INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN 2278 – 0211 (Online)

Adoption Strategy for Cloud Computing in Kenyan Research Institutions

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Abstract:
Cloud computing has transformed the aspect of distributed computing from many other prevailing methods by offering more unlimited benefits, like cutting down computing costs and allowing more capacity and agility. It is viewed as a game-changer in how information technology is provided since it allows computer resources like storage, processing capacity, network infrastructure, and applications to be offered as a service via the Internet. In business, it seems to have become strategic, with the potential for use in crucial parts of an organization's IT infrastructure, as it offers a potential alternative to traditional Enterprise Resource Planning (ERP) systems. Most Kenyan research institutes' systems experienced certain flaws and recognized incidents of system rigidity, which prevented these institutions from efficiently meeting their mandate, especially when they desired to access services from home via the Internet. The Research design that was utilized in the study was a survey research design. The study employed a systematic review approach that examined the current literature on cloud computing adoption strategy. The systematic literature review revealed that existing research was dominated by issues of the characteristics/peculiarities and IT environments of research institutions in Kenya and if they were amenable to cloud solutions, the current cloud computing technologies, adoption approaches and drivers fostering cloud computing and the adoption strategy that met the requirements for cloud computing for Kenyan research institutions. The present research was reviewed for knowledge gap identification purposes and future research opportunities. The researcher developed an adoption strategy favorable to research Institutions that was flexible to the provision of cloud computing resources, enhanced greater cloud computing efficiency, reduced capital expenditure in hardware and software and increased the performance of the research Institution's operations, provided the efficiency of data and information and supported the effectiveness of the management activities since the cloud strategies discussed did not promote cooperation, agility, scalability and flexibility and saving costs by using calculating resources efficiently and optimally. This study employed a purposive sampling approach that picked a sample size of twenty respondents from the KMFRI and related organizations. The analytical review of specifically identified studies exposed the kind of challenges that existed and gave an indication that cloud computing was applicable for Kenyan Research Institutions because of the organization size, possession of required skills to make use of cloud-based services, Government regulations, industry regulations and internal policies necessitated the move to cloud computing strategy. The cloud service providers have adequate capacity to run the services and are ready with the services they provide. Researchers noted that all the research Institutions have dedicated ICT personnel and ICT Policies. Efficient service delivery means there is easy access to any research information from the cloud at any time and anywhere. Using Factor Analysis, variable weights for various study constructs (Technological, Internal and External Contexts) were used to develop the adoption strategy for cloud computing (ASCC). The recommendations of the study from the developed strategy showed that the network infrastructure should be more developed so that the Kenyan Research Institutions can be connected to high-speed Internet to allow for sharing of information, which will ensure efficient service delivery using cloud computing services. The study also recommended that Kenyan Research Institutes train their customers and suppliers on using cloud computing services for efficient service delivery and the adoption strategy for cloud computing (ASCC) to achieve efficiency in service delivery. Areas for further related studies can be conducted to determine the long-term impact of the developed adoption strategy for adopting cloud computing in Kenyan research Institutions. Also, further studies could carry out to determine ways of improving the developed adoption strategy for the adoption of cloud computing in Kenyan Research.

Keywords: *Adoption, Computing, Strategy, Validity, Factor*

1. Introduction

The thesis covers the study scope, its significance, its problem statement and the study background.

Since it was set up, cyberspace has been an impetus for developing different technologies in this era of globalisation and information systems, where plenty of effort in computing is needed to provide ideas that are business related, adding an advantage to the competition. The organization's in-house data centres provide computing power which is used to process their data. However, data centre operation, especially when it is private, can become costly and complicated to operate and thus hinder an organization from keeping up with the fast-rising data requests to be processed. Cloud computing is a viable option. Cloud computing, as a phrase for internet-based computing, was coined in late 2006 by major corporations such as Google Inc. and Amazon.com (Rouse, 2012). It has the ability to meet increased demand for processing power while ensuring a speedier deployment, lower maintenance, and fewer IT workers at lower prices.

However, in recent years, the cloud computing viewpoint observed massive changes towards its acceptance setting precedence in information technology courtesy of the convenience it provides (Bhadauria & Sanyal, 2012). Cloud computing offers enormous advantages in its usage, which include diminished equipment upkeep cost, easy access around the world and adaptability of profoundly computerized measures. The National Institution of Standards and Technologies (NIST) refers to Cloud computing as a method of arranging computers to provide easy, ubiquitous, needs-based network access to collective storage of IT materials (Mell & Grance, 2011).

The potential of cloud computing is to promote cooperation, agility, scalability and flexibility and to save costs by using calculating resources efficiently and optimally. The cloud model is a technique of grouping computers to swiftly organize, supply, deploy, upgrade or downgrade resources for an assigned service on-demand. Computing cloud changes the game on how technological knowledge is provided since it allows computer resources like storage, processing capacity, infrastructure-network, and undertakings offered as service methods via the World Wide Web (Greeger, 2009). Cloud computing seems to be directly strategic on the way forward for businesses, with the potential use of crucial parts of the infrastructural IT of an institution. Cloud computing offers a potential alternative to traditional ERP systems. In the context of a company, cloud computing enhances traditional ERP.

Over the past 60 years, research institutions, like other economically reliant industries worldwide, have gone through numerous technology/computing regimes and are still under pressure to adapt to improved computing methods like computing cloud. Cloud computing will be regarded as the next phase in the evolution of computing. The mainframe era of computing began decades ago, lasting around 20 years before giving way to the client/server era, which saw businesses locate more personnel in branch offices, resulting in the emergence of Internet computing. Now, the sector is undergoing yet another transformation: the transition to cloud computing.

1.1. Background to the Study

The functions of KMFRI as stipulated under section 14 of the Science and Technology Act Cap 250 now repealed and affirmed under section 53 of the STI ACT 2013 is to:

- Carry out research in
    - Marine as well as freshwater fisheries,
    - Aquatic Biological studies involving ecological and environmental,
    - Research in the marine sector inclusive of physical and chemical oceanography.
    - Participate in training programs and related research with other organizations and institutes of higher learning,
    - Liaise with other research organizations in Kenya and elsewhere that are conducting comparable research
- Publish research findings in issues relating to research policies and priorities,
- Collaborate with the competent Ministry, the Council, and the relevant Research Committee.
- Carry out its tasks in any way that appears necessary, useful, or expedient.
- Address emerging trends in the blue economy, other Government development agendas, and emerging issues. KMFRI will carry out research, disseminate research findings, and build capacity in the blue economy or other related areas.

This research Strategy for Adoption of Cloud Computing in Kenyan Research Institutions will evaluate the level and appetite for the KMFRI to conduct its business in the cloud and the components afflicting the resolve to undertake computing cloud. It attempts to outline those key areas of concern as the research institute relocates its data, understands cloud operation, and experiences new opportunities and benefits of cloud computing.

1.2. Problem Statement

There are outright shortcomings among most Kenyan research institutions' systems and known cases of system rigidity that do not allow these institutions to effectively meet their mandate, particularly when they want to access services from home via the Internet. The research institutions lack efficiency, flexibility, security, increased productivity, strategic value, automatic software updates, remote access to information and cutting of costs (ISSN (Online): 2320-9801). Other challenges include deterrence to resource sharing among local research institutes due to a lack of integration and platform uniformity, while specific software licenses commonly restrict the computers on which the software is deployed. Moreover, in many cases, Research Institutions are not sure where to start in cloud adoption, given the many questions on the existing status of cloud-based services (Osama et al., 2016).

There is a need for a cloud adoption strategy that is appropriate for cloud computing adoption in research institutions in Kenya.

1.3. Study Objectives

1.3.1. General Objective

The study here has the objective of developing a strategy for adopting cloud computing in Kenyan Research Institutions.

1.3.2. Specific Objectives

This research aims at:

- Analyzing the characteristics of research institutions in Kenya, current cloud computing technologies, adoption approaches/strategies and drivers to establish the research gaps.
- Propose a cloud adoption strategy ideal for research institutions.
- Evaluate the effectiveness of the proposed strategy.

1.4. Research Questions

Key question in the thesis here is: Which cloud computing adoption strategy exist and what determines their adoption? Other research questions include:

- What are the characteristics of research Institutions in Kenya, current cloud computing cloud technologies, adoption approaches/strategies and drivers?
- Which adoption strategies can meet the requirements for cloud computing for Kenyan research institutions?
- How effective is the proposed adoption strategy?

1.5. Study Significance

This study is projected to be one of the few projects, which can be undertaken in the area of cloud computing, particularly by organizations working on research in Kenya. The study has the capacity to foster cooperation, scaling dexterity and availability, and providing opportunities to reduce costs by optimizing and efficiently using computing materials. Challenges in relation to strategy undertaking for cloud computing include exposure to the inflated cost budgets for Software, Hardware and management skills, maintaining information security and collaboration with customers not to mention customer frustration in terms of service and transaction costs and turnaround times. These factors will, therefore, form sufficient justification for investigating the situation to provide a solution in the form of recommendations and guidance into the use and access to uniform, secure, cost-effective, efficient and business-friendly computing environment shareable by all Kenyan research institutions. The interaction, therefore, with IT technicians in research institutes and other users will provide a whole wealth of information that will assist in aligning the needs and expectations of each party appropriately and enable secure computation of cloud data without exposing it to the deliberate risk and reduce the computational strain on the resources.

1.6. Limitation of the Study

Changes in IT Governance (policies and strategies) of an organization.

Research is not replicable to other organizations outside the Kenyan Government sponsored research community.

Field-testing was not possible because of the fixed research period as opposed to the rather lengthy implementation cycle

1.7. The Scope of the Study

The main focus of the study is cloud technology adoption by KMFRI in Kenya. The study investigates the current levels of cloud technology awareness and adoption and recommend how this technology can be adopted. An adoption strategy will be developed to provide a support tool to help ICT professionals implement their cloud adoption strategy in research institutions in Kenya.

1.8. Organization of the Study

There are 3 chapters outlined within this research work.

Chapter I simply provides the background information concerning the research topic. The chapter also highlights the research questions and explains the importance of this research.

Chapter II derives from the existing literature on cloud computing and existing literature. It also identifies the existing cloud adoption strategy and identifies the gaps.

Chapter III illustrates how the research will be carried out. It gives details to several important pieces of information, including the sample size and methods that will be used to conduct the research.

2. Literature Review

Over recent years, an important topic, just to mention a few among business areas which include the research institution sector, has been cloud computing and the benefits it can bring to a business (Queensland, 2017). This section will look at cloud computing from different perspectives, cloud computing and information security in research institutions and its implementation.

2.1. The State of Cloud Computing

The section here aims at providing a fresh look at cloud computing, beginning with its origins and progressing through its development, evolution, and applications.

2.1.1. Computing Clouds Brief History

Computing cloud is a network access concept that allows users to connect to collective storage of configurable computing materials, which may be released or supplied quickly without striving on the part of the administrator (Bhardwaj, Jain, & Jain, 2010). In simple terms, a cloud computer is a combination of computing technology and a platform that provides holding and storage servicing through the cyber space.

In truth, computing cloud is a new name for an old notion that has now come of age. John McCarthy argued, "Computers may ultimately be constituted as a resource for the public, just like the telephone systems were in the early 1960s, and the notion of cloud computing was born" (Garfinkel, 2011), and that is exactly what cloud computing is. It depicts an Internet phenomenon in which people, corporations and even governments may spend time in a shared computer infrastructure consisting of interchangeable computing, data-storage and communications components instead of acquiring and operating their own computer systems. If an element fails or has to be updated, programs and data are automatically transferred to others.

Amazon's pilot for (EC2) Elastic Cloud Computing became public on 24th August 2006; this date will probably be remembered as the 'birthday' of cloud computing (Herrmann, 2008).

This offer, which supplied flexible IT resources (processing power), marked a turning point in the dynamic economic relationships between IT buyers and sellers. Amazon's service was designed for developers who could not manage their information technologies infrastructure hence renting it on Amazon through cyberspace. Cloud computing was unheard of at the time. The term gained traction in 2007, as seen by English Wikipedia's first entry on 3rd March 2007, which included another utility computing reference.

A plethora of parties-active rapidly fostered the subject of computing cloud in 2008. Currently, on Google, computing cloud creates matches of about 10.3 million plus. Cloud computing has progressed above basic infrastructure services such as storage and computation materials containing applications (Hill & Hirsch, 2013). However, the indication is that service providers for applications that advocate for delivering Software as a Service (SaaS) would now be classified as cloud computing. The ultimate migration to World Wide Web from local computers in IT services was at the heart of these advances (Hill & Hirsch, 2013).

Cloud computing eventually fulfilled a concept that Sun Microsystems had conceived long before the cloud-computing craze: The PC will be connected to the network.

2.1.2. Core Technologies in Cloud Computing

Computing cloud employs features given by several key technologies. The following describes the most significant fundamental technologies utilized in cloud computing systems (Shawish & Salama, 2014).

- Distributed Computing: It addresses big computational problems by combining the processing power of numerous distributed computers.
- Distributed File System (DFS): It permits many hosts on a computer network to access files.
- Virtualization: It establishes an abstraction layer between the Virtual Machines (VMs) and the underlying hardware using (VMM) Virtual Monitoring Machine and/or hyper-visor.
- Web Services: This refers to a platform for interoperable software machine-to-machine communication across a network.
- Cryptography: This is the science of encrypting and decrypting messages to keep them safe. Many of the security needs for cloud computing can only be met via cryptographic approaches.

The confluence of these technologies accelerated and aided the development of cloud computing.

2.1.3. Architecture of Cloud Computing

Cloud computing architecture consists of four layers (Zhang, 2012). Figure 1 portrays cloud computing architecture.

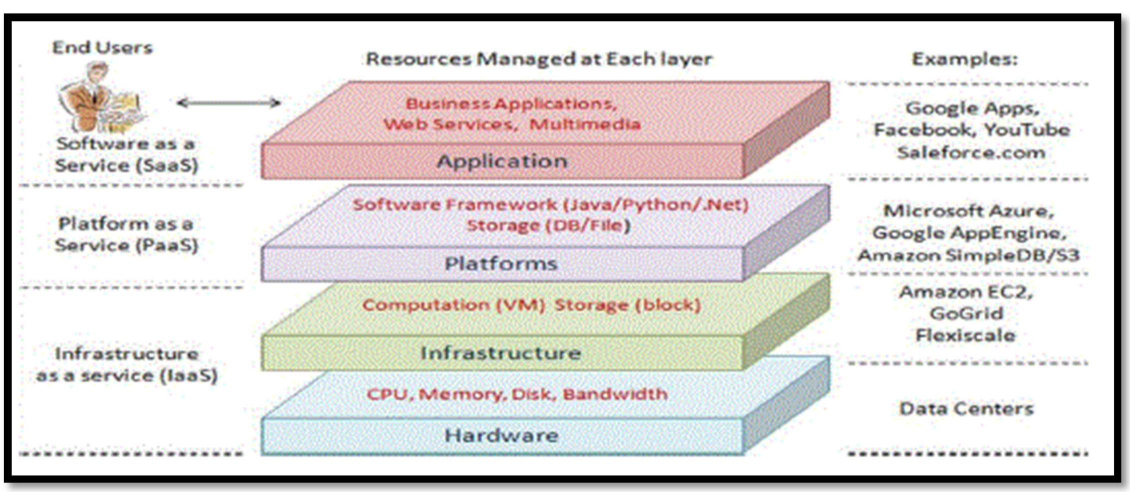

Figure 1: Cloud Computing Architecture (Zhang, 2012)

- Hardware Layer: This is the initial level of cloud architecture to manage tangible material (i.e., physical servers and cyber hardware). The above-mentioned layers of hardware are generally found in data stores that are designed for the accommodation of computer systems.
- Infrastructure Layer: This refers to separable cloud computing components that provide for resource pooling. Pools of resources offered through virtualization techniques are referred to as the virtualization layer.
- Platform Layer: This layer is built on the infrastructure layer and comprises platforms and operating systems.
- Application Layer: Being the most accessible to the cloud user, cloud computing applications are provided in this layer.

  Figure 2 portrays the differences between the scope and control of cloud service models.

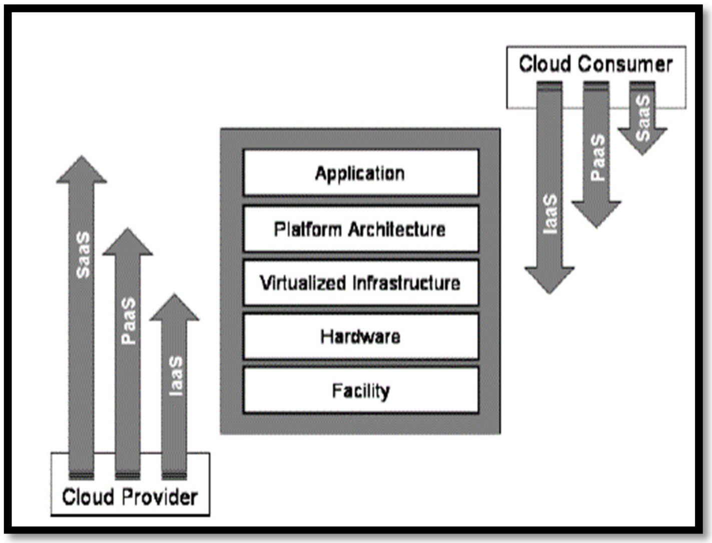

Figure 2: Scope of Controls between Provider and Consumer
Source: NIST, 2015, P. 9

<u>2.1.4. Cloud Service Models</u>

A cloud's service model determines an institution's capacity, management of its computing environment, and the degree of the vague notion of its usage (NIST, 2011).

Infrastructure, Platform and Software as services, that is, IaaS, PaaS and SaaS, respectively, form part of three prototypes that computing cloud providers use. The lower prototypes provide derived specifics for the higher prototypes, with Infrastructure as service being the primary model in use.

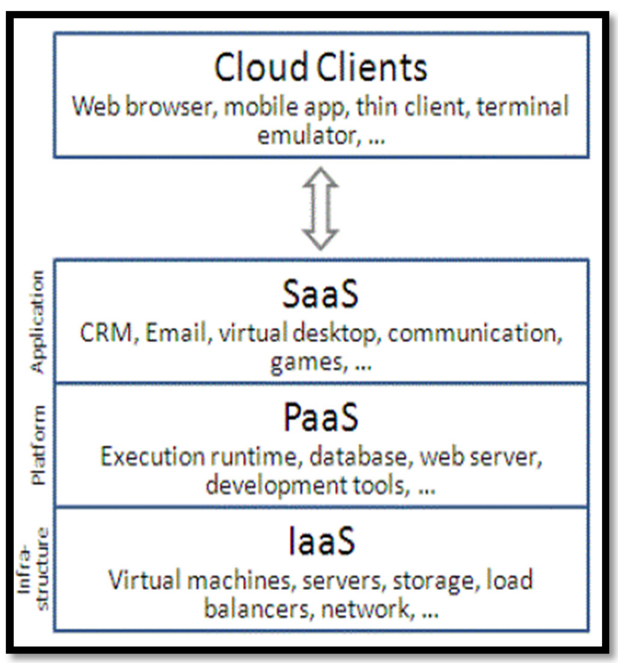

Figure 3: Cloud Service Prototypes (Root: 2015 Ride)

2.1.4.1. Infrastructural Service (IaaS)

The key in architectural cloud services is that providers supply tangible or computer-generated, raw (block) centers, load balancers, firewalls and networks. The materials here are at the behest of IaaS providers from huge pools deployed within input stores. Area networks-local and Internet Protocol addresses build up the package (Hill & Hirsch 2013). The Internet can be utilized for wide-area connection, or devoted computer-generated private networks (VPN) can be created in carrier clouds. Wide-area connections can be made through the Internet, or devoted private networks-virtual may form in carrier clouds. Cloud clients must first furnish their computers with operating system images and software applications before they can deploy their apps. Patching and upgrading software apps and operating systems remain the responsibility of a cloud user in this technique.

Except for a few peak times every year, it is generally known that most servers are running at 7 to 10% capacity (NIST, 2011). IaaS allows businesses to use the cloud during peak demand periods. Cloud bursting is a term used to describe this process. Internally, businesses must utilize sophisticated resource allocation tools to do this.

IaaS services are typically invoiced on a utility computing basis, which means the fee relies upon the number of materials available and used. Pros/Cons: Using IaaS, businesses may avoid the hefty capital expenses of infrastructure and data centers. It also has a low entry barrier and supports automatic scaling. One disadvantage of IaaS is that it introduces new security threats that necessitate additional safeguards. As a result, businesses must carefully examine where such data is stored and reduce any privacy concerns. Furthermore, the success of IaaS is reliant on the seller.

2.1.4.2. Platform as Service (PaaS)

Under the above-mentioned paradigm, cloud facilitators offer a computing stage that includes a language programming execution environment, operating systems, web servers and directories (NIST, 2011). Developers of software apps may deploy or construct solutions for software on a cloud stage without purchasing and maintaining soft and hardware underlying layers, saving time and money. Some PaaS solutions automatically scale the underlying processing and storage materials to match software app needs while removing the desire for cloud users to allocate materials explicitly.

- Pros/Cons: PaaS allows businesses to bring together materials and grow as required while simplifying the control of versions available (Nedal & Taleb, 2013). Notably, the most significant disadvantage is security concerns when data is centralized.

2.1.4.3. Software as Service [SaaS]

Facilitators of cloud furnish and run software applications on cloud, while its customers use cloud clients to access the program. The infrastructure of cloud and stage in which the application operates is not within the control of cloud clients. Hence, removing the need for cloud clients to furnish and operate programs on personal computers enables efficiency in management and support (Hill & Hirsch, 2013). A cloud application's versatility sets it apart from other programs. Jobs can be copied onto many virtual machines during runtime to accommodate varying work demands. Work is distributed over a number of virtual computers via load balancers.

Since the cloud user only sees one access point, this solution is obvious. To manage mass cloud clients, cloud applications can be used by multiple tenants, meaning one server can accommodate various cloud operating institutions. The following naming convention is often used to refer to different models of cloud-based software apps: Services offered on a desktop include business processing, environment tests and services on communication, to name a few. SaaS products are usually charged per user on a monthly or annual basis (NIST, 2011).

- Advantages/ Disadvantages: The cost-cutting potential of SaaS is apparent. Organizations can pay for software usage by the drink rather than purchasing licenses that are costly for every machine that remains unemployed or unutilized. In addition, SaaS reduces the upfront cost of acquiring software (Nedal & Taleb, 2013). Furthermore, since programs are centralized, version management and upgrades are flawless, and software deployment becomes instantaneous. Centralized applications, on the other hand, pose more security concerns.

2.1.5. Models for Cloud Deployment

The regulation and propensity of computing materials for service delivery to customers, and the distinction between categories of consumers, are all described by prototypes for deployment.

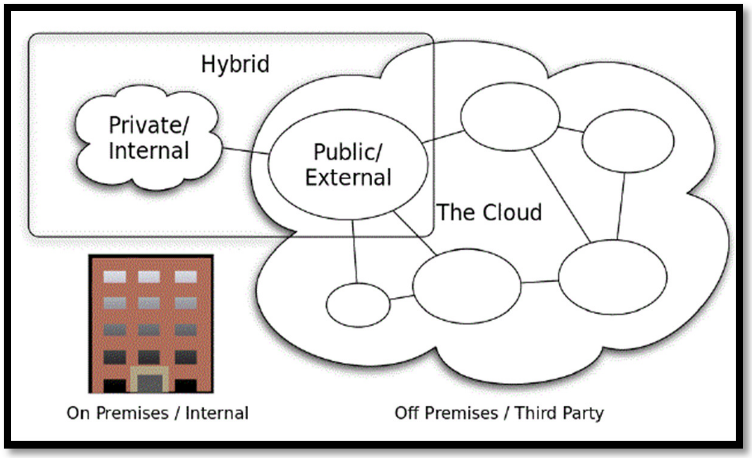

Figure 4: Cloud Computing Prototypes for Deployment (Johnstone, 2009)

There are three sorts of clouds that are important to most enterprises, organizations, or government agencies: hybrid public and private, also known as: mixed, external, and vendor-hosted, respectively. Every infrastructure from cloud contains its own set of characteristics, benefits and drawbacks.

2.1.5.1. Enterprise Private Cloud

Businesses can employ cloud technology on their own facilities, behind their own firewall, with a private cloud. Businesses are deploying private clouds in areas of their infrastructure where using a cloud model makes the most sense (Winkler, 2011). Cloud-private offers a range of advantageous services with an exception on security and management concerns that are common for traditional cloud prototypes on infrastructure. In a cloud-private, virtual technologies are used in improving scaling, system uses and resource control. This involves automatic data center provision, pricing based on services offered, and metering chargeback for usage. Thanks to identity-based security measures, only authorized persons can access necessary apps and infrastructure.

Private clouds- vendor hosted, commonly termed partner cloud, is not a rare type of cloud-private. It has gained popularity amongst users and is hosted in a secure storage center for the vendor. The host utilizes the tools of support for cloud enterprise, technologies for testing, and processes to transfer virtualized apps to vendor data center servers.

2.1.5.2. Pros/Cons of Cloud Infrastructure Private-Enterprise

Customers may make use of private cloud courtesy of the various advantages that come with cloud computing. This cloud architecture approach is suitable for clients that are concerned about their privacy (banks, government, etc.). However, owing to the necessary technological expenditures, a private cloud can deliver minimal to no real-time financial benefits (Nedal & Taleb, 2013).

A vendor-hosted private cloud enables businesses to benefit from computing experiences on cloud, methods and technologies while simultaneously eliminating security concerns. Furthermore, by enabling consumption-based invoicing, cloud-vendor-hosted releases stored-up resources and cuts down costs for IT support. However, this reduces projected capital expenditures on infrastructure while boosting capacity internally. In a nutshell, the paradigm allows customers to make use of vendor cloud techniques, tools and cheaper costs (Nedal & Taleb, 2013). Nevertheless, when it comes to computing clouds' best features, it underdelivers with regard to resource ramping, infinite flexibility and low pricing.

2.1.5.3. Public Cloud

Public cloud allows enterprises to connect to cloud-based software applications and infrastructure in cyberspace, which shares many similarities with electric utility bills. The collective combination of networks, software applications, storage data and services can be used by several persons or enterprises. End users who do not own these resources can obtain them quickly and easily through cyberspace use on their personal computers or basic terminals, on a needs basis and with minimal effort from the managing and servicing providers. The iTunes Stores provide a great example of a famous public cloud consumer (Mukundha & Vidyamadhuri, 2017).

2.1.5.4. Pros/Cons of Cloud Infrastructure (Public)

Based on its capacity for multiple-share, cloud public is a very cost-effective computing solution. It offers a great stage for quick concept proofing, needs-based performance testing, and document and information sharing via Microsoft SharePoint and other technologies. The placement and protection of private data are the fundamental downsides of this cloud computing paradigm (Nedal & Taleb, 2013). One source of concern is that administrators on cloud-vendor can access data, thereby increasing the risk of data theft or misuse. Data storage and location remain significant as it influences the regulations and rules that apply to data. Data recovery as well is a very sensitive and significant issue.

The vast majority of cloud servers-public is not designed with a failover or high availability in mind. Therefore, as a result of this, firms feel driven to increase their spending. These make businesses compelled to spend more money on backup and failover systems. Furthermore, suppliers are unable to deliver significant Service Level Agreements due to the utility nature of the public cloud model.

2.1.5.5. Cloud Infrastructure (Hybrid)

To get the best of both worlds, a hybrid or mixed cloud system combines characteristics of cloud infrastructure, both private and public. The approach here allows for the supplementation of an internal cloud or its enhancement through the use of cloud-public. For example, companies may use an internal cloud to exchange virtual or tangible resources through cyberspace only when necessary, such as at peak processing times (Mukundha & Vidyamadhuri, 2017). Businesses can choose whether their apps should be hosted on a public or private cloud using a hybrid cloud infrastructure. An example of this is the strategy that allows applications that are finance related and have the most to be covered by a firewall while customer service and collaboration-related apps, including those of chain supplies, are housed in the public cloud.

2.1.5.6. Pros/Cons of Cloud Infrastructure (Hybrid)

Long periods of high capacity are possible with hybrid cloud architecture, while security issues for applications that are mission-oriented critically are reduced. Positively it allows you to make use of the benefits of cloud public for flexible and suitable programs while managing older and important systems that require higher adherence, safety and performance needs (Nedal & Taleb, 2013).

Since companies may mix local infrastructure with scalable and provisioned-on-demand infrastructure, the hybrid model provides an ideal architectural strategy. As a result, a mixed approach delivers significant cost savings while still providing nearly limitless flexibility. It is worth noting that by employing this strategy, businesses are foregoing extra cost savings in exchange for increased security.

Due to these enormous benefits, cloud architecture-hybrid is often used as the infrastructure for worldwide businesses. The difficulty of observing and controlling components of the cloud-hybrid through a single terminal or desk of service is the major downside of this architecture. This involves considerable IT engineering or provision of what is considered the necessary 'glue' through acquiring third-party vendor services for monitoring a plethora of corporate backgrounds of knowledge with regard to boosting firm value, cutting expenses and releasing materials for more critical activities. Prioritized Applications Rationalization recommendations by Keane in implementation will result in quick demonstrable gains, allowing you to maximize your improvement efforts. The service and deployment prototypes, deployment models, service models, and characteristics of computing cloud are summarized below in figure 5.

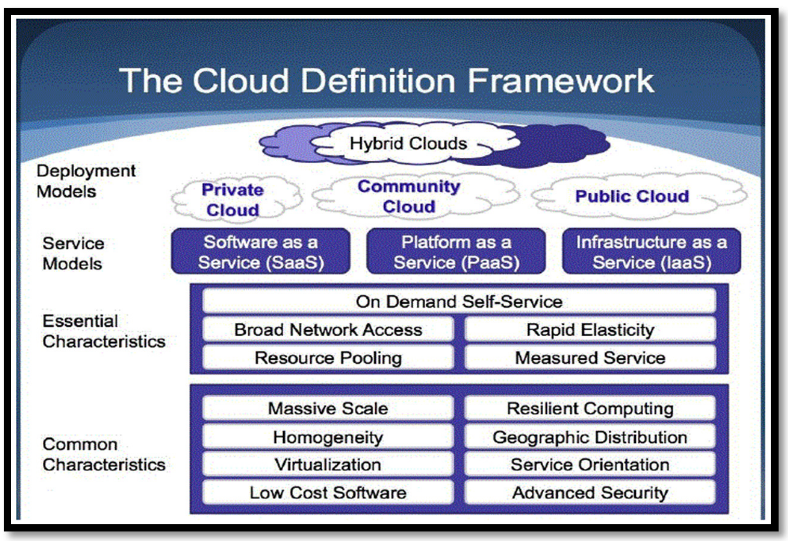

Figure 5: The Definition of Cloud Strategy – Root Http:// Kb.Esds.Co.In/A-Strategy-For-Cloud-Computing/

2.2. Cloud Computing Issues and Challenges

At the same time, cloud computing presents a plethora of opportunities and difficulties (Monjur & Hossain, 2014). Moving to cloud computing appears to be a good idea, but there are a number of obstacles to overcome. Many questions arise from the existing status of services that are cloud-based (Osama, 2016). The undertaking of computing cloud as a new technology is fraught with difficulties, as people remain suspicious of its validity. Security issues, legal and regulatory issues, and trust issues are some of the issues that cloud computing adoption faces.

- Security: It is indisputable that the most fundamental hurdle to Cloud computing adoption has been security. Many individuals are apprehensive about storing their information and operating an application on a different person's personal computer (Murthy & Selvam, 2015). Phishing, data loss, and botnets (a collection of remotely controlled devices) are all well-known security risks that are a danger to the information and applications of institutions. Among the challenges, security is seen as a major stumbling block to cloud computing is success (Monjur & Mohammad, 2014).

Cloud computing brings with it a slew of security issues that are both dynamic and wide. Data storage is an important part of cloud computing security. One of the most well-known benefits of cloud computing is location transparency. However, it also offers a security risk: lack of awareness of the exact location of information storage, and its security rules in various jurisdictions may be impacted and broken. In a cloud computing environment, private data security for cloud users is thus a key issue. Safeguarding computer systems has never been straightforward, and cloud computing's multi-tenancy adds to the security problems. A variety of problems that influence cloud security must be addressed by cloud computing and service providers. Clients' satisfaction and faith in the computing environment depend on how these problems are addressed and mitigation strategies are implemented.

- Trust: Another issue that causes worries about using cloud services is trust (Ryan & Falvey, 2012) because it is inextricably linked to the legitimacy and authenticity of cloud service providers. Establishing trust is essential for a successful computing environment. Herein, the supply of a trust prototype is critical because it is a common area of interest for all partners in any particular cloud computing situation. Trust in the cloud may be influenced by various variables, including automated control/oversight, human involvement, processes, and regulations. Cloud trust offers no safety concern that is technical but holds a significant factor which is softly driven to a large part by security vulnerabilities inherent in cloud computing (Monjur & Mohammad, 2014).
- Legal and compliance issues: When data and applications are managed by cloud providers, such as a third-party, determining the legal and compliance implications for all parties involved is challenging. The storing, privacy concerns, security, processing, location and e-discovery of data are all issues that need to be addressed (Murthy & Selvam, 2015). As a result, chief information officers and company managers should be aware of how resident data regulation laws in various nations can affect a firm in terms of compliance with a country's privacy and data protection legislation.

2.3. ICT Usage in Agricultural Research Institutions

ICTs have grown increasingly significant in agricultural innovation systems as they have evolved and become more widespread. The most important research, extension, and e-learning advances are briefly discussed as follows.

To begin with, ICT has been able to reach rural areas due to the persistence of communications networks. Long-applicable agricultural technologies have proven useless merely because they are inaccessible to rural consumers. The speed, precision, and reliability of information transmission between farmers and other stakeholders have improved as telecommunications networks have expanded (through text, voice, and apps). In developing countries, rural area farmers can now link up with workers in extension, agricultural businesses, one-another, and those in academia using low-bandwidth cyberspaces (Porcari, 2009).

For example, electronic learning has been fostered by advancements in telecommunication and the use of mobile phones. The need for power lines and power sources, both of which are essential in the use and maintenance of ICTs, is also increasing.

Second, cloud computing contains the capacity to enhance agricultural creativity. Cloud computing provides the advantage of delivering combined and flexible resources on a needs basis via cyberspace (Porcari, 2009). "The criterion for giving convenient, need-based cyberspace access to a shared combination of materials customizable for computing (i.e., applications, and services) which can be immediately provided without active service providers' interaction and administrative striving," according to the definition of clouds computing (Mell & Grance, 2019).

These platforms have made data-sharing programs previously too expensive for most colleges and students conducting masters or doctoral research. They have also simplified data collection and aggregation, which is critical for research, extension, and education. A website such as Amazon Web Services, for example, can be used to purchase a Windows or Linux server by specifying the amount of CPU, bandwidth, and storage space available. The necessary materials are immediately available over cyberspace, and the charges are calculated premised on the time the server is in use. Because of the flexibility and scalability of cloud computing, it is possible to handle large datasets that can be shared through internet access.

Third, the tendency toward open access and online public participation via mobile technologies stimulates innovation in agriculture among all actors in the innovation system, not only research institutions. Information and communication technology is used by institutions, private and public sectors to communicate among themselves and with society (Kinuthia, 2009). Knowledge exchange and multi-stakeholder participation are often seen to have increased as ICT has reduced the barriers that hinder the interaction of people from different areas.

More expert opinions and diversity can be incorporated into research (UNCTAD, 2017). Advisory services can access a far broader spectrum of current expertise and give advice to people who need it in a much more tailored manner. Even without a formal distance education program, e-learning may take place with an Internet connection, and online platforms like agropedia enable developing and transmitting information for e-learning programs much easier.

Through ICT, new types of knowledge brokering have become feasible. In agricultural innovation systems, knowledge brokering has always been an important component (UNCTAD, 2017). It is critical to generate and disseminate information to and fro between extension agents, researchers, and farmers. This will increase productivity and creativity by implementing agricultural methods and technologies that have evolved and improved over time.

Middlemen who identify information gaps have found a lucrative niche. Farmers, businessmen, and others in poor nations are selling information services for a modest charge as access to IT and literacy levels improve. This private activity has the capacity to double the availability of data knowledge in rural regions while also reducing the workload of public extension agents, who are responsible for providing farmers with timely and locally appropriate information (Mell & Grance, 2011).

Although, due to their broad objectives, private sector advisory services have traditionally been more effective than public sector advisory services, the expensive nature of such services placed a burden on private advising efforts until recently. Policymakers must, however, consider rural residents that lack access to and/or cannot afford innovative systems that rely on ICT and how information trading or sharing and public advisories can empower them and assist them in meeting these needs.

2.4. ICT Operations at Research Institutions: Case Study of Kenya Marine and Fisheries Research Institutions

The KMFRI ICT Strategic blueprint sets the enabling requirements for the ICT function and technologies to facilitate the delivery of the Institute's core mandate through the ICT technology and information service priorities.

The ICT function is cross-cutting and seeks to address the connectivity and harnessing of emerging technologies to enhance research capacity. Modernizing the relevant infrastructure and services that support the research activities of the Institute is a priority of the department. Its vision is to transform the institute into an automated work environment by providing ICT technical support to research in marine and fisheries activities within the Republic of Kenya. The Department is organized into five functional units, namely: technical support and helpdesk (hardware, software), library and information services (digitization, cataloging, classification, and online services), network and security services (LAN, WAN, security), System administration services (servers, ERP, e-mails, portals database).

2.4.1. ICT Policy

The ICT policy is necessary for improvement, consistency in decision-making processes and focus on research goals. The goals here are:

- To design a development and ICT strategy for implementing IT infrastructure and software applications.
- To provide guidelines and standards for ICT use within KMFRI.
- Promote the security of KMFRI ICT systems and information.
- Promote best ICT practice.
- Promote efficient use of ICT systems by KMFRI employees.
- Promote availability, reliability and sustainability of ICT systems.
- Promote a spirit of awareness, cooperation, trust and consideration for others.
- To conform to QMS standard operating procedures for ICT.
- To provide guidelines for e-waste management.

From the detailed policy document, the following features are of interest to this research:

- Software licensing: The Institute procures its original software.
- Software copyright: Software is legally used with respect to existing agreements on licensing.
- Software change management: It refers to maintenance, modifications and control of software components and requires approvals whenever necessary.
- Implementation of Software upgrade: This requires organized planning, control and management of critical systems to implement upgrades and minimize security risks.
- Network policy access and security: Firewalls and intrusion detection systems shall be used across the entire KMFRI network to monitor and prevent hackers, viruses and worms, including all other forms of attack. The in-charge of the network shall ensure that the policy is adhered to. All computers hooked into the network shall mandatorily have up-to-date antivirus software to prevent viruses and all other unnecessary devices disabled to prevent intrusion. All staff seek access rights from IT department to link to the cyberspaces on their personal computer.
- ICT policy on disaster recovery: ICT disaster recovery shall be carried out as outlined in the ICT business continuity plan (BCP). There is a process for designing recovery and prevention systems that protect a company, its assets and those of its personnel from threats in the event of a crisis. Manual backup and restoration procedures are not done automatically.
- ICT Procurement policy: (Warranty, with or without software, computer or related accessories) Hardware and Software: All purchases are approved by the Head of ICT, preferably through the ICT budget.

KMFRI has a number of stations spread around the country that also need ICT facilitation. However, the stations have various challenges, including a lack of proper alternative power backup, poor internet connectivity, poor implementation of ICT standards, procedures and policies, whereby two out of nine stations are connected for ICT staff, no proper documentation on existing hardware and software licenses, ever-evolving ICT security challenges, rapid technological changes, high cost of software licenses for each station, etc. The impact of all these challenges is that data and information are not shared timely, as well as other inefficiencies such as duplication of software licenses. Some of these can be solved if a proper strategy incorporating ICT policy issues is in place. It will ensure access to a uniform, secure, cost-effective, efficient, and business-friendly computing environment shareable by all Kenyan research institutions.

2.5. Cloud Adoption Strategys

Generally, a strategy is a physical or conceptual structure that supports or guides the creation of anything that will make the structure useful. A strategy is more prescriptive than a structure and more thorough than a procedure (Margaret, 2015).

2.5.1. IBM Cloud Adoption Strategy, IFCA (2010)

The IBM cloud computing adoption strategy specifies two overlapping variables to consider while establishing cloud computing strategies: methods of delivering and the nature of the services offered. Opportunities arise for assessing cloud deployment needs through basic adoption strategys, which occur when the two main criteria are merged. Comprehension of the mentioned needs will aid a business in deciding on the optimum services and delivering prototypes for tasks it wants to put on the cloud.

While developing a cloud strategy, the first factor to examine is the delivering prototype to be used, and this refers to the dimensions of the strategys-horizontal (the x-axis). The most frequent clouds delivering prototypes are both in private and public spheres. Hybrid is a third prototype that combines the two.

The second component of the IBM cloud computing adoption paradigm is the services prototype. This then represents the dimensions of the strategy vertically (the y-axis). The cloud service categories specified in the strategy are IaaS, PaaS, SaaS, and Business Processes as Services (BPaaS). Customers pay for business services rather than applications when they use BPaaS.

The important responsibilities in the consumption and delivery of cloud services are also outlined in the IBM cloud-based adoption paradigm. The roles are:

- Consumers (Subscribers/Users): They are in charge of making efficient use of cloud services while also ensuring that they are turned off when a task is completed.
- Providers: The cloud service provider provides customers with these services while retaining assets needed in developing and providing quality cloud services.
- The Integrator: Communication of the customer's IT needs properly to the provider is key; hence, an investigator provides the required level of IT literacy to achieve this.

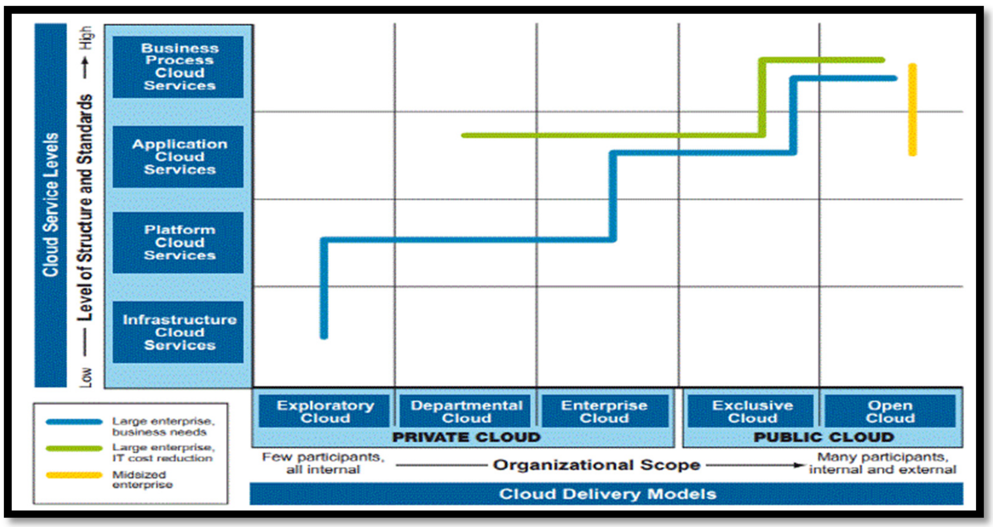

Figure 6: Visual Map of Potential Cloud Adoption Pathways, Adapted from:
"IBM's Thought Leadership White Paper on Global Technological Services" 2010, p.10

As seen in the graphic above, migration paths will differ depending on the institution's IT strategies, delivering prototype, service supplied, and if either IT or the business is the driving force for migration to cloud.

When a significant company's cloud strategies are headed by powerful business donors, then new opportunities for businesses follow paths to cloud use by solving emerging business problems that need able forms of technologies.

Demand for infrastructural optimization to provide dynamic services while cutting down on capital expenses by employing existing infrastructure properly will arise in an enterprise that has IT as the primary driver and this leads to the path of using cloud. For instance: implementation is bound to start with exploring private cloud initiatives at an infrastructural level, advancing and gaining skills along the way. For an IT department to better comprehend cloud abilities and later advance selected workloads to a public cloud, such as cyber conferencing or environmental testing, starting with a private cloud installation would enable this.

The need for offloading fundamental IT functions to decrease capital and operational costs, as well as the amount and depth of internal IT skills necessary, could be driving a midsized organization to the cloud. This should facilitate the existing IT department's capacity to concentrate on finding answers to business challenges while also allowing for elasticity in scaling to deal with demands on variables. Small businesses can also take advantage of public-sector business process services to lower their IT and business process delivery staffing needs.

- Limitation: The I.F.C.A attempts to give universal answers to all industries and cloud types.
  There are no case studies or application examples, which is a major issue (Chang et al., 2016).

2.5.1.1. Strengths and Weaknesses of the Strategy

Low capital costs of infrastructure and data centers and allows automatic scalability. The strategy is not appropriate for its adoption in Research Institutions since, in case of poor IT services being offered, the client cannot be able to change the provider to alternative services offered.

<u>2.5.2. Amazon Web Services Cloud Adoption Strategy II, 2017 (AWS CAF)</u>

The adoption strategy mentioned in this section (AWS CAF) gives advice that helps units in institutions understand methods of upgrading skills and modification procedures and introduce new processes, thus maximizing cloud computing's capabilities. The AWS CAF arranges instruction into six focal areas/perspectives at the highest level.

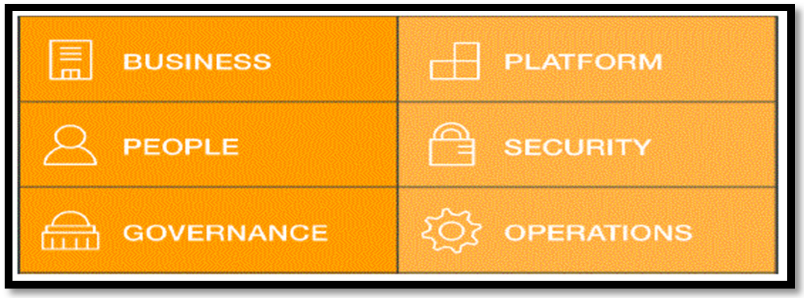

Figure 7: The AWS Cloud Adoption Strategy (CAF), Adapted from: "An Overview of Version 2 of Clouds Adoption Strategy (AWS)," 2017, p.2.

Every cloud adoption strategy comprises a variety of abilities, which are a combination of responsibilities normally owned and/or controlled by multifunctional related shareholders, making up a point of view. Every capability defines 'what' a shareholder owns or administers in the cloud adoption path. The abilities are standardized inside the CAF. Every capability is made up of a group of CAF abilities and procedures as a foundation for identifying skills and procedures that are currently lacking. Platform, Security, and Operations views focus on technological abilities, while Business, People, and Governance are geared towards business abilities.

- Business Perspective – Conventional roles: Business Managing, Finance Managing, Budget Owning, and Strategy Shareholders.

As businesses transition to the cloud, it is important for stakeholders to comprehend methods of updating their staff's capabilities and institutional procedures in order to maximize economic value.

- People Perspective – Human Resources, Staffing, and People Managers are all common roles. Those in charge of personnel development, training, and communications are given directives. It assists stakeholders in understanding how to upgrade the skills of the staff and organization procedures for maximizing and sustaining their workforce.
- Governance Perspective – Common roles: Program Managers, Project Managers, Enterprise Architects, Business Analysts, and Portfolio Managers are all examples of people who work in the IT industry.

Those in charge of employing technology to support business operations are given direction. It helps stakeholders understand how to upgrade the skills of the staff and organizational procedures to maintain cloud business governance, as well as how to monitor and measure cloud investments to assess business outcomes.

- Platform Perspective – Common roles: Solution Architects, IT Managers
- Assists stakeholders in better understanding how to improve staff skills and organizational procedures to offer and optimize cloud solutions and services.
- Security Perspective – Common roles: CISO, IT Security Managers and Analysts.
- It assists stakeholders in understanding how to update the skills of the staff and organizational processes to ensure that the architecture deployed in the cloud meets the organization's security control, resilience, and compliance needs.
- Operations Perspective – Common roles: IT Operations Managers and IT Support Managers.

It helps stakeholders know how to upgrade the skills of the staff and work procedures to guarantee system health and dependability throughout the transition to the cloud, as well as how to operate utilizing agile, continuing cloud computing best practices afterward.

A company may build an action plan to address the skills and process gaps between the present IT environment and the future cloud environment by identifying the gaps.

- Limitation: It focuses on updating skills but does not provide a clear roadmap or process for cloud adoption (Chang et al., 2016).

2.5.2.1. Strengths and Weaknesses of the Strategy

Its relationships with logistic providers provide a suitable platform to control costs and create a substantial value chain (Sundarakani, 2019). The strategy is unable to guarantee the highest safety levels leading to its inappropriateness in adoption strategys, insensitive, and increasing cybercrime insecurity.

<u>2.5.3. Oracle Consulting Cloud Computing Services Strategy (2011)</u>

Oracle Consulting created a strategy to assist customers with implementing cloud computing technologies. The blueprint phase is where the strategy and roadmap are developed at the start of this strategy. After that, the route to the cloud has four more major stages: Standardize-Consolidate-Automate-Optimize. For example, it is feasible to iterate through these steps a number of unified cloud platforms by repeating automation. Indeed, the entire architecture may be used to create numerous clouds.

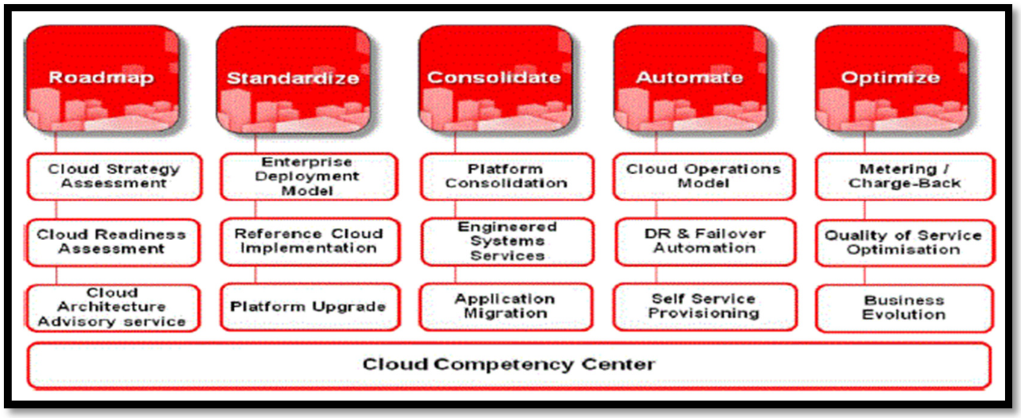

Figure 8: Oracle Consulting Cloud Computing Services Strategy,
Adapted from: "An Oracle White Paper" 2011, P.6.

- Roadmap Phase: This phase establishes the cloud solution's goal, plan, and strategy, as well as a reference architecture that outlines the services that will be provided by the cloud platform. This must be in line with the company's overall strategy; otherwise, there will be no reason for the company to use the platform (Oracle White Paper, 2011).
- Standardization Phase: A precondition for cloud computing adoption is the design and implementation of common platforms and services. The standard platforms for building a cloud environment are detailed, defined and implemented in this step. The standardization phase consists of three main activities: an analysis phase to choose which standard to adopt, a design phase to architect and defines the standard's implementation and deployment, and a deployment phase to actually implement the standard (Oracle White Paper, 2011).
- Consolidation Phase: The consolidation step occurs when a standard platform, application, or a set of infrastructure has been created. Disparate applications are moved to the standard. As customers migrate to the same platform, the number of apps that may be performing the same job decreases. In this case, an analysis step is necessary to determine which apps are suitable for migration and to determine the return on investment of transferring them. It may also be required to expand the cloud's resource pools to guarantee that there is adequate computing capacity to meet the increased load when more customers join the platform (Oracle White Paper, 2011).
- Automation Phase: Inefficient human-centric methods for administering and growing the cloud are automated and replaced by technologies during the automation phase. These solutions must also handle cloud-specific use cases, including enforcing cloud use restrictions, managing resource pools, and offering cloud administration capabilities to end users. The actions in this phase are mostly focused on lowering human expenses rather than IT software and hardware expenditures (Oracle White Paper, 2011).
- Optimization Phase: The strategy's final phase includes actions allowing for the most efficient use of IT resources and emerging new business models. Similarly, the major focus in this sector will be on improving hardware and software rather than replacing it, allowing the firm to develop (Oracle White Paper, 2011).
- Limitations: Oracle's program management methodology, or Oracle Unified Method, guides the execution of this strategy (OUM). Oracle's standards-based solution for enabling the complete enterprise IT lifecycle is referred to as OUM. It is also difficult to see how non-Oracle clients would completely embrace and apply this architecture (Masood et al., 2016). Customers should be able to pick any technologies and providers that can function under various types and situations for Cloud deployment under a solid and legitimate strategy. A functional strategy should also allow consumers to pick their goods and technology for effective delivery rather than requiring them to use only one method (Chang et al., 2016).

2.5.4. Masood Strategy (Masood et. al, 2016)

Masood et al. (2016) suggested a five-phase roadmap for cloud computing program adoption. They are: analysing, making plans, adoption, migration and management.

- Phase 1: Analysis: At this stage, the business case, as well as the first needs, feasibility, project scope, expenses, and initial plan, will be developed. Existing system strengths and possibilities are exploited, weaknesses and threats are minimized, negative effects on corporate culture, procedures, and structure are minimized, and the impact on SLAs, cost management, usability and access to resources is assured and maintained (Masood et al., 2016).
- Phase 2: Making Plans: Here, we establish security benchmarks for legal and complying issues uncovered during the analytical stage. Internal institutional best practices, regulations, and standards will be compared to industry best practices and standards, as well as how to achieve them while migrating towards cloud computing. The standards will also represent the law and complying issues best practices that must be followed while working on cloud computing (Masood et al., 2016).
- Phase 3: Adoption: This is the stage in which you prepare to move the systems or apps you have selected to the cloud platform and infrastructure of your choice. This process entails integrating systems and applications to ensure that the candidate apps function with both on-premises applications and the cloud platform of choice. The

vendor's capacity to provide services that will not interfere with the organization's service delivery or operations is assessed using the benchmarks established during the planning phase (Masood et al., 2016).

- Phase 4: Migration: The preparations for adopting cloud computing are now complete, and migration may begin. The project can be rejected or improved to fit the needs of the users. The roll-out strategy can be implemented based on the results of the three preceding phases. The transfer of applications and data can now begin. Users are supported during the migration process, and the project is monitored and controlled to guarantee a successful migration (Masood et al., 2016).
- Phase 5: Management: Even though the project should now be fully operational on the cloud, contract and supplier management, maintenance and testing, user assistance, and review should continue for several months following launch. System metrics or benchmarks from Phase 2 should be an indicator of project progress and be kept track of. Compliance standards of security, S.L.A.s, legal and complying concerns, IT governing best practices, and cost management are all desired indications (Masood et al., 2016).

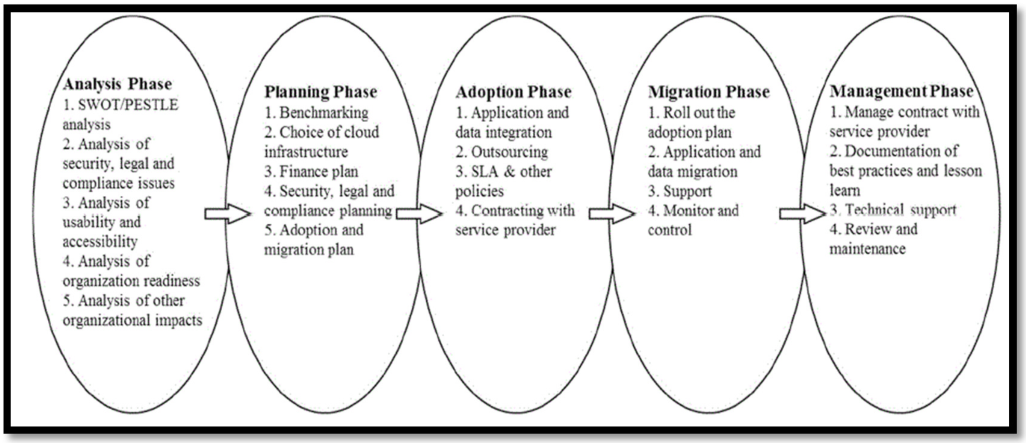

Figure 9: Cloud Computing Adoption Strategies (Masood et al., 2016)

<u>2.5.5. Gaps in Models Discussed Above</u>

Cloud's current evolving pattern and other aspects make it ideal for small and medium enterprises (SMEs) (Misra & Mondall, 2010).

Technology adoption is connected to independent factors like personal qualities, internal institutional structured features, and external institutional characteristics, according to the DOI model at the company level (Rogers, 1995).

Likewise, the TOE model highlights three components of an organization's context that impact how it accepts and executes technical innovations: technological context, organizational factors, and environmental factors. The models discussed above do not consider such variables that may affect the adoption intent and the adoption process as well.

Research institutions are purely driven by funds from themselves and mostly by profits. Therefore, the alignment of the cooperate strategy and the ICT strategy should provide enabling technology to efficiently and effectively deliver the research organization's core mandate. In a review of existing cloud computing adoption strategys, the following gaps were noted:

- External factors like data security and privacy issues have not been addressed by the current adoption strategys.
- The strategys assume the technical capability and human resource capacity to adopt cloud computing in the research institution whose mandate is not in ICT.
- Strategys provide thin lines for the key stakeholders to contribute or participate in the strategies of adopting cloud computing.
- The strategys are designed to be a generic adoption of cloud computing and not architecture towards a certain industry since the needs, purposes and intentions are different for different industries.

2.6. Technology Acceptance & Adoption

For enterprises (cloud users) interested in embracing cloud computing services from cost related perspective, Misra and Mondall (2011) established two kinds of business prototypes. There are business prototypes for companies with existing IT infrastructure and enterprise models for startups. A recent poll found that the cloud's present development pattern and other features make it excellent for small and medium-sized organizations (Misra & Mondal, 2011). On the other hand, the perceived strategic value of cloud computing in innovative technological development was found to be influenced by corporate size. Before a cloud solution can be deployed, several commercial and regulatory factors must be assessed, including the placement of business data and the implications for legal jurisdiction and compliance. After a cloud service has been installed, the influence on business operations and the capacity of the organization to respond to changing market circumstances must be evaluated.

To explain technology adoption at both the human and organizational levels, various information systems research theories have been applied (Oliveira & Martins, 2011). Some examples of these theories include the technology acceptance model (TAM, Davis 1989), the technological-organizational-environmental model (TOE, Tornatzky & Fleischer 1990), the theory of planned behavior (TPB, Ajzen 1985), and the unified theory of acceptance and use of technology (UTAUT, Ajzen

1985). (UTAUT, Venkatesh et al. 2003). Persons are the unit of analysis in TAM, UTAUT, and TPB, but organizations are the unit of analysis in DOI and TOE (Oliveira & Martins, 2011; MacLenna & Van Belle, 2014; Oliveira et al., 2014). As a result, this study will only investigate DOI and TOE models.

2.6.1. Innovation Diffusion (The DOI) Model

The prototype named Diffusion of Innovation (DOI) can be referred to as (IDT) Innovation Diffusion Theory (IDT). DOIs are commonly used in sociology, anthropology, education, marketing, and management, among other professions. This innovative undertaking paradigm was first got introduced in 1962 and continues to receive plenty of writers' attention.

DOI is a model of how, why, and at what rate new ideas and technology travel across society at the individual and corporate levels. The DOI model assumes that innovations are disseminated through time and within a certain social system via defined routes (Rogers, 1995). Individuals are thought to have varied levels of preparedness to accept innovations. Therefore, the fraction of the population who adopts a new idea is thought to be relatively evenly distributed across time (Rogers, 1995). People are categorized into five types of individual innovativeness (from earliest to later adopters) when this normal distribution is segmented: pioneers, early adopters, early majority, late majority, and laggards (Rogers, 1995).

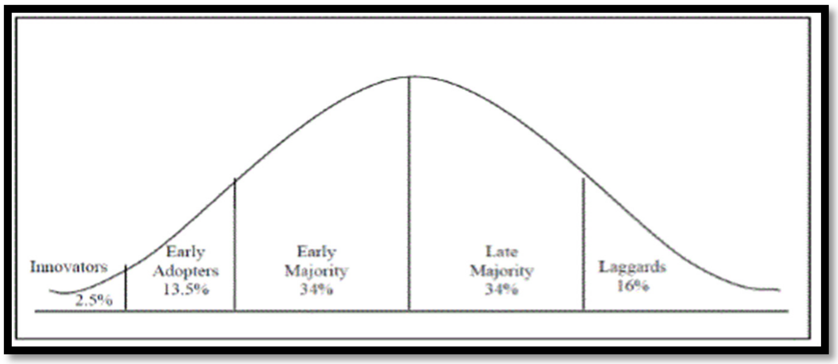

Figure 10: The Innovation Adoption Process
Source: Rogers, 1995, p.14

Organizational innovation is a much more difficult undertaking. It usually consists of a group of people, sometimes including both proponents and detractors of the new notion, all of whom have a say in the innovation-decision. According to the DOI model, innovation is linked to independent aspects at the corporate level, such as human (leader) traits, internal organizational structure features, and external organizational characteristics (Rogers, 1995).

- The leader's attitude toward change is described by individual traits
- Internal organizational structure features include observations whereby

Centralization refers to how much authority and influence in a system is concentrated in the hands of a small number of people. The complexity of an organization refers to the degree to which its members have a reasonable level of knowledge and expertise. The degree to which interpersonal networks connect the units of a social system is referred to as interconnectedness. The degree to which an institution emphasizes its staff's adherence to laws and regulation procedures is known as formalization. The quantity of non-aligned resources availed to a corporation is known as organizational slack, while the number of employees is known as size. The openness of the system is referred to as "external organizational features."

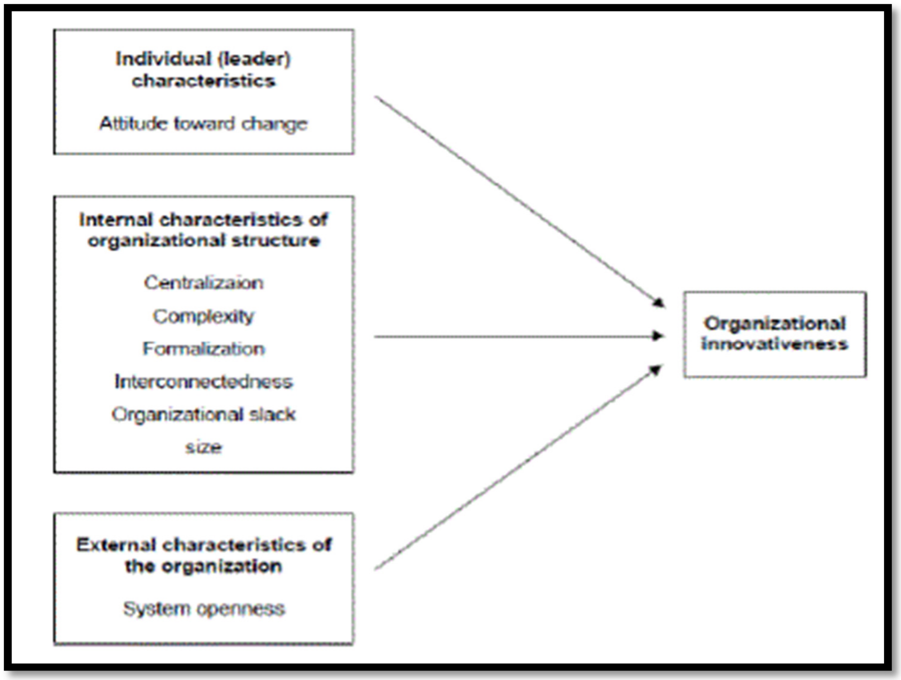

Figure 11: Diffusion of Innovation Model

Since its inception in IS research and technology adoption, the DOI model has been used and altered in various ways. Some research findings based on the DOI model are included in the table below (Rogers, 1995).

While DOI provides a thorough set of criteria for evaluating the technical merits of an IS innovation, the lack of consideration for the external environment is a significant flaw (Oliveira & Martins, 2011; Oliveira, Yazn, Savvas & Feng, 2013; Thomas & Espadanal, 2014). As a result, DOI is more frequently employed as a supplement to other approaches than a stand-alone model.

2.6.2. Technology Organization and Environment (TOE) Strategy

Although past study findings indicate that a variety of variables influence cloud computing adoption, all of these factors may be categorized as technological, organizational, or environmental settings. Therefore, it is possible to investigate the cloud computing adoption issue using the technology-organization-environment (TOE) paradigm. The majority of researchers have investigated the significance of technological variables influencing cloud computing adoption. Environmental as well as organizational variables, on the other hand, have varying effects on the adoption of cloud computing depending on the sector or company. As a result, it is necessary to study the drivers of such intentions to gain a better knowledge of cloud computing adoption intentions in various businesses.

The TOE strategy focuses on three areas of a company's environment that influence the acceptance and implementation of innovations of technology: such as technologies context, organizations context, and environmental context. The strategy was designed by Tornatzky and Fleisher (1990). While current, informative literature gives basic knowledge on cloud computing, there are a few empirical studies with large data sets that systematically explore the elements that may influence cloud computing adoption intentions (Behrend et al., 2010; Lin & Chen, 2012). Furthermore, the majority of existing cloud adoption literature addresses cloud computing as if it were just another type of IT adoption problem. However, there are several distinct cloud characteristics that distinguish it from conventional IT advances, such as its target consumers, pricing mechanism (pay-as-you-go), and deployment patterns (public, hybrid, private), all of which will be addressed in this study.

- The internal and outside technologies that are important to the institution are also known as the technological context. These include existing procedures, internal equipment, and the range of externally available technology.
- The scope, size, as well as organogram of an institution describe the measures of the institution.
- The arena in which a company does business, its industry, rivals, as well as contacts with the government is known as the environmental context.

  Several writers have used the TOE strategys to find an understanding of numerous IT adoptions involving EDIs (Kuan & Chau, 2001), open system (Chau & Tam, 1997), websites (Oliveira & Martin, 2008), e-commerce (Liuu, 2008; Martin & Oliveira, 2009; Oliveiras & Martin, 2009), enterprise resources planning (ERP) (Pan & Jang, 2008), and businesses to businesses (B2B) e-commercing (Teo & Martin, 2009; Lee, 2009).

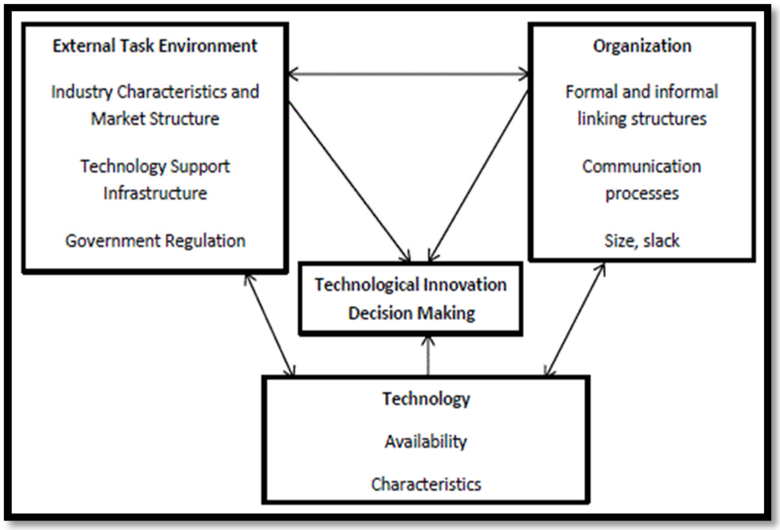

Figure 12: Technological, Institutional and Environmental (Root: Baker, 2010, P.11)

2.7. Conceptual Strategy

This works conceptual model is developed from both the DOI and TOE strategys since the two models view an organization as a whole as opposed to the other models that look at the individual level of technology adoption.

The TOE strategy will be utilized in this research to determine institutional, the surrounding environment and existing technologies contexts for cloud computing undertaking in research organizations. Since the strategy was created to relate IS innovation adoption choices to contextual considerations, it may be applied to cloud computing as an emerging technology (Chau & Tam, 2012).

Unlike the Technology Acceptance Model (TAM), which focuses on a single viewpoint, the strategy provides a comprehensive picture of an organization's many sides. Since the TOE strategy considers the environment, it is more suited to demonstrating intra-firm innovation technology adoption; as a result, it is thought to be more comprehensive (Zhu et al., 2014).

In comparison to the DOI theory, TOE places a greater emphasis on the environment rather than the invention or the organization. The TOE strategy is not limited to a single type of information technology, making it a flexible strategy that may be used for a wide range of IT advances (Oliveira & Martins, 2011).

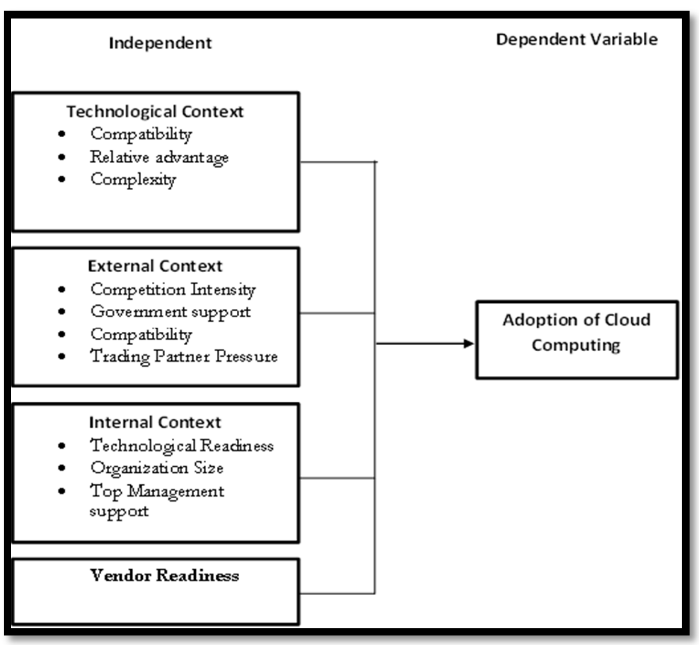

Figure 13: Conceptual Strategy Constructs adapted from DOI & TOE Strategys

<u>2.7.1. Justification</u>

Although much research supports the TOE as an effective model for explaining IS/IT acceptance, it is debatable whether the model can be used to analyze every case of IS/IT adoption and deployment.

To cope with quick changes in IS/IT and increase specificity and explanatory power, several empirical studies propose combining TOE and a variety of theories (e.g., DOIs, and/or Success models of IS by DeLlone and McLeann) (Carter & Belanger, 2005; Legris, Ingham, & Colerette, 2003).

TOE and DOI are comparable in certain ways and complement each other when it comes to examining IS/IT adoption. According to researchers, the components used in TOE are basically a subset of perceived innovation traits; hence, combining these two theories might result in a model that is even more powerful than either alone (Wu & Wang, 2015; Chen, Gillenson, & Sherrell, 2012). Previous research that combined the two ideas yielded positive outcomes (Sigala, Airey, Jones, & Lockwood, 2010; Chen et al., 2014).

This research intends to develop a cloud adoption strategy favorable to research organizations since the cloud strategys discussed in 2.6 above are general (they are not specific to any kind of organization).

2.8. Chapter Summary

The existing circumstances of cloud computing were addressed at the beginning of this chapter. Cloud computing's basic technologies were examined in depth. An analysis in comparison of the models of both cloud service and deployment was conducted. Different cloud computing adoption strategys were also examined, with gaps identified. TAM and DOI, two technology adoption models, were examined, and a prototype concept was developed to guide the work.

3. Research Methodology

3.1. Introduction

This work will employ primary empirical research that will use a survey method to answer the provided research questions in section 1.4 in three phases. Phase one will help answer RQ1 and RQ2. Phase two will help come up with the proposed strategy by answering RQ3 and Phase 3 will involve assessing the effectiveness of the strategy and answering RQ4.

The survey requires gathering facts and opinions from Kenyan research institutions regarding cloud computing adoption. The location of the research is laid out in part 3.2 and succeeding it is the survey design in part 3.3, population and sampling in section 3.4 and data collection instruments and procedures in section 3.5. Others are data analysis and presentation in section 3.6 and ethical issues in section 3.7.

3.2. Location of Study

The study will be carried out among Kenya Research Institutions. Representative institutions in the Coast region include Kenya Marine Fisheries and Research Institute of Kenya (KMFRI), Kenya Agricultural Livestock and Research Organization of Kenya (KALRO) in Mtwapa and Kenya Medical Research Institute (KEMRI) in Kilifi town.

3.3. Research Design

The plan of a study is called a research design, and it guides the collection and review of information. (McNamara, 2011) It provides 3 main models of research design:

- Causal, which focuses on establishing the relationship of cause-and-effect,
- Descriptive, which focuses on establishing specific phenomenon occurrence and its frequency while discussing how two variables relate, and
- Exploratory, which offers insights on how to dissect ambiguous statements of the problem into precise and smaller versions

The above designs are key.

According to McNamara (2011), clients offer 4 different levels of information that can be gathered, such as responses, perceptions, knowledge, and skill differentials. Productivity and the findings that are given much consideration seem to target the adequacy of the data provided at that time. Regrettably, obtaining reliable information on efficacy is challenging, despite the fact that learning and skill information is extremely helpful. According to McNamara (2011), there are a variety of data-gathering methods available: Case studies, group discussions, interviews, listening, verbal/one-on-one questioning, surveying and the use of questionnaires are all examples of Appreciative Inquiry.

The research approach used should provide the most valuable data to management personnel in a well-structured, affordable and adequate approach practically possible. Because of the special and rare nature of the area of research, the chosen approach was a survey research design.

Through literature review, we will be able to answer RQ1 and RQ2: 'What are the current cloud computing technologies, manners of adoption, and drivers in undertaking cloud computing?' and 'Which characteristics /peculiarities and computing environments of research institutions exist in Kenya?' These will be done by searching online using keywords such as attributes. Using interviews and questionnaires (appendix 1), we will be able to answer RQ3: 'Which adoption strategy can meet the requirements for cloud computing for Kenyan research institutions?' and a further questionnaire (appendix 3) to find out: 'How effective is the proposed adoption strategy?'

3.4. The Population and Sample

The target population will consist of all the ICT staff and its head in each station, a head of the research departments and the station directors of the researchers at the three selected stations.

The study will utilize purposive sampling. This will aid in developing and creating an adaptive strategy since purposive sampling looks at gathering a lot of information from the collected data. This will enable the research to come up with an applicable adoption strategy for the research institutions and other related organizations.

3.5. Instruments for Data Collection and Data Collection Processes

Research instruments, which are said to be tools used in acquiring research data, questionnaires and document reviews will be used. Data gathered from these tools often give answers to the respective research objectives that are to be ascertained by a research study (Annum, 2016).

3.5.1. Questionnaire

In this study, two questionnaires (appendix 1 and 2) will be used to collect data first for the proposed strategy and then assess the acceptability of the strategy.

3.5.2. Document Reviews

This research work will also involve reviewing relevant operations used by ICT administrators and managers in the three stations. The essence of this will be to understand the history, operations and processes involved in cloud computing adoption.

3.5.3. Research Assistants

The relationship between the researcher and the research assistant is primarily that of employment (Molony & Hammet, 2007). The researcher, who is the employer, must find a research assistant, develop a working relationship, and manage that relationship. Research assistants will play the function of assisting with primary data gathering. The researcher will seek out and recruit relevant staff, preferably in ICT departments in the mother organization, who are willing to participate in the research as research assistants. A short interview will be necessary, during which time the terms of engagement will be spelled out.

3.6. Data Analysis and Presentation

The survey aims to gather information and views on Kenyan research regarding cloud computing and its adoption. Both quantitative and qualitative methodologies will be used to analyze the responses. Quantitative responses will involve counting and displaying the frequency of each response numerically and also the percent of the total number of answers provided. On each question, the highest percentage reflected the majority opinion.

Cross-tabulation of selected replies will be used in some circumstances to establish linkages between provided answers and the likes of cooperation within industries. Data obtained will follow procedure by being keyed on a spreadsheet and coded to examine the available findings. Required tables will be generated using spreadsheet functions, the likes of sum-totals and tables for pivots as well. Some results, such as pie charts, will also be presented graphically. A portion of the findings will then be portrayed on pie charts and graphs for easy interpretation.

3.7. Ethical Issues

Informed permission, scientific value, secrecy, and beneficence are four basic principles that apply to all human research. The principle of informed consent requires that potential participants be told of all relevant details regarding a study before deciding whether or not to participate. A research must also have some scientific value to justify even minimal risk that human subjects will be exposed to. Every effort will be undertaken on account of the study to maintain confidentiality and secure sensitive information. Finally, the benefits from the findings should outweigh the risks of the proposed research (Strategy for adopting cloud computing in Kenyan Research Institutions).

These principles apply irrespective of the data collection methods used, such as direct observation and indirect observation, as in the use of the records of the subject. Likewise, they apply evenly whether the subjects are students, employees, volunteers, or organizations (KMFRI, KEMRI and KALRO).

The four principals need to be observed at all stages while dealing with the subjects and handling data. A meeting with the potential subjects and responses will be held right away to explain the objectives, scientific value, and benefits to the organization and sector in terms of efficiency. Only then will those who are willing to help be enlisted. Officials in senior ranking will ensure the removal of sensitive and unnecessary data before availing it to the researcher. This way, the confidentiality of the data and safety in the security identities of both individuals and institution is ensured. Copies of the complete thesis will be availed to the institution at the end of the research. Confidentiality agreements could be signed between the researcher and the organization's Chief Executive Officer (CEO).

4. Data Analysis of the Findings and Development of the Adoption Strategy for Cloud Computing

4.1. Introduction

The descriptive and inferential analyses of the findings for this research were outlined in this chapter in their respective subtopics accordingly.

4.2. Response Rate

A total number of 50 questionnaires were distributed to all the sampled Kenya Research Institutions based in the Kenyan Coastal Region (Kenya Marine Fisheries and Research Institute of Kenya (KMFRI), Kenya Agricultural Livestock and Research Organization of Kenya (KALRO) in Mtwapa and Kenya Medical Research Institute (KEMRI) in Kilifi town) to all the ICT staffs and their head in each station, heads of the departments of research and the station directors of the researchers. Evidently, 30 out of the 50 questionnaires were successfully filled up by the respondents and returned to the researcher, giving an effective response rate of 60%.

Mugenda (2010) notes that if a response rate of 50% or more is achieved, then it is deemed adequate for the study. Babbie (2004) also underscores that a questionnaire return rate of 50% of respondents is acceptable to analyze and publish though 60% is considered good and 70% very good. Therefore, the response rate achieved was considered acceptable in making conclusions and generalizations about the study population.

4.3. Demographic Information

This section summarizes all the personal and professional details of the respondents who participated in this study.

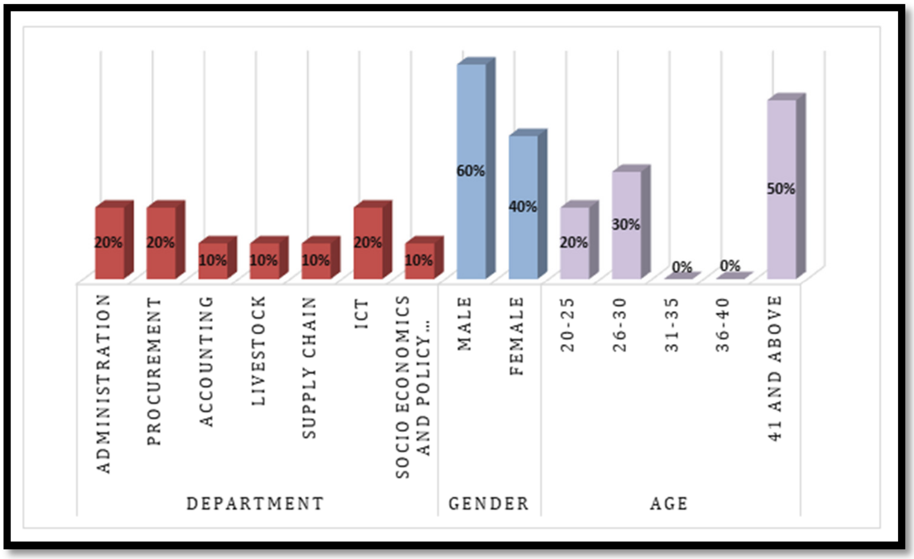

Figure 14: Department, Gender and Age of the Respondents

From figure 14, 20% of the respondents were from the Department of Administration, Procurement and ICT, while 10% were from the Department of Accounting, Livestock, Supply Chain, and Socio-Economics and Policy Development. This implies that the key departments identified prior to the data collection process as the most crucial ones in the development of the cloud computing strategy ideal for the Kenyan Research Institutions successfully participated in this study. Gender equity was also ensured in this study, as evidently indicated by 60% (Males) and 40% (Females). The study also shows that various age groups were involved in this study, as indicated by 20% (age group 20-25), 30% (age group 26-30) and 50% (41 years and above). It indicated that the most skilled, young and old personnel were all involved in this study. Hence, a collection of various opinions in data form was ensured, which is very critical in the development of the cloud computing strategy that is ideal for Kenyan Research Institutions.

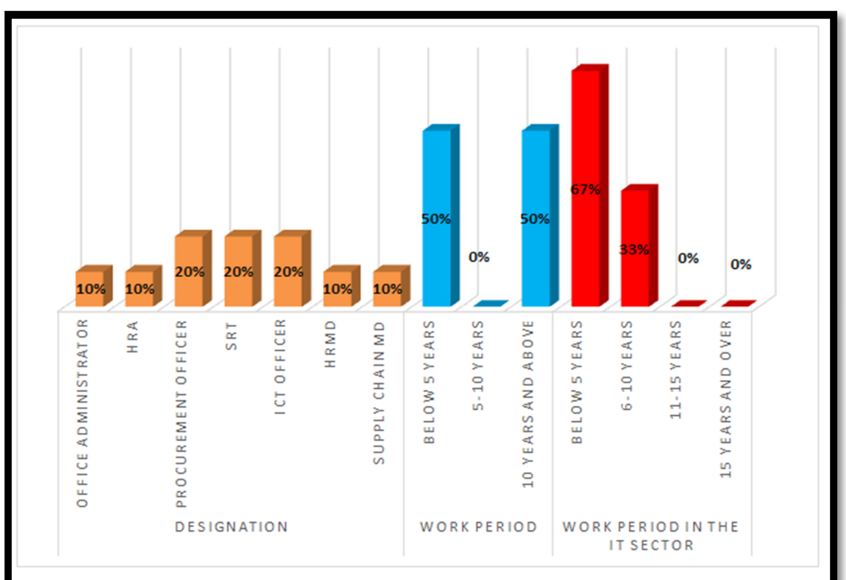

Figure 15: Designation, Work Period and Period in the IT Sector of the Respondents

Figure 15 shows that 20% of the respondents were designated as ICT Officers, Procurement Officers and SRTs (Senior Research Technicians), while 10% were designated as Office Administrators, HRAs (Human Resource Accountants), HRMDs (Human Resource Management Directors) and Supply Chain Management Director; an implication that various head of departments and personnel that were considered key respondents in the generalization of data in the construction process of the cloud computing strategy ideal for the Kenyan Research Institutions successfully participated in this study. The majority of the respondents had a work period experience of both below 5 years and another equal group of 10 years and above, which is a positive feedback in the development, assessment and validation of the proposed cloud computing strategy for Kenyan Research Institutions. Additionally, 67% had worked in the IT sector for below 5 years, while 33% for 6-10 years.

4.3.1. ICT Characteristics of Research Institution in Kenya

Statements	Yes	No	Unanswered
Does your organization have dedicated ICT personnel?	100%	0%	0%
Does your organization have ICT policy?	90%	0%	10%

Table 1: Characteristics of Research Institutions

Table 1 shows that all the sampled Kenya Research Institutions based in the Kenyan Coastal Region: Kenya Marine Fisheries and Research Institute of Kenya (KMFRI), Kenya Agricultural Livestock and Research Organization of Kenya (KALRO) in Mtwapa and Kenya Medical Research Institute (KEMRI) in Kilifi town have a dedicated ICT personnel as indicated by 100% response and 90% indicated to also have an ICT Policy.

4.3.2. Operations Automated within the Respondents' Organization

SN	Operations	Yes	No	Unanswered
i	Accounting	56.7%	6.7%	36.7%
ii	Inventory Management	63.3%	10.0%	26.7%
iii	HR	3.3%	3.3%	93.3%
iv	Email	60.0%	6.7%	33.3%
v	Payroll	72.4%	0.0%	27.6%

Table 2: Organization's Operations

Table 2 shows that 56.7% and 60% of the respondents stated Accounting and Emailing Operations as one of their Organization's automated operations, respectively, while 63.3% and 72.4% indicated Inventory Management and Payroll as their organization's automated operations and lastly, HR was the least stated automated operation in the respondent's organization as indicated by 3.3%. This is a positive indication that the majority of the sub-constructs under the Organization's Operations construct were significantly responded to hence contributing positively to the development of the Organization's Operations sub-strategy.

4.4. Adoption Drivers, Hindrances & Importance of Cloud Computing Adoption in Research Organizations

4.4.1. Technological Context (Relative Advantage)

	Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
i)	Using Cloud Computing Services improves operational efficiency in our organization	20%	3%	3%	63%	10%
ii)	Using Cloud Computing Services improves operational productivity in our organization	7%	13%	0%	73%	7%
iii)	Using Cloud Computing Services improves the operational quality of work in our organization	3%	17%	17%	60%	3%
iv)	There are enough advantages of Cloud Computing Services to consider using them in the company	7%	10%	10%	70%	3%
Average Relative Advantage	Mean (%Mean)	Std. Dev.	Std. Error of Mean	Minimum		Maximum
	3.4917 (69.83%)	.62451	.11402	1.75		4.00

Table 3: Relative Advantage

From table 3, the majority of the respondents agreed with the following sentiments:

- Using Cloud Computing Services improves operational efficiency, productivity and quality in the organization and

- There are enough advantages of Cloud Computing Services to consider using them in the company, as indicated by 63%, 73%, 60% and 70%, respectively.

On average, the relative advantage of sub-construct contributed to the development of the Technological Context sub-strategy by an equally large percentage of 92.86% (mean: 4.6429, Std Dev.: .82616), which is a key sub-strategy in the development of the main strategy for the adoption of Cloud Computing in Kenyan Research Institutions.

4.4.1.1. Technological Context (Compatibility)

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Using Cloud Computing fits into our organization's work style, norms & culture	3%	10%	10%	23%	53%
Average Compatibility	Mean (%Mean)	Std. Dev.	Std. Error of Mean	Minim um	Maximum
	4.1333 (82.666%)	1.16658	0.21299	1.00	5.00

Table 4: Compatibility

Table 4 shows that the majority of the respondents strongly agreed that using Cloud Computing fits into our organization's work style, norms & culture, as indicated by 53%.

On average, the compatibility sub-construct contributed to the development of the Technological Context sub-strategy by a large percentage of 82.666% (mean: 4.1333, Std. Dev.: 1.16658), which is a key sub-strategy in the development of the main strategy for the adoption of Cloud Computing in Kenyan Research Institutions.

4.4.1.2. Technological Context (Complexity)

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Cloud Computing is not complicated, and it is not difficult to understand what is going on	7%	3%	7%	33%	50%
Average Complexity	**Mean (%Mean)**	**Std. Dev.**	**Std. Error of Mean**	**Minimum**	**Maximum**
	4.1667 (83.334%)	1.14721	.20945	1.00	5.00

Table 5: Complexity

Table 5 shows that the majority of the respondents strongly agreed that Cloud Computing is not complicated and it is not difficult to understand what is going on, as indicated by 50%.

On average, the Complexity sub-construct contributed to the development of the Technological Context sub-strategy by a large percentage of 83.334% (mean: 4.1333, Std Dev.: 1.16658), which is a key sub-strategy in the development of the main Strategy for the adoption of Cloud Computing in Kenyan Research Institutions.

Average Technological Context	**Mean (% Mean)**	**Std. Dev.**	**Std. Error of Mean**	**Minimum**	**Maximum**
	3.7111 (74.222%)	.41276	.07536	2.67	4.33

Table 6: General Technological Context

Technological Context, as a sub-strategy in general, contributed to the development of the strategy for adopting Cloud Computing in Kenyan Research Institutions by a considerable percentage of 74.222 (Mean; 3.7111, Std. Dev.: .41276).

4.4.2. Internal Context

Internal Context (Organization Size)

Average Organization Size	**Mean (% Mean)**	**Std. Dev.**	**Std. Error of Mean**	**Minimum**	**Maximum**
	3.7667 (75.334%)	1.07265	.19584	1.00	5.00

Table 7: Organization Size

Table 5 shows that the majority of the respondents strongly agreed that Cloud Computing is applicable to them because of the organization's size, as indicated by 50%.

On average, the Organization's Size sub-construct contributed to the development of the Internal Context sub-strategy by a considerably large percentage of 75.334% (mean: 3.7667, Std Dev.: 1.07265), which is a key sub-strategy in the development of the main strategy for the adoption of Cloud Computing in Kenyan Research Institutions.

Statement	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Our organization is technically ready to use cloud-based services	3%	3%	10%	47%	37%
Most of our employees possess the required skills to make use of cloud-based services	10%	10%	20%	50%	10%
Our organization does not prefer to use traditional methods for customer communication and customer information management	3%	30%	13%	40%	13%
Average Technological Readiness	**Mean (%Mean)**	**Std. Dev.**	**Std. Error of Mean**	**Minimum**	**Maximum**
	3.600 (72%)	.69149	.12625	2.33	5.00

Table 8: Technological Readiness

Table 8 shows that the majority of the respondents agreed with the following sentiments:

- Their organization is technically ready to use cloud-based services, also that most of the employees possess the required skills to make use of cloud-based services and
- Their organization does not prefer to use traditional methods for customer communication and customer information management, as indicated by 47%, 50% and 40%, respectively

On average, the technological readiness sub-construct contributed to the development of the Internal Context sub-strategy by a fairly large percentage of 72% (mean: 3.600, Std. Dev.: .69149), which is a key sub-strategy in the development of the main strategy for the adoption of Cloud Computing in Kenyan Research Institutions.

Internal Context (Top Management Support)

Statement	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Our top management support's deployment of Cloud Computing at the organization for day-to-day operations	7%	3%	3%	27%	60%
Our organization's management is ready to make use of Cloud Computing	3%	3%	4%	20%	70%
Our top management invests in Cloud Computing to help improve our organizational efficiencies	0%	3%	4%	40%	53%
Average Top Management Support	Mean (% Mean)	Std. Dev.	Std. Error of Mean	Minimum	Maximum
	4.4111 (88.222%)	.58515	.10683	3.00	5.00
Average Internal Context Construct	Mean (% Mean)	Std. Dev.	Std. Error of Mean	Minimum	Maximum
	3.9714 (82.346%)	.49402	.09019	2.71	4.86

Table 9: Top Management Support

Table 9 shows that the majority of the respondents strongly agreed with the following sentiments; that their top management support's deployment of Cloud Computing at the organization for day-to-day operations, also that the organization's management is ready to make use of Cloud Computing and that the top management invests in Cloud Computing to help improve our organizational efficiencies as indicated by 60%, 70% and 53% respectively.

On average, the Top Management Support sub-construct contributed to the development of the Internal Context sub-strategy by a large percentage of 88% (mean: 4.4111, Std Dev.: .58515), which is a key sub-strategy in the development of the main strategy for the adoption of Cloud Computing in Kenyan Research Institutions.

4.4.3 External Context (Regulation)

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Government Regulations for our business type allow the use of Cloud Computing	0%	7%	0%	23%	70%
Our Industry Regulations allow the use of Cloud Computing	0%	7%	0%	17%	77%
Internal policies necessitated the move to Cloud Computing	0%	10%	3%	0%	87%
Average of the Government Support (Regulation) Construct	Mean (%Mean)	Std. Dev.	Std. Error of Mean	Minimum	Maximum
	4.6111 (93.222%)	.75345	.13756	2.00	5.00

Table 10: Government Support (Regulations)

Table 10 shows that the majority of the respondents strongly agreed with the following sentiments:

- The Government Regulations for their business type allow the use of Cloud Computing,
- The Industry Regulations allow the use of Cloud Computing and
- The Internal policies necessitated the move to Cloud Computing as indicated by 70%, 77% and 87%, respectively

On average, the Government Support (Regulations) sub-construct contributed to the development of the External Context sub-strategy by a very large percentage of 93.222% (mean: 4.6111, Std Dev.: .75345), which is a key sub-strategy in the development of the main strategy for the adoption of Cloud Computing in Kenyan Research Institutions.

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
It is easy for our customers to switch to another company for similar products/services without much difficulty.	0%	7%	10%	10%	73%
Competition in our industry has driven our organization towards the use of Cloud Computing.	3%	13%	67%	13%	3%
Average Competition Intensity	**Mean (% Mean)**	**Std. Dev.**	**Std. Error of Mean**	**Minimum**	**Maximum**
	3.7500 (75%)	.63991	.11683	1.50	4.50

Table 11: Competition Intensity

Table 11 shows that the majority of the respondents strongly agreed that it is easy for the customers to switch to another company for similar products/services without much difficulty, as indicated by 73%, while 67% were not certain whether the competition in the industry has driven their organization towards the use of Cloud Computing.

On average, the Competition Intensity sub-construct contributed to the development of the External Context sub-strategy by a fairly large percentage of 75% (mean: 3.75, Std Dev.: .63991), which is a key sub-strategy in the development of the main Strategy for the adoption of Cloud Computing in Kenyan Research Institutions.

External Context (Trading Partner Pressure)

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Our customers have forced us to make use of cloud-based services	3%	7%	20%	67%	3%
Our suppliers have forced us to make use of cloud-based services	0%	0%	7%	77%	17%
There are many options for cloud-based products/services for our organization	0%	0%	13%	80%	7%
Average Trading Partner Pressure	**Mean (% Mean)**	**Std. Dev.**	**Std. Error of Mean**	**Mini**	**Maxi**
	3.8778 (78%)	.28343	.05175	3.00	4.33

Table 12: Trading Partner Pressure

Table 12 shows that the majority of the respondents agreed with the following sentiments; that the customers and the suppliers have forced them to make use of cloud-based services, as indicated by 67% and 77%, respectively, while 80% strongly agreed that products/services are without much difficulty. Similarly, 80% agreed that there are many options for cloud-based products/services for the organization, respectively.

On average, the Trading Partner Pressure sub-construct contributed to the development of the External Context sub-strategy by a large percentage of 78% (mean: 4.1000, Std Dev.: .31197), which is also a key sub-strategy in the development of the main strategy for the adoption of Cloud Computing in Kenyan Research Institutions.

External Context Construct as a sub-strategy, in general, contributed to the development of the strategy for adopting Cloud Computing in Kenyan Research Institutions by a considerable large percentage of 83.388% (Mean; 4.1694, Std. Dev.; .37299).

4.4.4. Vendor Readiness

Average External Context	Mean (% Mean)	Std. Dev.	Std. Error of Mean	Minimum	Maximum
	4.1694 (83.388%)	.37299	.06810	3.25	4.42

Table 13: Vendor Readiness

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Cloud Service Providers provide enough information about the services.	3%	3%	10%	66%	17%
Some ICT services are only offered over the cloud hence our use of cloud-based services.	4%	0%	14%	54%	29%
Cloud Service Providers have adequate capacity to run the services.	3%	3%	3%	67%	23%
Overall, Cloud Service Providers are ready with the services they provide.	0%	0%	7%	57%	37%
Average Vendor Readiness	**Mean (% Mean)**	**Std. Dev.**	**Std. Error of Mean**	**Mini**	**Maxi**
	4.0667 (81.334%)	.33648	.06143	3.25	4.50

Table 14: Vendor Readiness

Table 14 shows that the majority of the respondents agreed with the following sentiments:

- The Cloud Service Providers provide enough information about the services,
- Some ICT services are only offered over the cloud hence the use of cloud-based services; it also agreed that the Cloud Service Providers have adequate capacity to run the services and
- Overall, Cloud Service Providers are ready with the services they provide as clearly indicated by 66%, 54%, 67% and 57%, respectively.

Vendor Readiness Construct as a sub-strategy, in general, contributed to the development of the strategy for adopting Cloud Computing in Kenyan Research Institutions by a considerable large percentage of 81.334% (Mean: 4.0667, Std. Dev.: .33648).

Respondents whose Organization Utilize Services on Cloud

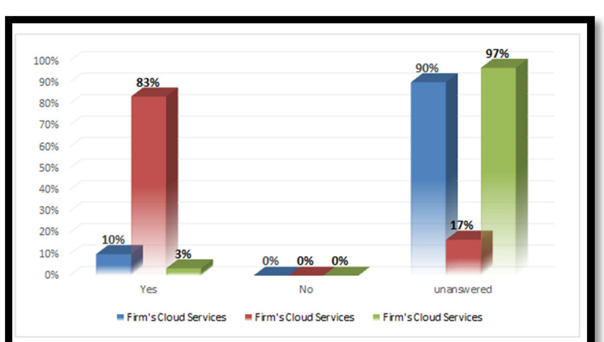

Figure 16: Cloud Services Consumed by the Respondent's Firms

Figure 16 clearly shows that the majority of the research institutions involved in this study consume Firm's Cloud Services Complete operating system and software package available via cloud services (PaaS), as indicated by 83% of the respondents, while 10% and 3%, respectively, indicated to consume Firm's Cloud individual software packages (SaaS) and Firm's Cloud Services just infrastructure services such as storage, network capacity, etc. (IaaS)
Respondents whose organization does not Utilize Services on Cloud

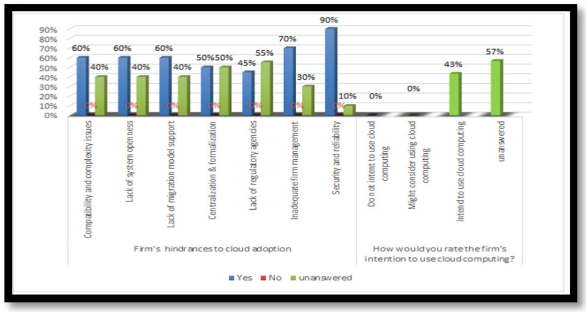

Figure 17: Respondents Whose Organization Does Not Utilize Services on Cloud

Figure 17 shows that 90% of the respondents indicated security and reliability as the major hindrances to cloud adoption in their firms. Seemingly, 70% stated Inadequate film management as also one of the hindrances, while 60% stated compatibility and complexity issues, lack of self-system openness and lack of migration model support as the hindrances towards their firm's cloud adoption. On the other hand, 50% stated centralization and formalization as the hindrance and 45% stated a lack of regulatory agencies. The data shows that the majority of the respondent's research institutions have the intent to use cloud computing despite the stated various hindrances. This is indicated by 43% in figure 17.

4.4.5. Adoption of Cloud Computing Variable

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Using Cloud technology is compatible with most aspects of the organization's work.	0%	0%	10%	86%	7%
Cloud technology is easy to use.	0%	0%	7%	23%	70%
Utilizing Cloud technology fits with the firm's work style	7%	17%	0%	0%	77%
I have knowledge of the existence of Cloud computing technology in the market.	10%	10%	3%	73%	3%
Average Adoption of Cloud Computing Variable	**Mean (% Mean)**	**Std. Dev.**	**Std. Error of Mean**	**Mini**	**Maxi**
	4.0833 (81.666%)	.74084	.13526	2.25	4.75

Table 15: Adoption of Cloud Computing Variable

Table 15 shows that 83.3% of the respondents agreed that using Cloud technology is compatible with most aspects of the organization's work, while 70% and 77%, respectively, strongly agreed that they believe that Cloud technology is easy to use and that utilizing Cloud technology fits with the firm's work style. Additionally, 73% of the respondents indicated having knowledge of the existence of Cloud computing technology in the market.

Averagely, the adoption of cloud computing was at 81.666% mean response (mean=4.0833, std. dev. =.74084), rated very high, as shown in table 15. This indicates that most Kenyan Research Institutions were seemingly ready for the proposed cloud computing strategy ideal for the research institutions.

	Yes	**No**	**Unanswered**
Public cloud (belonging to and maintained by another external party)	0%	0%	0%
Private Cloud (belonging to and maintained internally)	10%	0%	90%
Hybrid cloud (some services hosted internally and some hosted in the public cloud)	100 %	0%	0%

Table 16: Model Deployed by the Respondent's Institution with Reference to Taxonomy of Cloud Computing

Statistically, none of the research institutions involved in this study deployed their service models through the Public cloud (belonging to and maintained by another external party), as indicated by 0% in table 16, while 10% of the research institutions sampled deployed their service models through Private Cloud (belonging to and maintained internally) and all the respondents indicated that their respective research institutions deploy their service models through Hybrid cloud (some services hosted internally and some hosted in the public cloud) as indicate by 100% in table 16.

Reasons	Yes	No	Unanswered
Compatibility & complexity issues	72%	0%	28%
Security & reliability issues	50%	0%	50%
Firm management support	23%	0%	77%
Trading partner support	20%	0%	80%
System openness	10%	0%	90%
Competition	3%	0%	97%
Government support	13%	0%	87%
Relative advantage	23%	0%	77%

Table 17: Reasons for the Adoption of the Service Model

Table 17 shows that 72% of the respondents indicated compatibility and complexity issues as the reason for their firms adopting the service model. Evidently, 50%, 23%, 20%, 10%, 3%, 13% and 23%, respectively, stated the following reasons for the adoption of the service model by their organizations: security and reliability issues, Firm management and Trading partner support, system openness and competition.

4.5. Strategy Development

This subchapter discussed the development of the cloud adoption strategy ideal for research institutions in Kenya. It covers the identification of the constructs of the strategy by factor analysis technique, the communalities of the variables, Principal component analysis, factor rotation, strategy sub-constructs, cloud adoption strategy development ideal for research institutions and strategy validation.

<u>4.5.1. Strategy Constructs</u>

Factor analysis technique was used in this chapter to analyze and establish the variables that loaded together on a particular factor. The related variables were then categorized into thematic areas so that the constructs and sub-constructs of the strategy could be easily understood. In order to determine whether the data under the study were suitable for factor analysis, testing was performed to examine whether the sample was adequate and appropriate for the analysis (Laura & Stephanie, 2011). Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was used to affirm that the number of items used to measure a particular construct (variable) was adequate enough and Bartlett's Test of Sphericity was used to measure if the items were coming from a population with equal variance. Table 40 shows KMO and Bartlett's Test results.

Variable	Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy	Bartlett's Test of Sphericity		
		Approx. Chi-Square	Degrees of Freedom	p-value
1. Adoption of Cloud Computing	0.750	76.821	6	0.000
2. External Context	0.687	346.123	66	0.000
3. Internal Context	0.867	48.380	21	0.001
4. Technological Context	0.522	29.397	15	0.014
5. Vendor Readiness	0.793	26.352	6	0.000

Table 18: KMO and Bartlett's Test Results

A KMO value of 0.5 is considered appropriate for factor analysis (Hair, et al., 1995; Tabachinick & Fidel., 2001). The study found a KMO value of above 0.5 for all the study variable constructs, as indicated in table 18. Therefore, the sampled data is sufficient for exploratory analysis. Additionally, Bartlett's Test of Sphericity for the variables were all indicated by significant approximated Chi-Square values ($p<0.05$) hence an indication that the item correlation matrix is not an Identity matrix (.000) but a positive definite matrix. Thus, from the results of the findings above, the study data was adequate and appropriate for use in Exploratory Factor Analysis.

Based on the findings in table 18 and the discussion above, a set of factors were extracted, which summarizes the information in the data using principal component analysis. Table 19 summarizes the total variance explained within factors.

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.089	20.851	20.851	7.089	20.851	20.851
2	4.386	12.900	33.751	4.386	12.900	33.751
3	3.742	11.007	44.758	3.742	11.007	44.758
4	3.463	10.186	54.944	3.463	10.186	54.944
5	3.214	9.454	64.398	3.214	9.454	64.398
6	2.014	5.923	70.321	2.014	5.923	70.321
7	1.724	5.070	75.391	1.724	5.070	75.391
8	1.541	4.531	79.922	1.541	4.531	79.922
9	1.395	4.104	84.026	1.395	4.104	84.026
10	.980	2.882	86.909			
11	.917	2.698	89.607			
12	.809	2.378	91.985			
13	.626	1.841	93.826			
14	.539	1.585	95.411			
15	.373	1.098	96.508			
16	.275	.808	97.317			
17	.250	.734	98.051			
18	.179	.526	98.577			
19	.146	.431	99.008			
20	.121	.356	99.364			
21	.083	.243	99.608			
22	.066	.194	99.802			
23	.035	.104	99.905			
24	.020	.059	99.964			
25	.012	.036	100.000			
26	3.531E-016	1.039E-015	100.000			
27	-2.847E-016	-8.374E-016	100.000			
28	-4.951E-016	-1.456E-015	100.000			
29	-6.769E-016	-1.991E-015	100.000			
30	-9.142E-016	-2.689E-015	100.000			
Extraction Method: Principal Component Analysis						

Table 19: Total Variance Explained

Table 19 reveals that the first factor is the highest common variance of 20.851%, which is a 7.089 Eigen-value. Each of the following factors explains part of the remaining variance up to a point where the value of Eigen is 1.395. Factors cannot contribute to the strategy anymore at this stage. Factors with an Eigen-value of 1 and above were considered to give an adequate contribution and were considered appropriate. At this stage, the factors are not mutually related. Therefore, the factors that contributed to the development of the strategy include 1-9 with a common variance and the following autonomous values, as shown:

Factor 1, 20.851% and 7.089, Factor 2, 12.900% and 4.386, Factor 3, 11.007% and 3.742%, Factor 4, 10.186% and 3.463, Factor 5, 9.454% and 3.214, Factor 6, 5.923% and 2.014, Factor 7, 5.070% and 1.724, Factor 8, 4.531% and 1.541, Factor 9, 4.104% and 1.395. Factors 10 to 30 were excluded because their original level was less than 1 and less variance than a single variable was considered to explain as in table 20.

4.5.2. Communalities

The study sought to investigate the loading of each variable over factors by determining their communalities. The communality is normally between 0 and 1. In the study, communalities of 30 variables were identified as in the table 20.

Communalities	Initial	Extraction
• Accounting	1.000	.930
• Inventory Management	1.000	.836
• HR	1.000	.796
• Email	1.000	.935
• Payroll	1.000	.956
• Using Cloud Computing Services improves operational efficiency in our organization	1.000	.861
• Using Cloud Computing Services improves operational productivity in our organization	1.000	.875

Communalities	Initial	Extraction
• Using Cloud Computing Services improves operational quality of work in our organization	1.000	.751
• There are enough advantages of Cloud Computing to consider using them in the company	1.000	.842
• Using Cloud Computing fits into our organization's work style, norms & culture	1.000	.709
• Cloud Computing is not complicated, and it is not difficult to understand what is going on	1.000	.853
• Cloud Computing is applicable to us because of our organization's size	1.000	.794
• Our organization is technically ready to use cloud-based services	1.000	.923
• Most of our employees possess the required skills to make use of cloud-based services	1.000	.902
• Our organization does not prefer to use traditional methods for customer communication and customer information management	1.000	.886
• Our top management support's deployment of Cloud Computing at the organization for day-to-day operations	1.000	.682
• Our organization's management is ready to make use of Cloud Computing	1.000	.939
• Our top management invests in Cloud Computing to help improve our organizational efficiencies	1.000	.465
• Government Regulations for our business type allow the use of Cloud Computing	1.000	.906
• Our Industry Regulations allow the use of Cloud Computing.	1.000	.922
• Internal policies necessitated the move to Cloud Computing	1.000	.872
• It is easy for our customers to switch to another company for similar products/services without much difficulty	1.000	.806
• Competition in our industry has driven our organization towards the use of Cloud Computing	1.000	.897
• Our customers have forced us to make use of cloud-based services	1.000	.908
• Our suppliers have forced us to make use of cloud-based services	1.000	.902
• There are many options for cloud-based products/services that our organization can utilize.	1.000	.764
• Cloud Service Providers provide enough information about the services	1.000	.928
• Some ICT services are only offered over the cloud; hence our use of cloud-based services	1.000	.834
• Cloud Service Providers have adequate capacity to run the services	1.000	.756
• Overall, Cloud Service Providers are ready with the services they provide	1.000	.885
Extraction Method: Principal Component Analysis.		

Table 20: Communalities

Table 20 shows that communality 1 means that the factor(s), as indicated in the initial column, explores the whole variance within the strategy. All of these values contributed to the development of the strategy. It can be seen in table 20 that each variable described by the nine factors does not have the same proportion of variance. This means that each of the nine factors related to the communality of an individual variable has been taken into account.

4.5.3. Principal Component Analysis

The study also sought to establish the correlation between a variable and a factor involving a single factor or several orthogonal factors. The findings are presented in table 21.

Component Matrix[a]	Component								
	1	2	3	4	5	6	7	8	9
• Accounting	-.514	.	.591						
• Inventory Management									.
• HR								-.590	
• Email	-.537		.514						
• Payroll		.716							
• Using Cloud Computing Services improves operational efficiency in our organization		.523							
• Using Cloud Computing Services improves operational productivity in our organization	.850								
• Using Cloud Computing Services improves operational quality of work in our organization			.544						
• There are enough advantages of Cloud Computing to consider using them in the company	.791								
• Using Cloud Computing fits into our organization's work style, norms & culture								.509	
• Cloud Computing is not complicated, and it is not difficult to understand what is going on		-.690							
• Cloud Computing is applicable to us because of our organization's size	.503					-.560			
• Our organization is technically ready to use cloud-based services				.708					
• Most of our employees possess the required skills to make use of cloud-based services		.658							
• Our organization does not prefer to use traditional methods for customer communication and customer information management									
• Our top management support's deployment of Cloud Computing at the organization for day-to-day operations				.563					
• Our organization's management is ready to make use of Cloud Computing		-.509							
• Our top management invests in Cloud Computing to help improve our									

organizational efficiencies									
• Government Regulations for our business type allow the use of Cloud Computing	.782								
• Our Industry Regulations allow the use of Cloud Computing	.617								
• Internal policies necessitated the move to Cloud Computing	.617								
• It is easy for our customers to switch to another company for similar products/services without much difficulty		.676							
• Competition in our industry has driven our organization towards the use of Cloud Computing			-.582						
• Our customers have forced us to make use of cloud-based services	.923								
• Our suppliers have forced us to make use of cloud-based services	-.647				.614				
• There are many options for cloud-based products/services that our organization can utilize			.575						
• Cloud Service Providers provide enough information about the services							.672		
• Some ICT services are only offered over the cloud; hence our use of cloud-based services			.562	.510					
• Cloud Service Providers have adequate capacity to run the services				-.687					
• Overall, Cloud Service Providers are ready with the services they provide									
Extraction Method: Principal Component Analysis. 9 components were extracted.									

Table 21: Principal Component Analysis

Table 21 identifies 30 loading variables of the 9 extracted factors (components). Higher loading variables imply that the variable is closely linked to the factor. The gaps in table 21 represent loads below 0.5 (excluded).

4.5.4. Factor Rotation

The study also sought to determine the rotated values of the factor loadings. The main objective of this procedure was to make the overall estimates of the correlations between each of the variables and the estimated components. This was achieved by finding the rotation of the respective factors, as shown in table 22.

Rotated Component Matrix[a]									
	Component								
	1	2	3	4	5	6	7	8	9
Accounting		.849							
Inventory Management					.588		.613		
HR								.841	
Email		.904							
Payroll		.936							
Using Cloud Computing Services improves operational efficiency in our organization			.862						
Using Cloud Computing Services improves operational productivity in our organization	.856								
Using Cloud Computing Services improves operational quality of work in our organization			.608						
There are enough advantages of Cloud Computing to consider using them in the company	.553								
Using Cloud Computing fits into our organization's work style, norms & culture									.737
Cloud Computing is not complicated, and it is not difficult to understand what is going on		-.756							
Cloud Computing is applicable to us because of the size of our organization					-.825				
Our organization is technically ready to use cloud-based services								.747	
Most of our employees possess the required skills to make use of cloud-based services				-.567					
Our organization does not prefer to use traditional methods for customer communication and customer information management									.714
Our top management support's deployment of Cloud Computing at the organization for day-to-day operations			.610						
Our organization's management is ready to make use of Cloud Computing								.719	
Our top management invests in Cloud Computing to help improve our organizational efficiencies									
Government Regulations for our business type allow the use of Cloud Computing	.876								
Our Industry Regulations allow the use of Cloud Computing	.824								
Internal policies necessitated the move to Cloud Computing	.822								
It is easy for our customers to switch to another company for similar products/services without much difficulty	.531		.614						
Competition in our industry has driven our organization towards the use of Cloud Computing				-.916					

Our customers have forced us to make use of cloud-based services	.703								
Our suppliers have forced us to make use of cloud-based services	-.646					.644			
There are many options for cloud-based products/services for our organization				.584					
Cloud Service Providers provide enough information about the services							-.889		
Some ICT services are only offered over the cloud; hence our use of cloud-based services			.540						
Cloud Service Providers have adequate capacity to run the services									
Overall, Cloud Service Providers are ready with the services they provide							.709		

Table 22: Factor Rotation

Table 22 shows factors that load together for each factor and their corresponding factor loading values.

The factor presented in table 22 required further refining to make a reasonable interpretation of the strategy under the study. The absolute values of less than 0.6 were considered weak and excluded. By removing absolutes less than (0.6) in the context of very strong variable relationships with associated factors, the study sought to identify fewer factors for each component. For more accuracy in the strategy development, factors with variables loading below (0.6) were, therefore, reduced from each component because they had weak variable relations with associated factors.

Rotated Component Matrix[a]									
	Component								
	1	2	3	4	5	6	7	8	9
1. Accounting		.849							
2. Inventory Management							.613		
3. HR								.841	
4. Email		.904							
5. Payroll		.936							
6. Using Cloud Computing Services improves operational efficiency in our organization			.862						
7. Using Cloud Computing Services improves operational productivity in our organization	.856								
8. Using Cloud Computing Services improves operational quality of work in our organization			.608						
9. There are enough advantages of Cloud Computing to consider using them in the company									
10. Using Cloud Computing fits into our organization's work style, norms & culture									.737
11. Cloud Computing is not complicated, and it is not difficult to understand what is going on		.756							
12. Cloud Computing is applicable to us because					.825				

of our organization's size									
13. Our organization is technically ready to use cloud-based services								.747	
14. Most of our employees possess the required skills to make use of cloud-based services									
14. Our organization does not prefer to use traditional methods for customer communication and customer information management									.714
15. Our top management support's deployment of Cloud Computing at the organization for day-to-day operations			.610						
16. Our organization's management is ready to make use of Cloud Computing								.719	
17. Our top management invests in Cloud Computing to help improve our organizational efficiencies									
18. Government Regulations for our business type allow the use of Cloud Computing	.876								
19. Our Industry Regulations allow the use of Cloud Computing.	.824								
20. Internal policies necessitated the move to Cloud Computing	.822								
21. It is easy for our customers to switch to another company for similar products/services without much difficulty			.614						
22. Competition in our industry has driven our organization towards the use of Cloud Computing				.916					
23. Our customers have forced us to make use of cloud-based services	.703								
24. Our suppliers have forced us to make use of cloud-based services	.646					.644			
25. There are many options for cloud-based products/services for our organization									
26. Cloud Service Providers provide enough							.889		

information about the services									
27. Some ICT services are only offered over the cloud hence our use of cloud-based services									
28. Cloud Service Providers have adequate capacity to run the services									
29. Overall, Cloud Service Providers are ready with the services they provide							.709		
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.									
a. Rotation converged in 12 iterations									

Table 23: Summary of the Factor Rotation after Suppression

From table 23, Components 2, 7 and 8 have key components for the organization's operations, i.e., component 2 addresses the operations of Accounting, Email and Payroll, while component 7 addresses Inventory Management. Table 24 summarizes the loading factors of these operations.

Actor	**Loadings**		
	2	**7**	**8**
Accounting	.849		
Inventory Management		.613	
HR			.841
Email	.904		
Payroll	.936		

Table 24: Organization's Operation Factor Loading

Table 24 shows the Organization's Operation factors and their respective loadings. The core organization's operations that were identified for daily use and are vital in cloud computing by the research institutions were stated in table 24: Accounting, Inventory Management, HR, Email and Payroll. Figure 18 displays a clearer image of the relation of the factors together with their corresponding loadings that form a sub-strategy.

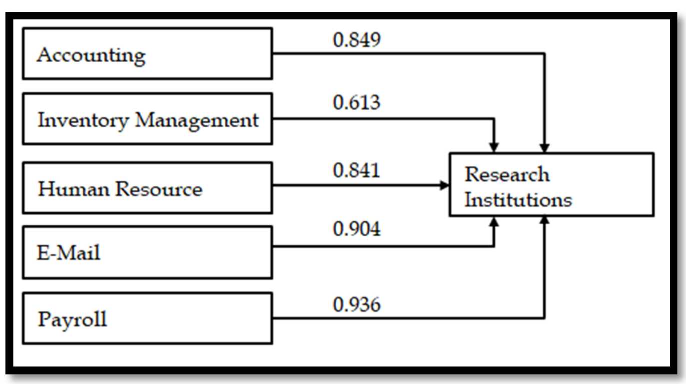

Figure 18: Organization's Operations Sub-Strategy

The organization's operations Sub-strategy in figure 18 above reveals that the core Kenyan Research institutions' operations seem to be Accounting with factor loading of (.849), Inventory Management with factor loading of (.613), HR with factor loading of (.841), Email with factor loading of (.904) and Payroll with factor loading of (.936). The following is how the weights of each variable in the Organization's Operations sub-strategy were calculated: To begin, the sum of the loadings together (.849+.613+.841+.904+.936 = 4.143). After that, a proportion of what each contributes to the strategy was calculated by dividing the loading factors variable by the total loadings of variables, yielding: Accounting (.849/4.143 = 2049), Inventory Management (.613/4.143 = .1480), HR (.841/4.143 = .2030), Email (.904/4.143 = .2182) and Payroll (.936/4.143 = .2259) as in table 25.

Factor	Loadings	Total Loading	Weight
Accounting	.849	4.143	.2049
Inventory Management	.613		.1480
HR	.841		.2030
Email	.904		.2182
Payroll	.936		.2259

Table 25: Organization's Operations Variables Weights

Table 25 can graphically be represented as in figure 19.

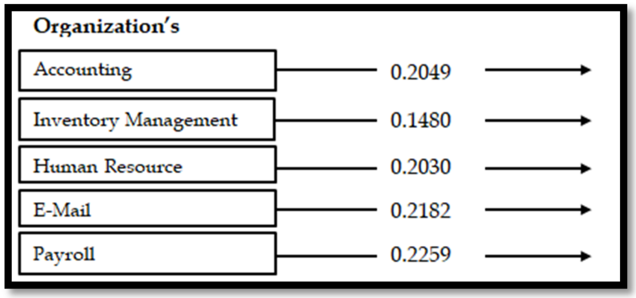

Figure 19: Organization's Operations Sub-Strategy

It can be seen clearly in figure 4.6 that: Organization's Operations = Accounting (.2049) + Inventory Management (.1480) +HR (.2030) + Email (.2182) + Payroll (.2259) = 1

From table 23, Components 3 and 1 have key components of Relative Advantage, i.e., component 3 addresses that using Cloud Computing Services improves operational efficiency in our organization (.862) and that using Cloud Computing Services improves operational quality of work in our organization (.608) and component 1 addresses that using Cloud Computing Services improves operational productivity in our organization (.856). These components can be combined to form the element of Relative Advantage (a sub-construct of Technological Context) variable and their corresponding loadings together with their respective components are shown in the sliced table 19.

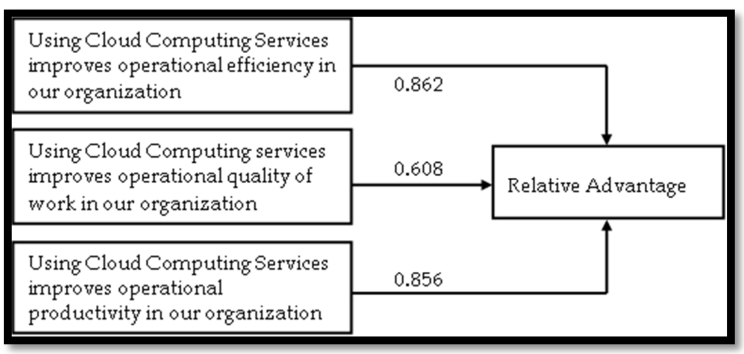

Figure 20: Relative Advantage Factor Loadings

Figure 20 shows the Relative Advantage factors and their respective loadings. Figure 4.7 displays a clearer image graphically of the relation of the factors together with their corresponding loadings that form a Relative Advantage sub-strategy.

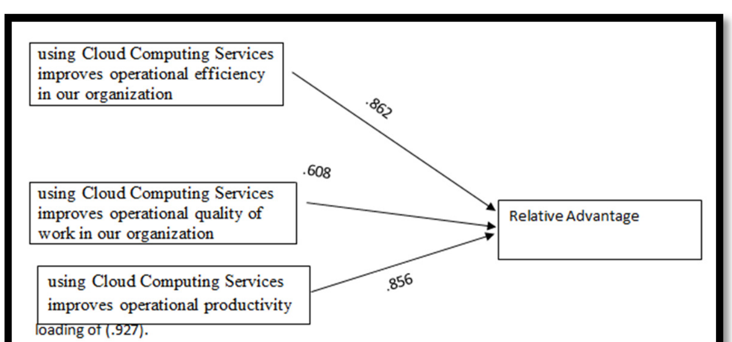

Figure 21: Relative Advantage Sub-Strategy

The relative advantage Sub-strategy in figure 21 above reveals that the relative advantage of many Kenyan Research institutions using Cloud Computing Services in their operations is seemingly to improve their operational efficiency (.862), productivity (.856) and quality (.608). The following is how the weights for each variable in the Relative Advantage sub-strategy were calculated: To begin, sum the loadings together (.862+.856+.608 = 2.326). After that, a proportion of what each contributes to the strategy was calculated by dividing the loading factors variable by the total loadings of variables, yielding: Using Cloud Computing Services improves operational efficiency in our organization variable (.862/2.326 = .3706), using Cloud Computing Services improves operational productivity in our organization variable (.856/2.326 = .3680) and using Cloud Computing Services improves the operational quality of work in our organization (.608/2.326 = .2613) as shown in table 26.

Factor	Loadings	Total Loading	Weight
Using Cloud Computing Services improves operational efficiency in our organization	.862	2.326	.3706
Using Cloud Computing Services improves operational productivity in our organization	.856		.3680
Using Cloud Computing Services improves operational quality of work in our organization	.608		.2613

Table 26: Relative Advantage Variable Weights

Table 26 can graphically be represented in figure 22.

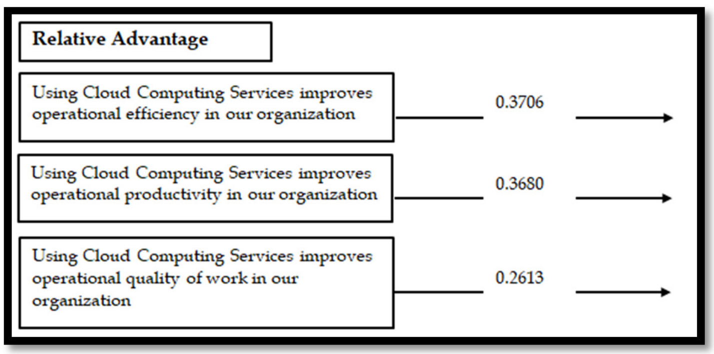

Figure 22: Relative Advantage of Sub-Adoption Strategy

It can be seen clearly in figure 22 that: Relative Advantage = Efficiency (.3706) + Productivity (.3680) + Quality (.2613) = 1

From table 23, Components 9 and 2 have key components of Compatibility and Complexity (a sub-construct of Technological Context), respectively, i.e., component 9 addresses that using ICT fits into our organization's work style, norms & culture (.737), and component 2 addresses that ICT is not complicated, and it is not difficult to understand what is going on (.756). These two variables can be combined with the Relative Advantage variable to form the element of Technological Context variable, as shown in figure 23.

The computing devices Sub-strategy in figure 30 above reveals that the core computing device used in Private universities were smartphones with factor loading of (.847), laptops with factor loading of (.929) and desktops with factor loading of (.927).

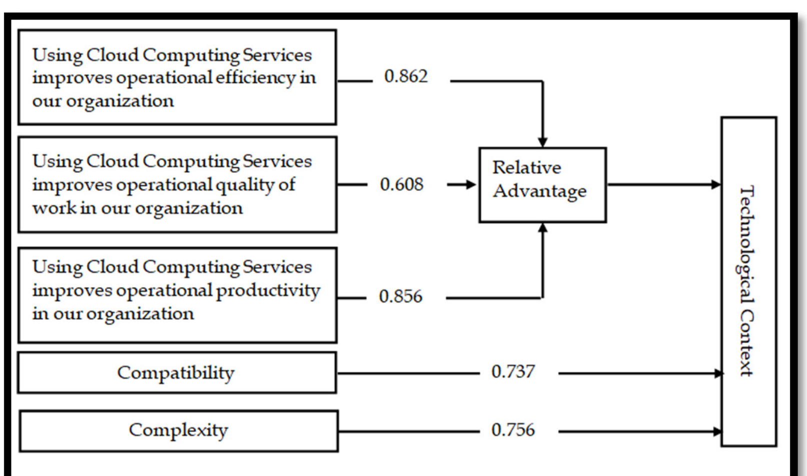

Figure 23: Technological Context Sub-Adoption Strategy

The average loading of each sub-construct in the Technological Context strategy was calculated as follows:

First, by adding the loadings for all the variables in the sub-construct, the Relative Advantage sub-construct (.862+.608+.856 = 2.326). An average for the three variables was calculated by dividing the total of the loadings of the variables (2.326) by the number of variables (3), which gives an average factor loading of the relative advantage sub-construct (.7753).

Then there are the average loadings of the sub-construct in the Technological Context strategy (.7753 +.737 + .756 = 2.2683). A ratio of what each sub-construct contributes to the Technological Context strategy was afterward calculated by dividing the average loading factors of each sub-construct by the total of the average loadings of the sub-construct, which gives: Relative Advantage ($\frac{.7753}{2.2683}$ = .3418), Compatibility ($\frac{.737}{2.2683}$ = .3249) and Complexity ($\frac{.756}{2.2683}$ = .3333), as summarized in figure 24.

The computing devices Sub-strategy in figure 30 above reveals that the core computing device used in Private universities were smartphones with factor loading of (.847), laptops with factor loading of (.929) and desktops with factor loading of (.927).

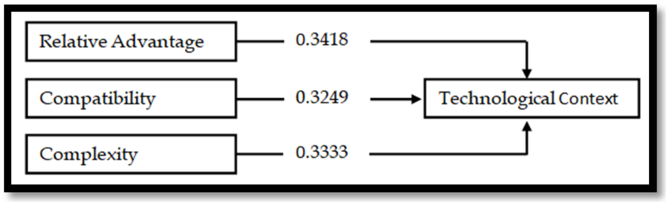

Figure 24: Technological Sub-Adoption Strategy

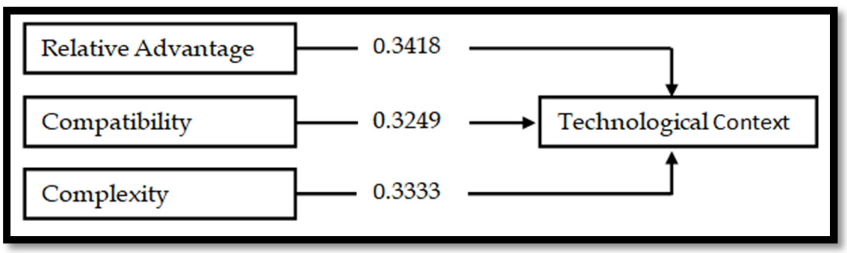

Figure 25: Is Displayed in a More Detailed Form as Shown in Figure 26

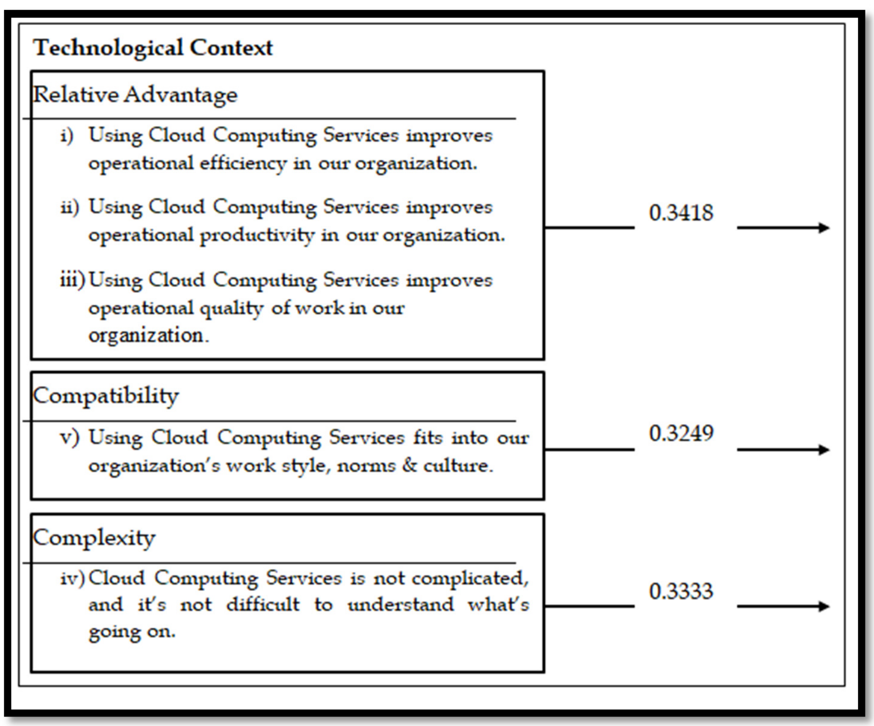

Figure 26: Technological Context Sub-Adoption Strategy

It can be seen clearly in figure 26 that: Technological Context = Relative Advantage (.3418) + Compatibility (.3249) + Complexity (.3333) = 1

From table 23, components 8 and 9 have components of Technological Readiness (a sub-construct of Internal Context), i.e., component 8 addresses that our organization is technically ready to use cloud-based services (.747), and component 9 addresses that our organization does not prefer to use traditional methods for customer communication and customer information management (.714). Statement 14 (loading .567) also forms part of Technological Readiness Variable but was left out as it did not attain a threshold of 0.6 loading and above. These particular components 8 and 9 can be combined to form the element of Technological Readiness variable. Corresponding loadings, together with their respective components, are shown in the sliced table 27.

Factor	Loadings		
	8	9	
1. Our organization is technically ready to use cloud-based services	.747		
2. Our organization does not prefer to use traditional methods for customer communication and customer information management		.714	

Table 27: Technological Readiness Factor Loadings

Table 27 shows that both of the two factors had obtained a strong factor loading (above 0.6 loadings) hence perfect for the development of a technological readiness sub-strategy. Figure 27 displays a clearer graphical image of the relation of the factors together with their corresponding loadings that form a Technological Readiness sub-strategy.

The computing devices Sub-strategy in figure 30 above reveals that the core computing device used in Private universities were smartphones with factor loading of (.847), laptops with factor loading of (.929) and desktops with factor loading of (.927).

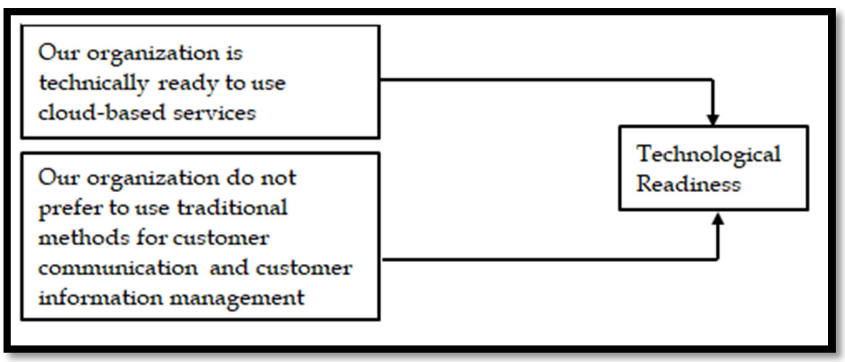

Figure 27: Technological Readiness Sub-Adoption Strategy

The Technological Readiness Sub-strategy in figure 27 above evidently shows that most of the respondent's research institutions are technically ready to use cloud-based services (.747) and most of their organizations do not prefer to use traditional methods for customer communication and customer information management (.714).

The following is how the weights for each variable in the Technological Readiness sub-strategy were calculated: To begin, sum the loadings together (.747+.714 = 1.461). After that, a proportion of what each contributes to the strategy was calculated by dividing the loading factors variable by the total loadings of variables, yielding:

- Our organization is technically ready to use cloud-based services ($\frac{.747}{1.461}$ = .5113), and
- Our organization does not prefer to use traditional methods for customer communication and customer information management ($\frac{.714}{1.461}$ = .4887), as shown in table 28.

Factor	Loadings	Total Loading	Weight
Our organization is technically ready to use cloud-based services	.747	1.461	.5113
Our organization does not prefer to use traditional methods for customer communication and customer information management	.714		.4887

Table 28: Technological Readiness Variable Weights

To get a clearer picture of the sub-strategy, table 28 is graphically represented as shown in figure 28.

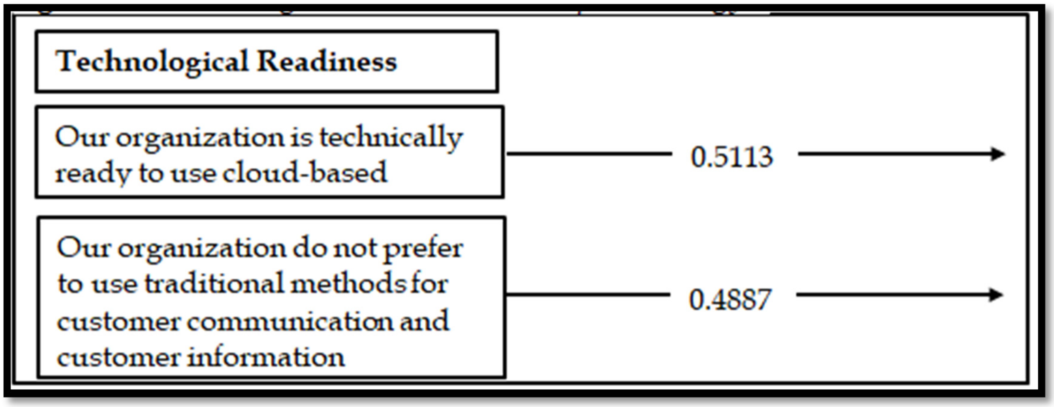

Figure 28: Technological Readiness Sub-Adoption Strategy

It can be seen clearly from figure 28 that: Technological Readiness = .5113 + .4887 = 1

From table 23, components 3 and 8 have components of Top Management Support (a sub-construct of Internal Context) variable, i.e., component 3 addresses our top management support's deployment of ICT at the organization for day-to-day operations (.610), and component 8 addresses that our organization's management is ready to make use of ICT (.719). Statement 18 (loading .354) also formed part of T op Management Support Variable but was left out as it did not attain a threshold of 0.6 loading and above. Components 3 and 8 can be combined to form the element of the Top Management Support variable. Corresponding loadings, together with their respective components, are shown in the sliced table 29.

Factor	Loadings		
	3	8	
1. Our top management support's deployment of Cloud Computing at the organization for day-to-day operations	.610		
2. Our organization's management is ready to make use of Cloud Computing Services		.719	

Table 29: Top Management Support Factor Loadings

Table 29 shows that both of the two factors had obtained a strong factor loading (above 0.6 loading) hence perfect for the development of the Top Management Support sub-strategy. Figure 29 displays a clearer graphical image of the relation of the factors together with their corresponding loadings that form a Top Management Support sub-strategy.

The computing devices Sub-strategy in figure 30 above reveals that the core computing device used in Private universities were smartphones with factor loading of (.847), laptops with factor loading of (.929) and desktops with factor loading of (.927).

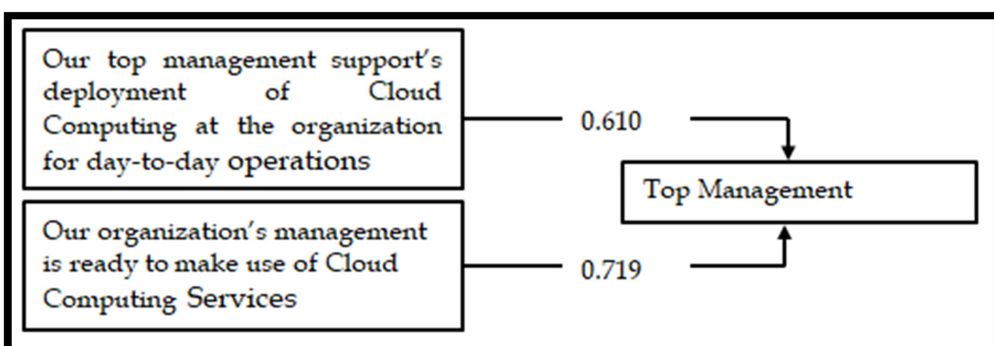

Figure 29: *Top Management Support Sub-adoption Strategy*

The Top Management Support Sub-strategy in figure 29 above evidently shows that most of the respondents' top management supports the deployment of Cloud Computing at the organization for day-to-day operations (.610) and most of their organizations' management seems to be ready to make use of Cloud Computing (.719).

The following is how the weights for each variable in the Top Management Support sub-strategy were calculated: To begin, sum the loadings together (.610+.719 = 1.329). After that, a proportion of what each contributes to the strategy was calculated by dividing the loading factors variable by the total loadings of variables, yielding:

- Our top management support's deployment of Cloud Computing at the organization for day-to-day operations ($\frac{.610}{1.329}$ = .4590) and
- Our organization's management is ready to make use of Cloud Computing Services ($\frac{.719}{1.329}$ = .5410), as shown in table 30

Factor	Loadings	Total Loading	Weight
i. Our top management support's deployment of Cloud Computing at the organization for day-to-day operations.	.610	1.329	.4590
i. Our organization's management is ready to make use of Cloud Computing Services.	.719		.5410

Table 30: Top Management Support Variable Weights

To get a clearer picture of the sub-strategy, table 30 is graphically represented as shown in figure 29.

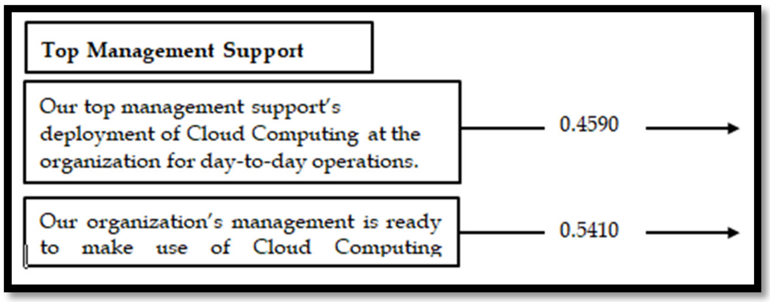

Figure 30: Top Management Support Sub-Adoption Strategy

It can be seen clearly from figure 30 that: Top Management Support = .4590 + .5410 = 1

From table 23, component 5 has a key factor of Organization Size (a sub-construct of Internal Context), i.e., component 5 addresses that using Cloud Computing is applicable for us because of our organization's size (.825). This variable (Organization Size) can be combined with the Technological Readiness and Top Management Support variables to form the element of Internal Context variable, as shown in figure 30.

The computing devices Sub-strategy in figure 30 above reveals that the core computing device used in Private universities were smartphones with factor loading of (.847), laptops with factor loading of (.929) and desktops with factor loading of (.927).

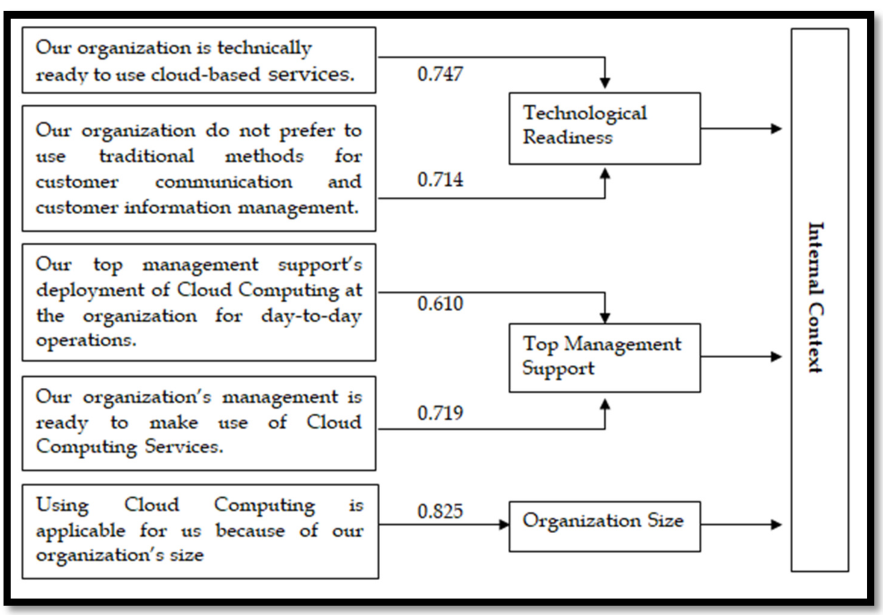

Figure 30: Internal Context Sub-Adoption Strategy

The average loading of each sub-construct in the Internal Context strategy was calculated as follows:

First, it was calculated by adding the loadings for all the variables in the sub-construct. The Technological Readiness sub-construct (.747 + .714) = (1.461). An average for the two variables was calculated by dividing the total of the loadings of the variables (1.461) by the number of variable (2), which gives an average factor loading of Technological Readiness sub-construct (.7305). The Top Management Support sub-construct (.610 + .719) = (1.329). An average for the two variables was calculated by dividing the total of the loadings of the variables (1.329) by the number of variable (2), which gives an average factor loading of Top Management Support sub-construct (.6645).

Then the sum of the average loadings of the sub-construct in the Internal Context strategy (.7305 +.6645 + .825) = (2.22). A ratio of what each sub-construct contributes to the Internal Context strategy was afterward calculated by dividing the average loading factors of each sub-construct by the total of the average loadings of the sub-construct, which gives: Technological Readiness Sub-Construct ($\frac{.7305}{2.22}$), giving (.3291), Top Management Support Sub-Construct ($\frac{.6645}{2.22}$), giving (.2993) and Organization Size ($\frac{.825}{2.22}$), giving (.3716), as summarized in the figure 4.17.

The computing devices Sub-strategy in figure 30 above reveals that the core computing device used in Private universities were smartphones with a factor loading of (.847), laptops with a factor loading of (.929) and desktops with factor (.927).

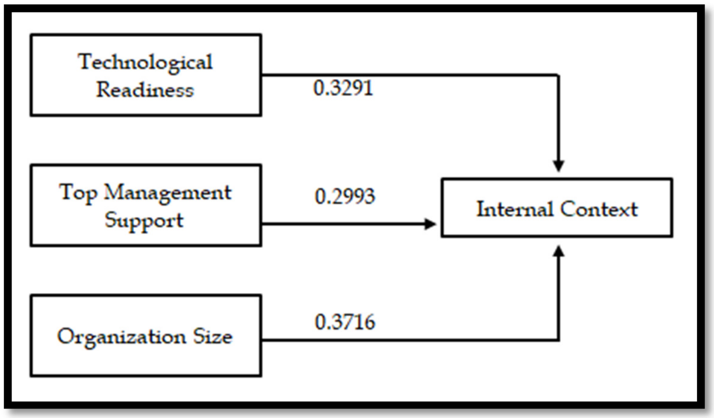

Figure 31: Internal Context Sub-Adoption Strategy

Figure 31 displayed in a more detailed form the respective sub-constructs, their factors and variable weights, as shown in figure 32.

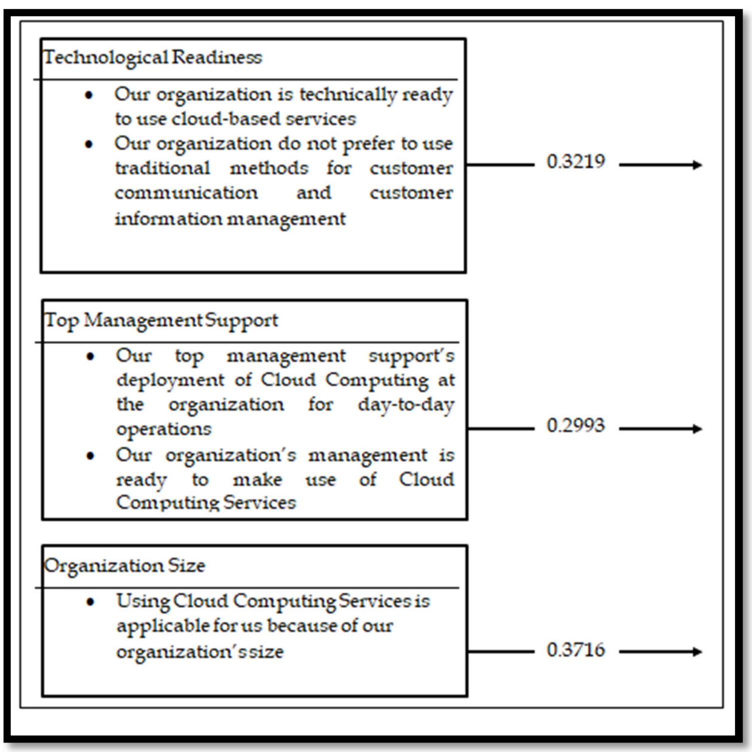

Figure 32: Internal Context Sub-Adoption Strategy

It can be seen clearly in figure 32 that: Technological Context = Technological Readiness (.3291) + Top Management Support (.2993) + Organization Size (.3716) = 1

From table 23, component 1 has three factors of Government Support (a sub-construct of External Context) variable. This component 1 addresses that Government Regulations for our business type allow the use of Cloud Computing

(.876), Our Industry Regulations allow the use of Cloud Computing (.824) and Internal policies necessitated the move to the use of Cloud Computing (.822). Components 3 and 8 can be combined to form the element of Government Support variable. Corresponding loadings, together with their respective components, are shown in the sliced table 31.

Factor	Loadings
	1
1. Government Regulations for our business type allows the use of Cloud Computing.	.876
2. Our Industry Regulations allow the use of Cloud Computing.	.824
3. Internal policies necessitated the move to the use of Cloud Computing Services.	.822

Table 31: Government Support Factor Loadings

Table 31 shows that all three factors had obtained a strong factor loading (above 0.6 loading) hence perfect for the development of the Government Support sub-strategy. Figure 33 displays a clearer graphical image of the relation of the factors together with their corresponding loadings that form a Government Support sub-strategy.

The computing devices Sub-strategy in figure 30 above reveals that the core computing device used in Private universities were smartphones with factor loading of (.847), laptops with factor loading of (.929) and desktops with factor loading of (.927).

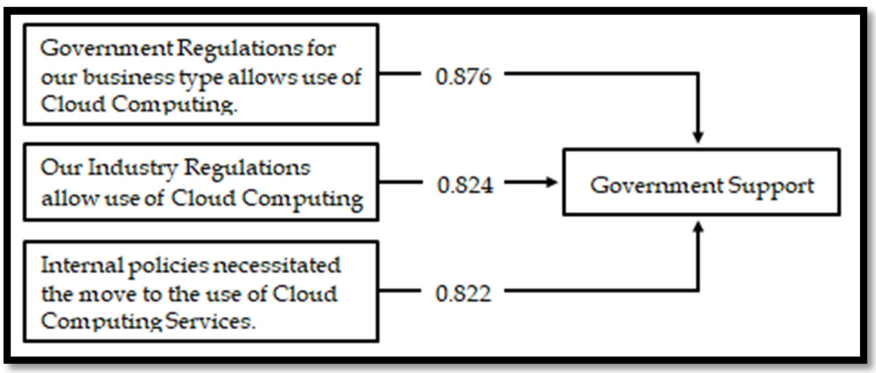

Figure 33: Government Support Sub-Adoption Strategy

The Government Support Sub-strategy in figure 33 above evidently shows that the Government Regulations for Research Institutions allow the use of Cloud Computing (.876), the respondent's Industry regulations allow the use of Cloud Computing (.824) and most of the respondent's Internal policies necessitated the move to the use of Cloud Computing Services (.822).

The following is how the weights for each variable in the Government Support sub-strategy were calculated: To begin, sum the loadings together (.876 + .824 + .822), yielding (2.522). After that, a proportion of what each contributes to the strategy was calculated by dividing the loading factors variable by the total loadings of variables, yielding:

- Government Regulations for our business type allows the use of Cloud Computing ($\frac{.876}{2.522}$), giving (.3473),
- Our Industry Regulations allow the use of Cloud Computing ($\frac{.824}{2.522}$), giving (.3267) and
- Internal policies necessitated the move to the use of Cloud Computing Services ($\frac{.822}{2.522}$), giving (.3259), as shown in table 32.

Factor	Loadings	Total Loading	Weight
Government Regulations for our business type allows the use of Cloud Computing	.876	2.522	.3473
Our Industry Regulations allow the use of Cloud Computing	.824		.3267
Internal policies necessitated the move to the use of Cloud Computing Services	.822		.3259

Table 32: Government Support Variable Weights

To get a clearer picture of the sub-strategy, table 32 is graphically represented as shown in figure 34.

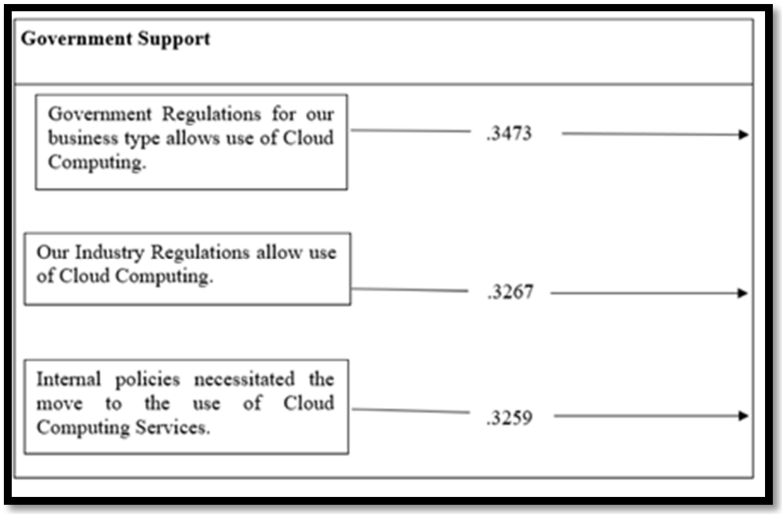

Figure 34: Government Support Sub-Adoption Strategy

It can be seen clearly from figure 34 that: Government Support = .3473 + .3267 + .3259 = 1

From table 23, components 3 and 4 have key factors of Competition Intensity (a sub-construct of External Context) variable. Component 3 addresses that it is easy for our customers to switch to another company for similar products/services without much difficulty (.614), and Competition in our industry has driven our organization towards the use of Cloud Computing Services (.916). These particular components 3 and 4 can be combined to form the element of Competition Intensity variable. Corresponding loadings, together with their respective components, are shown in the sliced table 33.

Factor	Loadings		
	3	4	
1. It is easy for our customers to switch to another company for similar products/services without much difficulty	.614		
2. Competition in our industry has driven our organization towards the use of Cloud Computing Services.		.916	

Table 33: Competition Intensity Factor Loadings

Table 33 shows that both of the two factors had obtained a strong factor loading (above 0.6 loading) hence perfect for the development of a competition intensity sub-strategy. Figure 35 displays a clearer graphical image of the relation of the factors together with their corresponding loadings that form a competition intensity sub-strategy.

The computing devices Sub-strategy in figure 30 above reveals that the core computing device used in Private universities were smartphones with factor loading of (.847), laptops with factor loading of (.929) and desktops with factor loading of (.927).

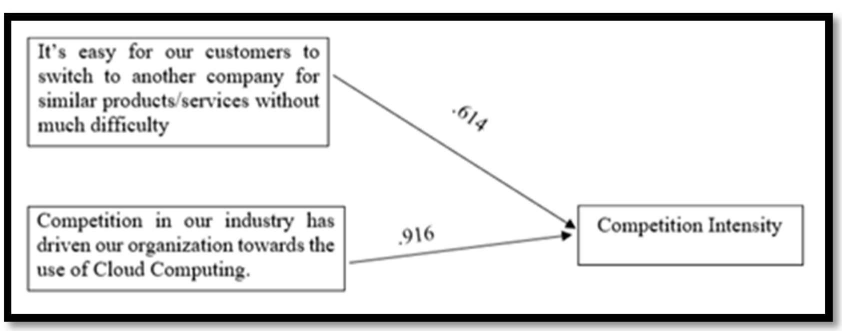

Figure 35: *Competition Intensity Sub-Adoption Strategy*

The Competition Intensity Sub-strategy in figure 35 above evidently shows that it is easy for the customers to switch to another company for similar products/services without much difficulty (.614), and seemingly, the competition in the industry has driven the organizations towards the use of the Cloud Computing (.916).

The following is how the weights for each variable in the Competition Intensity sub-strategy were calculated: To begin, sum the loadings together (.614 +.916), yielding (1.53). After that, a proportion of what each contributes to the strategy was calculated by dividing the loading factors variable by the total loadings of variables, yielding:

- It is easy for our customers to switch to another company for similar products/services without much difficulty ($\frac{.614}{1.53}$), giving (.4013), and
- Competition in our industry has driven our organization towards the use of ICT ($\frac{.916}{1.53}$), giving (.5987), as shown in table 34.

Factor	Loadings	Total Loading	Weight
i. It is easy for our customers to switch to another company for similar products/services without much difficulty.	.614	1.53	.4013
ii. Competition in our industry has driven our organization towards the use of Cloud Computing Services.	.916		.5987

Table 34: Competition Intensity Variable Weights

To get a clearer picture of the sub-strategy, table 34 is graphically represented as shown in figure 34.

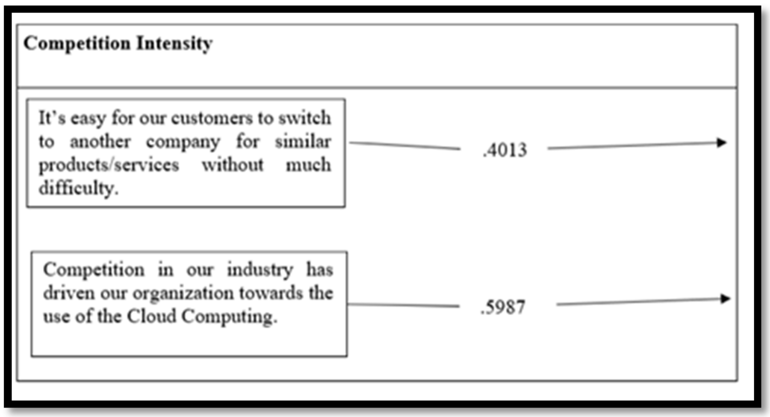

Figure 36: Competition Intensity Sub-Adoption Strategy

It can be seen clearly from figure 36 that: Competition Intensity = .4013 + .5987 = 1

From table 23 of rotated factor loadings, components 1 addresses key factors of Trading Partner Pressure (A sub-construct of External Context) variable, i.e., component 1 addresses the following factors: Our customers have forced us to make use of cloud-based services (.703), and our suppliers have forced us to make use of cloud-based services (.646).

Statement (28): There are many options for cloud-based products/services for our organization (loading .584).

Table 23 also formed part of Trading Partner Pressure Variable but was not included in the development of this sub-strategy because both factors did not attain the required threshold of 0.6 loading and above. These particular components can be combined to form the element of Trading Partner Pressure variable. Corresponding loadings, together with their respective components, are shown in the sliced table 35.

Factor	Loadings
	1
1. Our customers have forced us to make use of cloud-based services.	.703
2. Our Suppliers have forced us to make use of cloud-based services.	.646

Table 35: Trading Partner Pressure Factor Loadings

Table 35 shows that all 5 factors had obtained a strong factor loading (above 0.6 loading) hence perfect for the development of a Trading Partner Pressure sub-strategy. Figure 37 displays a clearer graphical image of the relation of the factors together with their corresponding loadings that form a Trading Partner Pressure sub-strategy.

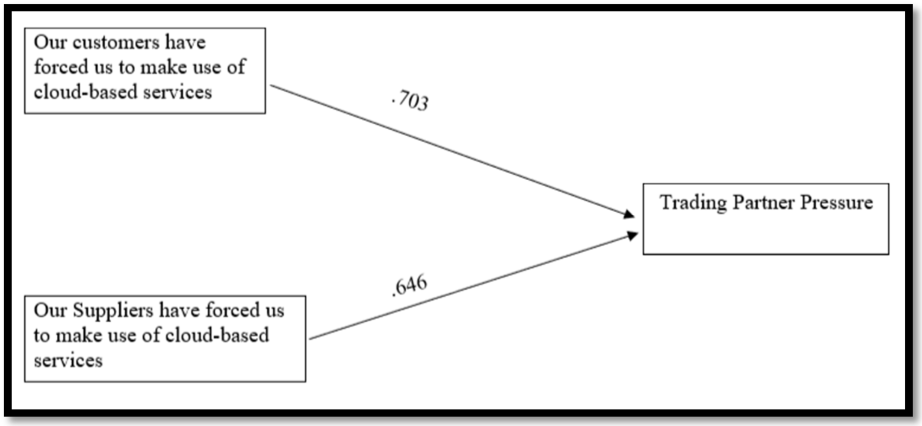

Figure 37: Trading Partner Pressure Sub-Adoption Strategy

The Trading Partner Pressure Sub-strategy in figure 37 above evidently shows that most of the research institutions' customers and suppliers have forced us to make use of cloud-based services (.703 and .646, respectively).

The following is how the weights for each variable in the Trading Partner Pressure sub-strategy were calculated: To begin, sum the loadings together (.703 + .646), yielding (1.349) as a result. After that, a proportion of what each contributes to the strategy was calculated by dividing the loading factors variable by the total loadings of variables, yielding:

- Our customers have forced us to make use of cloud-based services ($\frac{.703}{1.349}$), giving (.5111) and
- Our Suppliers have forced us to make use of cloud-based services ($\frac{.646}{1.349}$), giving (.4789), as shown in table 36.

Factor	Loadings	Total Loading	Weight
Our customers have forced us to make use of cloud-based services	.703	1.349	.5111
Our suppliers have forced us to make use of cloud-based services	.646		.4789

Table 36: Trading Partner Pressure Variables Weights

To get a clearer picture of the sub-strategy, table 36 is graphically represented, as shown in figure 38.

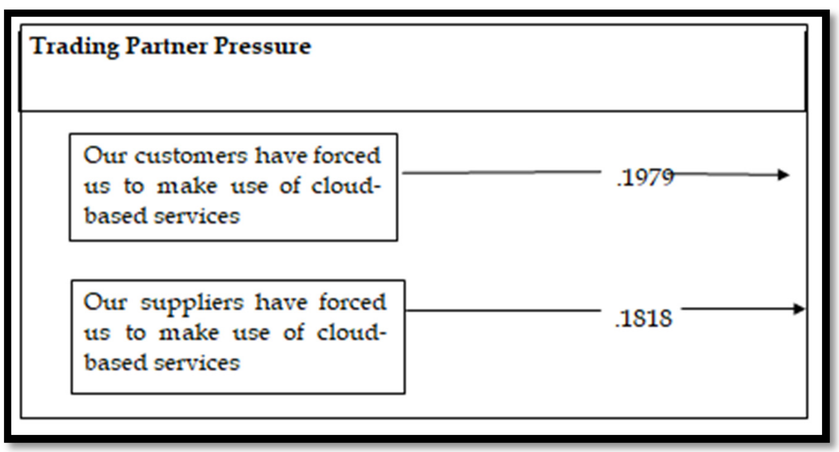

Figure 38: Trading Partner Pressure Sub-Adoption Strategy

It can be seen clearly in figure 38 that: Trading Partner Pressure = .5111 + .4789 = 1

Government Support, Competition Intensity and Trading Partner Pressure Variables can all be combined to form the element of External Context variable, as shown in figure 39.

The computing devices Sub-strategy in figure 30 above reveals that the core computing device used in Private universities were smartphones with factor loading of (.847), laptops with factor loading of (.929) and desktops with factor loading of (.927).

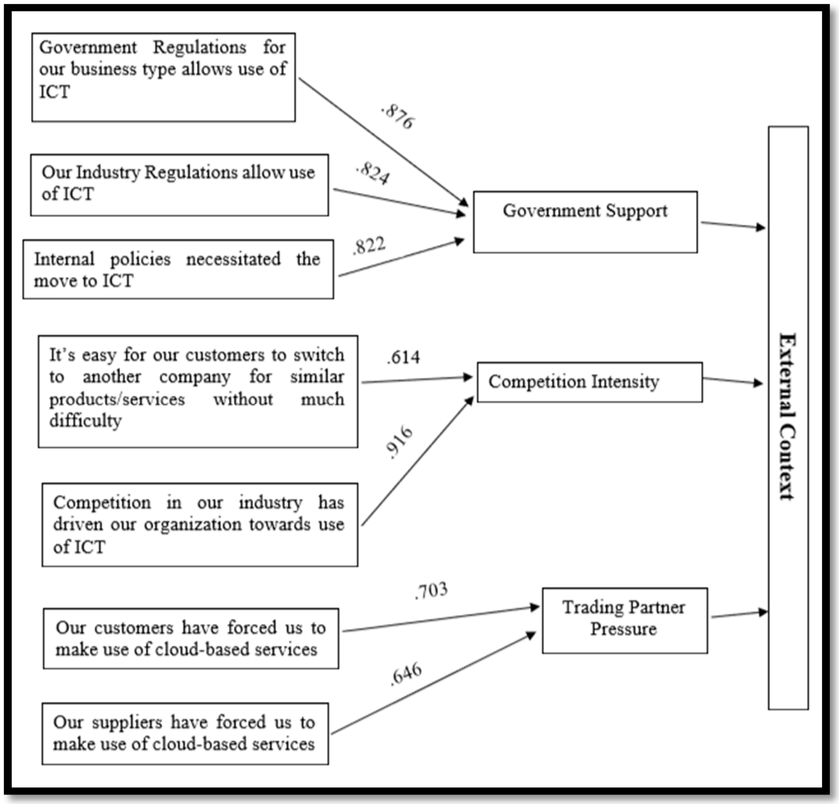

Figure 39: External Context Sub-Adoption Strategy

The average loading of each sub-construct in the External Context strategy was calculated as follows:

First, it was calculated by adding the loadings for all the factors of their respective sub-constructs. The Government Support sub-construct (.876 + .824 + .822) = (2.522). An average for the three variables was calculated by dividing the total of the loadings of the variables (2.522) by the number of variable (3), which gives an average factor loading of Government Support sub-construct (.8407). The Competition Intensity sub-construct (.614 + .916) = (1.53). An average for the two variables was calculated by dividing the total of the loadings of the variables (1.53) by the number of variable (2), which gives an average factor loading of Competition Intensity sub-construct (.765). Then for the Trading Partner Pressure sub-construct (.703 + .646) = (1.349). An average for the five variables was calculated by dividing the total of the loadings of the variables (1.349) by the number of variable (2), which gives an average factor loading of Trading Partner Pressure sub-construct (.6745).

Then the sum of the average loadings of the sub-constructs in the External Context strategy (.8407 +.765 + .6745) = (2.2802). A ratio of what each sub-construct contributes to the External Context strategy was afterward calculated by dividing the average loading factors of each sub-construct by the total of the average loadings of the sub-construct, which gives: Government Support Sub-Construct ($\frac{.8407}{2.2802}$), giving (.3686), Competition Intensity Sub-Construct ($\frac{.765}{2.2802}$), giving (.3354) and Trading Partner Pressure sub-construct ($\frac{.6745}{2.2802}$), giving (.2958), as summarized in the figure 40.

The computing devices Sub-strategy in figure 5.1 above reveals that the core computing device used in Private universities were smartphones with factor loading of (.847), laptops with factor loading of (.929) and desktops with factor loading of (.927).

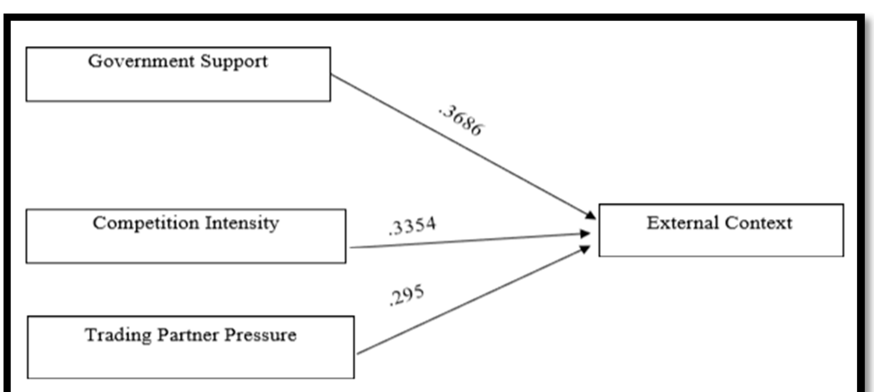

Figure 40: External Context Sub-Adoption Strategy

Figure 40 is displayed in a more detailed form - the respective sub-constructs, their factors and variable weights, as shown in figure 41.

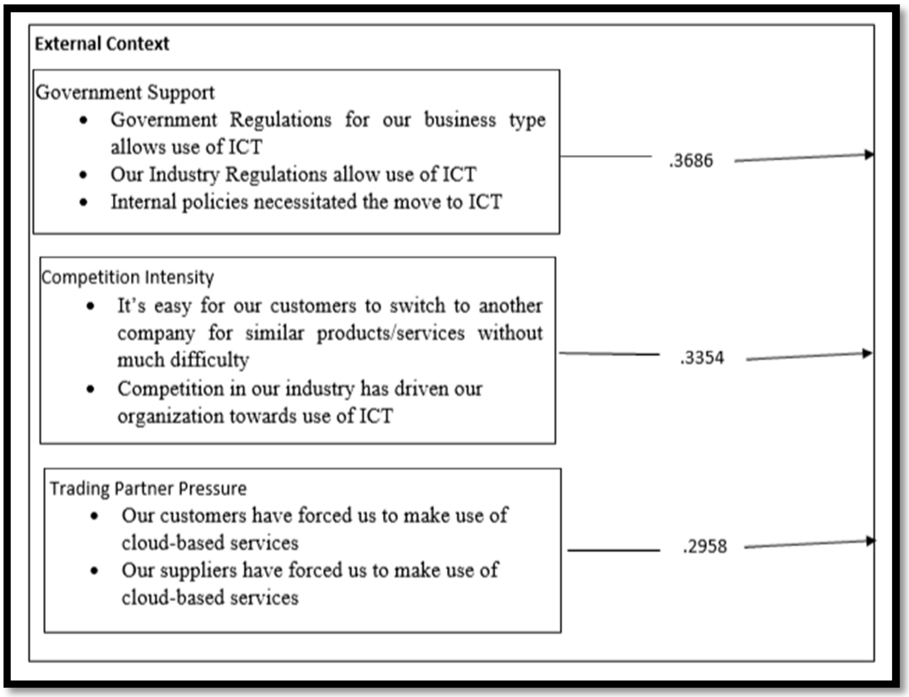

Figure 41: External Context Sub-Adoption Strategy

It can be seen clearly in figure 41 that: External Context = Government Support (.3686) + Competition Intensity (.3354) + Trading Partner Pressure (.2958) = 1

From table 23, component 7 has key factors of Vendor Readiness variable. This Component addresses that:

- Cloud Service Providers provide enough information about the services (.889), and
- Overall, Cloud Service Providers are ready with the services they provide (.709).

Statement (32): Some ICT services are only offered over the cloud and hence our use of cloud-based services, and

Statement (33): Cloud Service Providers have adequate capacity to run the services (loading .540 and .453, respectively). Table 25 also formed part of Vendor Readiness Variable but was not included in the development of this strategy because both factors did not attain the required threshold of 0.6 loading and above. These particular factors under the component that obtained a loading of 0.6 and above can be combined to form the element of Vendor Readiness variable. Corresponding loadings, together with their respective components, are shown in the sliced table 37.

Factor	Loadings
	7
1. Cloud Service Providers provide enough information about the services	.889
2. Overall, Cloud Service Providers are ready with the services they provide	.709

Table 37: Vendor Readiness Factor Loadings

Table 37 shows that both of the two factors had obtained a strong factor loading (above 0.6 loading) hence perfect for the development of a Vendor Readiness sub-strategy. Figure 41 displays a clearer graph of the relation of the factors together with their corresponding loadings that form a vendor readiness sub-strategy.

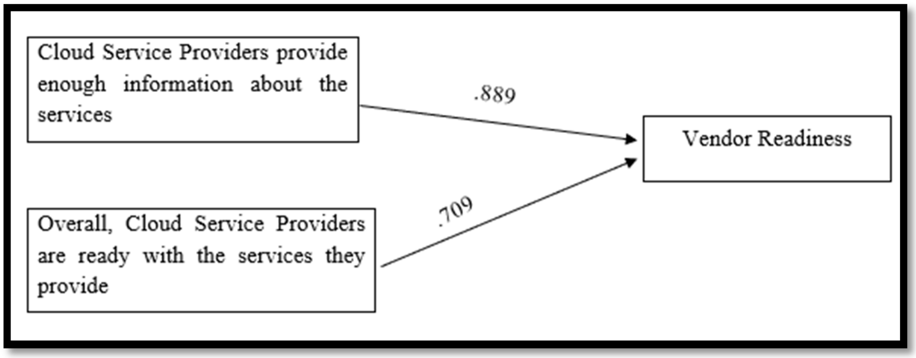

Figure 42: Vendor Readiness Sub-Adoption Strategy

The Vendor Readiness Sub-strategy in figure 42 above evidently shows that Cloud Service Providers provide enough information about the services (.889), and overall, Cloud Service Providers are ready with the services they provide (.709).

The following is how the weights for each variable in the Vendor Readiness sub-strategy were calculated: To begin, sum the loadings together (.889 + .709), yielding (1.598). After that, a proportion of what each contributes to the strategy was calculated by dividing the loading factors variable by the total loadings of variables, yielding:

- Cloud Service Providers provide enough information about the services ($\frac{.889}{1.598}$), giving (.5563), and
- Overall, Cloud Service Providers are ready with the services they provide ($\frac{.709}{1.598}$), giving (.4437), as shown in table 38.

Factor	Loadings	Total Loading	Weight
Cloud Service Providers provide enough information about the services	.889	1.598	.5563
Overall, Cloud Service Providers are ready with the services they provide	.709		.4437

Table 38: Vendor Readiness Variable Weights

To get a clearer picture of the sub-strategy, table 38 is graphically represented as shown in figure 43.

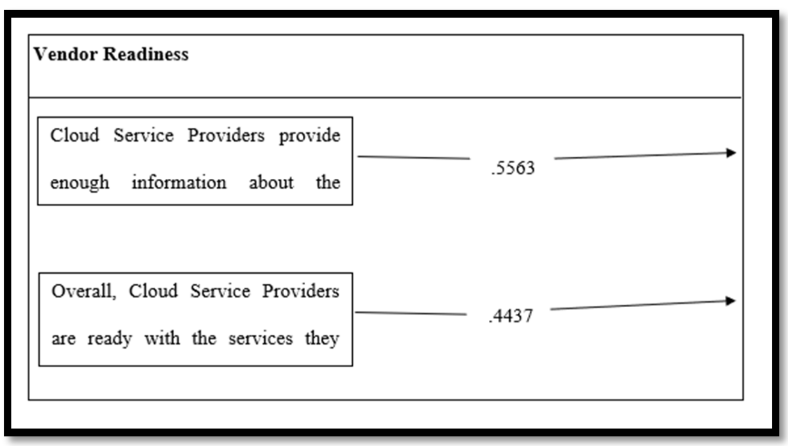

Figure 43: Vendor Readiness Sub-Adoption Strategy

It can be seen clearly from figure 43 that: Vendor Readiness = .4437 + .5563 = 1

Based on the discussions above and their corresponding results, table 39 summarizes sub-constructs, constructs and their corresponding factor loadings and weights. They contribute to the development of the strategy for the adoption of cloud computing in Kenyan Research Institutions (FACC).

Constructs	Sub-constructs Loading	Construct Total Loading	Construct Weights
Organization's Operations			
Accounting	.849	4.143	.2049
Inventory Management	.613		.1480
HR	.841		.2030
E-mail	.904		.2182
Payroll	.936		.2259
Technological Context			
Relative Advantage	.7753	2.2683	.3418
Compatibility	.737		.3249
Complexity	.756		.3333
Internal Context			
Technological Readiness	.7305	2.22	.3291
Top Management Support	.6645		.2993
Organization Size	.825		.3716
External Context			
Government Support	.8407	2.2802	.3686
Competition Intensity	.765		.3354
Trading Partner Pressure	.6745		.2958
Vendor Readiness			
Cloud Service Providers provide enough information about the services	.889	1.598	.5563
Overall, Cloud Service Providers are ready with the services they provide	.709		.4437

Table 39: Sub-Constructs, Constructs and Their Corresponding Factor Loadings and Weights

4.5.5. Strategy for Adoption of Cloud Computing in Kenyan Research Institutions (FACC)

This section provides the construction of the strategy for the adoption of cloud computing in Kenyan Research Institutions (FACC). It provides a unified approach for combining various core components to achieve affordable adoption of cloud computing in Kenyan Research Institutions by using Factor analysis. These factors were extracted through the rotation process of the factors described. The study thus identified Organization's Operations, Technological Context, Internal Context, External Context and Vendor Readiness as core constructs of the strategy, as summarized in table 39.

From the findings in table 39 and the sub-strategys developed from each construct, the FACC strategy is made by combining the Organization's Operations sub-strategy, Technological Context sub-strategy, Internal Context sub-strategy, External Content sub-strategy, and Vendor Readiness sub-strategy together. In the strategy for the adoption of cloud computing in Kenyan Research Institutions (FACC), each construct and sub-construct of the strategy was considered and the contribution of each was calculated as follows:

Organization's Operations had Accounting with a weight of .2049, Inventory Management with a weight of .1480, HR with a weight of .2030, E-mail with a weight of .2182 and Payroll with a weight of .2259, their overall contribution to the strategy is: (.2049+.1480+.2030+.2182+.2259)/5= 1.00/5= 0.2. Technological Context had Relative Advantage with a weight of .3418, Compatibility with a weight of .3249, and Complexity with a weight of .3333. Their overall contribution to the strategy is: (.3418+.3249+.3333)/3=1.00/3=0.3333. Internal Context had Technological Readiness with a weight of .3291, Top Management with a weight of .2993, Organization Size with a weight of .3716. Their overall contribution to the strategy is: (.3291+.2993+.3716)/3 =1.00/3 = 0.3333. External Context had Government Support with a weight of .3686, Competition Intensity with a weight of .3354, and Trading Partner Pressure with a weight of .2958. Their overall contribution to the strategy is (.3686+.3354+.2958)/3 = 1.00/3 = 0.3333. Vendor Readiness had Cloud Service Providers who provided enough information about the services with a weight of .5563. Overall, Cloud Service Providers are ready with the services they provide, with a weight of .4437. Their overall contribution to the strategy is: (.5563+.4437)/2 = 1.00/2 = 0.5.

In adding up the contribution of each construct in the strategy, we get (.2+.3333+.3333+.3333+.5), yielding a sum of 1.6999. This total (1.6999) is then used to compute the effective contribution of each construct towards the affordability strategy. When the effective weights of the constructs to the strategy are added up, the sum should not exceed a value of one (1.00). The outcomes of the computation are as presented below:

Organization's Operations = (.2/1.6999) = .1177
Technological Context = (.3333/1.6999) =.1961
Internal Context = (.3333/1.6999) =.1961
External Context = (.3333/1.6999) =.1961
Vendor Readiness = (.5/1.6999) = .2941

When the values are summed together, they yield a value that is not exceeding one (1.00). Organization's Operations (OO), Technological Context (TC), Internal Context (IC), External Context (EC), and Vendor Readiness (VR) form the metrics of the strategy for the adoption of Cloud Computing in Kenyan Research Institutions. The sum total of the metrics is equal to one (1).

Adoption of Cloud Computing= .1177(OO) +.1961(TC) +.1961(IC) +.1961(EC) +.2941(VR) =1.000

The FACC strategy presented in figure 44 was developed from the complete contribution of each sub-strategy in the final strategy. The sub-strategy was, thus, integrated to come up with the FACC strategy that can be employed to achieve a cloud adoption strategy ideal for Kenyan research institutions.

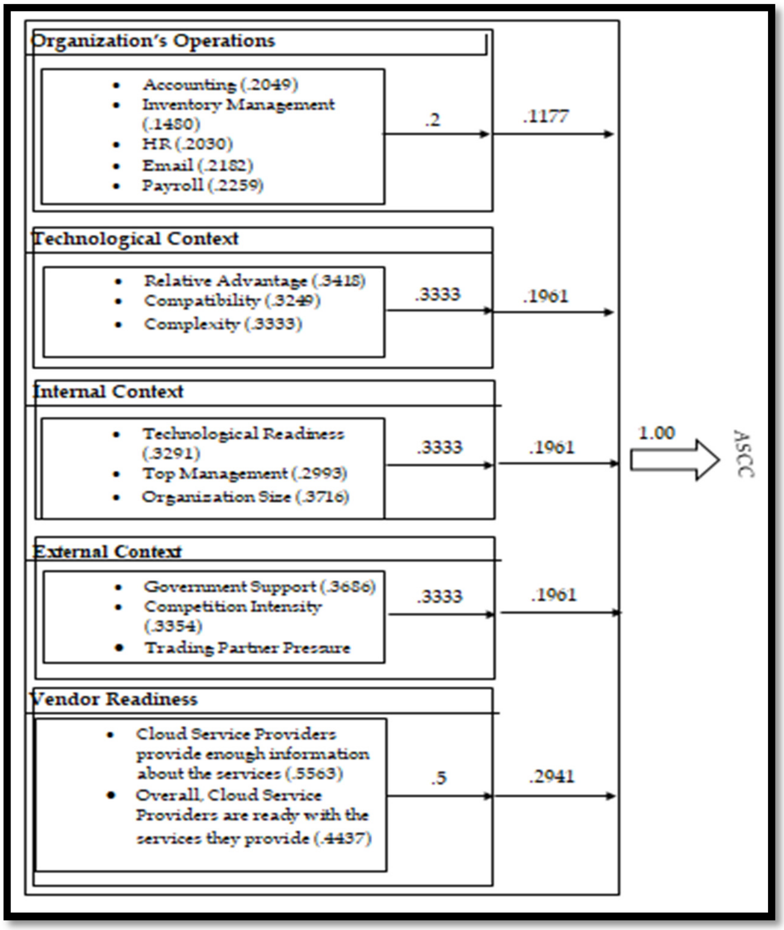

Figure 44: ASCC Adoption Strategy

	CONSTRUCTS/ COMPONENTS		
	Vendor Readiness	Contexts	Organizational Operations
SUB CONSTRUCTS	1. Cloud Service Providers provide enough information about the services 2. Overall, Cloud Service Providers are ready with the services they provide	1. Government Support 2. Relative Advantage 3. Competition Intensity 4. Competition Intensity 5. Complexity 6. Compatibility 7. Trading Partner Pressure	1. Payroll 2. Email 3. Accounting 4. HR 5. Inventory Management

Figure 45: Strategies for Implementing ASCC

Based on the values in figure 45, it is statistically clear that Vendor Readiness contributes a higher value towards the development of the proposed cloud adoption strategy ideal for research institutions (.2941), followed by Technological Context, Internal Context and External Context that had a similar value of .1961 while Organization's Operations had the least value of .1177.

5. Validation, Assessment and Benefits of the Strategy

5.1. Introduction

This chapter investigates the designed strategy for adopting cloud computing in Kenyan Research Institutions (FACC) by assessing it through the engagement of a certain portion of the respondents who were Cloud Computing Experts, which enabled this study to determine the strategy's benefits and its validity.

5.2. Strategy Validation

The activity of validation is part of the strategy development procedure. This phase has been carried out to guarantee that the designed strategy is appropriately accurate for the purpose it was intended for. When it is conducted with stakeholders, the importance of strategy validity is vital. The study involved Cloud Computing Experts in determining the validity of this strategy.

5.2.1. Kayer-Mayer Olkin Test (KMO Test) and Bartlett's Test of Sphericity

Construct validity is defined as the extent to which instruments used for data collection in the field measure the actual hypothesis of the study (Kendell & Jablensky, 2003). Construct validity involved both Kaiser-Meyer-Olkin (KMO), Bartlett's tests, and factor analysis with Varimax rotation. KMO was used to measure sampling adequacy; that is, to ascertain if the number of items used to measure a FACC variable were adequate; it ranges between 0 and 1, with the value of 1 indicating perfect results and a minimum threshold of 0.5 established as the better results (Kendell & Jablensky, 2003). Bartlett's Test of Sphericity was used to test if the study items used to measure the validity of FACC variable were actually coming from a population with equal variance. Principal component analysis was used to identify and compute composite scores for the factors underlying our 5-point Likert scale that we used in the study questionnaire. Communalities were conducted to check if all the items used to measure FACC variable actually shared a common variance that can be explained by the factors, and a value of 0.3 is considered a minimum threshold (Costello & Osborne, 2008). The study results for construct validity are shown in table 40.

Variable	Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy	Bartlett's Test of Sphericity		
		Approx. Chi-Square	Degrees of freedom	p-value
FACC Variable	0.888	120.754	11	0.000

Table 40: Sampling Adequacy and Sphericity Test Results

The findings from table 40 show that the FACC variable's KMO results for sampling adequacy were above 0.5 minimum threshold value as established by Kendell, 2003 (FACC KMO; 0.888>0.05). The significant results of Bartlett's Test of Sphericity indicated that the sampled items for the FACC variable were from a population with equal variance, as shown in table 41: ($\chi 2$ (11) =120.754, $p=0.000 < 0.05$).

Statement	Factor Loading	Communalities	Decision
The strategy is flexible to the provision of Cloud Computing resources.	.614	.795	Retained
The strategy is capable of making the availability of cloud computing services.	.702	.862	Retained
The strategy can enhance greater Cloud Computing efficiency.	.839	.804	Retained
The strategy is able to reduce capital expenditure on hardware.	.900	.897	Retained
The strategy is able to reduce capital expenditure on software.	.518	.654	Retained
The strategy is increasing the performance of the research institution's operations.	.941	.338	Retained
The strategy supports the effectiveness of the firm's management activities.	.991	.544	Retained
The strategy can enhance data exchange and collaboration, which contributes to efficiency in service delivery.	.540	.706	Retained
The strategy provides the safety of data/information, which contributes to efficiency in service delivery.	.685	.422	Retained
The strategy enhances the storage of data/information, which contributes to efficiency in service delivery.	.890	.488	Retained
The strategy is statistically correct.	.911	.897	Retained

Table 41: Factor Analysis Based on a Principal Components' Analysis with Varimax Rotation for the Eleven Items

Table 41 shows that the communalities for all the eleven items under FACC Variable were all above the minimum threshold of 0.3 (Costello & Osborne, 2008). These indicated that all the items shared a common variance. The Factor loadings for all the items were above a minimum threshold of 0.4 (see table 42), an indication that the sample size of the eleven items was adequate enough to measure the validation of the Strategy for Cloud Computing in the Kenyan Research Institutions.

5.2.2. Reliability Analysis

Reliability test was conducted to assess the reliability of the 5-point Likert scale used in the questionnaire to measure the FACC variable. To achieve this, a coefficient of 0.7 Cronbach's Alpha coefficient was adopted as the minimum threshold for deciding on the sufficiency of the reliability of the study scale (Kendell & Jablensky, 2003). Results for the reliability test are indicated in table 42 below.

Variable	Number of items	Cronbach Alpha
FACC	11	0.932

Table 42: Reliability Test Results

The results from table 42 above clearly shows that Cronbach alpha coefficients for the FACC variable were above the minimum threshold of 0.7 (Kendell, 2003), (0.932>0.700). Therefore, our study concluded that the 5-point scale of the items used to measure the validation of the FACC strategy was reliable and acceptable for further analysis.

5.2.3. FACC Validation Process

The process of validating a strategy usually involves 'outsiders.' The process is conducted to monitor the quality of the study and the potential for the bias in the research. The study engaged seven cloud computing experts to validate the developed strategy. These experts reviewed the items displayed in table 40 and commented on their behavior test context of the developed strategy. The experts were randomly picked from the Kenya Research Institutes that were involved in this study. The constructs of the strategy were presented to experts in determining whether:

- The constructs presented provide a perfect replication that underlies the study.
- The constructs signify the focus of this study.
- The constructs were carefully designed such that they perfectly fit in with real-world models.
- The designed and submitted strategy is accepted in the aim domain.

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The strategy is flexible to the provision of Cloud Computing resources	24%	10%	5%	14%	48%
The strategy is capable of making the availability of cloud computing services	14%	5%	10%	14%	57%
The strategy can enhance greater Cloud Computing efficiency.	0%	0%	10%	0%	90%
The strategy is able to reduce capital expenditure on hardware.	0%	0%	0%	33%	67%
The strategy is able to reduce capital expenditure on software.	0%	0%	0%	24%	76%
The strategy is increasing the performance of the research institution's operations.	5%	5%	0%	14%	76%
The strategy supports the effectiveness of the firm's management activities.	0%	14%	10%	5%	71%
The strategy can enhance data exchange and collaboration, which contributes to efficiency in service delivery.	5%	0%	0%	24%	71%
The strategy provides the safety of data/information, which contributes to efficiency in service delivery.	0%	0%	14%	0%	86%
The strategy enhances the storage of data/information, which contributes to efficiency in service delivery.	0%	0%	5%	10%	86%
The strategy is statistically correct.	0%	0%	14%	0%	86%

Table 43: Validation of FACC Strategy

Table 40 clearly shows that the majority of the experts strongly agreed with the following sentiments about the designed FACC strategy:

The strategy is flexible to the provision of Cloud Computing resources and its capacity to make cloud computing services available. Also, the strategy can enhance greater Cloud Computing efficiency, as represented by 48%, 57% and 90% of the respondents, respectively. Similarly, more than half of the respondents strongly agreed that the strategy is able to reduce capital expenditure on hardware and software and that the strategy is increasing the performance of the research institution's operations and supports the effectiveness of the firm's management activities as represented by 67%, 76%, 76% and 71% of the respondents, respectively.

The majority of the respondents also strongly agreed that the strategy provides the safety of data/information, which contributes to efficiency in service delivery, and that the strategy enhances the storage of data/information, which contributes to efficiency in service delivery and that FACC is statistically correct as represented by 71%, 86%, 86% and 86%, respectively, as shown in table 40.

5.3. Benefits of the FACC Strategy

Table 42 above clearly deduces the following as the benefits of the designed strategy for adopting cloud computing in Kenyan Research Institutes: It provides efficient service delivery such that there is easy access to any research information from the cloud at anytime and anywhere. FACC strategy demonstrates how cloud computing stores data over the internet which is termed cyberspace. Therefore, research institutes can easily diminish the usage of hardware. This will help to save time and effort.

FACC strategy shows that access to data becomes flexible using the proposed approach as the data is stored in cyberspace. Anyone with proper authorization can access those data from any device at any point in time. This phenomenon improves the efficiency and productivity of the research institutions. The strategy is able to reduce the capital expenditure on software and hardware. Data privacy is ensured by the proposed strategy.

5.4. Summary and Conclusion

This chapter discussed the validation process of FACC Strategy. It presented the testing validity and reliability of the data collection tool adopted by using KMO and Bartlett's test of sphericity and determined the factor loadings and communalities of the items used to measure the FACC Variable. A descriptive analysis of the responses from the experts clearly shows that the majority of them, in general, gave positive feedback about the designed strategy. This implies that FACC Strategy is an effective model that could be adopted for cloud computing in Kenyan Research Institutions.

6. Summary, Conclusion and Recommendations

6.1. Introduction

This chapter details the summary of the significant results of the study. It also shows the overall conclusion to the findings, recommendations and suggestions for further research.

6.2. Summary of the Study

The general objective of this study was to develop a strategy for adopting cloud computing in Kenyan Research Institutions. The specific objectives were:

- To analyze current cloud computing technologies,
- To adopt approaches and drivers in cloud computing,
- To establish the characteristics of research institutions in Kenya,
- To propose a cloud adoption strategy ideal for research institutions and
- To assess the effectiveness of the proposed strategy

6.2.1. Analyzing Current Cloud Computing Technologies, Adoption Approaches and Drivers in Cloud Computing

This particular objective was achieved by measuring the sub-constructs which contributed to the development of the sub-strategys; Technological Context (Relative Advantage, Compatibility and Complexity), which indicated that using Cloud Computing Services improves operational efficiency in the research institutions, using Cloud Computing Services improves operational productivity in the research institutions, using Cloud Computing Services improves the operational quality of work in the research institutions, and that there are enough advantages of Cloud Computing Services to consider using them in the company as this was represented by 63%, 73%, 60% and 70% of the respondents respectively. In general, the relative advantage sub-construct contributed to the development of the Technological Context sub-strategy by an equally large percentage of 92.86%. The results also showed that using Cloud Computing fits into our organization's work style, norms & culture and that Cloud Computing is not complicated, and it is not difficult to understand what is going on as this was represented by 53% and 50% of the respondents, respectively. Compatibility and Complexity sub-constructs, in general, contributed to the development of the Technological context Sub-strategy by 82.666% and 83.334%, respectively. Technological Context as a sub-strategy, in general, contributed to the development of the strategy for the adoption of Cloud Computing in Kenyan Research Institutions by a considerable percentage of 74.222%.

The Internal Context (Organization Size, Technological Readiness and Top Management Support) showed that Cloud Computing is applicable to us because of the organization's size, that the organization is technically ready to use cloud-based services, and that most of the employees possess the required skills to make use of cloud-based services, and that the organization does not prefer to use traditional methods for customer communication and customer information management as this was represented by 50%, 47%, 50% and 40% of the respondents respectively. In general, the Organization's Size and Technological Readiness contributed to the development of the Internal Context Sub-Strategy by

75.334% and 72%, respectively. The sub-construct Top Management Support showed that the top management supports the deployment of Cloud Computing at the organization for day-to-day operations, that the organization's management is ready to make use of Cloud Computing, and that the top management invests in Cloud Computing to help improve our organizational efficiencies which are represented by 60%, 70% and 53% respectively. In general, top management Support contributed to the development of the Internal Context Sub-strategy by 88%. The Internal Context Sub-strategy contributed to the development of the major FACC strategy by 82.346%.

The External Context (Government Support, Competition Intensity and Trading Partner Pressure) showed that the Government Regulations for the organization's business type allows the use of Cloud Computing, that the Industry Regulations allow the use of Cloud Computing and that the Internal policies necessitated the move to Cloud Computing. That it is easy for our customers to switch to another company for similar products/services without much difficulty and the Competition in the industry has driven the organization towards the use of Cloud Computing, as represented by 70%, 77%, 87%, 73% and 67% respectively. The Government Support and Competition Intensity contributed to developing the External Context Sub-strategy by 93.222% and 75%, respectively. The trading partner pressure indicated that the customers had forced the organization to make use of cloud-based services, that the suppliers have forced us to make use of cloud-based services and that there are many options for cloud-based products/services for our organization, as represented by 67%, 77% and 80%, respectively. Trading partner contributed to the development of the External Context Sub-strategy by 78%. The External context sub-strategy contributed to the strategy for the adoption of Cloud Computing in Kenyan Research Institutions by a considerable percentage of 83.388%.

Vendor Readiness sub-strategy showed that the Cloud Service Providers provide enough information about the services, that some ICT services are only offered over the cloud hence our use of cloud-based services, that the cloud service providers have adequate capacity to run the services and that overall, Cloud Service Providers are ready with the services they provide as they are represented by 66%, 54%, 67% and 57% respectively. Vendor Readiness Construct as a sub-strategy, in general, contributed to the development of the strategy for the adoption of Cloud Computing in Kenyan Research Institutions by a considerable large percentage of 81.334%.

6.2.2. Establishment of the Characteristics of Research Institutions in Kenya

The study showed that all the sampled Kenya Research Institutions based in the Kenyan Coastal Region (Kenya Marine Fisheries and Research Institute of Kenya (KMFRI), Kenya Agricultural Livestock and Research Organization of Kenya (KALRO) in Mtwapa and Kenya Medical Research Institute (KEMRI) in Kilifi town) have a dedicated ICT personnel as indicated by 100% response and 90% indicated to also have an ICT Policy. Accounting and E-mailing Operations were shown to be one of the organization's automated operations. Inventory Management and Payroll were also stated as the organization's automated operations, as indicated by 56.7% and 60%, 63% and 72%, respectively. HR was the least stated as the automated operation in the respondent's organization, as indicated by 3.3%. This was a positive indication that the majority of the sub-constructs under Organization's Operations construct were significantly responded to, contributing positively to the development of the Organization's Operations sub-strategy.

The study showed that the Firm's Cloud Services Complete operating system and software package available via cloud services (PaaS) as indicated by 83% of the respondents, while 10% and 3%, respectively, indicated consuming Firm's Cloud individual software packages (SaaS) and Firm's Cloud Services just infrastructure services such as storage, network capacity, etc. (IaaS).

6.2.3. Strategy for Adoption of Cloud Computing Ideal for Research Institutions (FACC)

The adoption of cloud computing indicated that using Cloud technology is compatible with most aspects of the organization's work, that cloud technology is easy to use, that utilizing Cloud technology fits with the firm's work style and that the respondents had some knowledge of the existence of Cloud computing technology in the market as represented by 83%, 70%, 77% and 73% of the respondents respectively.

All the study constructs (Technological Context variables, Internal Context Variables and External Context variables) were found to have a KMO value of above 0.5. Therefore, the sampled data were deemed to be sufficient for the exploratory analysis. Additionally, Bartlett's Test of Sphericity for the variables were all indicated by significant approximated Chi-Square values ($p<0.05$) hence an indication that the item correlation matrix is not an Identity matrix (.000) but a positive definite matrix. Thus, from the results of the findings above, the study data were adequate and appropriate for use in Exploratory Factor Analysis. The Factor analysis procedure involved checking the communalities of the variables and running the Principal Component Analysis that excluded some variables using a threshold of 0.5.

Organization sub-strategy was developed using accounting, Inventory Management, HR, E-mail and Payroll components in which all of them had attained a threshold of 0.5 and above. The weights of each variable were calculated by dividing each individual's loading by the total loadings of the five variables. The outputs were:

Accounting (.849/4.143) = (.2049),
Inventory Management (.613/4.143) = (.1480),
HR (.841/4.143) = (.2030),
Email (.904/4.143) = (.2182) and
Payroll (.936/4.143) = (.2259)

All these weights summed up to 1, an indication that they were statistically measuring the organizations' operations construct.

The relative Advantage sub-strategy was developed using the following components:

- Using Cloud Computing Services improves operational efficiency in the organization (.862), and
- Using Cloud Computing Services improves the operational quality of work in the organization (.608) and

- Using Cloud Computing Services improves operational productivity in the organization (.856)

Clearly, all of these components attained a value above the threshold of 0.5. The weights of each variable were calculated by dividing each individual's loading by the total loadings of the three variables. The outputs were:

- Using Cloud Computing Services improves operational efficiency in our organization variable (.862/2.326), giving (.3706),
- Using Cloud Computing Services improves operational productivity in our organization variable (.856/2.326), giving (.3680) and
- Using Cloud Computing Services improves the operational quality of work in our organization (.608/2.326), giving (.2613).

All of these weights summed up to 1, an indication that they were statistically measuring the Relative Advantage sub-construct.

Compatibility and Complexity (a sub-construct of Technological Context) respectively were developed using the following components respectively:

Using ICT fits into the organization's work style, norms & culture (.737), and the ICT is not complicated, and it is not difficult to understand what is going on (.756). These two variables were combined with the Relative Advantage variable to form the element of Technological Context variable. The average loading of each sub-construct in the Technological Context strategy was calculated as follows:

First, it was calculated by adding the loadings for all the variables in the sub-construct. The Relative Advantage sub-construct (.862+.608+.856) = (2.326). An average for the three variables was calculated by dividing the total of the loadings of the variables (2.326) by the number of variable (3), which gives an average factor loading of the relative advantage sub-construct (.7753). Then the average loadings of the sub-construct in the Technological Context strategy (.7753 +.737 + .756) = (2.2683). A ratio of what each sub-construct contributes to the Technological Context strategy was afterward calculated by dividing the average loading factors of each sub-construct by the total of the average loadings of the sub-construct, which gives: Relative Advantage (.7753/2.2683) = (.3418), Compatibility (.737/2.2683) = (.3249) and Complexity (.756/2.2683) = (.3333). All of these weights summed up to 1, an indication that they were statistically measuring the Technological Context Construct.

Technological Readiness (a sub-construct of Internal Context) sub-strategy was developed using the following components:

The organization is technically ready to use cloud-based services (.747), and the organization does not prefer to use traditional methods for customer communication and customer information management (.714). These particular components were combined to form the element of Technological Readiness variable. Clearly, all of these components attained a loading of over 0.5. The weights of each variable were calculated by dividing each individual's loading by the total loadings of the two variables. The outputs were: the organization is technically ready to use cloud-based services (.747/1.461), giving the weight of .5113, and the organization does not prefer to use traditional methods for customer communication and customer information management (.714/1.461), giving the weight of .4887. All of these weights summed up to 1, an indication that they were statistically measuring the Technological Readiness sub-construct.

Top Management Support (a sub-construct of Internal Context) sub-strategy was developed using the following components:

- The top management support's deployment of cloud computing at the organization for day-to-day operations (.610) and
- The organization's management is ready to make use of cloud computing (.719)

It is clear that all of these two components attained a loading of 0.5 and above. The weights of each variable were calculated by dividing each individual's loading by the total loadings of the two variables. The outputs were:

- For the top management support's deployment of Cloud Computing at the organization for day-to-day operations (.610/1.329), giving the weight of .4590, and
- For the organization's management is ready to make use of Cloud Computing Services (.719/1.329), giving the weight of .5410

All of these weights summed up to 1, an indication that they were statistically measuring the Top Management Support Construct. Organization Size (a sub-construct of Internal Context) Sub-strategy was developed using the following component:

Using Cloud Computing is applicable to us because of our organization's size (.825). This component clearly attained a value above the threshold of 0.5. Organization Size, Technological Readiness and Top Management Support variables were combined to form the element of Internal Context variable. The average loading of each sub-construct in the Internal Context strategy was calculated as follows: First, by adding the loadings for all the variables in the sub-construct. The Technological Readiness sub-construct (.747 + .714) = (1.461). An average for the two variables was calculated by dividing the total of the loadings of the variables (1.461) by the number of variable (2), which gives an average factor loading of Technological Readiness sub-construct (.7305). The Top Management Support sub-construct (.610 + .719) = (1.329). An average for the two variables was calculated by dividing the total of the loadings of the variables (1.329) by the number of variable (2), which gives an average factor loading of Top Management Support sub-construct (.6645). Then the sum of the average loadings of the sub-construct in the Internal Context strategy (.7305 +.6645 + .825) = (2.22). A ratio of what each sub-construct contributes to the Internal Context strategy was afterward calculated by dividing the average loading factors of each sub-construct by the total of the average loadings of the sub-construct, which gives: Technological Readiness Sub-Construct (.7305/2.22) = (.3291), Top Management Support Sub-Construct (.6645/2.22), giving (.2993) and Organization Size (.825/2.22) = (.3716). All of the weights of the sub-constructs summed up to 1, an indication that they were statistically measuring the Internal Context Construct.

Government Support (a sub-construct of External Context) sub-strategy was developed using the following components; the Government Regulations for the organization's business type allows the use of Cloud Computing (.876), the Industry Regulations allow the use of Cloud Computing (.824) and Internal policies necessitated the move to the use of Cloud Computing (.822). All of these three components attained a Factor loading value of 0.5 and above. The weights of each variable were calculated by dividing each individual's loading by the total loadings of the three variables. The outputs were:

- For the Government Regulations for our business type allowing the use of Cloud Computing (.876/2.522), giving the variable weight of .3473,
- For the Industry Regulations allowing the use of Cloud Computing (.824/2.522), giving the weight of .3267, and
- For the Internal policies necessitated the move to the use of Cloud Computing Services (.822/2.522), giving the weight of .3259.

All of these weights summed up to 1, an indication that they were statistically measuring the Government Support sub-construct.

Competition Intensity (a sub-construct of External Context) sub-strategy was developed using the following components:

- It is easy for the organization's customers to switch to another company for similar products/services without much difficulty (.614), and
- The competition in our industry has driven our organization towards the use of Cloud Computing Services (.916)

Both of these components attained a factor loading value above the study threshold of 0.5. The weights of each variable were calculated by dividing each individual's loading by the total loadings of the two variables. The outputs were:

- For the (1), it is easy for our customers to switch to another company for similar products/services without much difficulty (.614/1.53), giving the average variable weight of .4013, and
- For the (2), competition in our industry has driven our organization towards the use of ICT (.916/1.53), giving the variable weight of .5987.

All of these weights summed up to 1, an indication that they were statistically measuring the Competition Intensity sub-construct.

Trading Partner Pressure (A sub-construct of External Context) sub-strategy was developed using the following components:

- The organization's customers have forced them to make use of cloud-based services (.703) and
- The organization's suppliers have forced them to make use of cloud-based services (.646)

Clearly, these two components attained a factor loading that is above the study threshold of 0.5. The weights of each variable were calculated by dividing each individual's loading by the total loadings of the two variables. The output was:

- Our customers have forced us to make use of cloud-based services (.703/1.349), giving a variable weight of .5111 and
- Our Suppliers have forced us to make use of cloud-based services (.646/1.349), giving a variable weight of .4789.

All of these weights summed up to 1, an indication that they were statistically measuring the Trading Partner Pressure sub-construct.

The average loading of each sub-construct in the External Context strategy was calculated as follows: First, by adding the loadings for all the factors of their respective sub-constructs. The Government Support sub-construct (.876 + .824 + .822) = (2.522). An average for the three variables was calculated by dividing the total of the loadings of the variables (2.522) by the number of variable (3), which gives an average factor loading of Government Support sub-construct (.8407). The Competition Intensity sub-construct (.614 + .916) = (1.53). An average for the two variables was calculated by dividing the total of the loadings of the variables (1.53) by the number of variable (2), which gives an average factor loading of Competition Intensity sub-construct (.765). Then for the Trading Partner Pressure sub-construct (.703 + .646), giving (1.349). An average for the five variables was calculated by dividing the total of the loadings of the variables (1.349) by the number of variable (2), which gives an average factor loading of Trading Partner Pressure sub-construct (.6745). The sum of the average loadings of the sub-constructs in the External Context strategy (.8407 +.765 + .6745) = (2.2802). A ratio of what each sub-construct contributes to the External Context strategy was afterward calculated by dividing the average loading factors of each sub-construct by the total of the average loadings of the sub-construct, which gives: Government Support Sub-Construct (.8407/2.2802), giving (.3686), Competition Intensity Sub-Construct (.765/2.2802) = (.3354) and Trading Partner Pressure sub-construct (.6745/2.2802) = (.2958). All of the weights of the sub-constructs summed up to 1, an indication that they were statistically measuring the External Context Construct.

Vendor Readiness Construct was developed using the following components:

- Cloud Service Providers provide enough information about the services (.889) and
- Overall, Cloud Service Providers are ready with the services they provide (.709)

These two components attained a factor loading of above 0.5, which is the study's threshold. The weights of each variable were calculated by dividing each individual's loading by the total loadings of the two variables. The output was:

- Cloud Service Providers provide enough information about the services (.889/1.598), giving a variable weight of .5563, and
- Overall, Cloud Service Providers are ready with the services they provide (.709/1.598), giving a variable weight of .4437.

The FACC strategy was developed using the following procedure; Organization's Operations had Accounting with a weight of .2049, Inventory Management with a weight of .1480, HR with a weight of .2030, E-mail with a weight of .2182 and Payroll with a weight of .2259, their overall contribution to the strategy is: (.2049+.1480+.2030+.2182+.2259)/5= 1.00/5= 0.2.

Technological Context had a Relative Advantage with weight of .3418, Compatibility with weight of .3249, and Complexity with weight of .3333. Their overall contribution to the strategy is: (.3418+.3249+.3333)/3=1.00/3=0.3333.

Internal Context had Technological Readiness with weight of .3291, Top Management with a weight of .2993, Organization Size with a weight of .3716, their overall contribution to the strategy is: (.3291+.2993+.3716)/3 =1.00/3 = 0.3333.

External Context had Government Support with a weight of .3686, Competition Intensity with a weight of .3354, Trading Partner Pressure with a weight of .2958. Their overall contribution to the strategy is (.3686+.3354+.2958)/3 = 1.00/3 = 0.3333. Vendor Readiness had Cloud Service Providers provide enough information about the services with a weight of .5563, and Overall, Cloud Service Providers are ready with the services they provide with a weight of .4437. Their overall contribution to the strategy is (.5563+.4437)/2 = 1.00/2 = 0.5.

In adding up the contribution of each construct in the strategy, we get (.2+.3333+.3333+.3333+.5), yielding a sum of 1.6999. This total (1.6999) is then used to compute the effective contribution of each construct towards the affordability strategy. When the effective weights of the constructs to the strategy are added up, the sum should not exceed a value of one (1.00). The outcomes of the computation are as presented below:

Organization's Operations = (.2/1.6999) = .1177
Technological Context = (.3333/1.6999) =.1961
Internal Context = (.3333/1.6999) =.1961
External Context = (.3333/1.6999) =.1961
Vendor Readiness = (.5/1.6999) = .2941

When the values are summed together, they yield a value that is not exceeding one (1.00). Organization's Operations (OO), Technological Context (TC), Internal Context (IC), External Context (EC), and Vendor Readiness (VR) form the metrics of the strategy for the adoption of Cloud Computing in Kenyan Research Institutions. The sum total of the metrics is equal to one (1).

6.2.4. The Assessment of the Effectiveness of the Proposed Strategy

The study findings showed that the FACC variable's KMO results for sampling adequacy were above 0.5 minimum threshold value as established by Kendell (2003) (FACC KMO; 0.888>0.05). The significant results of Bartlett's Test of Sphericity indicated that the sampled items for the FACC variable were from a population with an equal variance; ($\chi 2$ (11) =120.754, $p=0.000 < 0.05$). The items of the FACC Variable had communality values of above 0.3, which is the study's threshold and a factor loading of above 0.5, which is also the study's threshold. The validation process showed that the developed strategy had the following advantages according to the expert's feedback:

The strategy is flexible to the provision of Cloud Computing resources, and it is capable of making cloud computing services available.

Also, the strategy can enhance greater Cloud Computing efficiency, as represented by 48%, 57% and 90% of the respondents, respectively. Also, the responses showed that the strategy is able to reduce capital expenditure in hardware and software and that the strategy is increasing the performance of the research institution's operations and supports the effectiveness of the firm's management activities as represented by 67%, 76%, 76% and 71% of the respondents respectively. Lastly, the experts' feedback showed that the strategy provides the safety of data/information, which contributes to efficiency in service delivery, that the strategy enhances the storage of data/information, which contributes to efficiency in service delivery and that FACC is statistically correct as represented by 71%, 86%, 86% and 86% respectively.

6.3. Conclusion

Based on the study's objectives, this study was able to make the following conclusions:

For the first objective, which was to analyze current cloud computing technologies, adoption approaches and drivers in cloud computing, it was concluded that Cloud Computing Services improve operational efficiency, productivity and quality in Kenyan Research Institutions. Cloud Computing fits into the Kenyan Research Institutions' work style, norms & culture, and Cloud Computing is not complicated, and it is not difficult to understand what is going on. Cloud Computing is applicable for Kenyan Research Institutions because of the organization's size, that the organization is technically ready to use cloud-based services, and that most of the employees possess the required skills to make use of cloud-based services, and that the organization does not prefer to use traditional methods for customer communication and customer information management. It was also concluded that the Government Regulations for the organization's business type allows the use of Cloud Computing, and the Industry Regulations allow the use of Cloud Computing and that the internal policies necessitated the move to Cloud Computing. It is easy for the organization's customers to switch to another company for similar products/services without much difficulty, and the Competition in the industry has driven the organization towards the use of Cloud Computing. It was also discovered that customers and suppliers had forced the research organizations to make use of cloud-based services. Cloud Service Providers provide enough information about the services and some ICT services are only offered over the cloud hence the importance of using cloud-based services. The cloud service providers have adequate capacity to run the services and are ready with the services they provide.

For the Second Objective, which was to establish the characteristics of research institutions in Kenya, the study concluded that from the sampled Kenya Research Institutions, all the research institutions seem to have dedicated ICT personnel and an ICT Policy. The research Organization's operations seem to include: Accounting, E-mailing, Inventory Management, Payroll and HR. The majority of these Firm's Cloud Services are Complete operating systems and software packages available via cloud services (PaaS) and some consume Firm's Cloud individual software packages (SaaS) and Firm's Cloud Services, just infrastructure services such as storage, network capacity, etc. (IaaS).

For the Third objective, which was to propose a cloud adoption strategy ideal for research institutions, the study concluded that a Strategy for the Adoption of Cloud Computing in Kenyan Research Institutions (FACC) was successfully developed using the following constructs:

- Organization's Operations (OO),
- Technological Context (TC),
- Internal Context (IC),
- External Context (EC), and
- Vendor Readiness (VR)

These constructs form the metrics of the strategy for the adoption of Cloud Computing in Kenyan Research Institutions. The sum total of the metrics is equal to one (1).

Adoption of Cloud Computing=.1177(OO) +.1961(TC) +.1961(IC) +.1961(EC) +.2941(VR) =1.000

For the fourth objective, which was to assess the effectiveness of the proposed strategy, the study concluded that based on the feedback of the experts, the developed strategy provides efficient service delivery such that there is easy access to any research information from the cloud at anytime and anywhere. FACC strategy demonstrates how cloud computing stores data over the internet which is termed cyberspace. Therefore, research institutes can easily diminish the usage of hardware. This will help to save time and effort. FACC strategy shows that access to data becomes flexible using the proposed approach as the data is stored in cyberspace. Anyone with proper authorization can access those data from any device at any point in time. This phenomenon improves the efficiency and productivity of the research institutions. The strategy is able to reduce the capital expenditure on software and hardware. Data privacy is ensured by the proposed strategy. Therefore, in conclusion, the developed FACC strategy was found to be effective.

6.4. Recommendations

The recommendations of the study are as follows:

- The network infrastructure should be more developed so that the Kenyan Research Institutions can be connected to high-speed internet to allow for sharing of information, which will ensure efficient service delivery using cloud computing services.
- The study also recommended that Kenyan Research Institutes train their customers and suppliers on using cloud computing services for efficient service delivery.
- The study also recommended that research institutes adopt the FACC strategy for cloud computing to achieve efficiency in service delivery.

6.5. Areas for Further Studies

This study mainly focused on developing the strategy for adopting cloud computing in Kenyan Research Institutions (FACC). Areas for further related studies can be conducted to determine the long-term impact of the developed strategy for the adoption of cloud computing in Kenyan research Institutions. Also, further studies could determine ways of improving the developed strategy for adopting cloud computing in Kenyan Research.

7. List of Acronyms and Abbreviations

CC – Clouds Computing
NIST – National Institution of Standards and Technology
KMFRI – Kenya Marine and Fisheries Research Institute
CEOs – Chief Executive Officers
TOE – Technology Organization and Environment
DOI – Diffusion of Innovation Model
EC2 – Elastic Computing Cloud
DFS – Distributed file system
VMM – Virtual Machine Monitor
VMs – Virtual Machines
IAAS – Infrastructure as services
PAAS – Platforms as services
SAAS – Software as services
POC – Proofs of concepts
UTAUT – Unified theories for acceptance and use of Technology
TAM – Technologies Acceptance Models
TPB – Theories for planned behaviors
EDI – Electronic Data Interchange
B2B – Business to business
KMS – Knowledge management systems
TAM – Technology acceptance model
BPAA – Business process as a service
CAF – Cloud adoption strategy
OUM – Oracle unified method

8. Acknowledgements

It is to God all special thanks I give, having fought tough battles on my behalf. Because of this, the work here is complete. I recognize the efforts of my Supervisors, Dr. Kennedy Ondimu and Dr. Gabriel Mafura. Your continuous encouragement and support throughout the journey of doing this work are well-appreciated. At every stage of working and understanding the development of this proposal, I learnt much as lessons that helped me keep the focus. I extend my humble appreciation to the Technical University of Mombasa, specifically Institute of Computing and Informatics. Special thanks to Dr. Mvurya Mgala, Dr. Fullgence Mwakondo, Dr. Kennedy Hadullo and Dr. Anthony Luvanda. This research is possible thanks to you. I wish to extend to my colleagues at Technical University of Mombasa my appreciation for our collectively shared experiences and encouragement that motivated me to complete the work here. To my employer, Kenya Marine and Fisheries Research Institute (KMFRI), for providing a conducive environment and enabling me to undertake this course. Finally, my work colleagues, your encouragement cannot be forgotten and played a part here, too; I appreciate it. To all, I say, "God bless you."

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Appendices

Introduction Letter
ASNATH NYACHIRO,
DEPARTMENT OF COMPUTING AND INFORMATICS,
TECHNICAL UNIVERSITY OF MOMBASA,
P.O BOX 90420 – 80100
MOMBASA, KENYA.
Email- nasenath@yahoo.com or nasenato@gmail.com
Dear Respondent,
Re: Data Collection Request
I am a graduate student at TUM undertaking MSc I.T. At the moment, I am carrying out my research study on "Strategy for Adoption of Cloud Computing in Kenyan Research Institutions: A case study of Kenya Marine Fisheries Research Institute."
This questionnaire is meant to aid in data collection for this research.
Please use the space provided to fill in the information required as honestly and objectively as possible. The information provided will be treated with strict confidentiality for the purpose of this study only. Whatever information you will give us shall be kept confidential and will not be shared out with any third party unless with your permission.
I would appreciate any assistance accorded to me in any form. This will enable the successful completion of this work.
Thank you in advance.
Sincerely,

Asnath Nyachiro
MSIT/0011/2021

Questionnaire
Section 1: Demographic Information
1. Which department do you belong to? …………………………………..
2. What gender are you?

M [ ] F [ ] T [ ]

3. Which age bracket do you belong to? (tick on the appropriate bracket)

20-25 [ ]
26-30 [ ]
31-35 [ ]
36-40 [ ]
41 and above [ ]

4. What is your designation? …………………………………..
5. For how long have you worked with your organization?

Below 5 years [ ] 5-10 years [ ] 10 Years and over [ ]

6. How long have you worked in the IT sector?

Below 5 years [ ] 6-10 years [ ]
11-15 years [ ] 15 years and over [ ]

Section 2: Adoption drivers, hindrances & importance of cloud computing adoption in research organizations
ICT Characteristics of Research Institutions in Kenya
Does your organization have dedicated ICT personnel?
[ ] Yes [ ] No
Does your organization have an ICT policy?
[ ] Yes [ ] No
What operations are automated within your organization?
Accounting [ ] Inventory Management [ ] HR [ ]
E-mail [ ] Payroll [ ]
Other, please elaborate……………………………………………………..

Statement	Strongly Disagree	Disagree	Neither Agree or	Agree	Strongly Agree
Technology					
Relative Advantage					
Using cloud computing improves operational efficiency, productivity and quality of work in our organization.					
There are enough advantages of cloud computing to consider using them in the company.					
Compatibility					
Using cloud computing fits into our organization's work style, norms & culture.					
Complexity					
Statement	**Strongly Disagree**	**Disagree**	**Neither Agree or Disagree**	**Agree**	**Strongly Agree**
Cloud computing is complicated; it is difficult to understand what is going on.					
Organization					
Organization Size					
Cloud computing is applicable to us because of our organization's size					
Technological Readiness					
Our organization is technically ready to use cloud-based services.					
Most of our employees possess the required skills to make use of cloud-based services.					
Our organization prefers to use traditional methods for customer communication and customer information management.					
Top Management Support					
Our top management support's deployment of cloud computing at the organization for day-to-day operations					
Our organization's management is ready to make use of cloud computing.					
Our top management invests in ICT to help improve our organizational efficiencies.					
Environment					
Regulations					
Government Regulations for our business type allow the use of ICT.					
Statement	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
Our Industry Regulations allow the use of ICT.					
Internal policies necessitated the move to ICT.					
Competition Intensity					
It is easy for our customers to switch to another company for similar products/services without much difficulty.					
Competition in our industry has driven our organization towards the use of ICT.					
Trading Partner Pressure					
Our customers have forced us to make use of ICT.					
Our suppliers have forced us to make use of ICT.					

Statement	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
products/services without much difficulty					
Competition in our industry has driven our organization towards the use of cloud-based services.					
There are many options of cloud-based products/services that our organization can switch to that perform similar functions.					
Trading Partner Pressure					
Our customers have forced us to make use of cloud-based services.					
Our suppliers have forced us to make use of cloud-based services.					
Vendor Readiness					
Cloud Service Providers provide enough information about the services.					
Some ICT services are only offered over the cloud, hence our use of cloud-based services.					
Cloud Service Providers have adequate capacity to run the services.					
Overall, Cloud Service Providers are ready with the services they provide					

1. Does your organization utilize any services on Cloud?
[ ] Yes (Go to question 4) [ ] No (answer questions 2 &3 &7 only)
2. How would you rate the firm's intention to use cloud computing?
[ ] Do not intend to use cloud computing
[ ] Might consider using cloud computing
[ ] Intend to use cloud computing
3. What are the hindrances to cloud adoption in your firm?
[ ] Compatibility and complexity issues [ ] Centralization & formalization
[ ] Lack of system openness [ ] Lack of regulatory agencies
[ ] Lack of migration model [ ] Inadequate firm management support
[ ] Security and reliability
4. Which cloud services does your firm consume? Specify below:
[ ] Individual software packages (SaaS)
[ ] Complete operating system and software package available via cloud services (PaaS)
[ ] Just infrastructure services such as storage, network capacity, etc. (IaaS)
5. Why was the service model adopted?
[ ] Compatibility & complexity issues [ ] System openness
[ ] Security & reliability issues [ ] Competition
[ ] Firm management support [ ] Government support
[ ] Trading partner support [ ] Relative advantage
6. Which model did your institution deploy with reference to taxonomy of cloud computing **(you may choose more than one)**?
[ ] Public cloud (belonging to and maintained by another external party)
[ ] Private Cloud (belonging to and maintained internally)
[ ] Hybrid cloud (some services hosted internally and some hosted in the public cloud)
Other (Please specify)…………………………………………………………
7. Please indicate to what extent you agree with the listed statements by using the following scale.
Where:
1=Strongly Agree,
2=Agree,
3=Not Sure,
4=Disagree,
5= Strongly Disagree

Tick only one

NO.	Description: Question	1	2	3	4	5
A	Using Cloud technology is compatible with most aspects of the organization’s work.					
B	I believe that Cloud technology is easy to use.					
C	Utilizing Cloud technology fits with the firm's work style.					
D	I have knowledge of the existence of Cloud computing technology in the market.					
F	I think that utilizing Cloud computing suits well the way I would want to work.					
G	Learning to the usage of cloud services seems easy for me.					
H	I have knowledge that Cloud computing technology is being utilized by other organizations.					

Table 45

		JULY - SEPTEMBER 2021	OCTOBER - DECEMBER 2021	JANUARY – MARCH 2022	APRIL 2022	MAY 2022	JUNE 2022
Writing of proposal	Chapter 1						
	Chapter 2						
	Chapter 3						
Present proposal	Chapter 1 Discussions and corrections						
	Chapter 2 Discussions and Corrections						
	Chapter 3 Discussions and Corrections						
Collecting Data	Filling Questionnaires						
	Document Reviews.						
	Interviews						
Analysis of Data	Chapter 4 Qualitative and quantitative						
	Chapter 5 Qualitative and quantitative						
	Spreadsheets, Pivot tables, pie charts and Graphical forms						
Writing of a Report							
Submission							

Work Plan

NO	ITEM	TOTAL COST
1	Library Services & Binding	3,500
2	Stationaries	4,000
3	Expenses for travelling	20,000
4	Online internet	4,000
5	Collection of data fees and analysis	50,000
6	Publishing of an article	10,000
7	Miscellaneous	5,000
8	Printing and Binding	10,000

NO	ITEM	TOTAL COST
9	Research license	10,000
10	conference work	5,000
11	Reference materials	4,000
12	External hard disk	7,000
13	Research Assistants (3) @40,000	120,000
14	Printing Questionnaire	10,000
	TOTAL	262,500

Research Budget