

Analysis of Cloud Solution Adoption in Higher Learning Institutions of North-Western Region of Nigeria

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Abstract

This study investigates the trends of cloud computing adoption in higher educational institutions of North-western part of Nigeria. A sample size of 252 IT related staff was selected from different higher educational institutions of the study area using stratified random sampling technique with the aid of well-structured questionnaire. Copies of the questionnaire were administered to twenty one (21) different higher educational Institutions of north-western part of Nigeria; 223 were returned which is 88.49% of the research population.

The results have shown high level of cloud computing awareness but the level of adoption in teaching and learning processes is very low. Achievable benefits of cloud solution adoption in education process were discussed and important recommendations were provided for the institutions willing to adopt the cloud solution in education process.

Keywords: Cloud Computing Awareness, Education Process, Infrastructure as a Service, Platform as a Service, Software as a Service.

1.0 Introduction

Education in many developing countries is in bad shape and crying for salvation. The dream of every parent is for their children to acquire good quality education, unfortunately for some countries with large population, inadequate learning institutions, inadequate qualified academic staff, limited budgets and resources that dream may not likely become a reality. Many companies such as Amazon [1], Google [2], Microsoft [3], iTunes University by Apple [4] etc., are providing cloud services applicable in teaching and learning processes to educational institutions almost free of charge, when such services are properly adopted and utilized by educational institutions, that will break down the existing barriers between well-being institutions and less privileged institutions, and the underdeveloped institutions will definitely prosper, be in line with today's technological world, achieve desired educational objectives and subsequently increase the institution's rating all at a little or no cost.

With cloud computing and continuous proliferation of the use of modern communication devices such as portable PCs, smartphones, touchscreen tablets, e-readers etc., among the students and staff, things such as collaborative learning (e.g. the exchange of documents and sharing of ideas between the students and their teachers, and between the students themselves, not necessarily of the same institution but with the students or teachers from other institutions far or near, conducting group projects or team works, consultations, interactive lessons), intelligent classrooms, virtual lecture theatres, easy access to educational resources anytime and anywhere, organizational works could all become a reality especially to less privileged institutions. That will provide the students with an opportunity to learn outside the school premises, on a sick bed, as well as outside the school calendar (holidays, ongoing learning after school or postgraduate training).

Reliability, availability, easy scalability, almost zero maintenance costs are some of the key advantages of cloud solution. Considering these advantages, some educational institutions have rushed to start using cloud services in education process and with such a clarion call many are expected to join them. Hence in the near future most of educational services would be provided on the basis of cloud computing, and this will lead to abandoning of traditionally owned IT-infrastructure and traditional teaching tools and techniques. The cloud computing technology will help in broadening the accessibility of education to the people in remote and underdeveloped communities, where there are no skilled teachers, latest text books, lab

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facilities, etc. It is very important for the educational institutions' management to have a solid understanding of how cloud computing is evolving and the trends of its adoption in education process.

With all the above stated, we deemed it very important to study and analyze the trends of cloud solution adoption in higher learning institutions of North-Western region of Nigeria and offer important recommendations to institutions willing to adopt the cloud solution. Section I of the paper provides the background of the study. Section 2 discusses on the cloud computing architecture and its service models. In section 3 the objectives and methodology of the research would be provided. Section 4 provides the results of the research and the results are discussed in the section. In section 5 achievable benefits of cloud usage in education process are provided and in section VI recommendations are offered. Section VII concludes the paper.

2.0 Cloud Computing Architecture And Its Service Models

Cloud computing is an emerging computing paradigm that provide computation, storage and communication resources as service based on user's need in a scalable and virtualized manner. Cloud computing enables massive scale sharing, which allow users to access technology enabled services without the knowledge of, expertise with, or control over technology infrastructure that supports them [5].

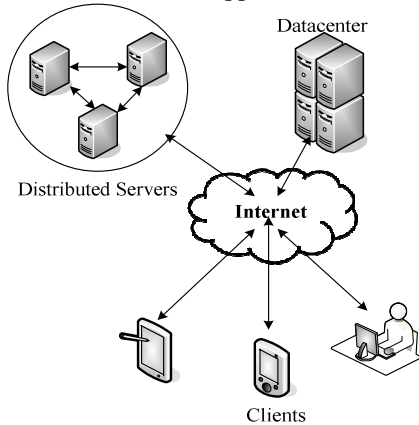


Figure 1: Cloud computing architecture

Generally cloud computing composes of three major components, namely: clients, datacenter and distributed servers (Figure 1).

Clients - clients are generally devices that end-users use to interact with and to manage their data on the cloud. Clients are of three types:

- i. **Mobile Clients** – mobile devices consist of personal digital assistants (PDAs), windows and android smartphones or an iPhone.
- ii. **Thin Clients** – are essentially computers that have no internal memory/hard drives, they depend on server for computational tasks, and all they do is to display the computational results.
- iii. **Thick Clients** – are just regular desktop computers with which users connect to the cloud using a web browser like Firefox or Internet explorer.

Datacenter - Datacenter is generally a collection of servers where the applications and resources to which a user subscribed to are stored. It could be a large room at the basement of the user's building or a room full of servers on the other side of the world that a user can access via the Internet.

Distributed Servers - Often servers are geographically located at different locations, instead of hosting them at only one location. But to the cloud subscriber, these servers act as if they are residing just next to each other. This provides more reliability and better security. For instance, Amazon [1], a cloud service provider company have their cloud servers all over the globe, if failure occurred at one server, the services would still be accessed through another server.

Traditionally cloud services are offered in three different models [5,..., 8], which are:

- i. **Infrastructure as a Service (IaaS)**
- ii. **Platform as a Service (PaaS)**
- iii. **Software as a Service (SaaS)**

Let's consider in detail each of the above cloud service models, since each one of them has a its targeted audience and a purpose, about which is necessary to have a precise knowledge of, before transiting from traditional IT paradigm to cloud computing.

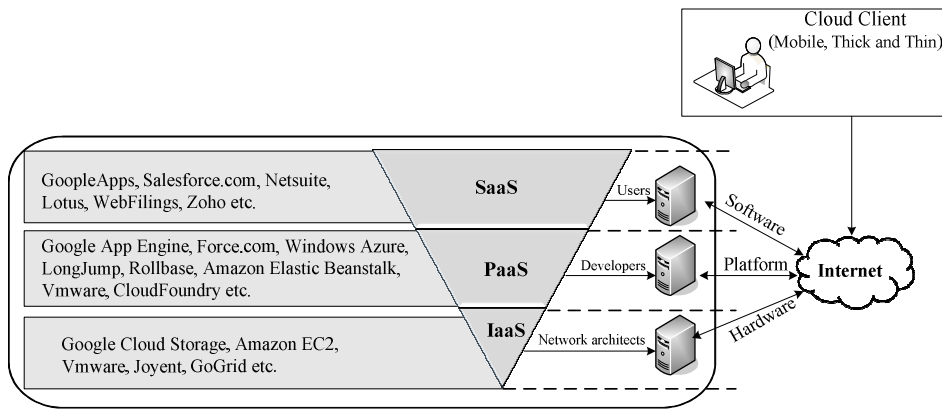


Figure 2: Cloud service models

On the Figure 2 above, a generalized scheme of the cloud service models is presented in a form of turned pyramid, which is divided into three layers, where the service models names are indicated at the centers of these layers. Upper layer of the turned pyramid contains all the features found at the layer beneath it. For instance, to provide the service “platform as a service”, the service provider must be able to provide the service “infrastructure as a service”.

On the left side of the turned pyramid, examples of the providers offering a service model are presented and on the right side of the pyramid the targeted end-users mostly use a service model are also shown.

Infrastructure as a service (IaaS): In this service model, a customer can independently create IT infrastructure on the cloud and control it in a virtualize form. For example, a user can create a virtual network, add virtual devices (e.g. server space, storage space, CPU cycles, memory, switches, routers and other network equipment) and install software packages as well as the operating systems necessary for the functionality of the constructed system. And in this case an educational institution will use the cloud provider’s machines as if it is using its real and traditionally owned IT-infrastructure. Additionally, the infrastructure can dynamically scaled up or down based on the application resource need. Some of the prevalent players in this service model are Amazon Elastic Compute Cloud (Amazon EC2) and GoGrid.

Platform as a service (PaaS): In this service model, cloud service provider offer all the resources required to build applications completely from the Internet without the need to purchase or download and install software systems. Examples of resources provided include, application design, tools for development, testing, deployment as well as hosting, operational systems, database control systems, etc. Thus, a customer will have the means and tools for independent development, testing and exploiting of own software system. In this case, however, all informational infrastructures (e.g. server spaces, storage spaces and other network elements) are controlled by the PaaS service provider. Below are the examples of some known PaaS.

- i. Google Apps Engine (for development of software in Java and Python);
- ii. Windows Azure (for ASP.NET and PHP);
- iii. Cloud Foundry (Programming languages, Java, Ruby, Scala).

Software as a Service (SaaS): In this service model, customer is provided with readymade software package as service by SaaS providers. All data are stored on the cloud; a customer is only required to have a web-browser in order to have access to them. This type of service model is the most relevant and more attractive to educational institutions than the other service models described above, because it does not in any way require extra cost for installation and setup of a software systems. It is important to note that in the majority of cases charges are made based on the number of users using a software package in SaaS, and enterprise-licenses that allow any quantity of users to have access to particular software package without any restriction is not offered in SaaS. In SaaS costs for accessing the software can be an ongoing thing, the more a customer uses it, the more the charges. Examples of free of charge SaaS for educational institutions are Google Apps for Education and Microsoft Live@Edu services (Microsoft Office 365 for education). They comprise of all the functions found in Office Package (e.g. working with documents, tables and presentations), means of communication (e.g. E-mail, calendar, instant messaging, etc.) as well as the effective means of information delivery (in the form of static presentations, video clips or interactive applications).

3.0 Research Objectives and Methodology

The major objectives of the research are:

- i. To study the awareness level of cloud computing in higher educational institutions of the study area;
- ii. To study the adoption level of cloud solution in education process in the institutions of the study area;
- iii. To study the concerns associated to the cloud solution adoption in the study area;
- iv. To offer recommendations for the cloud solution adoption.

This study is an empirical research which investigates the level of awareness, adoption and the concerns of cloud solution adoption in higher educational institutions of the study area. For the purpose of the study, a survey method was adopted [9]. Questionnaires were designed to generate data from the samples selected. The research population consists of academic staff in the computer and IT related departments and non-academic staff with interest in computer and IT related fields. To ensure that all parts of the population are represented in the sample and to increase the efficiency (i.e. to decrease the error in the estimation) a stratified random sampling technique was adopted in selecting samples.

In a stratified sampling a set of samples N with a population of $|N| = N$ is divided into K disjoint groups $N_1, \dots, N_k, \dots, N_K$, with $N_1 = |N_1|, \dots, N_k = |N_k|, \dots, N_K = |N_K|$ units. These groups are called strata, together they compromised the whole population, i.e. $N = \bigcup_{k=1}^K N_k$, $N = \bigcap_{k=1}^K N_k = \emptyset$, hence $N = N_1 + \dots + N_k + \dots + N_K$.

From each stratum, a sample of predefined size is drawn independently. Then the collection of these samples constitutes a stratified sample. If a simple random sample selection scheme is used in each stratum then the corresponding sample is called a stratified random sample and the process of getting such kind of sample is called stratified random sampling. Below are notations for stratified random sampling technique. Denote by j as a unit within k -stratum, n_k the total number of samples units in k -stratum and X_{kj} - the value of the characteristics for the j -th unit in k -stratum. Then

$$W_k = \frac{N_k}{N} \text{ - The weight of } k\text{-stratum.} \tag{1}$$

$$X_{k+} = \sum_{j=1}^{N_k} X_{kj} \text{ - Population total of X-values for units belonging to } k\text{-stratum.} \tag{2}$$

$$\bar{X}_k = \frac{\sum_{j=1}^{N_k} X_{kj}}{N_k} = \frac{X_{k+}}{N_k} \text{ - Population mean of X-values for units belonging to } k\text{-stratum.} \tag{3}$$

$$\sigma_k^2 = \frac{1}{N_k} \sum_{j=1}^{N_k} (X_{kj} - \bar{X}_k)^2 \text{ - Population variance of X-values for units belonging to } k\text{-stratum.} \tag{4}$$

$$\bar{X} = \frac{\sum_{k=1}^K \sum_{j=1}^{N_k} X_{kj}}{\sum_{k=1}^K N_k} = \sum_{k=1}^K \frac{N_k}{N} \frac{\sum_{j=1}^{N_k} X_{kj}}{N_k} = \sum_{k=1}^K W_k \bar{X}_k \text{ - Population mean of X-values.} \tag{5}$$

$$x_{k+} = \sum_{j=1}^{n_k} x_{kj} \text{ - Sample total of X-values for units belonging to } k\text{-stratum.} \tag{6}$$

$$\bar{x}_k = \frac{\sum_{j=1}^{n_k} x_{kj}}{n_k} = \frac{x_{k+}}{n_k} \text{ - Sample mean of X-values for units belonging to } k\text{-stratum.} \tag{7}$$

$$s_k^2 = \frac{1}{n_k - 1} \sum_{j=1}^{n_k} (x_{kj} - \bar{x}_k)^2 \text{ - Sample variance of X-values for units belonging to } k\text{-stratum.} \tag{8}$$

$$\bar{x} = \frac{\sum_{k=1}^K \sum_{j=1}^{n_k} x_{kj}}{\sum_{k=1}^K n_k} \text{ - Sample mean of X-values.} \tag{9}$$

The population selected was stratified according to their institutions. In each of the twenty one (21) institutions; twelve (12) respondents were randomly selected. Therefore, the sample size for the study was 252. In view of this sample size, 252 questionnaires were drawn and delivered to the sampled respondents. Among the 252 questionnaires distributed, 223 were returned. The Table 1 shows the questionnaire distribution among the population.

Table1: Questionnaires distribution among the research population

Institution	Number of Distributed Questionnaires	Number of Retrieved Questionnaires
Universities	84	75
Colleges of Education	84	68
Polytechnics	84	80
Total	252	223

The instrument for data collection was a well-structured questionnaire with four (4) parts. The first part covers vital bio data information about each respondent; the second part covers the information about the awareness and the adoption of cloud solution in education process while the third part investigates the concerns of the cloud solution adoption in the study area.

4.0 Results and Discussion

Each of the main research questions correspond to some aspects in the questionnaire, the results of the research on the level of cloud awareness, level of cloud adoption in education process as well as the concerns for the cloud adoption in higher educational institutions of the study area are presented and discussed in this section.

This section provides the demographic profile of the respondents as shown in Table 2:

Table 2: Demographic profile of the respondents

Category	Respondents	Respondents Frequency	Percentage (%)
Gender	Male	171	76.68
	Female	52	23.32
Qualification	Bachelor Degree	132	59.19
	Master’s Degree	69	30.94
	PhD	6	2.69
	Others	16	7.17
Age	Below 30 Years	101	45.29
	From 30 to 39 years	56	25.11
	From 40 to 49 years	39	17.49
	50 years and above	27	12.11
Years of Experience	Less than 5 years	69	30.94
	5 to 10 years	112	50.22
	11 years and above	42	18.83
Institution	Universities	79	35.43
	Colleges of educations	78	34.98
	Polytechnics	66	29.60

Research objective One: To study awareness level of cloud computing in the study area.

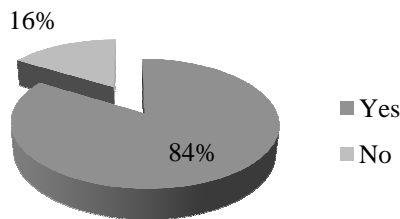


Figure 3: Awareness of cloud computing

Figure 3 above shows that 84% of the respondents are aware of cloud computing, which is significantly high. Further analysis would be conducted based on the information obtained from these 187 respondents who are aware of the cloud solution.

Research objective two: To study the adoption level of cloud solution in education process in the institutions of the study area.

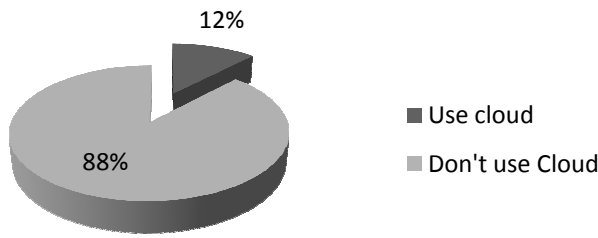


Figure 4: Cloud solution adoption level in education process

Figure 4 shows that 88% of the respondents in various institutions don't use cloud solution in their educational activities, only 12% of the respondents use cloud services in education process and hence the level of adoption in education process in the study area is very low. The next aspect of the research will investigate the possible reasons of not utilizing the cloud services (which are in most cases provided at a little or no cost) in education process.

Research objective three: To study the concerns associated to cloud solution adoption in education process in the study area. For measuring the concerns various factors were used along with five point likert scales. Figure 5 shows the responses of the respondents with regards to the concerns.

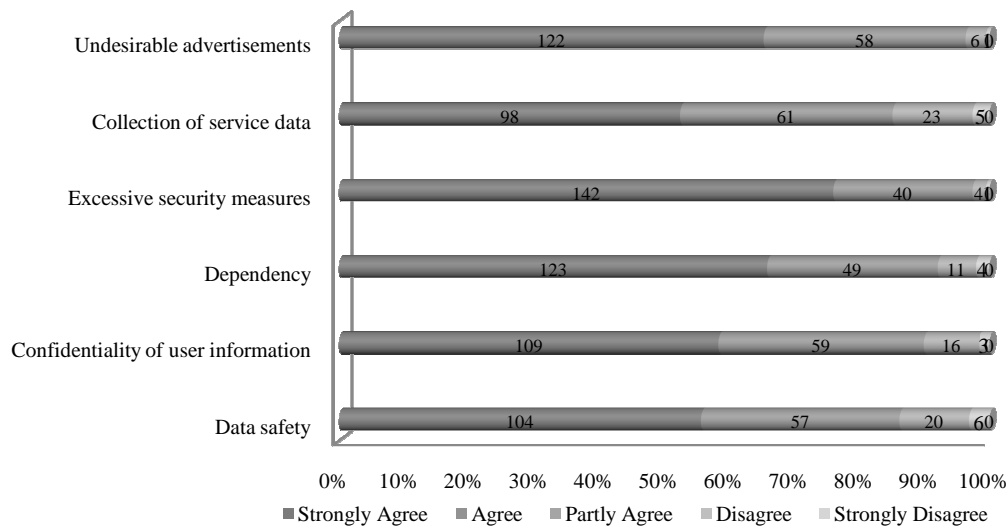


Figure 5: Respondents' views on the concerns for cloud solution adoption

- i. **Data safety.** The results obtained show that many of the respondents consider the safety of their data stored on the cloud as a concern for adoption (Figure 5).
- ii. **Dependency.** Majority of the respondents in the study area consider difficulties involved in changing a cloud service provider as one of the obstacle for cloud adoption (Figure 5).
- iii. **Excessive security measures.** Majority of the respondents consider excessive security measures by the service providers as a threat for cloud services adoption in education process (Figure 5).
- iv. **Undesirable advertisements.** Many respondents consider undesirable advertisements as nuisance while using cloud services in education process (Figure 5).
- v. **Collection of service data.** Some respondents consider collection of their data by cloud service provider to measure performance of their services as a cause for concern (Figure 5).
- vi. **Confidentiality of user information.** Majority of the respondents worry about the confidentiality of their information while using cloud services in educational activities (Figure 5).

Based on the results obtained above, we deem it important to clear the perceptions on the above concerns.

On the safety of data: Cloud computing had surfaced relatively recently, that is why some users have mistrust feelings towards it. It is quite difficult to some users to imagine a situation, whereby their confidential data are physically placed in data-centers located in other countries, which are perhaps parts of other continents. Actually there is no special cause to worry about data safety on the cloud. Data are usually encrypted while they are being transported in an open communication medium. Additionally, before signing a contract with the cloud service provider, there must be an agreement on nondisclosure of confidential data. The user (a student or staff of an educational institution) has the right to take a legal action against the cloud service provider in case of confidentiality violation or when a loss of data occurred, which can lead to a

huge legal cost and strong damage to the provider's reputation. That is why in the current condition of modern market competition, each cloud service provider tries to use best efforts to guarantee integrity and safety of data.

On dependency: Really costs for migrating from locally deployed IT-infrastructure to the cloud are quite significant, if for instance the cloud service provider ceased to satisfy the needs of an educational institution for one reason or the other, or if the charges for the services provided are increased, or if new service providers with high quality and cheap services emerged etc., to switch to another service provider will cost a lot and the process will last for a long time. The advice we can offer here is for the educational institutions to carefully and responsibly choose cloud service provider from the very beginning.

On excessive security measures issues: Actually cloud service providers reserve the right to block the delivery of any type message if it is necessary for the protection of their services or their clients. Cloud service providers treats the right of blocking e-mails essentially more widely, for example, any letter which the provider counts as a threat could be blocked for the protection of their clients. Unfortunately such strict spam detection method can lead to the blockage of practically many non-spam user e-mails. Although in practice, blockage of e-mails is connected in a greater extent to spam-message filtration, as such the educational institutions should note that using cloud mail server, any e-mail could potentially be blocked, which couldn't have been the case if the traditional e-mail server is used in the educational institution.

On undesirable advertisements: Unfortunately, according to the agreement for the provision of cloud services by some providers to educational institutions, the service providers reserve the exclusive right to sale and accommodate advertisements in the services offered, and the institution itself has no right to do so. The advertisement could be graphical (advertisement banners), textual (a running line) or in video and audio form. Though as stated in the agreement, the advertisements are for different type of provider's products as well as for the services the provider offers.

On collection of service data: At times cloud service providers can automatically compile, use and disclose some data from the user's device in order to analyze the performance of their services (if such disclosure will not lead to the identification of the user identity). Usually these sorts of information are not confidential; therefore such disclosure will not pose any risk to the user.

On confidentiality of user information: Actually while transferring personal data outside the limit of the country where a user is located i.e. to a third country, cloud service providers must observe the Safe Harbour Privacy Principles [10], with respect to collection, use and storage of data received from other countries. Additionally, all personal data of any user from the educational institution are protected in accordance with the 95/46/EC directives of European Parliament and the Council of the European Union [11].The disclosure of end user's personal information (including the contents of received or sent messages) can occur in the following cases:

- i. For granting answers to judicial inquiries or fulfilling the requirements of judicial bodies;
- ii. For the protection of the service provider's employees, clients or other persons.

4.1 Achievable Benefits of Cloud Adoption in Education Process

For cloud computing adoption in education process we can extract the following benefits.

On-demand self-service: A customer can independently choose the set of computing capabilities and resources for use (e.g., storage space, server space, network equipment, memory, CPU cycles etc.). However, a customer can scale up or down the resources as needed in an automatic mode without any human interaction or collaboration with the service provider. Cloud services are sometimes based on *pay per use mode*, i.e. customers pay only for actually consumed resources (e.g. the amount of transferred data, used bandwidth etc.)

Scalability of resources: Thanks to scalability, computing resources can easily be reduced or increased, based on the educational institution's need. In the case of high load on a service, the quantity of computing resources will promptly rise without significant preliminary investments, and if the load decreased, the resources will be reduced. The workloads dictate computing resources. If the educational institution will urgently need more computing resources, especially when the workload is at its peak (example, during academic session), the management does not need to spend time and monetary resources to purchase and install additional equipment and its related software package, which are afterwards rarely used or utilized by students or institution's staff. With local IT infrastructure, institution may unknowingly purchase under- or over-sized resources. Typically 50-90% of server capacity is unused.

Upgrades guarantee: The cloud service providers provide automatic update to IT equipment and the associated software in a centralized passion commensurate to the change in technology, this helps to ensure that all IT equipment and software packages are appropriate, relevant and up-to-date.

Cost savings: The use of cloud solution does not require capital expenses for creation and maintenance of own data processing centers, purchase of servers and network devices for the creation of own local IT infrastructure. Additionally, cloud computing eliminates operational expenses, since there is no need for the purchase and installation of expensive software packages, system updates, regular platforms, management skills, physical security for the premises where servers and other equipment are housed and payment of electricity charges for power consumed by equipment of the local IT infrastructure. All these expenses are shouldered by the cloud service provider.

Human resources savings: The main objective of any educational institution is to concentrate maximum effort on teaching, learning and researches. The use of cloud technology in an institution expunges the deployment of local IT infrastructure as explained above, subsequently the workload on technical personnel decreases or in other words, human resources are liberated, and as such they can be fully utilized in other important academic activities, rather than concentrating efforts on the locally deployed IT infrastructure.

Fault tolerance and high level of availability: Data-centers of cloud service providers are reliably networked together, where the participating nodes are strategically placed at various corners of the world. Fault-tolerance of such networks is obviously above that of any local network, since it is designed with reiterative redundancy and the data-centers are under the control or serviced by highly qualified technical personnel. As a result, such distributed networks provide services with high level of availability. Many educational institutions cannot afford to establish such a distributed network system. Availability of most cloud services is around 99.5% (of all time), and some cloud service providers guarantee availability up to 99.9%. This makes the cloud service more comfortable for teachers and students, because with high availability, the dream of learning anything, anywhere and anytime can become reality, without depending on the local educational resources of the institution. Besides that, constant availability removes the obstacles for distance learning, for instance in remote regions, where a time difference could affect the learning process or for people in remote communities, that cannot afford for transportation to the Institution. High availability of educational resources will favorably influence the rating of educational institution.

User satisfaction: Cloud technology offers more advantages to end users. It is very convenient when data are accessible from anyplace, anytime using devices such as personal computers, smartphones or tablets; the only thing required is an access to Internet. Users do not need to bother themselves about data backup copies; data are safely stored on the cloud, since the cloud infrastructure guarantees the safety of data. Teachers and students do not need to purchase, install expensive educational software packages and update them regularly on their devices, everything is provided by the cloud service provider, the only thing required is, users to regularly update their web-browsers.

4.2 Recommendations for the Choice of Cloud Service Provider

Certain aspects are very essential to consider before adopting the cloud solution, in this section, some very important criteria are recommended for consideration before the total migration to cloud.

Functionality: Before choosing a cloud service provider it is important to consider the institution's requirements and the possibilities of using other programmes while working on the cloud. For instance, for office packages the need will be to list all the supported formats and their compatibility with other cloud and non-cloud applications, possibility of their export to other formats. It is also important to assess the maximum storage capacity offered to each user. Additionally, it is necessary to analyze additional functionalities of the applications offered by the service providers, which will add "zest" to their usage in teaching and learning activities (such as ability to send a notification message on the time shift for forthcoming examination or lecture to all the students instantly etc.)

Platform: Nowadays developers of web-browsers are doing their best to make sure that web-page contents are displayed correctly regardless of the kind of operating system used by a concrete user. But nevertheless the educational institution should give a special attention on the choice of basic platform, it is especially important for all the users to adopt the platform recommended by cloud service provider in order to enjoy high level functionality e.g. to recommend users to install and use a specific operating system recommended by a service provider in order to ensure better compatibility and high response speed.

Testing technical features and simplicity of the system: Before totally transferring working processes on to the cloud, it is required to test the technical features of the system by conducting some routine actions on an automation mode. It is important however, before choosing a cloud service provider to consider how friendly the system is to users. User friendly interface will allow users to carry out a task before them more effectively. Many cloud service providers give free of charge test period, hence it is recommended to organize a control group consisting staff and students, which would test the comfort and simplicity of the use of the system. People with disabilities may perhaps be among the users of the chosen system, therefore they must be taken into consideration while testing simplicity.

Contract agreement: It is necessary to analyze the terms and conditions given by the provider in the contract agreement. Special attention should be given to the following items: validity of the contract; penalties for early termination of the contract; possibility of migrating data to external sources or systems; initial and subsequent charges for the services. In accordance with the service level agreement, there must be a specified compensation in the case of failures while using the system. It is however important to assess the scope of the guarantee, especially for the cases where the services are provided free of charge. Before adopting such services it is recommended to know the opinion of other users, who have already been using the services of the provider on the effectiveness and reliability of the services. Even though cloud services are very easy to use, it is very important to consider the possibility of rendering technical support in certain situations, in such cases it may appear more favorable to order for a paid technical support from the cloud service provider, than to outsource technical supports locally.

Charges: While planning budget for migration to cloud it is necessary to estimate and consider not only the charges of the cloud services, but also to estimate and consider all the accompanying expenses, which could be expenses related to management of the project, coordination and technical realization of the project, various legal consultation associated to the contract conclusion, works on initial training of users on how to work with the system etc.

5.0 Conclusion

The research was conducted to analyze the cloud solution adoption in higher educational institution of the north-western region of Nigeria. The results showed high level of cloud solution awareness among the population selected for the study. Despite the high level of awareness, the results showed very low level of adoption in the study area. The concerns for the cloud adoption in the study area were studied, and respondents are largely concerned on the excessive security measures by the providers, dependency on a particular provider as well as safety and confidentiality of user information. The concerns for the cloud adoption were discussed to clear the general perceptions. Achievable benefits of adopting the cloud solution in education process were discussed. And finally based on the general results obtained, recommendations are offered to educational institutions willing to adopt the cloud solution in order to ensure smooth transition from locally deployed IT facilities to the cloud and to ensure effective use of the cloud services.

6.0 References

- [1]. Amazon. aws.amazon.com. Feb., 2016.
- [2]. Google Apps for Education. www.microsoft.com/enterprise/it-trends/cloud-computing/. Feb., 2016.
- [3]. Microsoft Live@Edu. [Http://products.office.com/en-IN/student/office-in-education/](http://products.office.com/en-IN/student/office-in-education/).
- [4]. iPad in Education. www.apple.com/education/ipad/itunes-u/. Feb., 2016.
- [5]. Anthony T.V., Toby J.V., Rober E. Cloud computing: A practical approach. ISBN: 978007162695-8. MHID: 0-07-162695-6. McGraw-Hill.
- [6]. The National Institute of Standards and Technology. "The NIST definition of cloud computing". September 2011. NIST Special Publication, 800-145.
- [7]. Shuai Z., Shufen Z., Xuebin C., and Xiuzhen H. Cloud computing research and development trend. Second International Conference on Future Networks, IEEE. 2010, pp. 93-97.
- [8]. Vaquero L.M., Rodero-Merino L., Caceres J., Linder M. A break in the clouds: towards a cloud definition. *Computer Communication Review*. 2009, v.39, pp. 50–55.
- [9]. SamahSadeq A. "Student's Awareness of Cloud Computing: Case Study Faculty of Engineering at Aden University, Yemen". *International Journal of Engineering Development and Research IJEDR* Volume 2, Issue 1, 2014, pp. 22 -29.

- [10]. U.S.-EU Safe Harbor Framework. A guide for self-certification. Published by US Department of Commerce, 2009.
- [11]. Directive 95/46/EC of the European Parliament and of the Council, 24th October, 1995. Official Journal of the European Communities, 1995, v.6, pp. 31-39