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Systematic Analysis of Enterprise Perception towards Cloud Adoption in the African States: The Nigerian Perspective

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Abstract

The desirous benefits of cloud computing such as high return on investment through efficient resource management, high application throughput and on-demand capabilities have resulted in the unprecedented global acceptance of the computing paradigm. However, research on cloud adoption indicates that fewer organisations in the African states are adopting cloud services. Thus, the purview of the paper is to examine the factors responsible for the poor adoption of cloud computing in most African enterprises using Nigeria as a case study. The study focus on the perception of IT and non-IT employees towards cloud computing. Moreover, the paper reviews the literature on cloud adoption in organisations and from scholars to identify the motivating factors of cloud computing. A proposed 3AI model was conceptualised for analysing the processes involved in adopting cloud services. Research finding identifies employee misconception of job loss, cyber threat, privacy issue and data theft as strong delimitative factors.

Keywords

INTRODUCTION

Cloud computing in recent years has become the de facto information technology (IT) standard due to its ubiquitous characteristics. Cloud computing is a trending IT paradigm, as various organisations are increasingly exploiting its various desirous benefits to leverage their IT opportunities with innovative and flexible business processes (Isaila, 2013). Cloud computing technology operates on a service-based architecture where utilisation and consumption of computing resources are provided as infrastructure cloud. Moreover, the architectural structure of cloud computing necessitates the use of the internet, which enables service providers the capability to provide various cloud services in form of software, hardware, storage and resources (Malik, Huet, & Caromel, 2012). However, unlike managed service provider (MSP) platform, cloud computing offers service flexibility to users, as service clients can specify the amount of computing power and applications required to meet their business needs over a vast geographical distance (Idris, Anuar, Misron, & Fauzi, 2014; John W. Rittinghouse, 2010) Cloud flexibility can be illustrated with a cloud user working at MTN Group headquarter in Johannesburg, South Africa during the day time, and accessing his computing resources in the evening in Lagos, Nigeria. The user only needs to pay a fee for the computing time and resources utilised similar to utility consumption such as heating, water, and electricity (Shelly, Vermaat, Quasney, Sebok, & Freund, 2012). As a result, the overall positive effect of cloud computing has enabled its increasing level of acceptance as an effective computing approach (Kshetri, 2010). Several African states including South Africa, Kenya and Nigeria were identified as leading countries implementing the computing paradigm, with 50% of South African, 48% of Kenya and 36% of Nigeria's large and small-scale enterprises already adopting cloud services for their business operation (Cisco, 2013). The desirous potentials of cloud computing have been identified in health, education and business for improved data access, efficiency and high quality of service (QoS), resulting in the intense advocacy of cloud services inclusion and application (Kumalo & Van der Poll, 2015; Mgozi, Weeks, & Erasmus., 2015; Mwesigwa, 2014)

The interesting nature of cloud computing has triggered different authors to opine their diverse views on cloud computing using different methodologies. *Laverty* evaluates the desirous features of cloud computing in his survey, as a contributing technology to economic growth in African states (Laverty, 2011). His survey concludes that pursuance of policies and investment in cloud activities in Africa by developed countries will close the technological

divide between these continents, which will invariably create a wealth of opportunities in infrastructure, resource sharing and computing activity. *Dahunsi* opines his view on cloud computing by highlighting the benefits and the numerous challenges using an ecosystem approach (Dahunsi. & Owoseni., 2015). He further identifies basic amenities, ICT manufacturing and infrastructure as crucial requirements necessary for the sustainability of cloud computing, with emphasis on government intervention in policy making and the creation of viable cloud investment environment. Moreover, *Chinedu* conducts a quantitative survey by analysing the numerous issues relating the cloud computing from the consumer perspective to identify the various impediments to cloud adoption (Chinedu, Nworuh, Osuagwu, Onyesolu, & Ahaiwe., 2015). *Awosan* reviews cloud computing with a view to analysing and identifying the factors motivating cloud adoption from the IT/telecommunication perspective (Awosan, 2014). He opines that cloud computing is generally perceived in Nigeria as the next computing tools but that its adoption is relatively low compared to some developed countries. *Alemayehu* in his work examining the complexities of cloud computing in terms of selection to decision making. opined that the computing paradigm will enable on-demand computing resources with minimal management effort or service provider interaction (Alemayehu, 2012).

Different authors in the African states gave a divergent description of computing paradigm owing to its dynamic nature. *Youseff* describes cloud computing as a way for IT departments to increase their capacities or add capabilities on the fly without having to invest in new infrastructure, train new personnel or license new software (Youseff, Hadhri, & Maherzi, 2014). *Anjomshoaa* describes cloud computing as an evolution of existing technologies in the field of information communication technology (ICT) that could dynamically restructure enterprises computing activities (Anjomshoaa & Tjoa, 2011.). *Cowhey and Aronson* in their book describe cloud computing as a new computing and information architecture. Cowhey et.al. identifies cloud adoption as a means of massively integrating low-cost information storage with services that can provide virtual computer systems with the flexibility, to meet the needs of the end-user (Cowhey, Aronson, & Abelson, 2009). *Olufeagba* in his report of the most viable economic sectors in Africa identifies the possible deployment of cloud services into the industries would fundamentally change their daily operating procedures and processes (Olufeagba, 2015). Nevertheless, on a global scale, different authors identified key distinct factors as being responsible for cloud adoption in organisations, developed and in a few developing countries. Some authors in their work identified technical and non-technical factors as been key determinant responsible for cloud adoption readiness. They categorised these determinants

based on technology and performance, organisation and strategy, economic and valuation, and regulatory (Alhammadi, Stanier, & Eardley, 2015; Hassan, Mohd Nasir, & Khairudin, 2017; Kauffman, Ma, & Yu, 2016). In addition, Carcary et.al. in their work, analyses existing cloud adoption frameworks for evaluating cloud readiness and benefits in Irish small and medium-scale (SME) industries (Carcary, Doherty, Conway, & McLaughlin, 2014). Based on their qualitative research, they conclude that cloud adoption frameworks vary between large and SME enterprises. Furthermore, other authors developed diverse models for analysing issues relating to cloud adoption for different organisations (Gangwar & Date, 2016; Gangwar, Date, & Ramaswamy, 2015; Leroux & Pupion, 2016; Mohammed, Ibrahim, Nilashi, & Alzurqa, 2016; Okai, Uddin, Arshad, Alsaqour, & Shah, 2014). In a nutshell, most of these authors conclude that factors influencing cloud computing adoption vary across geographical places and organisations. In addition, data security is identified has statistically significantly related to cloud adoption.

Thus, a reflection of these authors 'assertions raises the question as to why growth rate of cloud computing is poor in Africa compared to developed countries. In addition, another question as to what the effect of the viewpoint of employees in IT and non-IT enterprises will be, as a catalyst to the growth of cloud computing. These questions serve as the motivation for this study. Thus, the paper investigates the perception of employees to cloud computing. To better appreciate the factors behind each cloud service policy maker, the 3AI (Awareness, Acceptance, Adoption and Integration) model is proposed. The model is used as a method of understanding the processes involved in enterprise adoption. The paper is organised as follows: Section II presents a brief overview of deployment models and web services in cloud computing. We proposed the 3AI model and highlight on the various constituents of the model in Section III. Section IV discusses the approach adopted for this research. Section V discusses the performance indicators of cloud computing and evaluates them under the sampled population. Results and findings are discussed in section VI. Section VII concludes the paper.

CLOUD BASES

Cloud Deployment Model

The goal of this section is to examine the various approaches often implemented in cloud service deployment to subscribers. The ubiquity experienced in cloud computing application is a strong enabling factor to the dynamism experienced in its services by subscribers. Figure 1 shows a simplified overview of various cloud deployment models.
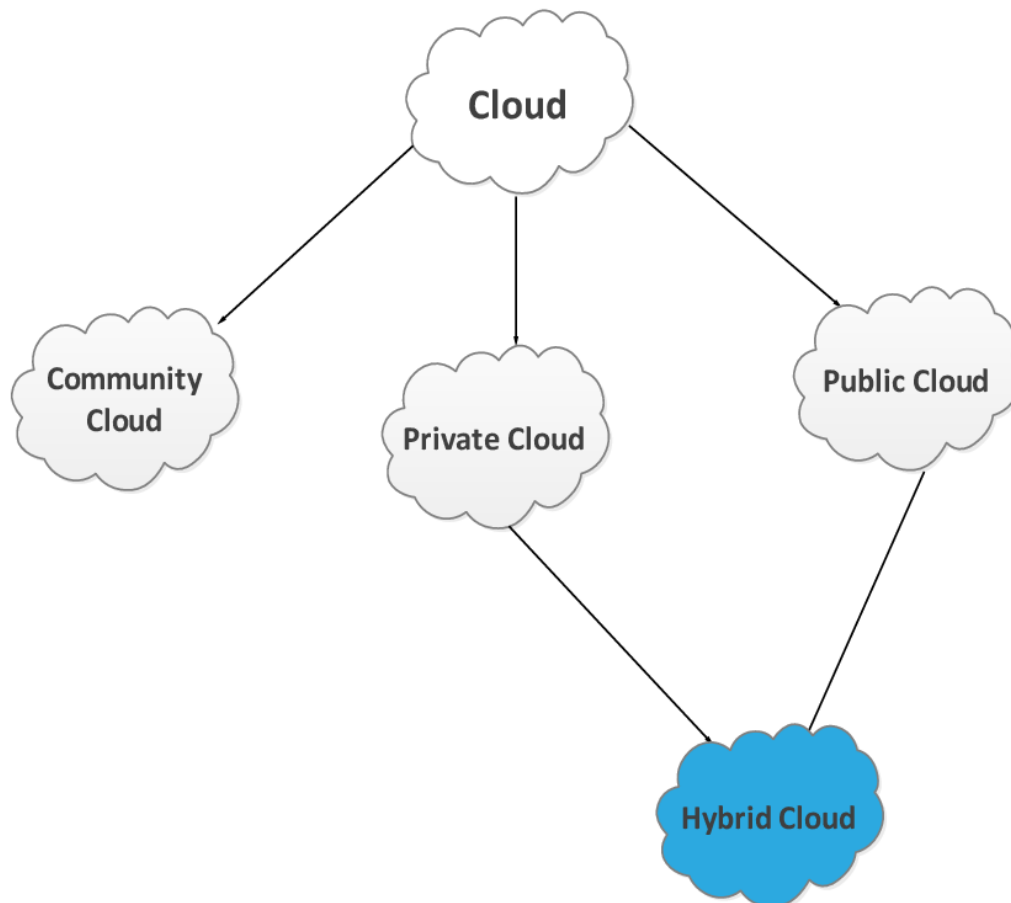
Figure 1. Simplified Overview of Cloud Deployment Models

Cloud resource can be made *public* whenever cloud resources are dynamically allocated to the public on a pay-as-you-go basis over the Internet using different web applications from an off-site third-party provider. However, cloud resources can be deployed *privately* for single business enterprises who either manages or allows a third-party to host its resources. In addition, for private cloud deployment, users are often required to purchase, build, and manage their own cloud activities. This deployment approach often gives users a lower, up-front capital costs and reduced hands-on management, which essentially makes the economic benefits of cloud computing an intriguing concept (Alkhatib & Rine, 2010). Furthermore, private cloud deployment is often useful for mission critical systems and other operational systems required to protect critical infrastructures. Nevertheless, *community* Cloud is usually deployed whenever several organisations with similar business requirements want to share their infrastructures together to realise combined cloud benefits. Moreover, the combined characteristics of the community cloud allow cost to be shared across each individual enterprise. H*ybrid* cloud,

however, incorporates the combined privilege of both private and public cloud deployment. This makes it flexible for the enterprise to run some computing resources from their systems while others are outsourced remotely. The ease and flexibility in hybrid cloud deployment make it newer approach to IT infrastructure (Hurwitz, 2012). Thus, hybrid cloud serves as a bridge between the private and public clouds.

Cloud Web Services

Figure 2 shows the various web services in the general architecture of the service cloud. The infrastructure cloud represents the virtual infrastructure which enables the provision of cloud resources via the Internet to the subscribers. The content cloud deals with the service stacks provided for Cloud service subscribers by the cloud service providers.
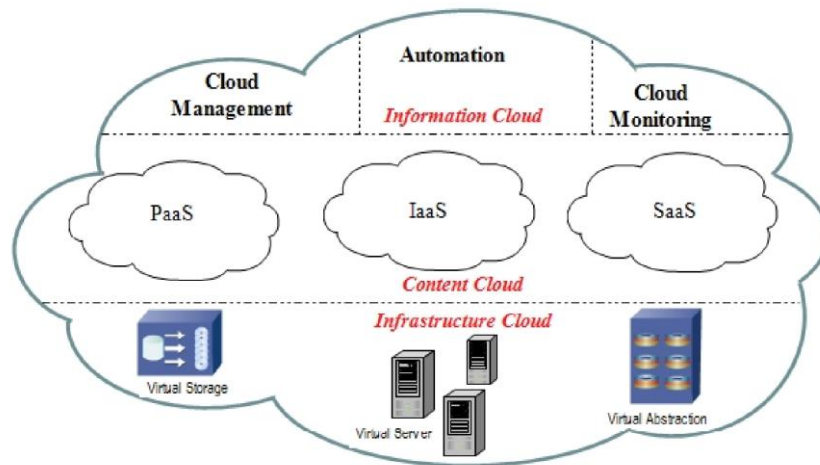
Figure 2. General Architecture of Cloud Web Services

Furthermore, the information cloud represents the cloud activities engaged in by the cloud service providers to ensure high-quality service throughput is achieved and maintained. Nevertheless, service stack is provided to the subscriber as the following model:

- *Infrastructure-as-a-Service (IaaS)* centres around service delivery that provide a predefined, standardised IT infrastructure specifically optimised for cloud subscriber. IaaS allows business enterprises to purchase their own infrastructure from cloud service providers as virtual resources. This leverages significant technology, service and data centre investments to deliver IT as service to subscribers. Among the popular IaaS providers include Google Compute Engine, Amazon EC2, and Rack space.

- *Software-as-a-service (SaaS)* is a software distribution model. SaaS provides a bundle of business software functionality that would ordinarily be expensive and difficult to manage as on-site, local solutions. The software is however hosted by the service provider and is made available to the enterprise subscribers over a network on a pay-as-you-go subscription licensing model. This gives the subscriber the advantage of using commercially licensed, internally operated software without any associated installation complexity, licensing, management support and high overhead (Antonopoulos, 2010).

- *Platform-as-a-service (PaaS)* provides a platform that is standardised, dynamically scalable with the flexibility of sharing IT capability. This enables the creation and deployment of customised applications, databases and business services which can all be integrated into one platform for any SME and large enterprises. PaaS model focusses on IT innovations rather than complex infrastructure implementing the pay-as-you-go scheme like SaaS.

- *Communication-as-a-service (CaaS)* model is an outsourced enterprise IT solution that is implemented with the management of hardware and software required by the enterprise subscriber. Since the web service is concerned with IT solution management, CaaS offers higher guaranteed quality-of-service (QoS) under a service level agreement (SLA), and high resource flexibility and scalability that SME might sometimes not readily be able to afford.

- *Monitoring-as-a-service (MaaS)* is an outsourced IT solution implemented at providing enhanced data security predominantly on business platforms that leverage the internet to conduct transaction free from cyber threats.

PROPOSED MODEL

Figure 3 shows the various processes involved in the proposed 3AI model. The 3AI model is used in explaining the distinct activities in terms of actions and decision leading to the adoption of cloud service. The various blocks depicted in the model include:
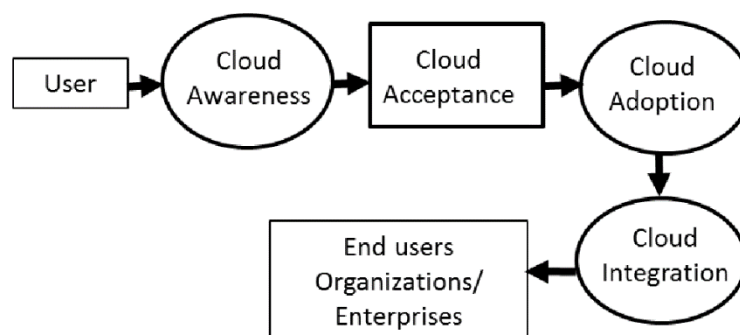
Figure 3. Proposed 3AI Model

Cloud Awareness describes the starting point of the model. Cloud awareness is concerned with the degree of public attention Cloud computing is receiving. This can be through various platforms including seminars, technical IT meeting, public awareness programmes. The purpose of the awareness is to elucidate the benefits of implementing cloud services for a deeper understanding of the computing paradigm by IT experts, employees, and organisations. Thus, in the model, cloud awareness is predominantly concerned with the degree of publicity cloud computing is receiving within the various enterprises in the African states.

Cloud Acceptance is concerned with the willingness of the various enterprises; public and private, to implement the computing paradigm while still maintaining their traditional computing practices. Several enabling factors such as level of return on resource investment, application throughput, the efficiency of resource management and data security are considered in this stage. This cloud acceptance stage serves as a measure for decision making, and the viability of cloud adoption is considered.

Cloud Adoption indicates the ability of enterprises to shift to the implementation of cloud services for their daily operation. Thus, cloud adoption process validating the viability of the decision to use cloud services for regular business practices.

Cloud Integration expound the degree of confidence gained from implementing various cloud services. Cloud integration shows the ability of the enterprise to fully implement cloud service with or without the traditional computing approach for a longer duration of time.

The relationship between the various steps in the proposed 3AI model serves as an approach to analysing the enterprise response in terms of policy making toward the computing paradigm. Nevertheless, the linearity between the various processes in the model takes a forward path which shows the dependence of a process on the succeeding process.

METHODOLOGY

The study was designed as a mixed method approach at providing a clearer view of the research objectives. The research design was chosen to collect primary and secondary data simultaneously. The primary source is through a survey (administration of questionnaires), and a few telephone conversations made with some IT experts and government officials on the subject matter. The secondary source was derived from existing literature from academic journals, gazettes as well as existing data on the subject. This was carried out to serve as an additional source of data. These sources are used to gather the view of authors on the subject matter, whilst at developing the literature review. Moreover, these sources also provide the

basis for the research objective and plan. The study design will also accommodate the generalisation of the findings of the study on the target population.

Rationale Behind the Study

The subject of cloud adoption and its exciting effects in the African states have been greatly researched in the most literature (Gumbi & Mnkandla, 2015; Johnston, Loot, & Esterhuyse, 2016; Sabi, Uzoka, Langmia, & Njeh, 2016). However, very little attention has been given in these papers to investigate the factors responsible for the poor adoption rate in the most African states from the employee's perspective (Cuppens, Lagae, Ceulemans, Van Huffel, & Vanrumste, 2010). Moreover, since various ICT and non-ICT employees of different enterprises constitutes to a significant percentage of cloud users. Thus, their view on cloud service for daily organisational activities will, therefore, be useful in analysing the research.

Research Population

The sampled population is Nigeria and is divided into two distinct public enterprises; government-owned establishments and private enterprises. For centralised data collection, the six geopolitical zones in Nigeria were stratified and a state in each zone was selected, excluding the North-East zone due to some challenges[1] as at the time of the survey. A total of five states from each of the remaining five geopolitical zones was sampled. A multistage sampling procedure was used to select one government agency and one private organisation from each state. A stratified random sampling procedure was used to select twenty respondents per state from each of the government and private organisations selected for the study. A total number of the 200 respondents was sampled, with 110 from government institutions and 90 from private enterprises as shown in percentage from Figure 4. Furthermore, the participating public enterprise's employees are IT experts and some policy management staff.

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[1] Part of the region was affected by the Boko Haram crisis as at the time of data collection.
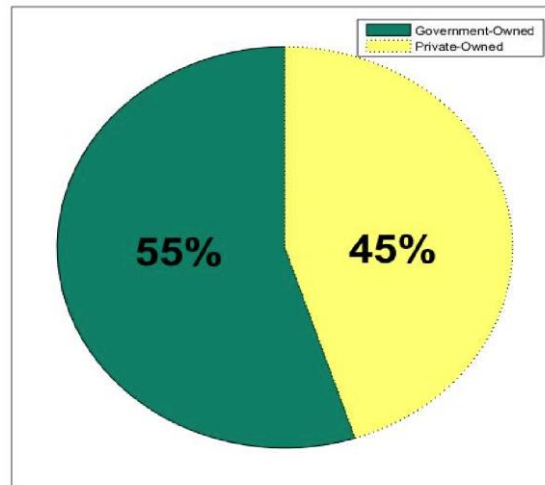
Figure 4.　Research Population Distribution

Instrument

An instrument titled "Assessment of Cloud Adoption and Integration in Public Enterprise" (ACAIPE) in the form of the questionnaire was used in generating the primary data for the study. The instrument was divided into two sections, section A was to elicit the socio-economic data of respondents while section B delved into the perceived factors contributing to the adoption and integration of cloud computing into public enterprises. Section B was further subdivided into five subheadings. Each of the headings has four questions which were to elicit responses relating to each subheading. Interviews, online chat, and telephone conversations with some directors in both enterprises were made and are used as a secondary data source.

Data Analysis

The sampled data was analysed using simple data processing software and MATLAB for easy representation of sampled data.

PERFORMANCE INDICATORS

To effectively present the benefits of cloud service to the respondents, key cloud performance indicators are used in the questionnaire. Among the major service cloud performance indicators as identified in most literature includes: on-demand service delivery, guaranteed quality of service, scalability and flexibility, user-centric interface, data security and user autonomy (Cowhey et al., 2009; Lu, Lin, Liang, & Sherman, 2010; Michael et al., 2009). Figure 5 shows

a conceptualised framework for these performance indicators. From figure 5, it can be observed that each performance indicator interoperates with each other which indicates the dynamic, composite nature of cloud computing.

a. On-demand Service Delivery (OSD)

On-demand service delivery is a major motivating factor for cloud service adoption. OSD describes the ability of cloud service providers to provide access to resources and service for users on a pay-as-you-go basis. Moreover, OSD allows cloud users to customise and personalise their computing environment for later activities.

b. Guaranteed Quality of Service (GQ)

GQ describes the degree of efficiency of cloud service providers in allocating cloud resources to subscriber applications. GQ serves a means of guaranteeing an efficient negotiating platform for improved QoS. Attributes of GQ include availability, serviceability, operation, performance and reliability in billing and even penalties in case of a violation of their Service Level Agreement (SLA).

c. User-centric Interface (UI)

A user-centric interface describes the ability of service clouds to be easily accessed through simple and pervasive methods. Cloud computing adopts utility computing, subscribers either as an entity or corporate organisation can individually implement computing resources easily as basic public utilities.

d. Scalability and Flexibility (SF)

SF are two key motivating features of cloud computing, as cloud services and their computing platforms can easily be deployed across a variety of organisations at different geographical locations. SF guarantees high hardware performance and efficient software configurations. Moreover, computing platforms are also flexible in adapting to various user requirements.

e. Security of Data (SD)

SD is concerned with the security and viability of data stored in the cloud. Cyber threats pose a key mitigating challenge to cloud service deployment and application which often results in huge data loss and breaches. Earlier studies identified nine key notorious that usually impact cloud activities negatively. (Alliance, 2013). Thus, most cloud service providers implementations strong countermeasure to mitigate the effects of most of the notorious threats.
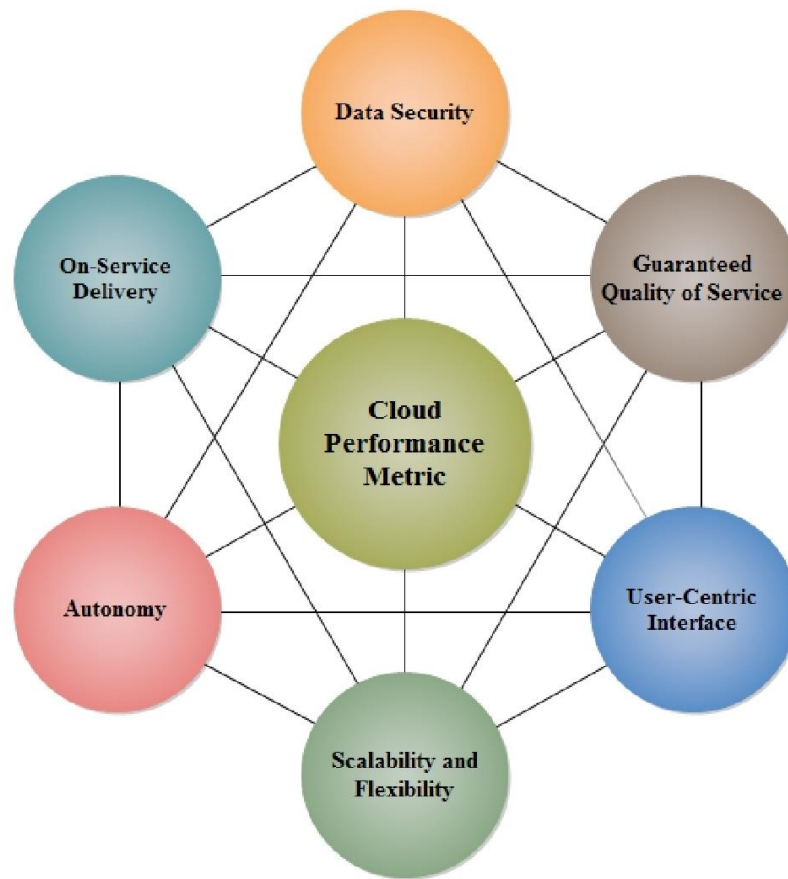
Figure 5.   Conceptual Model of Cloud Performance Metrics

f.   Autonomy (A)

Cloud autonomy indicates the transparency exhibited between cloud services and end-users. This gives cloud subscribers the computing power to manage their computing resources. Conversely, hardware, software, and data inside any of the clouds can, therefore, be automatically reconfigured and consolidated to present a single platform image by cloud service provider which is finally rendered to users.

RESULTS AND DISCUSSION

Data collected from respondents in the sampled population is used in generating Table 1. The performance indicators of cloud computing outlined in the proposed 3AI model in the questionnaire to initiate clarity of research objectives and benefits of cloud computing to each respondent. Respondents could, therefore, classify their assessments based on the strata of activities involved in the eventual adoption of cloud service. The data collected was classified

into the following respondent class range R: Strongly agree = (70 – 100), Agree = (40 – 69), Disagree = (30 – 39), Strongly Disagree = (10 – 29), Indifferent = (0 – 9).

Action Flow	Strongly Agree		Agree		Disagree		Strongly Disagree		Indifferent	
	G	P	G	P	G	P	G	P	G	P
Awareness	19	15	78	70	7	5	3	0	3	0
Acceptance	15	9	76	81	10	0	4	0	5	0
Adoption	7	4	56	84	23	0	11	0	13	2
Integration	0	4	50	69	36	13	9	0	15	4
Mean	11.5	9.0	65.0	76.0	13.5	4.5	6.75	0	9.0	1.5
SD	6.61	7.07	14.1	7.62	11.2	5.66	3.85	0	5.89	1.41

Table 1: Entire population response frequency

[G - Government-owned Enterprises, P - Privately-owned Enterprises]

Figure 6 shows the level of priority respondents put on cloud service performance indicators with a peak response of 190 agreeing with guaranteed quality of service as a most viable motivating factor to cloud acceptance and adoption. On-service delivery, user-centric nature of the computing paradigm, scalability and flexibility in terms of its pay-as-you-go scheme, was also agreed to be major contributing factors. However, some of the respondents especially those whose primary responsibility revolves around core IT activities indicate concerns in relation to cloud data security and autonomy as shown by the decline in the response frequency graph in figure 7. Data breaches, data theft resulting in loss of valuable information, hijacking of cloud accounts by insiders, and regulatory body to handle cases of accountability between cloud service providers and users are being raised as key cloud adoption issues and consideration among others.
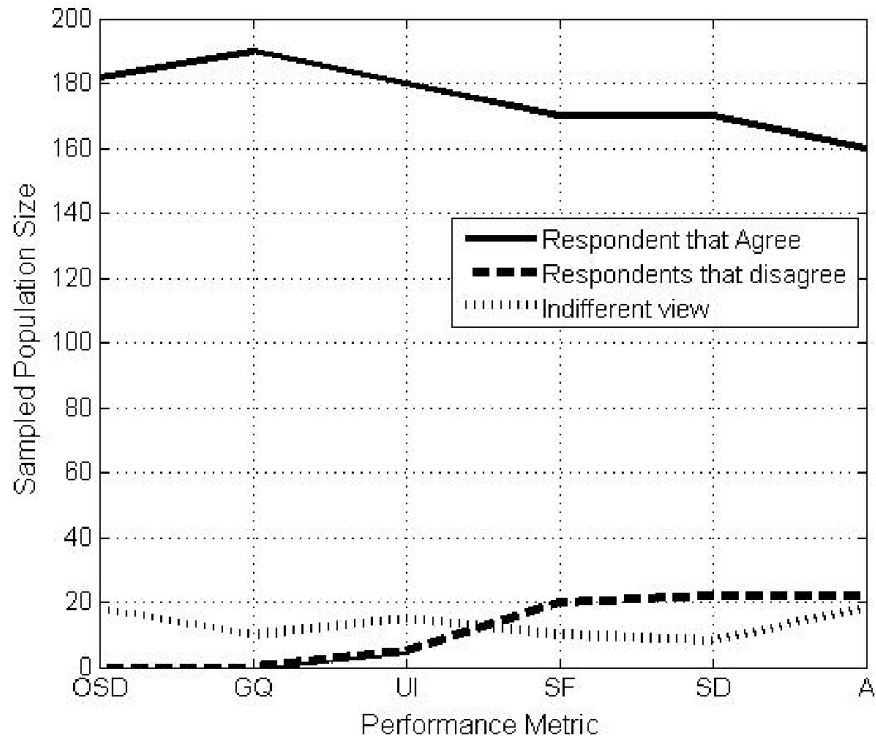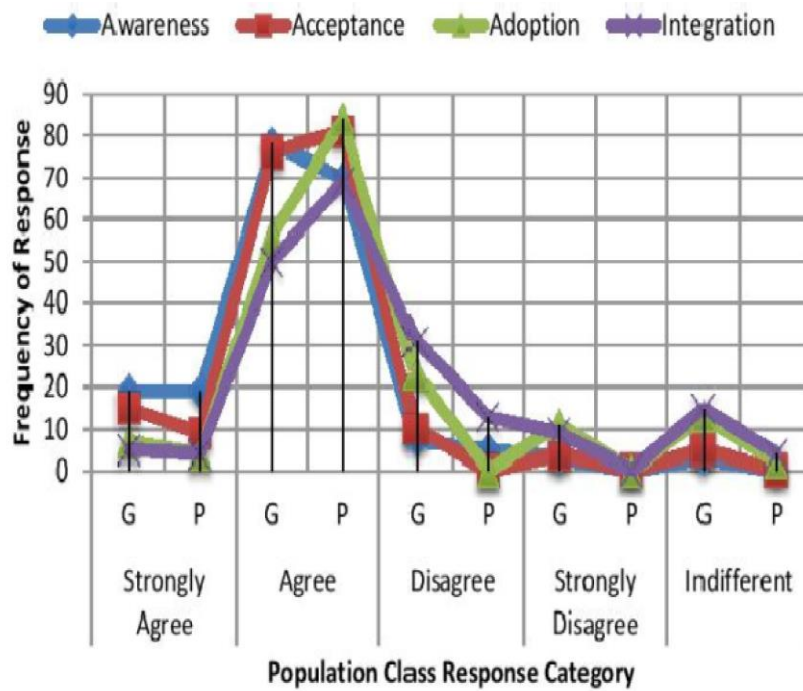
**Figure 6. Performance Metric of Cloud Adoption**

Figure 7. Frequency Response of cloud users in both enterprises;
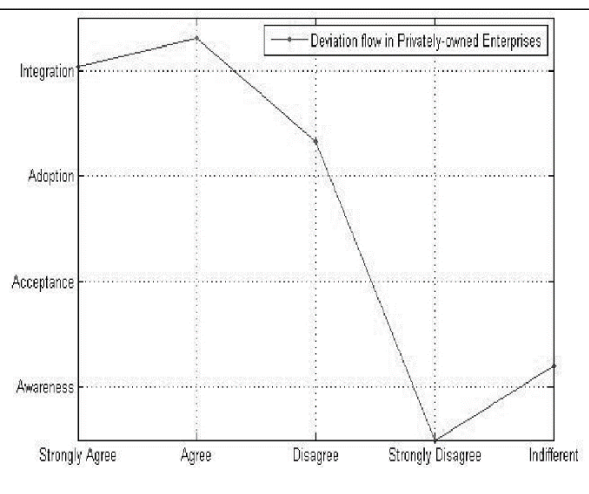
G = Government-owned Enterprises, P = Private-owned Enterprises, R = Respondents Class range.

Figures 8 and 9 show the individual response frequency of the respondents in both population class and their subsequent response distribution. The layers in the 3AI model are used as a basis of sampled questions under section B of the questionnaire to evaluates and validates the authenticity of the model. The result obtained shows that a peak positive response of 95% of the population agrees with the flow of processes outlined in the model. This implies the acceptance of the proposed 3AI model by the respondents, as an evaluating model for analysing their perception towards cloud adoption. In addition, the respondent's acceptance of the proposed model also validates the forward direction outlined in the model for cloud service adoption and integrating for continuous business operations. However, a small fragment of the sampled population (5%) is indifferent about the order of steps expressed in the model. Nevertheless, none of the respondents strongly disagree with the order of the 3AI model used. This, therefore, validates the proposed model as a reliable approach to evaluating the action and decisions involved in cloud adoption and possibly integration.
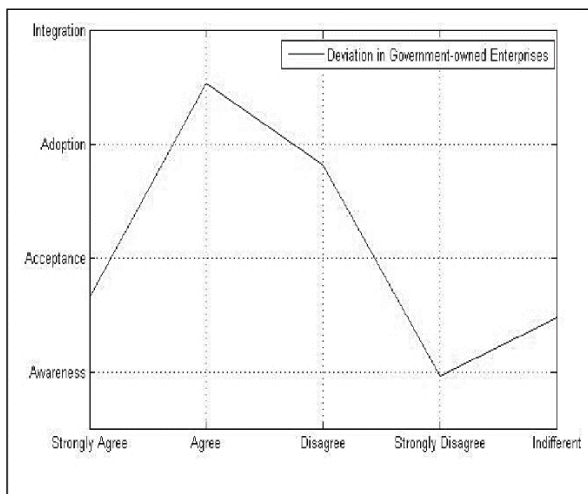
Figure 8. Response Distribution in Government-owned Enterprises	**Figure 9. Response Distribution in Privately-owned Enterprises**

The data obtained is categorised as positive and negative feedback. The positive feedback concentrates on the acceptance of cloud computing based on the different performance indicators outlined in the questionnaire and the benefits derived from using the computing paradigm. However, the negative feedback relates to the various mitigating factors affecting the computing adoption. The results gathered from the primary source of data, most of the respondents agree to the deepening growth of cloud computing in some of Nigerian large and

SM enterprises. In addition, most of the respondents, especially in the privately-owned enterprises largely accept cloud computing as a dynamic computing paradigm with a huge return on investment. However, most of the respondents in the government-owned enterprises expresses strong militating "fears" about the long-term effect of cloud adoption into their organisations for daily operations. The misconception that complete migration to cloud-based IT operation services would lead to the eventual loss of jobs was expressed. Most of these respondents perceive that only IT personnel might be needed for daily activities, resulting in reduced number of the employees. Other cloud adoption issued from various respondents includes data loss and accountability issue in a situation where a database of confidential information is being hacked and accessed by unauthorised persons or insider. Furthermore, the reliability of cloud service providers to provide secured, sustainable cloud services and the availability of qualified ICT personnel to monitor their cloud resources a key issue raised to affect cloud adoption.

The need for wider corporate awareness of cloud services at stakeholder and subscriber level is, therefore, a paramount necessity. This is to help develop the right perception of cloud benefits which will invariably result in its cloud adoption. Furthermore, since several private and government initiatives such as e-government, e-banking and cashless policy, e-education, m-farming, and e-health in most African states involves the deployment of cloud services. This, therefore, necessitates the investment of necessary infrastructures and the environment for effective cloud implementation by all key ICT key players, which will in effect, facilitate its increased adoption. The benefits of such investment would, therefore, be immeasurable as the technological gap between Africa and the rest of the world will, therefore, be reduced. Moreover, the desirous effect will result in improved education, efficient data management, speed and quality of work delivered, improved healthcare resulting in longevity and better governance. Thus, Africa ICT investors and policy-makers need to open this door of technological advancement wider. Advocating, developing and focusing on the changes cloud computing will make on business throughput will lead to the spontaneous action and investment decisions. This, in turn, will capture the opportunities associated with the computing paradigm invariably help the economy of most African states.

CONCLUSION

This paper conducted a mixed method research on the perception of enterprise employee to cloud computing services and its adoption for daily business operation. The proposed 3AI

model was used to serves as a basis for clarity and analyses of the respondent's view and processes involved in migrating to cloud service. The results obtained shows that fewer number of enterprises fully implements cloud services in comparison with the number of enterprises that are fully aware of the computing paradigm. Moreover, the misconception by most of the respondents, especially in government organisation about the adoption of cloud computing been an avenue for lowering the workforce in these enterprises, is a strong mitigating cloud adoption issue. Nevertheless, the continuous success of cloud computing depends to a larger degree on the efficient service benefits derived from it. Research predicted that Africa will be having the second highest cloud workload by 2018 with the increasing number of business migrating to this computing paradigm. However, this necessitates proper perception of the computing paradigm. Thus, as a way forward, appropriate channels and policies must be implemented to encourage employees and decision-makers to embrace the realities of clouds computing. Furthermore, the pursuance and eventual adoption of cloud service will result in efficient business service delivery.

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