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Abstract: The emerging cloud computing technology provides a compelling prospect for Institutions of Higher Learning to outsource their Information and Communications Technology (ICT). Although its reputation is escalating quickly, there are concerns that must be taken into account.

The goal of this paper is to explore the potential of cloud computing in transforming and automating the operations of Higher Learning Institutions in Kenya, both public and private. Cloud computing technology offers many opportunities such as disaster recovery, business continuity, data consolidation, availability, confidentiality and data integrity.

This paper investigates the significant issues related to the Strengths, Weaknesses, Opportunities and Threats (SWOT) of cloud computing adoption in Institutions of Higher Learning for hosting their e-learning resources, e-library services and digital repositories. The paper adopts a SWOT analysis to assess the implementation level of this technology and presents a framework for adoption and realization of this technology in institutions of higher learning in Kenya.

The impact of this paper can be seen in two folds; academic and practice. Its findings add to the body of knowledge in the area of cloud computing. Promotion and adoption of this technology by these institutions is of dire need to policy makers and regulators such as Communication Commission of Kenya (CCK), other stakeholders such as the government, service providers like Kenya Education Network (KENET), industry and research institutions.

Key words: Adoption, Cloud computing, Institutions of Higher Learning, ICT.

1. Introduction

Institutions of higher learning in Kenya are in the process of acquiring technology to help them in teaching which is their main objective. Some of the technologies applied in these institutions include development of enterprise resource planning systems, simulation laboratories and e learning.

E-learning is the most recent way to carry out distance education by distributing learning material and processes over the Internet. Its “any time, any place” nature could be part of a winning strategy for particular needs, such as decongestion of overcrowded education facilities, support for students or teachers who live far away from schools and universities and adult education. Making remote educational data and tools available to learners requires considering their different characteristics such as cultural background, technical experience, technological equipment, physical and cognitive abilities [1].

One of the main problems of e-learning systems is satisfying heterogeneous needs of individual learners and groups. Some of these needs include enabling adequate accessibility at anytime and anywhere. During 2009, an E-readiness survey was conducted in five
African countries (i.e. Kenya, Uganda, Tanzania, Rwanda and Burundi), which revealed that, on average Personal Computers ratios were less than 10% of students enrolled in their respective universities. 25% of university students had access to computers at home and approximately 50% of the total number of students, accessed computers in cyber cafés while 14% of them were accessing computers both at home and workplace [7].

The political leadership in Kenya has been quoted in the recent past of its intentions to increase student intake to public universities through a double intake. This statement meant that each public university will take higher number of students above the admissions of previous years. The academic year (2011/2012) admitted 32,611 students. This number was 8,000 more than the 24,000 students admitted the previous year (Daily Nation June 21, 2011). This increase in student numbers was done alongside upgrading and acquisition of tertiary colleges by public universities. In many cases, the acquired institutions switch to production of courses offered by the universities at degree, diploma and certificate levels. The effect is that universities are putting effort in services outside their core function, which should be production of the highest caliber of human capital for the society. The acquisitions also implied that the production of fewer diploma and certificate holders and university space being occupied by students who should be admitted in other tertiary institutions. This meant that institutions of higher education will be admitting very many students per year [4]. E-learning is therefore very effective in delivery of education to these students.

Some of the common e learning platforms found in Institutions of Higher Learning in Kenya are Moodle, Blackboard and Web Case Tools (WebCT). These are open source and therefore need to be customized to meet the end users needs. However a few of the institutions have opted to develop their own e-learning platforms so as to meet the needs of their students.

The physical organization of the chapters and concepts in this paper are as follows; Section one highlights the introduction and use of cloud computing for e-learning in Institutions of Higher Learning in Kenya. It brings out the definition of E-learning and also institutions of higher learning in Kenya. Section two lists the objectives that are expected to be met at the end of this research. Section three reviews the methodology used in the research. The primary aim of the study is, interpreting the implications caused by use of cloud computing for e-learning by institutions of higher learning in Kenya; this is by gathering data from key players in these institutions by use of interviews. Section four highlights the data collection method used which is interviews. Section five identifies the technology used in using e-learning. Section six describes the various developments derived from the research and the results of the research. Section eight discusses the conclusion and the recommendation of the research which has the summary of the achievements, further work needed and recommendations provided.

2. Objectives

The objectives of this paper are:
1) To determine the extent of the use of cloud computing for E-learning Institutions of higher learning in Kenya.
2) To determine whether the Institutions of higher learning have the capacity like access to internet and infrastructure to introduce and ensure use of cloud computing for e-learning.
3) To investigate the impact of the use of cloud computing for e-learning in institutions of higher learning in Kenya to both students and the lecturers.
4) To make recommendations for effective use of cloud computing for e-learning in institutions of higher learning.
3. Methodology

This paper informs on an investigation and analysis of the issues within the academic and technical aspects that challenges the use of cloud computing for e learning in institutions of higher learning in Kenya.

Data for this study was essentially drawn from interviews with university lecturers, information technology personnel and Information technology managers. The data analysis method that was applied was typically qualitative data analysis. The paper considers this design appropriate since it guides in gathering of reliable data.

3.1. Population Sampling

Target population is the entire set of units for which the study data are to be used to make inferences. It defines those units for which the findings of the study are meant to generalize [2]. The target population will be ten institutions of higher learning in Kenya namely; Jomo Kenyatta University, Moi University, Kenyatta University, The University of Nairobi, Maseno University, Egerton University, United States International University, Nazarene University, Kenya Methodist University and Catholic University. The study population comprises of Information Technology managers, lecturers, information technology students and information technology personnel.

<table>
<thead>
<tr>
<th>Category</th>
<th>Population</th>
<th>Sample</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecturers</td>
<td>50</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>I.T Managers</td>
<td>10</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>I.T personnel</td>
<td>30</td>
<td>5</td>
<td>16.7</td>
</tr>
<tr>
<td>I.T Students</td>
<td>1000</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>TOTAL</td>
<td>90</td>
<td>35</td>
<td></td>
</tr>
</tbody>
</table>

3.2. Sampling Design

There are two alternative approaches for determining the size of a sample. The first approach is to specify the precision of estimation desired and then to determine the sample size necessary to insure it. The second approach uses Bayesian statistics to weigh the cost of additional information against the expected value of the additional information [3].

4. Data collection

In this paper, interviews were conducted so as to find out the adoption process and the decision behind it, the research is an exploratory research [3].

Interviews can be done in different ways when it comes to research. Open ended, closed, standardized, general and informal interviews. The researcher opted to gather most of the information and data in form of interviews. It could be good to have some sort of other gathering method to get better reliability but interviews worked as a good source [6].

The researcher conducted interviews with the following institutions of Higher Learning in Kenya: Jomo Kenyatta University, Moi University, Kenyatta University, The University of Nairobi, Maseno University, Egerton University, United States International University, Nazarene University, Kenya Methodist University and Catholic University. The approach was mostly informal in the first interview with some initial questions that were provided in advance. The reason of the approach was that the researcher wanted to have the interviewees to take part and talk without restraint about the subject. Trying to get as much data as possible from the sessions, interviews were written down from the talk so it was in text. It had to be done right away so as to not lose any data.
5. Technology Description

The National Institute of Standards and Technology (NIST) defines cloud computing as “a model for enabling convenient, on demand network access to a shared pool of configurable computing resources (e.g., network, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction” [9]. The use of cloud computing therefore benefits many institutions of higher learning and they are able to store their data at a low cost. This cloud model promotes availability and is composed of five essential characteristics and three service models and four deployment models”. Cloud computing is a mechanism that enables management of computing and IT infrastructure to be consolidated in one or more data centers to reduce the overall cost of operating computing facilities. As a form of outsourcing of IT components that comes in many forms, from the use of third-party resources to store data to delivery of IT services within an enterprise, cloud computing is based on virtualized infrastructure, self configuration, and automated provisioning. The concept incorporates infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS) as well as Web 2.0 and other recent technology trends that have the common theme of reliance on the Internet for satisfying the computing needs of the users [5].

Institutions of higher learning can benefit by use of cloud computing for their e learning models. They students can be in able to access learning materials from anywhere.

6. Developments


As part of socio-economic pillar, the need for skilled labour force, which requires advanced training at degree level, was realized and necessitated the development and expansion of university education. This was however, further reinforced by the increasing Kenyan population and due to the fact that it was also recognized as an essential ingredient in achieving the country’s vision 2030, the main national flagship project for socio-economic development agenda [8].

E-learning enhances the level of high quality education that students receive from Institutions of Higher Learning.

<table>
<thead>
<tr>
<th>STRENGTH</th>
<th>WEAKNESS</th>
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<tbody>
<tr>
<td>• Access of information from any computer irrespective of geographical location.</td>
<td>• Low internet connectivity</td>
</tr>
<tr>
<td>• Enhances easy communication between lecturers and students.</td>
<td>• Poor infrastructures like few computer laboratories.</td>
</tr>
<tr>
<td>• Makes registration easy.</td>
<td>• Lack of enough technical skilled lecturers.</td>
</tr>
<tr>
<td>• Economical, no need for students to photocopy notes. They download at their convenience.</td>
<td>• Some of the platforms like moodle are open source, so they have to be highly customized to meet the students and the lecturer’s needs.</td>
</tr>
<tr>
<td></td>
<td>• Moodle lacks a help button, students who are not computer literate have a hard time navigating through it.</td>
</tr>
</tbody>
</table>
### OPPORTUNITIES
- Learning new skills.
- Being marketable in the industries.
- High chances of good jobs.
- Allows the student to get feedback from the lecturers.
- Students can easily interact with each other and also with others from different parts of the world.

### THREATS
- Technological challenges
- Privacy issues
- Security issues

7. **Benefits of Cloud Computing**

The target population will be ten institutions of higher learning in Kenya namely; Jomo Kenyatta University, Moi University, Kenyatta University, The University of Nairobi, Maseno University, Egerton University, United States International University, Nazarene University, Kenya Methodist University and Catholic University. The study population comprises of Information Technology managers, lecturers, information technology students and information technology personnel.

The respondents of the sample data found that they were able to get information from any computer irrespective of geographical location. The students also realized that they were able to communicate to the lecturers in a more efficient manner. They were also able to register for new courses easily. They students also did not need to photocopy notes because they were able to download them at their own convenience.

8. **Conclusion and Recommendations**

Cloud computing will therefore facilitate e-learning in Institutions of Higher Learning in Kenya. The lecturers will be in a position to upload their notes and also the semester’s calendar in advance. This leads to convenient teaching for both the lecturer and the student.

Kenya Vision 2030 is the country’s “development blue print designed to transform Kenya into a newly industrialized middle income country providing a high quality life to all its citizens by the year 2030” (Government of the Republic of Kenya, 2007). This will be achieved by providing globally competitive quality education, training and research to all citizens for their development and enhanced individual well being (Kenya Vision 2030—The Popular Version, 2007).

Institutions of Higher learning being answerable to the public as stakeholders need to guarantee that they offer quality teaching, research and community service to its students. With the increasing numbers of students seeking places in public universities, the question of quality is critical.

The paper concludes that institutions of Higher Learning that use cloud computing to facilitate e-learning have students that perform better and therefore have relevant knowledge and skills that the market needs. More Institution of Higher Learning should be encouraged to use this form of technology if the country is to achieve its Vision 2030.

While this paper covers both internal and external factors, nevertheless for future research a study based on software user ability measurement inventory is recommended. This is because it approaches the evaluation based on the user’s perception. Also the institutions of higher learning needs to focus more on the user interactivity with the platforms.
Reference