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Cloud Computing: Solution to ICT in Higher Education in Nigeria

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ABSTRACT

Information and communication technologies (ICT) have become commonplace entities in all aspects of life. Across the past twenty years the use of ICT has fundamentally changed the practices and procedures of nearly all forms of endeavour within business and governance. Within education, ICT has begun to have a presence but the value of ICT is not affordable. Unfortunately, there are some limitations confronting institutions in Nigeria from infusing ICT. The basic principle of cloud computing entails the reduction of in-house data centres and the delegation of a portion or all of the Information Technology infrastructure capability to a third party. This holds the promise of driving down cost while fostering innovation and promoting agility. Institutions of higher learning, such as Universities and Colleges, are the core of innovation through their advanced research and development. Subsequently, Higher Institutions may benefit greatly by harnessing the power of cloud computing, including cost cutting as well as all the above types of cloud services. This paper explores the application of cloud computing in higher education in Nigeria, issues with ICT in Nigeria and touches upon some aspired benefits as well as expected limitations of cloud computing.

Keywords: ICT, Cloud Computing, Higher Education, Security, IaaS, PaaS, SaaS.

INTRODUCTION

Cloud computing is a recent concept that is still evolving across the information technology industry and academia. Several definitions have evolved so far, the National Institute of Standards and Technology [4], defines cloud computing as "a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction[5]. Three typical kinds of cloud computing services are: Processing Clouds that provide scalable and mostly affordable computing resources that run enterprise programs, which is also sometimes known as Infrastructure as a service (IaaS), Storage Clouds that offer an alternative to local file systems also known as a Platform as a Service (PaaS), and Application Clouds also called Software as a Service (SaaS), that allow a thin client to interact with services that are completely hosted on an external infrastructure.

Similarly, cloud may be hosted and employed in different fashions, depending on the use case. [7] state the use or deployment type of cloud computing as; Private Clouds: this is typically owned by the respective enterprise and / or leased. Functionalities are not directly exposed to the customer, though in some cases services with cloud enhanced features may be offered – this is similar to (Cloud) Software as a Service from the customer point of view. Example: eBay, Public Clouds. Organizations may use cloud functionality from others, respectively offer their own services to users outside of the company. Providing the user with the actual capability to exploit the cloud features for his / her own purposes also allows other enterprises to outsource their services to such cloud providers, thus reducing costs and effort to build up their own infrastructure. As noted in the context of cloud types, the scope of functionalities thereby may differ. Example: Amazon, Google Apps, Windows Azure. And Hybrid Clouds. Though public clouds allow enterprises to outsource parts of their infrastructure to cloud providers, they at the same time would lose control over the resources and the distribution / management of code and data. In some cases, this is not desired by the respective enterprise. Hybrid clouds consist of a mixed employment of private and public cloud infrastructures so as to achieve a maximum of cost reduction through outsourcing whilst maintaining the desired degree of control over e.g. sensitive data by employing local private clouds. There are not many hybrid clouds actually in use today, though initial initiatives such as the one by IBM and Juniper already introduce base technologies for their realization [6].

This paper addresses various aspects of computing requirements in general, and as applied to university settings in specific, and will attempt to tie these aspects to typical decision criteria to move to cloud computing, such as cost and unsteady and inadequate power supply. The paper concludes with a set of recommendations and plans for future work.

2.0 ICT in Higher Education in Nigeria

A basic understanding of ICT in education is vital in keeping abreast of rapidly changing technologies. Emphasis has been laid on IT in administrative and financial transactions, wireless and mobile communications with promising results, Funding projects in this direction has yielded proportionate outcomes too in developed and developing countries in the world. However, the infusion of ICT in Higher education in Nigeria is still at infant age couple up with issues that are limiting it. [8] identify some issues that are limiting the infusion of ICT in Nigeria as;

- Scarcity of ICT Infrastructure and Lack of Access

The underlying assumption for ICT in education is universal access to the network. Although some progress has been made in this front, there is urgent need to break the crippling access barrier confronting institutions of higher learning in Nigeria. The profile is vastly different from campus to campus. Some have Campus Area Networks (CAN) backed by wireless narrowband or fibre-optic backbone; some have only internet cafes with grossly insufficient computers for the user base with a 50:1 ratio being typical and others have departmental LANs. The expected quality and performance will correspondingly be low. Web based education in the form of online, mobile and distance education requires reliable computer networks, broadband connectivity, fibre-optic backbones for all the bandwidth hungry applications and to interconnect offices, departments and centres to the public internet via the campus area network. High student enrolment, inadequate funding of universities and lack of technology budget exacerbate the problems of ICT infrastructure.

- High cost to the Consumer

The cost to the consumer of ICT services is quite expensive. Staff, students and researchers visit on-campus business cyber cafes to use the Internet. In these cafes, the average cost of browsing is N150 to N300 per hour, which is between $1 to$2 per hour . As a result of the high cost, student and staff browse only when absolutely necessary. One could get a home internet subscription of N450 of slow and on and off internet connectivity to N750 of stable and fast access. Mobile companies also sales modem e.g (Zain, MTN, glo etc) which cost are on the high side and are not reliable, must a time. A fortune could therefore be spent on Internet connectivity alone.

- High Cost of Ownership

There is a realisation in Nigeria that the government alone cannot adequately shoulder the high cost of quality education in the 21st century. Partnership between government, industry and stakeholders appears to be the preferred option. In Nigeria a number of organisations for example, Education Trust Fund (ETF), Petroleum Technology Development Fund (PTDF), National Information Technology Development Agency (NITDA) etc donate ICT laboratories equipped with 20 – 50 computers to some tertiary institutions. In addition they pay for one year or two years internet subscription and mandate the recipient institution to sustain the facility. Most of these laudable efforts have failed because the recipients were unable to pay for the high cost of equipment renewal, maintenance and bandwidth. This is because network costs in Nigeria consist of not only capital cost but also high operating cost. Thus the cost of ownership is very high. This factor is not yet appreciated by donors.

- Unsteady and Inadequate Electrical Power Supply

The irregular supply of electrical power has crippled the Nigerian economy and hindered the progress of research carried out by institutes, groups and individuals in the country. It is maddening for any establishment to start off new projects without addressing the almighty power supply problem. It is even worse to embark on extensive ICT project within an educational institution, without solving power problems first. The Federal government is however, working towards improving the generation of enough megawatts of power in the country. The average power supply in the year 2008 was about 4hrs/day. Alternate sources of power are standby generators, batteries and solar panels. The premier universities cannot foot the bill of maintaining several standby generators that gulp down 10 – 30 litres of diesel per hour; nor can they purchase enough solar panels to go round the campus. Not all local ISPs can maintain their boosters for 24hrs due to high cost of gas; and many subscribers cannot use the Internet effectively as there is hardly electrical power to do as wished. Sometimes, in the country, low voltages that do more harm than good is supplied. When power is rarely supplied, the admirable goals of transforming education with ICT and taking a paradigm shift in education is all a dream; having access to educational resources on demand, anytime, anyhow and anywhere is a story; e-learning would not be sustained either.

3.0 Concern Over adoption of Cloud computing

There are several obstacles that cloud computing faces before adopted. A research conducted by the IDC Enterprise Panel [4] 2008 concluded that the primary concerns are of various levels expressed are:

1. Security: there are several concerns surrounding the implementation of security in cloud computing.

2. Performance and Availability experiments that are required for research endeavours require extensive computing power. Some of the concerns include how to guarantee such performance from an outside vendor. Availability of services is another related concern in terms of the possibility of massive vendor outages. This is especially true since it may impact student learning or the timely delievery of research results, which are typically tied to strict timelines.

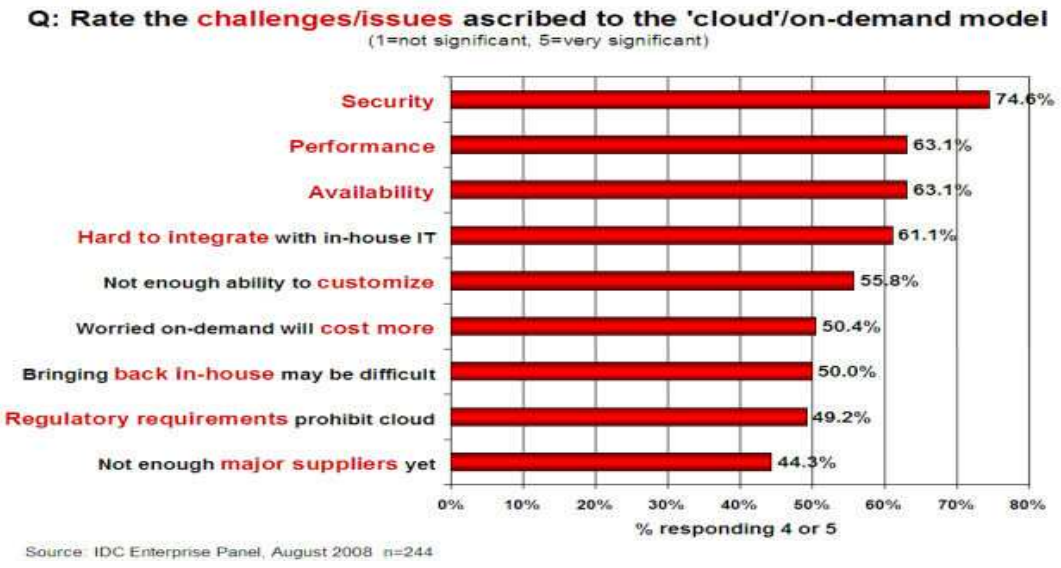
3. Integration with In- House IT and Customizability: University IT administrators typically use their own house applications with a considerable portion that is customized to their own IT lab structure. A paramount concern is the transitioning of such in house applications to the cloud environment and how much of the customizability will be lost in that process.

4. Cost is another factor that may be introduced by additional vendor relationship management or possibly additional measures that are unique to cloud computing.

A primary concern that cloud computing adopters have is the security of enterprise information. Data placed in storage clouds, can potentially be located in, and sent across the communication channels of different country, with potentially different data privacy laws, and therefore expose potentially sensitive data to the prying eyes of unauthorized individuals. However in a sense, this is not much different than the current outsourcing endeavours that tend to make such information available to various users and administrators in an offshore location, such as in the case of call centres that are located in various countries. [3] Indicates that the majority of intellectual property breaches typically result from internal attacks and therefore do not impact the decision whether or not to adopt cloud computing. On the other hand, in a higher education setting, this can become more challenging especially with research projects that address issues of national security or hospital patients' confidentiality.

Some of the challenges and issues ascribed to the cloud computing/ on demand model as describe in [8] is shown below.

Fig 1 Challenges anticipated from adoption of cloud computing (NIST, 2009)



Some of the challenges of cloud computing to higher education adopters are; how seamless the integration can be and how effective it will be in maintaining confidentiality, data integrity and availability, another challenge is Application problem resolution and auditing, finally the major

challenge is moving their data to an external provider while such sites are likely equipped with a disastrous recovery and business continuity capabilities.

RESULTS AND DISCUSSION

Despite the fact that cloud computing is a relatively young concept with many questions still open, there is overpowering agreement regarding the potential of this concept in advancing technology and providing new avenues for enterprises to explore that may cut cost and adopt better IT capabilities. Furthermore, new advanced network technologies make the move to cloud computing a logical choice[4]. From a financial perspective, purchasing, installing, and maintaining extensive hardware for high-powered servers contribute to some of the higher budgets that universities are currently forced to allocate. This is paired with the high cost of licensing for the software packages that are scattered across campuses. In contrast, adoption of a cloud environment relieves the institution of the need to acquire an actual costly server in order to conduct research. The prospect of a maturing cloud of on-demand infrastructure, application and support services is important as a possible means of; Driving down the capital and total costs of ICT in higher education, Facilitating the transparent matching of IT demand, cost, and funding, Scaling ICT, Fostering further ICT standardization, Accelerating time to market by reducing ICT supply bottlenecks, Countering or channelling the ad hoc consumption of enterprise ICT services, Increasing access to scare ICT talent, Creating a pathway to a 24 x 7 x 365 environment and enabling the sourcing of cycles and storage powered by renewal energy, and increasing interoperability between disjointed technologies between and within institution.

Researchers are provided with the ability to leverage the "rent-by-the-hour" or "pay-as-you-go" concept to rent computing and storage horsepower such as Amazon's Elastic Cloud Computing (EC2), which claims to provide "resizable compute capacity in the cloud [1].

The Electrical Engineering and Computer Sciences Department at the University of California at Berkeley had a first-hand dealing with this matter. They indicated that their lab "has benefited substantially from the ability to complete research by conference deadlines and adjust resources over the semester to accommodate course deadlines." As adopters of cloud computing, they "were relieved of dealing with the twin dangers of over-provisioning and under provisioning our internal data centres[2]. Adoption of cloud computing permits significant savings in the area of supportive technologies, such as the massive air conditioning that is typically installed in university in-house server rooms in order to maintain a required level of temperature. Furthermore, there are additional savings that could be achieved in terms of physical security requirements for such rooms, like fortified safes and advanced door locks. Complexity can be reduced with cloud computing.

The varieties of disciplines that are inherent within a university learning environment impose the need for a variety of hardware and software platforms that are installed on campus. This contributes to the increase in the complexity of such platforms, which adds to the already challenging tasks of ICT administrators, including those that manage network and software. This can be even more detrimental with the budget cuts that affect the allocation of sufficient ICT staff, thus overwhelming these administrators even further. The adoption of cloud computing is hoped to relieve these administrators from such burden. However, adoption has to be planned carefully as different applications make different usage of resources.

Several issues hindering ICT in Higher Education in Nigeria were pointed out and benefits of the transition to cloud computing were also discussed in this paper along with concerns regarding

the general implementation. The key question remains whether or not it makes sense from a business and strategic point of view to move to cloud computing. And the possible answer is yes, since it will in some way solve almost all the issues hindering ICT in the country. One main conclusion that we draw from this research is that cloud computing may have considerable potential in improving the ICT application and infrastructure at higher education institutions. However, since this field is still relatively young, it is strongly recommended that early University adopters, plan the transition carefully and keep in close contact with organizations that establish industry standards, such as NIST, in order to ensure a uniform and smooth transition. Another outcome is that it may be practical to follow a hybrid approach whereby, depending on the evaluation of the factors outlined above, university ICT management and administration may decide to pursue a hybrid approach thus transitioning some application and data to cloud computing while leaving others to be served in-house.

CONCLUSION

Cloud computing technology is still relatively young in terms of maturity and adoption. The expectation is that it will undergo several changes in the future, in terms of resources, issues, risks, and ultimately best practices and standards. However, there are some sought of greet advantages it can potentially provide value for institutions of higher education. On-demand services can reverberate positively with the current university tight budgets across the nation and other parts of the world.

REFERENCES

[1] Amazon Elastic Compute Cloud." Retrieved from http://aws.amazon.com/ec2/.
[2] Armbrust, Michael, Armando F. Above the Clouds: A Berkeley View of Cloud Computing." Technical Report No. UCB/EECS-**2009**-28, Electrical Engineering and Computer Sciences, University of California at Berkeley.**2009**.
[3] Creeger Mache. Cloud Computing: An Overview." ACM Queue, Association for Computing Machinery.**2009**.
[4] NIST. Presentation on Effectively and Securely Using the Cloud Computing Paradigm v25. **2009**.
[5] Mell Peter and Tim Grance .Draft NIST Working Definition of Cloud Computing. **2009**.
[6] Sims, K. IBM Blue Cloud Initiative Enterprise Cloud Computing **2009**.
[7] Wikipedia. Cloud Computing. http://en.wikipedia.org/wiki/cloud-computing
[8] Ekundayo H. T and Ajayi I. A. Towards effective management of University Education in Nigeria. Academic Journal. **2009**.