers provide supporting tools such as programming environments, virtual machine management, etc. [8].

Benefits, capabilities and challenges of the cloud technologies

The capabilities of the cloud form the basis for the benefits and hence the adoption drivers. These capabilities can be divided into two as shown in Table 3[8]:

Table 3: Non-functional and Economic considerations.

Non-Functional aspects	Economic considerations
Elasticity	Cost Reduction
Reliability	Pay per use
Quality of Service	Improved time to market
Agility	Return on investment
Adaptability	Turning CAPEX into OPEX
Availability	Going Green

Further, the following are technological benefits which also pose as challenges in successful implementation of cloud systems [8]:

- **Virtualization:** Hiding the technological complexity from the user and enables enhanced flexibility. Virtualization supports ease of use through hiding complexity of the infrastructure, ease of developing new applications and reduction of overheads for controlling the system.
- **Infrastructure independency:** Enables higher interoperability by making code platform independent.
- **Flexibility and Adaptability:** By using virtualization, the underlying infrastructure can change more flexibly according to different conditions and requirements.
- **Location independence:** services can be accessed independent of the physical location of the user and the resource.
- **Multi-tenancy:** The location of code and data is principally unknown and the same resource may be assigned to multiple users.

Specific challenges that have been identified include security, privacy and compliance; data management; appropriate APIs and programming enhancements as well as metering.

Cloud computing in Africa

South Africa, Kenya and Nigeria are leading countries in use of cloud computing in Sub-Saharan Africa as of the year 2013. According to a survey carried out by Cisco and World Wide Worx [4]. The study found that 50% of South Africa's medium and large businesses were using cloud services, compared to 48% in Kenya and 36% in Nigeria.

South Africa currently leads the continent in Cloud computing uptake, but appears to not be growing fast enough to retain that position in the years to come. For Kenya, in addition to the 48%, another 24% of organisations in Kenya were considering adopting within a short while. Some of the key highlights of the study include:

- Rapid adoption of cloud computing in Nigeria and Kenya was mainly due to the growing confidence of the IT decision makers in the technology and environment.
- 57% of decision-makers across the three countries had high confidence in the security of the cloud, while a further 34% were neutral. Only 1 in 10 respondents did not trust security in the cloud.

- 73% of respondents across the three countries expressed high confidence, while the rest - 25% - were mainly neutral on reliability.
- Private cloud was the most popular in 2013 with 25% of organizations surveyed currently deploying this compared to 13% opting for Hybrid cloud and only 7% of companies opting for the Public cloud. The most popular category for cloud use was storage (28% of companies) followed by SaaS (10% of companies surveyed).

African countries have introduced cloud computing at different levels according to a study conducted by ITU in 2012 [I2]. There are very many initiatives by individual countries to upgrade and revise legislative and regulatory frameworks with particular emphasis on the following:

- Transposition to the national level of regional or international texts on data protection;
- Revision of the relevant legislation to take account of the status of data hosted in the cloud;
- Strengthening of legislation, codes of conduct and standards applicable to the ICT sector;
- Clarification of relations between data centre managers, cloud computing and data protection.

With regard to training, several African countries surveyed expressed priority requirements in regard to the legal environment of cloud computing and technical considerations relating to networks, IT and the management of data centres.

As of 2012, all countries surveyed indicated that cloud computing was being considered in the country. The study targeted all South Sahara African countries. Twenty-five countries were surveyed. The study revealed that in 68% of the countries surveyed, the government administration was at the stage of studying the introduction of cloud computing. 11% were piloting, 16% implementing while 5% were already using.

At the level of the mobile operators, cloud computing technology was already used by 33% of the African country operators surveyed, while 23% of those operators had embarked upon its implementation. In the study, over 50% of the economic operators such as big companies had already adopted cloud computing.

A number of countries had more than one operational data centre: Tanzania, Gabon, Burkina Faso, Rwanda, Zimbabwe, Kenya, Senegal, Cape Verde and Cameroon.

A number of governments had taken specific initiatives to promote cloud computing in their countries. These countries were Benin, Burkina Faso, Burundi, Cape Verde, Gabon, Mali, Rwanda, Tanzania and Togo. About half of the countries had no legislation on data protection.

METHODOLOGY

The study was planned in specific steps as summarized in Table 4.

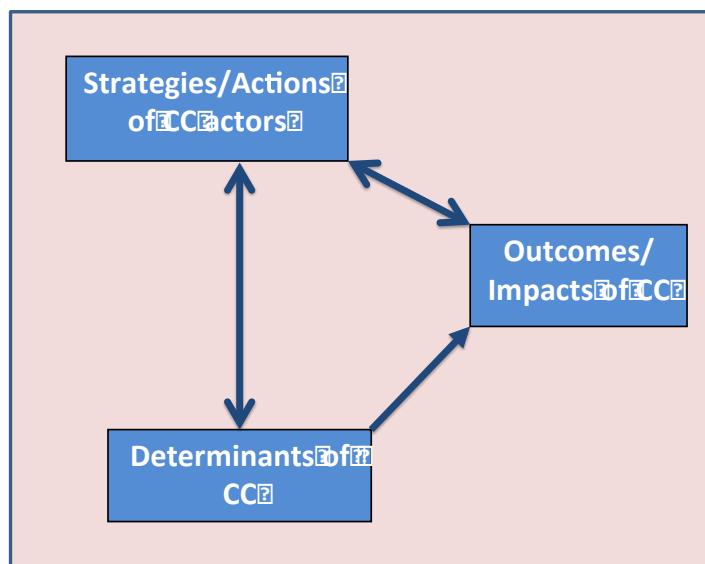
Table 4: Cloud computing study steps

Task	Description
Research design	Determining the framework for the study, defining the deliverables, articulating the methodology, and establishing stakeholder contacts as well as scoping.
Review of literature	Review of relevant literature including similar studies.
Data collection methodology and instrument development	Based on the conceptual framework, developing the data collection tools and testing them.
Determination of respondents	Developing a stakeholder analysis leading to a set of respondents.
Data collection	Quantitative and qualitative data collection from sampled stakeholders.
Data analysis	All collected data analysed and framed for reporting and presentations.
Report Generation	Based on the data collected, a draft prepared for discussion with appropriate stakeholders. After inputs, a final report generated.
Round table (workshop for dissemination)	A round table workshop organized to disseminate study results.

Kshetri (2010) proposed a framework [7] that explains contexts, mechanisms and processes associated with the development of the cloud industry in the developing world in terms of three inter-connected flows: determinants, cloud related performances and impacts of the cloud. We modified this framework and created a more relevant framework for our study, integrating ideas from other sources as well as our own ideas. Figure 2 shows the resulting conceptual framework that we used to carry out the baseline study on cloud computing in

Kenya. The direction of arrows shows an element of causal effect which could either be one directional or bi-directional.

Figure 2: Conceptual Framework for cloud computing study



The elements of the concepts in Figure 2 are elaborated in Table 5.

Table 5: Concept details of the conceptual framework

Concept	Meaning	Components
Determinants of cloud computing	Key factors that affect cloud related performance and its outcomes/impacts	Technologies deployed by product/service providers, with the following characteristics: <ul style="list-style-type: none"> • Reliability • Investment cost • Agility • Usability • Availability of the technology • Sustainability
		Technological capabilities of local firms
		Policy and legal frameworks, with the following considerations: <ul style="list-style-type: none"> • Availability

		<ul style="list-style-type: none"> • Flexibility • Comprehensiveness • Effectiveness
		Market, with the following considerations: <ul style="list-style-type: none"> • Availability • Readiness • Dominance by certain actors
		Standards compliance
		Development and structure of related industries, with the following considerations: <ul style="list-style-type: none"> • Forward linkages, e.g. e-government services availability and strong demand strengthen forward linkages • Backward linkages, e.g. R&D, bandwidth provision • Horizontal linkages, e.g. bandwidth provision
		Institutional legitimacy to the cloud, with the following considerations: <ul style="list-style-type: none"> • Government support • Institutional preferences/ innovation culture
Strategies or actions of CC actors	Strategies or actions of various actors that are instrumental in delivering the outcomes/impacts of the cloud	Strategies/actions include: <ul style="list-style-type: none"> • Costing • Promotion • Training and capacity development • Adoption • Usage • Cloud-related entrepreneurship • Deployment decisions (e.g. open source or proprietary solutions)

Outcomes/Impacts of CC	The ‘value’ created by the cloud (benefits), which are the ultimate objectives that policy makers want to accomplish	Impacts/outcomes of CC implementation include: <ul style="list-style-type: none"> • Improved operational efficiency • New products and services • Extended/enhanced market reach • Export of cloud related services • Job creation • Enhanced security enhancement
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The components of the three concepts in the last column were used to generate questions for the study. In addition to the above framework, some additional questions were included to capture the demographics and challenges across the value chain, among others aspects.

Instrument design

Each of the components identified in Table 5 was framed into a question. The nature of question was structured to accommodate an appropriate response. Format of the responses included a likert scale of 1 to 5, Yes/No or enumeration. Since not all variables could apply to each type of organization, a different questionnaire was developed for the different kinds of organizations as identified in the scope.

To translate the framework into questionnaires, a mapping was done to the various categories so as to guide the design. The mapping is show in Appendix 1. A sample questionnaire developed is included in the Appendix 2. The questionnaires were piloted and timed and improved after the results of the piloting.

In addition to the quantitative data collection, the study considered qualitative data collection. A total of 12 in depth interviews were planned, targeting policy makers, opinion leaders and large organizations involved in cloud computing. An in-depth interview guide was designed based on the constructs identified in the conceptual framework. Out of the 12 planned respondents, a total of seven were available to participate. The insights from these was detailed enough to be considered sufficient for the study.

Population and Sampling

To identify potential respondents for the study, a stakeholder analysis was done that resulted in a taxonomy of various cloud computing stakeholders. Out of the various categories, organizations were identified that would fall in each of them.

A stakeholder with respect to cloud services can be defined as “any group or individual who can affect or is affected by the outcome” of such a service. This definition is adapted from a more generic definition of stakeholders as seminally proposed by Edward Freeman (1984). The concept of a stakeholder therefore covers both the individuals who can affect the decision making process of policy formulation and also groups that are eventually affected by those policies.

With respect to Kenya, we can divide the cloud stakeholders into three broad categories, namely; cloud service providers, cloud administrators and cloud users. With respect to the primary goal of stimulating economic growth, service providers can be thought of as those entities that invest in both cloud infrastructure and other data products and services that will be available on the cloud infrastructure for the purpose of generating revenue. The administrators perform the function of policy formulation, articulation and execution as well as regulation to ensure the smooth running of the cloud sub-sector while the users are represented by a wide array of entities from the government, to corporations and individuals within the civil society who make use of the services available through the cloud.

The stakeholder analysis was done in two parts, the first being the identification of the stakeholders using the Freeman stakeholder definition, which was then followed by an analysis of their *salience* or *importance* to the cloud project design and deployment process based on a framework developed by Mitchell et al (1997).

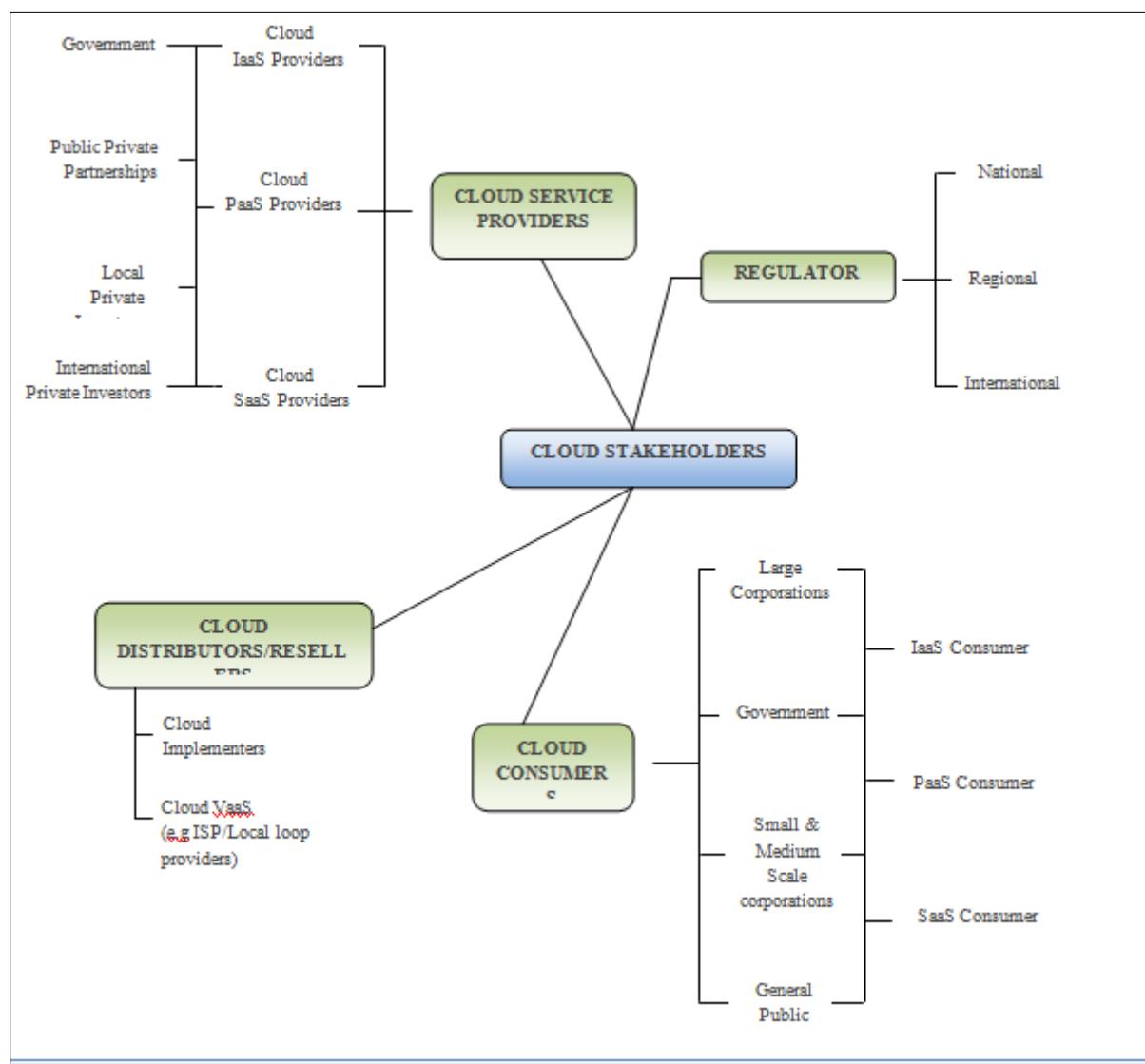
The Mitchell framework classifies the stakeholders according to the attributes of power, legitimacy and urgency, which in the context of cloud deployment can be defined as:

- *Power: The ability to affect the design, operation, or outcome of cloud deployment*
- *Legitimacy: The degree to which the cloud deployment affects the stakeholder*
- *Urgency: The need perceived by a stakeholder to change the cloud sub-sector and deployment*

According to Mitchell's research, for an entity to be considered a stakeholder, it needs to possess at least one of these attributes. The more attributes possessed by a given stakeholder, the more salient that stakeholder would be and the greater consideration that stakeholder should be given. It therefore follows that the most salient stakeholder would be the one with a legitimate and urgent need to influence the cloud deployment and has the power to do so.

The three broad categories (service providers, administrators and consumers) are broken down into organizations that are shown in Figure 3.

Figure 3: Cloud computing stakeholders' taxonomy



A total of 207 organizations were identified who could participate in the study. The identification was based on the possibility that they could either be utilizing or supplying cloud computing services. The organizations were classified into categories as per Table 6. A total of 60 companies were targeted as an ideal sample for the study. Gaps such as incomplete questionnaires or unavailable respondents would be compensated by the additional 20. The sampled organizations were identified using a variation of stratified random sampling whereby a list of potential organization was organized into strata and a proportionate sample was picked from each of the strata. In each of the categories identified, a particular number of organizations were selected for interview as per the sampling formula. This is shown in Table 6 (sample column, where the number of sampled organization is proportional to the population). The PaaS category did not reach a threshold

of 5 in the population and were therefore considered for qualitative interview as opposed to quantitative questionnaires.

Table 6: Grouping of organizations identified and selected

Category	Population	Sample
Government entities	14	8
Banks	10	4
Consulting firms	5	4
Insurance firms	10	4
Hospitals	9	4
Universities	10	4
Business and Industries	24	8
Technology companies ¹	25	8
SaaS Companies	11	8
PaaS Companies	3	0
IaaS Companies	18	8
Total	207	60

Data Collection

Research assistants went out between October 10th, 2013 and November 10th, 2013 interviewing relevant individuals in these organizations. In particular individuals who held positions equivalent to ICT Manager, Information Security Managers or Chief Information Officers were interviewed. These individuals were chosen because they were most likely familiar with the IT challenges facing the organizations, were likely to be involved in the formulation and implementation of ICT strategies and were likely to have a bird's view of the effectiveness and efficiencies related to ICT investments.

Of the 60 companies targeted, a total of 54 companies participated and filled in the questionnaires. The other six were either unwilling to participate or were not available during the study period.

¹ Some of the technology companies coupled as SaaS, PaaS or IaaS.

To complement the quantitative data, a total of 12 industry leaders were identified to participate in in-depth interviews. Of the 12, a total of seven were available during the data collection period. An additional two were later available to respond to specific questions. The industry leaders were a mix of IaaS providers, PaaS providers, policy makers and academics.

ANALYSIS & FINDINGS

General Findings

Though there is debate regarding the significance and risks of cloud technology, there is an appreciation of the value of this technology. Cloud computing is already having some impact in the way the government, organizations and the general population are consuming technology related services. File sharing, online social networks, web mail, which are fundamentally cloud-based, are some of the common internet based applications in use.

The companies that participated are grouped according to their core business as shown in to the distribution Figure 4. Compared with Table 6, it is evident that all the categories that had been identified actually participated in the study.

Though the provision and utilization of cloud services seems to have been introduced in the market as early as 2000, most organizations indicated that they adopted from the year 2010 and 2011. A total of 37 organizations responded to this question, with more than 50% (21) indicating they adopted either 2010 or 2011 as shown in Figure 5, implying that adoption of cloud computing in Kenya is fairly recent.

Figure 4: Organizations participating in study according to core business

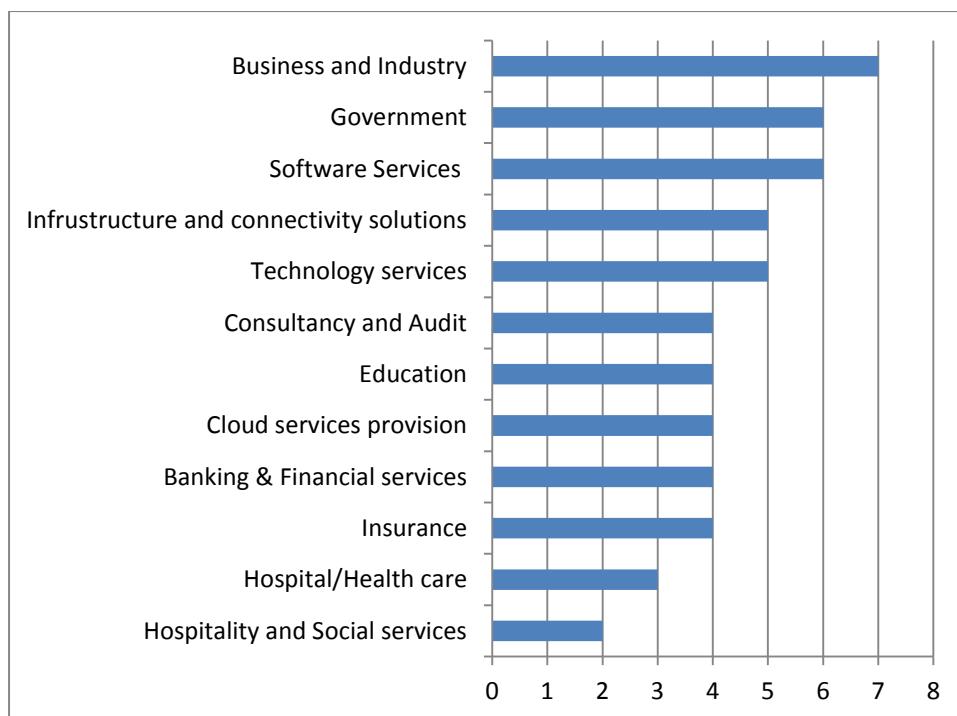
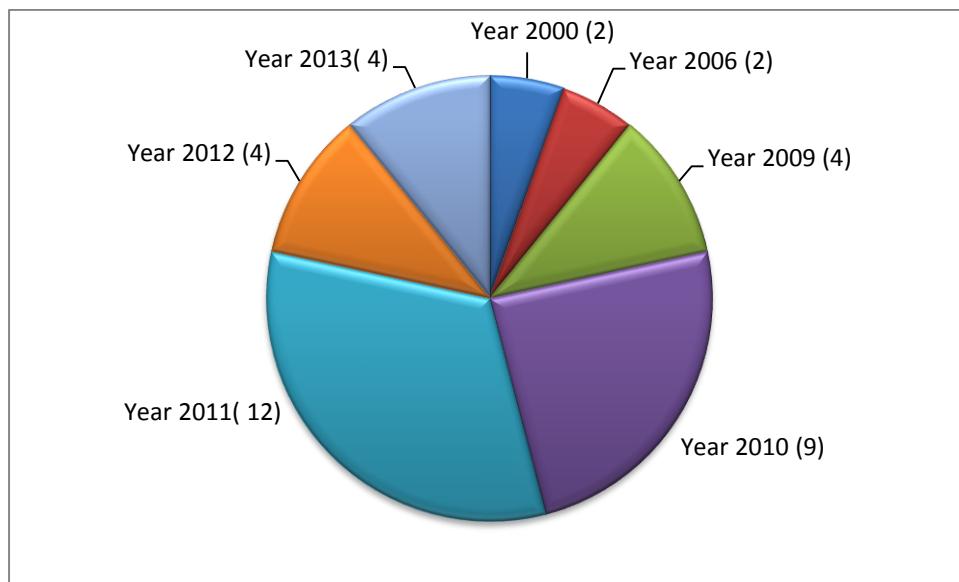


Figure 5: The year organization ventured into cloud computing



The utilization of the private cloud is more pronounced than public. There were more organizations utilizing pure private cloud (39%) than those utilizing a public cloud (22%). The remaining organizations were utilizing both private and public or were yet to adopt.

Though all systems have been implemented in Kenya, the IaaS option is the most prominent. This is consistent with the findings of the UNCTAD that in countries that are in nascent stages of cloud readiness, IaaS is often the first category to emerge [13].

Specific Findings

Technologies Deployed by Cloud Computing Providers

A total of 37 organizations participated in the study as consumers of one form of cloud computing or another. This number constituted 69% of the respondents. Some questions were directed to solely consumers, while in some cases both consumers and suppliers responded. Questions framed using a five point likert scale were converted into a three point scale for the purposes of this report. Below is a summary of the responses regarding the cloud computing technologies being deployed. Table 7: Responses to selected technologies deployed questions

	Agree	Neutral	Disagree
Cloud technologies received from cloud providers are reliable	81%	16%	3%
Cloud services offered through the cloud are more agile than traditional solutions	87%	6%	7%
Does usability of the cloud based services affect their uptake and usage?	76%	11%	13%
Is the lack of technical skills (human capacity) hampering the deployment of Cloud Computing in Kenya?	87%	4%	9%
Providing/utilising cloud services is sustainable	Yes (85%)		No (15%)

For providers of cloud services, the investment is viewed as significantly high and most of the respondents were yet to recover the funds invested. The cost of infrastructure is viewed as a major barrier to entry. However from the responses of the five questions in Table7cloud computing is appreciated by the industry players. However, according to opinion leaders, the lack of technical skills had significantly hampered the growth of the technologies adoption and diffusion.

Considering that most organizations were consumers, there is need for assurance that their technical staff is well equipped with skills to manage the technology. Both consumers and suppliers of cloud services were asked what they considered to be the three main skills lacking in the Kenyan market. The data collected showed that *security* (networks, data etc.) skills ranked highest followed by *architecture and design* skills for the cloud technology. Distant third and fourth were *storage and virtualization* skills. This response provided more details to the earlier response that indicated lack of skills affected the growth of cloud technology in Kenya.

Suppliers of cloud computing were asked to state the factors that determine the reliability of the services they offer. Several factors were listed, with the top being *a reliable connectivity and infrastructure, dependable technical support and a high systems uptime* listed in decreasing order of significance. Other factors identified included the nature of

cloud services demanded, varying customer requirements, pricing and payment flexibility, quality requirements, availability and ability to scale. Not many providers are able to meet all these requirements. In some cases, respondents were concerned about the reliability of power supply, an issue that is not within the control of the stakeholders.

The primary reason providers view cloud computing as a sustainable business is that it brings in an annuity income as opposed to one time revenue.

While providing cloud services, organizations have to equip themselves appropriately. Power supply must be guaranteed, cooling, physical security; sufficient server capacity and dependable infrastructure were identified as critical elements.

Policy and Legal Frameworks

All the respondents were asked if they knew of any policy framework for cloud computing in Kenya and majority (80%) indicated that they did not know of any. Similarly when asked, 80% indicated they were not aware of any legal framework. Of interest was the fact that most of the respondents who indicated they knew of some kind of a policy framework also indicated they knew about some kind of legal framework. No questions were asked about the details of the policy or legal framework that they knew of. All respondents, irrespective of what they knew were asked what they thought of the flexibility, comprehensiveness and effectiveness of the policy and legal frameworks. They were also all asked to provide recommendations for both the frameworks.

Since only 20% of the respondents indicated they knew some aspect of the framework, only their responses regarding flexibility, comprehensiveness and effectiveness are analysed further. The responses generally indicate that the legal and regulatory frameworks are not as flexible, comprehensive and effective as they would have wished. The responses are shown in Table 8.

Table 8: Flexibility, comprehensiveness and effectiveness of policy and legal frameworks for cloud computing in Kenya - 2013

Question	Agree	Neutral	Disagree
Does the Policy Framework give you flexibility to exploit cloud computing as you wish?	27%	55%	18%
The existing Policy Framework for cloud computing in Kenya is comprehensive	27%	55%	18%
The Policy Framework for cloud computing in Kenya is effective enough to facilitate growth in the sub-sector	45%	45%	10%
Does the Legal Framework give you flexibility to exploit cloud computing as you wish?	33%	50%	17%
The existing Legal Framework for cloud computing in Kenya is comprehensive	33%	50%	17%
The Legal Framework for cloud computing in Kenya is effective enough to facilitate growth in the sub-sector	16%	42%	42%

The results show that most respondents tended to agree with the statements given, perhaps a problem arising from a central tendency bias. However, a significant proportion felt that the policy framework was effective enough while legal framework was not effective enough to facilitate growth in the sub-sector. In addition, there was a view by opinion leaders that regulation should be well managed so as not to frustrate the uptake and penetration of the young sub-sector.

All respondents were asked to make specific recommendations regarding the policy and legal frameworks. Several recommendations were provided by respondents.

Table 9 provides an extraction of the four most commonly mentioned recommendation items for both the policy and legal frameworks.

Table 9: Selected recommendations on the policy and legal frameworks in Kenya

Policy	Legal
Increased awareness of availability and power of cloud computing	Mechanisms for controlling cybercrime and offenders
Guidelines for ensuring security, privacy and standards	Mechanisms for guaranteeing privacy
Guidelines for service level agreements	Mechanisms to manage service level agreements
Appropriate licensing and certification of providers as well as pricing.	Mechanisms for conflict resolutions and addressing liability

Standards

In addition to policy and legal frameworks, all respondents were asked if they were familiar with any standards that would apply to cloud computing. Majority of the respondents (75%) indicated they were not aware of any. The other 25% did not give any specific standards, even when asked. They gave names of organizations such as IEEE and specific institutional (e.g. Google, VM ware or Oracle) standards. One provider had a pretty good appreciation of ISO Standards, VCE- Certification for infrastructure and requirements for Cloud Security Alliance Certification. A few opinion leaders who participated in in-depth interviews mentioned the corporate and consumer protection laws which are viewed both as standards and policy guidelines. A number of providers who participated in the study had developed their own internal guidelines and standards.

This feedback gives a strong indication about the need to develop the technical skills, besides general awareness of cloud computing standards and development of the policy and legal frameworks.

Markets

The purpose of this set of questions was to understand the readiness and characteristics of the market in the context of cloud computing.

Users of cloud services were asked if they thought the market was ready and 90% of them answered affirmatively, 5% were not sure while 5% disagreed.

Suppliers indicated that the financial sector is the leader in consuming cloud services, followed by the telecommunication sector. Education and government are moderate users of cloud services.

Smaller institutions like research organizations and universities who generate a lot of data are finding cloud computing very appropriate considering the cost cutting and opportunity to outsource the technical issues.

The leading providers according to the respondents are Safaricom, Dimension Data and KDN in decreasing order of market share. The factors that keep these players ahead are financial capability and early entrance in the market. In addition, costing of services, public confidence, innovative products and positioning, skilled staff are significantly contributing to their market leadership.

Support received

Respondents were asked to indicate the kind of support they are receiving from the government, either as consumers or suppliers. Only 13 respondents gave a particular support from the government. The support provided was fairly generic such as appropriate environment for development of infrastructure e.g. fibre connectivity; encouraging reduction of operational costs; promoting utilization of ICT in all sectors; revising the general ICT regulatory environment. Some providers indicated that they received particular financial investment from the government and the World Bank.

The responses to this question suggest that providers or consumers were not very familiar with government initiatives or what the government was doing was not at the top of their minds.

When asked for recommendations on how the government should intervene to grow the sub-sector, 77% of the respondents gave at least one recommendation, with most giving two of them. A high level summary of the recommendation is provided in **Table 10**.

The two greatest concerns for consumers are fear resulting from the loss of control of their data and trust in the cloud provider. These two fears are partly a result of lack of awareness and a need to get assurance from independent authorities, particularly the government.

Responses from participants from within the government did not reveal a great deal of the role that the government is playing. Besides recognizing players, there are currently no specific initiatives towards standards or guidelines. Government respondents also felt that most of the security concerns result from either misunderstanding or lack of knowledge.

Table 10: Summary of the recommendations to government

1	Capacity building and Sensitization
2	Cyber security enhancement
3	Adopting cloud services in government and encourage local providers
4	Subsidizing cost of technology and provision of incentives
5	Enforcing security, SLA and privacy
6	Ensuring standardization and appropriate legislation

Strategies or actions of cloud computing actors

The actions taken by stakeholders may have an effect on the uptake and diffusion of cloud within the market. The research sought to understand the views of respondents regarding potential specific actions by stakeholders. Almost all respondents (consumers and providers) agreed that pricing seems to significantly determine adoption and usage. As many as 92% of the respondents answered affirmatively, while 5% were unsure and the rest disagreed. Other actions are summarized in

Table 11. The general impression is that suppliers had a responsibility and opportunity since their actions determined uptake and usage, at least in the short term.

Table 11: Views of all respondents regarding actions by suppliers

Question	Agree	Neutral	Disagree
Promoting cloud computing to potential consumers significantly determines uptake and usage	98%	0%	2%
Training and capacity development on cloud computing to potential consumers significantly determines uptake and usage	96%	0%	4%
Promoting cloud-related entrepreneurship significantly determines uptake and usage	94%	2%	4%
Deployment decisions and approaches (e.g. open source or proprietary solutions) significantly determine uptake and usage of cloud computing	96%	0%	4%

The researchers' impression is that there is a significant majority of people in Kenya are unaware of cloud computing and its benefits. The lack of awareness implies some organizations are still spending a lot of resources that could be saved in light of the ballooning labour costs, high energy consumption systems, complexity of managing data systems and growing demands of users. A number of providers were addressing this issue by promoting their services at ICT forums. However, more outreach work needs to be done.

Industry leaders observe that due to the pricing challenges, some providers are deliberately selling their services at significantly lower prices in order to penetrate the market. International providers, who are able to remain profitable despite low pricing strategy, are a great threat to local providers.

A number of providers had already taken specific measures to develop the market and increase demand. Specific actions included promotions (e.g. 1 month free trial of the service) as well as training of customers. The nature of services offered has also proved to determine adoption of cloud services. Some of the services appealing to consumers include virtual hosting, domain email and domain hosting, online accounting and payroll systems

Outcomes/Impact of cloud computing

The study also sought to find out what the perceived or real impacts or outcomes had been. Operational efficiency is largely viewed as an immediate outcome, with 81% of the respondents answering affirmatively. Cloud provider is left in charge of the operation of the technology letting the consumer concentrate on the core business. Specific outcomes mentioned include a significant drop in capital investment and the ability for cloud to offer anywhere access on various devices as well as synchronization of data.

Besides the perceived notion, several of the respondents (76%) indicated that cloud computing had resulted in at least one new product or service to their organization. Some of the services listed included online accounting systems, backup and storage services. When asked about the effect on market reach and security, 87% said they realize that using cloud computing results in an extended or enhanced market reach while 62% indicated that cloud computing results in security enhancement. The cloud providers who had a regional or global presence indicated that the enhanced market reach had been a great benefit to them. These providers had an advantage in exporting cloud services, though a few local providers were also exporting, particularly at regional level.

The general impression created is that cloud computing is viewed as a valuable technology both for consumers as well as suppliers. This impression is both perceived and real.

CONCLUSIONS AND RECOMMENDATIONS

From the findings, we make the following conclusions:

- a) The adoption drivers among providers and users in Kenya are consistent with what the literature has established, particularly cost savings in hardware, software and personnel, improved system performance and management, flexibility in access to processing and storage capacity as well as higher elasticity degree.
- b) Adoption of cloud computing in Kenya is fairly recent, with most organizations having adopted either 2010 or 2011. This partly implies the appreciation of the impact of the technology is rather limited.
- c) More organizations utilized pure private cloud (39%) compared to utilizing a public cloud (22%). The choice is more likely a result of concerns around security and control of access of organizational data.
- d) The key barrier to entry into the cloud business was the cost of investment. The cost of cloud services was also found to be a key determinant of adoption and usage. In addition, lack of technical skills had also significantly hampered the adoption and usage of cloud computing. Specific skills lacking are security, architecture and design, storage and virtualization skills. Consistent with literature on cloud adoption in other developing countries, concerns about the reliability of service, security and privacy of data, geographical location of the data are some of concerns of potential and current users or providers.
- e) Majority (80%) were not aware of either policy or legal frameworks for cloud computing. Even those who were aware, majority indicated that these frameworks were not as flexible, comprehensive and effective as they would have wished. In addition, a significant proportion felt that the policy framework was effective enough while the legal framework was not effective enough to facilitate growth in the sub-sector.
- f) Majority of the respondents (75%) indicated they were not aware of any standards applicable to cloud computing.
- g) 90% of the respondents thought the cloud services market was ready. The biggest consumers of these services were the financial sector followed by the telecommunications sector while the leading providers were Safaricom, Dimension

Data and KDN in decreasing order of market share. The factors that keep these players ahead are financial capability and early entrance in the market.

- h) The actions of suppliers largely influenced the impact of cloud computing and the cloud services had real and perceived positive outcomes or impacts.

Based on the findings, we make specific recommendations described below:

The government should come out strongly to welcome and support cloud computing technology. This would increase user confidence and accelerate adoption and exploitation of the technology.

It is recommended that regulatory mechanisms be sought to bring down the cost of entry into the cloud computing services business as well as to reduce the cost of these services to the end consumer. In addition, the ICT policy and legal frameworks should be reviewed to promote cloud computing and to ensure that these frameworks are flexible and effective. The frameworks should seek to create an enabling environment that encourages organizations to invest in cloud systems, migrate their data and systems with ease and safety.

Having specific and targeted laws help ensure the protection of end users. Though it is not absolutely necessary to develop laws focusing on cloud computing, aspects related to it need to be clearly outlined. These include data protection, information security, privacy and cybercrime [13].

Consistent with recommendations in other similar studies, such as the UNCTAD report on cloud computing in developing countries, the government, at national policy level could consider the following specific measures:

1. Assessment of the cloud readiness of the country

To make informed decisions, the government needs to clearly understand the current situation at national level. Challenges and gaps need to be clearly identified and addressed. This would best be done by starting with an elaborate national assessment.

2. Developing a national cloud strategy

Based on the assessment, a national cloud strategy should be developed. One way to execute this is through a task force set up to provide direction on the strategy development, focusing on issues like capacity building, architectures and implementation. A cloud strategy document could be either a stand-alone document or be part of a national ICT strategy.

3. Be a champion in the utilization of cloud services

The government is a large consumer and provider of services. By adopting use of the cloud, the government would set pace for better uptake by the private sector. Being the largest single consumer of computing resources in the country, the cost saving that would be derived from adopting cloud would be significant. By providing services through the cloud, the government is likely to improve the quality of delivery.

4. Enhance the relevant legal and regulatory frameworks

The legal and regulatory frameworks are technically part of the national strategy. As mentioned earlier, protection of cloud service users, addressing cyber security challenges, guaranteeing secure online payments, privacy and data security need to be clearly outlined. The gaps in the regulatory and legal frameworks identified in this report, would be highlighted in the national assessment mentioned above.

5. Develop the human resource capacity

The human capacity challenge needs to be addressed at national strategy level. In addition to technical skills, some of which are mentioned in the report, management skills to oversee the new business processes as well as legal skills to ensure contracts are well formulated and managed.

6. Enhance the awareness of cloud technologies

There is a lot of confusion about what the cloud economy really is and its potential impact. Through a multi-stakeholder approach, the technology needs to be demystified and accurate information sent to potential consumers.

In addition to these recommendations, the government may need to develop mechanisms to ensure reliable supply of power and address the infrastructural challenges. Reliable power supply to data centres, availability of reliable and affordable bandwidth and a

capability to monitor the quality of services are vital for developing confidence in cloud technology.

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Appendix 1: From the framework to questionnaires

	Determinants of CC	SaaS	Government ²	PaaS	Consumers	IaaS
	Technologies deployed by product/service providers					
1	How reliable is the cloud related technology/product/service you are receiving by cloud providers (scale of 1 to 5)	No	Yes	Yes (C)	Yes	Yes
2	Is the Investment cost a barrier for you to provide CC services? (scale of 1 to 5)	Yes	Yes	Yes (Pr)	Yes	NO
3	Are services offered through the cloud necessarily more agile than traditional solutions ? (scale of 1 to 5)	No	Yes	Yes (C)	Yes	Yes
4	Does Usability of the cloud based services affects their uptake and usage (scale of 1 to 5)	Yes	Yes	Yes C, Pm	Yes	Yes
5	Technology for deploying/using CC is hardly available (scale of 1 to 5)	Yes	Yes	Yes Pr, C	Yes	Yes
6	Providing cloud based services is not sustainable/affordable (scale of 1 to 5) {Is CC services sustainable/affordable? Y/N. If Y, extent? If N, what are factors that make it unsustainable/unaffordable}	Yes	Yes	Yes Pm, Pr, C	Yes	Yes
7	Are the technological capabilities of local firms hampering the uptake of CC? (scale of 1 to 5) {– rephrase using technical skills. Name 3 skills that are critically lacking (a list to choose – BO) }	Yes	Yes	Yes Pm, Pr, C	Yes	Yes
	Policy and legal frameworks					
8	There is lack of a policy and legal framework for cloud computing in Kenya (scale of 1 to 5) {Are you aware of any policy/legal framework for CC in Kenya? Y/N}	Yes	Yes	Yes	Yes	Yes

²Government can be a Consumer, Policy Maker or an IaaS. Different instruments to be created for these roles

	If Y, which? If N, recommendations}					
9	If Y (from 8), The existing policy and legal framework for cloud computing in Kenya is not flexible (scale of 1 to 5)	Yes	Yes	Yes	Yes	Yes
10	If Y (from 8), The existing policy and legal framework for cloud computing in Kenya is not Comprehensive (scale of 1 to 5)	Yes	Yes	Yes	Yes	Yes
11	If Y (from 8), The existing policy and legal framework for cloud computing in Kenya is not effective (scale of 1 to 5) {Do you think CC infrastructure and service provision subject to regulation? Y/N/ If N, why not? If Y, give a list of regulatory actions}	Yes	Yes	Yes	Yes	Yes
	Market					
12	The market for CC in Kenya is not available (scale of 1 to 5) {Who constitutes the market for CC?}	Yes	Yes	Yes	Yes	Yes
13	The market for CC in Kenya is not ready (scale of 1 to 5){Readiness: Name 3 factors that are limiting CC market growth? What interventions would you recommend?}	Yes	Yes	Yes	Yes	Yes
14	Who are the largest players in the market (in order of market share)? What factors make the top players dominant? {The market for CC in Kenya is dominated by certain players (scale of 1 to 5)}	Yes	yes	yes	Yes	No
	Standards					
15	Are you aware of any standards for infrastructure CC deployment and service provision? Y/N {The players in CC in Kenya are	Yes	Yes	Yes	Yes	Yes

	complying to international standards in providing their services (scale of 1 to 5)}					
	Development and structure of related industries					
16	<i>Forward linkages, e.g. e-government services availability and strong demand strengthen forward linkages</i> <i>Refer to 13</i>					
17	<i>Backward linkages, e.g. R&D, bandwidth provision</i> <i>Refer to 13 and others</i>					
18	<i>Horizontal linkages, e.g. bandwidth provision</i> <i>{Which organizations are critical partners in providing CC? List the services that these partners provide}</i>	Yes	Yes	Yes - Pr	Yes	No
	Institutional legitimacy to the cloud					
19	The government is providing the support we need to provide CC services (scale of 1 to 5) <i>{What support is the Government providing?</i> <i>What kind of support do you think the Government should provide?</i> }		Yes	No	Yes	Yes
20	Our institution prefers to use CC whenever possible (scale of 1 to 5) <i>{On a scale of 1 to 5, how is CC a priority? What are the critical barriers?}</i>	No	No	Yes	No	Yes
	Strategies or actions of CC actors					
22	The way we price CC seems to significantly determine adoption and usage (scale of 1 to 5)	Yes	Yes	Yes	Yes	Yes
23	Promoting CC to potential consumers significantly determines uptake and usage (scale of 1 to 5)	Yes	Yes	No	Yes	Yes
24	Training and capacity development on	Yes	Yes	Yes	Yes	Yes

	CC to potential consumers significantly determines uptake and usage (scale of 1 to 5)					
25	What other factors drive adoption? Move to before outcomes					
27	Promoting cloud-related entrepreneurship significantly determines uptake and usage (scale of 1 to 5)		Yes	Yes	Yes	Yes
28	Promoting cloud-related entrepreneurship significantly determines uptake and usage (scale of 1 to 5) delete		Yes	Yes	Yes	Yes
29	Deployment decisions and approaches (e.g. open source or proprietary solutions) significantly determine uptake and usage of CC (scale of 1 to 5)		Yes	Yes	Yes	Yes
Outcomes/Impacts of CC						
30	Using CC results in Operational efficiency (scale of 1 to 5)	Yes	Yes	Yes	Yes	Yes
31	CC results in new products and services (scale of 1 to 5)	Yes	Yes	Yes	Yes	Yes
32	Using CC results in extended/enhanced market reach	Yes	Yes	Yes	Yes	Yes
33	Export of cloud related services					
34	CC results in job creation	Yes	Yes	Yes	Yes	Yes
35	CC results in Security enhancement	Yes	Yes	Yes	Yes	Yes

Appendix 2: Sample Questionnaire – IaaS



UNIVERSITY OF NAIROBI

SCHOOL OF COMPUTING AND INFORMATICS

Cloud Computing in Kenya

Dear Respondent,

Thank you for your willingness to contribute towards this study on Cloud Computing in Kenya. The objective of the study is to capture the status and direction of cloud computing in Kenya as well as make recommendations on the POLICY and regulatory environment for cloud computing in the country.

In the process of this study, we hope to identify opportunities that stakeholders could tap into, not only as providers and consumers but also as participants in market growth and development.

We are planning a workshop to disseminate the results and are happy to invite you to attend. Details shall be circulated as soon as the data collection process is complete.

The School of Computing and Informatics at the University of Nairobi is currently spearheading the study, working with several partners including the Ministry of ICT.

In case you have any specific questions or concerns regarding this study, do not hesitate to contact the lead researcher whose details are provided below.

Dr. Tonny K. Omwansa (tomwansa@uonbi.ac.ke)

INTERVIEWER

INTRODUCTORY (DEMOGRAPHIC) QUESTIONS

1	Date of interview	
2	Name of respondent	
3	Position within the company	
4	Email address and phone number	
5	Name of company	
6	Company's core business	
7	The year the company became active with cloud computing	
8	Company utilizing a private or public cloud implementation	

A. TECHNOLOGIES DEPLOYED BY THE CLOUD COMPUTING PROVIDERS

1	What are the factors that determine the reliability of cloud services you offer? (you may call them the inputs to cloud services)	
	i.	_____
	ii.	_____
2	Investment cost is a barrier to provision of cloud computing services?	
	<input type="checkbox"/> Strongly agree <input type="checkbox"/> Somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> Somewhat disagree <input type="checkbox"/> Strongly disagree	
3	Are services offered through the cloud necessarily more agile than traditional solutions ?	
	<input type="checkbox"/> Strongly agree <input type="checkbox"/> Somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> Somewhat disagree <input type="checkbox"/> Strongly disagree	
4	Does Usability of the cloud based services affect their uptake and usage?	
	<input type="checkbox"/> Strongly agree <input type="checkbox"/> Somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> Somewhat disagree <input type="checkbox"/> Strongly disagree	
5	What are the barriers to effectively providing cloud services? (<i>select all that apply</i>)	
	i. Technology <input type="checkbox"/>	
	ii. Reliability of solution Providers <input type="checkbox"/>	
	iii. Technical support <input type="checkbox"/>	
	iv. Reliable utility services <input type="checkbox"/>	
	v. Other _____ <input type="checkbox"/>	
	vi. Other _____ <input type="checkbox"/>	
6	Is providing cloud computing services a sustainable business?	
	i. Yes <input type="checkbox"/>	
	ii. No <input type="checkbox"/>	

	<p>If NO, what are factors that make it unsustainable(<i>select all that apply</i>)</p> <p>a. Nature of market <input type="checkbox"/></p> <p>b. Operational costs <input type="checkbox"/></p> <p>c. LEGAL concerns <input type="checkbox"/></p> <p>d. Others _____ <input type="checkbox"/></p>
7	Is the lack of technical skills (human capacity) hampering the deployment of Cloud Computing in Kenya? <input type="checkbox"/> Strongly agree <input type="checkbox"/> Somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> Somewhat disagree <input type="checkbox"/> Strongly disagree
8	Name 3 skills that are critically lacking(<i>select all that apply</i>) i. Security (networks, data, etc.) <input type="checkbox"/> ii. Networking <input type="checkbox"/> iii. Architecture/Design <input type="checkbox"/> iv. Storage (NAS/SAN) <input type="checkbox"/> v. Virtualization <input type="checkbox"/> vi. Other _____ <input type="checkbox"/>

B. POLICY FRAMEWORKS

9	Are you aware of any POLICY FRAMEWORK for cloud computing in Kenya? i. Yes <input type="checkbox"/> ii. No <input type="checkbox"/>
10	What recommendations regarding the POLICY FRAMEWORK for cloud computing in Kenya would you give i. _____ ii. _____
11	Does the existing POLICY FRAMEWORK give you flexibility to exploit cloud computing as you wish? <input type="checkbox"/> Strongly agree <input type="checkbox"/> Somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> Somewhat disagree <input type="checkbox"/> Strongly disagree
12	The existing POLICY FRAMEWORK for cloud computing in Kenya is COMPREHENSIVE <input type="checkbox"/> Strongly agree <input type="checkbox"/> Somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> Somewhat disagree <input type="checkbox"/> Strongly disagree
13	The POLICY FRAMEWORK for cloud computing in Kenya EFFECTIVE enough to facilitate growth in the sub-sector

<input type="checkbox"/> Strongly agree	<input type="checkbox"/> somehow agree	<input type="checkbox"/> Not Sure	<input type="checkbox"/> somewhat disagree	<input type="checkbox"/> strongly disagree
-----------------------------------------	----------------------------------------	-----------------------------------	--------------------------------------------	--------------------------------------------

C. LEGAL FRAMEWORKS

14	Are you aware of any LEGAL FRAMEWORK for cloud computing in Kenya?
	<p>i. Yes <input type="checkbox"/></p> <p>ii. No <input type="checkbox"/></p>
15	What recommendations regarding the LEGAL FRAMEWORK for cloud computing in Kenya would you give
	<p>i. _____</p> <p>ii. _____</p>
16	Does the LEGAL FRAMEWORK give you FLEXIBILITY to exploit cloud computing as you wish?
	<input type="checkbox"/> Strongly agree <input type="checkbox"/> somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> somewhat disagree <input type="checkbox"/> strongly disagree
17	The existing LEGAL FRAMEWORK for cloud computing in Kenya is COMPREHENSIVE
	<input type="checkbox"/> Strongly agree <input type="checkbox"/> somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> somewhat disagree <input type="checkbox"/> strongly disagree
18	The POLICY FRAMEWORK for cloud computing in Kenya is EFFECTIVE enough to facilitate growth in the sub-sector
	<input type="checkbox"/> Strongly agree <input type="checkbox"/> somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> somewhat disagree <input type="checkbox"/> strongly disagree
19	Do you think cloud computing infrastructure and service provision should be subject to regulation?
	<p>i. Yes <input type="checkbox"/></p> <p>ii. No <input type="checkbox"/></p> <ul style="list-style-type: none"> • If Yes, What regulatory actions do you recommend? <ul style="list-style-type: none"> a) _____ b) _____ • If No, Why? <ul style="list-style-type: none"> a) _____ b) _____

D. MARKETS

20	Which of the following market categories are you serving? (<i>select all that applies</i>)
	<p>i. Education <input type="checkbox"/></p> <p>ii. Financial sector <input type="checkbox"/></p>

	iii. Telecommunication	<input type="checkbox"/>
	iv. Government	<input type="checkbox"/>
	v. Other _____	<input type="checkbox"/>
	vi. Other _____	<input type="checkbox"/>

21 Who are **the TOP THREE largest players** in terms of market share in Kenya

- i. _____
- ii. _____
- iii. _____

22 What factors make the top players dominant?

- i. Financial capability
- ii. Early entrant
- iii. Other _____

iv.

E. STANDARDS

23 Are you aware/apply any **STANDARDS** for cloud computing deployment and service provision?

- i. Yes, which one _____
- ii. No

F. INSTITUTIONAL LEGITIMACY TO THE CLOUD

24 What support is the government providing in relation to Cloud Computing implementation

- i. _____
- ii. _____
- iii. _____

25 What kind of support do you think the government should provide

- i. _____
- ii. _____
- iii. _____

26 Among other services you offer, cloud computing is a high **priority** service in your organization?

Strongly agree Somehow agree Not Sure Somehow disagree Strongly disagree

G. STRATEGIES OR ACTIONS OF CLOUD COMPUTING ACTORS

27 The way we **price** cloud computing seems to significantly determine adoption and usage

	<input type="checkbox"/> Strongly agree <input type="checkbox"/> Somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> Somewhat disagree <input type="checkbox"/> Strongly disagree
28	Promoting cloud computing to potential consumers significantly determines uptake and usage <input type="checkbox"/> Strongly agree <input type="checkbox"/> Somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> Somewhat disagree <input type="checkbox"/> Strongly disagree
29	Training and capacity development on cloud computing to potential consumers significantly determines uptake and usage <input type="checkbox"/> Strongly agree <input type="checkbox"/> Somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> Somewhat disagree <input type="checkbox"/> Strongly disagree
30	Promoting cloud-related entrepreneurship significantly determines uptake and usage <input type="checkbox"/> Strongly agree <input type="checkbox"/> Somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> Somewhat disagree <input type="checkbox"/> Strongly disagree
31	Deployment decisions and approaches (e.g. open source or proprietary solutions) significantly determine uptake and usage of cloud computing <input type="checkbox"/> Strongly agree <input type="checkbox"/> Somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> Somewhat disagree <input type="checkbox"/> Strongly disagree

H. OUTCOMES/IMPACTS OF CLOUD COMPUTING

32	Using cloud computing translates in OPERATIONAL EFFICIENCY <input type="checkbox"/> Strongly agree <input type="checkbox"/> Somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> Somewhat disagree <input type="checkbox"/> Strongly disagree
33	Has cloud computing resulted in new products and services? i. Yes, which one(s) _____ <input type="checkbox"/> ii. No <input type="checkbox"/>
34	Using cloud computing results in extended/enhanced market reach <input type="checkbox"/> Strongly agree <input type="checkbox"/> Somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> Somewhat disagree <input type="checkbox"/> Strongly disagree
35	Do you export of cloud related services beyond Kenya? <input type="checkbox"/> Strongly agree <input type="checkbox"/> Somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> Somewhat disagree <input type="checkbox"/> Strongly disagree
36	Cloud computing results in Security enhancement <input type="checkbox"/> Strongly agree <input type="checkbox"/> Somehow agree <input type="checkbox"/> Not Sure <input type="checkbox"/> Somewhat disagree <input type="checkbox"/> Strongly disagree

Hospitals	PaaS	Universities	Consulting firm
Nairobi Hospital	<i>Safaricom</i>	UON	PWC
Aga Khan	<i>Microsoft</i>	Kenyatta University	KPMG
Nairobi Women's	<i>Google</i>	JKUAT	Deloitte
Kenyatta Hospital		USIU	Dahlberg
M P Shah		Daystar	E&Y
Mater		Utalii	
Karen		Multimedia	
Coptic Mission		KCA	
Meridian Equator		KMTC	
		KTTC	
SaaS	Banks	Insurance	
Safaricom	CBK	AIG	
Crimson	CBA	Jubilee	
Kenya Data Backup	KCB	Mercantile	
EA Data Handlers	SCB	Madison	
Uchaguzi	Equity	UAP	
Ushahidi	CFC-Stanbic	Cannon Assurance	
Microsoft	FCB	First Assurance	
SasaHost	DTB	Geminia Insurance	
Flexus	Faulu	Heritage	
Biashara Cloud	NIC	Occidental	
MTN			
Tech Companies	Government	Business and Industry	IaaS
Safaricom	KRA	Kenya Airways	Safaricom
Airtel	NSSF	Air Kenya	Access Kenya – Seacom
YU	NHIF	Fly540	Angani
Orange-Telkom	RBA	Easy coach	Dimension Data
Africa Online	KEBS	Guardian	Macro source
Jamii (Fabia)	CCK	Coast Bus	Naisoft
Jambo Telkom	KRA	Modern Coast	KDN – Liquid Networks
SimbaNet	KWS	Kenya Railway	Microsoft(IDI)
NairobiNet	Kenya Army	African Express Airways	IBM
DSTV	Kenya Navy	Jet link	Seacom
ZUKU	Ministry - ICT	HARCO	Syspro
CITIZEN	Ministry –Edu	Roto	Seven Seas Technologies

NMG	Judiciary	Tekpark	SimbaNet
KTN/Standard	NSIS	Coca Cola	Comtec
Kiss		Keroche	Amazon
Hope FM		EABL	
The Star		Sameer Group	
True Love		Unga Group	
Ghafla		BAT	
Microsoft		Del Monte	
IBM		Shell	
Google		Total	
Cellulant		Bamburi Cement	
Software Technologies		Athi River Mining	
Access Kenya			

ABOUT THE AUTHORS

Dr.Tonny K. Omwansa

Tonny Omwansa, who holds a PhD in Information Systems lecturers at the School of Computing and Informatics, University of Nairobi in Kenya. He is the co-author of the book “Money, Real Quick: Kenya’s Disruptive Mobile Money Innovation” among several papers and reports covering topics in information systems and information and communication technologies (ICTs). Tonny has done extensive researches, which have been commissioned by organizations such as the World Bank, the Bill and Melinda Gates Foundation, Rockefeller Foundation and the Economic Commission of Africa, spanning the design, adoption and impact of innovative ICTs in developing countries. He is a member of the Association for Computing Machinery (ACM) and Information Systems Audit and Control Association (ISACA).

Prof. Timothy Mwololo Waema

Prof. Timothy Mwololo Waema is a Professor of Information Systems in the School of Computing and Informatics in the University of Nairobi, Kenya. He has extensive ICT4D research and consultancy experience in many aspects of ICTs and development spanning over more than 25 years. He holds a PhD in Strategic Management of Information Systems from University of Cambridge (UK) and a Honours Degree in Electrical and Electronic Engineering from University of Bath (UK). Prof. Waema has published widely in journals, conference proceedings and in books in information systems and ICTs for development. He has edited two books, one on electronic governance and another on ICTs and poverty. He sits on editorial boards of several peer reviewed journals and is a Professional Member of the Association for Computing Machinery (ACM).

Mr. Brian Omwenga

Brian Omwenga is a computer science doctoral candidate at the University of Nairobi, School of Computing and Informatics. He holds a Master of Science in Engineering Systems, Technology and Policy from the Massachusetts Institute of Technology ('09), and a Bachelors in Business Information Technology from Strathmore University ('04). Brian is a part-time lecturer at the University of Nairobi, lecturing the Design and Analysis of Algorithms as well as Innovation Studies. He has previously worked for Microsoft as an academic consultant within their Schools of Government 4Afrika program. As a software engineer, Brian has previously worked at the Nokia Research Center, where he was credited as a respected African inventor with several publications and software patents. He is also an official champion of the Africa Innovation Foundation's, Innovation Prize Africa. He is also currently the chairman of the Software Engineering technical committee (TC94) that sets national software engineering standards at the Kenya Bureau of Standards.

ACKNOWLEDGEMENT

Special thanks to the University of Nairobi and Microsoft East Africa LTD for providing financial support for this project. We are also most grateful to Marsha Lulu, Pauline Wanjiku, and Mark Ngotwa who assisted in data collection as well as Samuel Bonnke and Ann Atambo who assisted in data collection, analysis and proof reading of this work.