Revamping Nigeria's Economy through Cloud-Based Technology

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Abstract

Cloud Computing is a distributed architecture that centralizes server resources on a scalable platform so as to provide on demand computing resources and services. It is a viable tool for revamping the economy considering the benefits it provides though they are not without some challenges. The unprecedented success of internet in the last few years has made computing resources to be available more ubiquitously. Cloud computing environment requires the traditional service providers to have two different ways. Cloud computing provision can be in form of infrastructure or service. In infrastructure provision, cloud platforms are managed and resources are leased according to usage. In the other form, service providers offer services to the end users by renting resources from infrastructure providers. The results of cloud computing technology in revamping Nigeria's economy are: reduced IT costs, scalability, business continuity, collaboration efficiency, flexibility of work practices and access to automatic updates.

***Keywords*:** Cloud computing, infrastructure, service providers, economy, technology.

Introduction

Cloud computing allows the access of data and programs outside one's own computing environment. Instead of storing data and software on one's personal computer or server, it is stored in the cloud. This includes applications, databases, email and file services (Business Queensland, 2022). An analogy to describe cloud computing is renting versus buying. Capacity (server space or access to software) is rented from a cloud service provider and connected over the internet. Rather than purchasing one's own IT requirements, one rents from a service provider, paying for only the resources used. There are 4 models of cloud computing in terms of different access and security options. Before moving an organization's data into the cloud, there is a need to consider their data needs and which model works best for them. Althoff (2022) noted that since the start of the pandemic, organizations representing a cross-section of industries have mobilized to adopt digital technologies to gain insights from their data and unlock cloud-based innovation. With the Microsoft Cloud, customers are reimagining ways to deliver patient care and provide access to critical services, secure their digital environments to scale and maintain business operations, extend frontline worker productivity, enhance employee experiences, and encourage new forms of business engagement and interaction. According to Xue & Xin (2016), cloud computing enables the organizations to manage their business efficiently. Although cloud computing can

provide advantages but it does not mean that there are no drawbacks. Security has become the major concern in cloud and cloud attacks too. Business organizations need to be alert against the attacks to their cloud storage. Cloud computing has successfully gained the interest from organizations because it offers a wide range of solutions and advantages to business (Xue & Xin, 2016). The adoption of cloud computing is on the rise and forecast shows that it will increase as technology continues to advance in the coming years.

This is shown in figure 1.

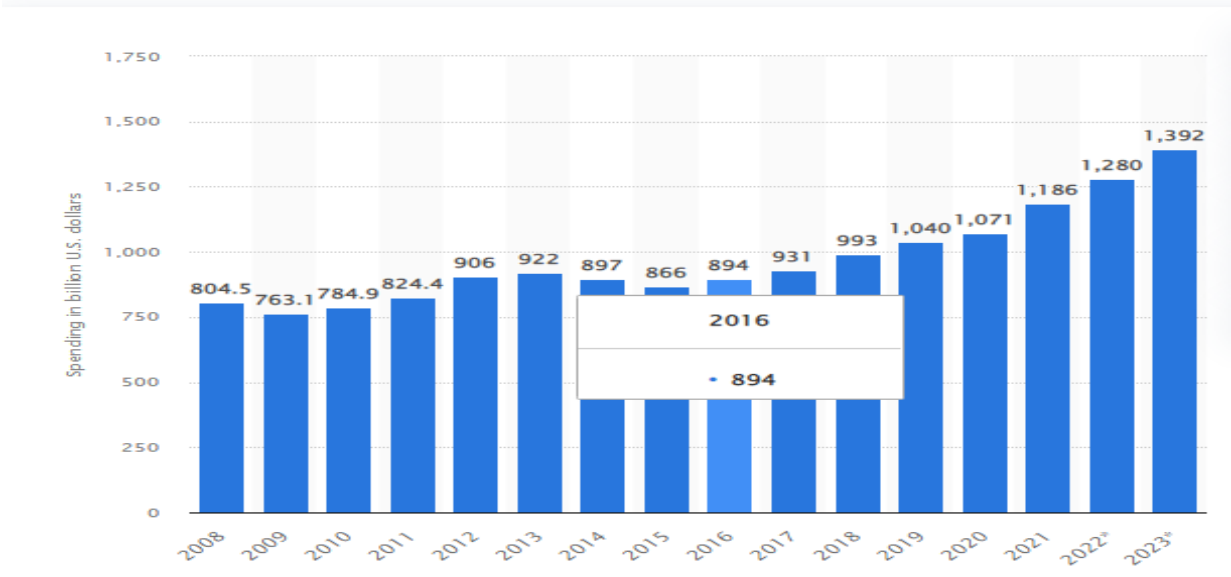

Figure 1: Information Technology (IT) services spending forecast worldwide from 2008 to 2023(in billion U.S. dollars). Source: Sava (2022)

The Meaning of Cloud Computing

Aakash (2017) stated that cloud computing is defined as a distributed architecture that centralizes server resources on a scalable platform so as to provide on demand computing resources and services. Due to the unprecedented success of the internet in the last few years, computing resources is now more ubiquitously available, leading to the realization of Cloud Computing. Cloud Computing environment requires the traditional service providers to have two different ways. These are infrastructure and service providers. Infrastructure providers manage cloud platforms and lease resources according to usage. Service providers rent resources from infrastructure providers to serve the end users. It also provides facilities for users to develop deploy and manage their applications on the cloud which entails virtualization of resources that maintains and manages itself (Rao, Rao & Kumari, 2009).

Singh and AnuragJain (2014) noted that cloud computing provides a surrounding for

resource sharing in terms of frameworks, middleware, application development platforms and business applications.

Architecture of Cloud Computing

Yashpalsinh and Kirit (2012) posited that cloud computing system can be divided into two sections: the front end and the back end. Each unit is connected with one another through a network, sometimes the net. Front end is what the consumer (user) sees whereas the rear end is the cloud part of the system. Front end has the client's laptop and therefore the application needed to access the cloud while the back end has the cloud computing services like numerous computers, servers and information storage.

The word "cloud" can be defined as remote environment from Information Technology perspective (Nabil, 2010). However Amol, Vikram, Seema & Gopakumaran (2015) defined cloud as a large pool where computing resources are stored. Usually, it provides a single, simple interface for the users to use and hide the architecture. The architecture of a cloud computing can be categorized into four layers: the physical layer, the infrastructure layer, the platform layer and the application layer (Singh & AnuragJain, 2014).

This is as indicated in Figure 2.

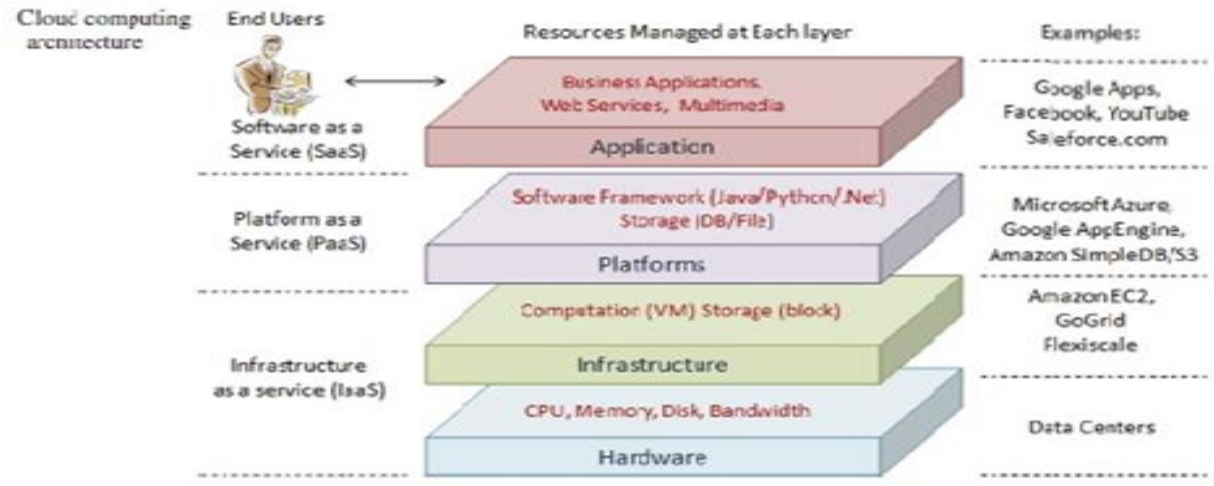

Figure 2: Architecture of Cloud-based Computing (Singh & AnuragJain, 2014)

The Hardware Layer is responsible for dealing with the physical assets of the cloud, including routers, servers, switches, cooling systems and power. The infrastructure layer makes a pool of storage capacity and computing resources by partitioning the physical resources using different virtualization technologies. The platform Layer is based on top of the infrastructure layer and this layer comprises of operating systems and other software structures while the application

layer comprises of the actual cloud provisions, for e.g. Business Applications, Multimedia & Web Services.

Cloud Computing Deployment

Singh and AnuragJain (2014) stated that the deployment of clouds is based on the owner of the Cloud data centers. The different deployment modes are: Private cloud, community cloud, public cloud and hybrid cloud. A private cloud is where the services and infrastructure are maintained and managed by an organization or a third party. This option reduces the potential security and control risks, and will suit them if their data and applications are a core part of their business and they need a higher degree of security or have sensitive data requirements. It is easier to manage security, maintenance and upgrades and conjointly provides additional management over the preparation and use (Yashpalsinh & Kirit 2012). A community cloud exists where several organizations share access to a private cloud, with similar security considerations. For example, a series of franchises have their own public clouds, but they are hosted remotely in a private environment. A public cloud is where the services are stored off-site and accessed over the internet. The storage is managed by an external organization such as Google or Microsoft. This service offers the greatest level of flexibility and cost saving; however, it is more vulnerable than private clouds. For those organizations that cannot afford huge IT investments and do not have a lot of confidential information, public cloud appears to be an honest selection. A hybrid cloud model takes advantages of both public and private cloud services. Through the spreading of options across different cloud models, an organization gains the benefits of each model. Dillon, Wu and Chang (2010) noted that the entities are bound together by standardized or proprietary technology.

How cloud computing works

According to Business Queensland (2022), there are 3 main types of cloud computing service models available. They are: *Software as a Service (SaaS), Infrastructure as a Service (IaaS) and Platform as a Service (PaaS).* Based on the organizational needs, one of these service models or a mixture of the 3 could be used. Software as a Service (SaaS) is the most common form of cloud computing for small businesses where internet-hosted software applications can be accessed using a browser, rather than traditional applications stored on one's own computer or server. The software application host is responsible for controlling and maintaining the application, including software updates and settings. A user has limited control over the application and configuration settings. The users can access the software applications without the concerns of installation and maintenance (Xue & Xin, 2016). SaaS does not require personal software and hardware resources. SaaS is popular due to its scalability, compatibility, worldwide accessibility and the users do not need to do/worry about scaling, configuration and updates (May, Shaikha, Sabika, & Imtiaz, 2013). A typical example of a SaaS is a web-based mail service or customer relationship management system. Infrastructure as a Service typically means buying or renting the computer power and disk space from an external service provider. This option allows you access

through a private network or over the internet. The service provider maintains the physical computer hardware including CPU processing, memory, data storage and network connectivity. Examples of an IaaS include Amazon EC2, Rackspace and Windows Azure. Platform as a Service (PaaS) can be described as a crossover of both SaaS and IaaS. Essentially the hardware, operating systems, storage and network capacity that IaaS provides is rented, as well as the software servers and application environments. PaaS offers more control over the technical aspects of the computing setup and the ability to customize to suit one's needs. Users do not need to know how much processing unit, memory, storage they need for their applications (Xue & Xin, 2016).

Althoff (2022) recorded some types of organizations that have thrived through Microsoft's Cloud-Based Technologies: Companies and Cloud Computing Usage, Healthcare and Cloud Computing Technologies in **advancing patient care and secure personal health data**, t**he Public Sector and the cloud in maintaining access to services and securing its environments**, **Manufacturing organizations are building cloud infrastructures to scale operations and keep employees connected,** financial services companies are embracing cloud solutions to maintain business operations and respond to customer needs.

Benefits of cloud computing in Revamping the Economy

Nurudeen (2021) notes that cloud-based technology will play a critical role in enabling inclusive economic recovery. Investing in the latest technology (which includes cloud computing) results in 20 to 30 percent higher workforce productivity, and 40 to 50 percent faster speed to market amongst some of the other benefits (The Resilience Institute, 2020). Cloud computing offers businesses many benefits. It allows them to set up what is essentially a virtual office to give the flexibility of connecting to their business anywhere, any time. With the growing number of web-enabled devices used in today's business environment (e.g. smartphones, tablets), access to your data is even easier (Queensland, 2022).

There are many benefits of moving business to the cloud according to Queensland (2022). They are:

a. Reduced IT costs: Moving to cloud computing may reduce the cost of managing and maintaining an organization's IT systems. Rather than purchasing expensive systems and equipment for a business, an organization can reduce their costs by using the resources of their cloud computing service provider. They may be able to reduce their operating costs because the cost of system upgrades, new hardware and software may be included in their contract; they no longer need to pay wages for expert staff; their energy consumption costs may be reduced and there are fewer time delays.

b. Scalability: An organization can scale up or scale down their operation and storage needs quickly to suit the situation, allowing flexibility as their needs change. Rather than purchasing and installing expensive upgrades themselves, their cloud computer service provider can handle this for them. Using the

cloud frees up their time so they can get on with running the business.

c. Business continuity: Protecting your data and systems is an important part of planning business continuity. Whether one experiences a natural disaster, power failure or other crisis, having the data stored in the cloud ensures it is backed up and protected in a secure and safe location. Being able to access the data again quickly allows one to conduct business as usual, minimizing any downtime and loss of productivity.

d. Collaboration efficiency: Collaboration in a cloud environment gives a business the ability to communicate and share more easily outside of the traditional methods. If one is working on a project across different locations, one could use cloud computing to give employees, contractors and third parties access to the same files. A cloud computing model that makes it easy for one to share one's records with the advisers (e.g. a quick and secure way to share accounting records with an accountant or financial adviser).

e. Flexibility of work practices: Cloud computing allows employees to be more flexible in their work practices. For example, one can have the ability to access data from home, on holiday, or via the commute to and from work as far as there is an internet connection. If there is a need to access one's data while off-site, one can connect to a virtual office, quickly and easily.

f. Access to automatic updates: Access to automatic updates for the IT requirements may be included in the service fee. Depending on the cloud computing service provider, the system will regularly be updated with the latest technology. This could include up-to-date versions of software, as well as upgrades to servers and computer processing power.

Challenges of Cloud Computing:

Although cloud computing brings some benefits to the organizations as aforementioned, there are some shortcomings for decision makers that need to be taken into consideration. According to Xue and Xin (2016), they are:

a. **Data Stealing**: The number of users and organizations connected to the Internet is increasing. This also increases the probability of probing and attacking using viruses, worms and cyber terrorists.

b. **Denial of Service (DoS) Attack**: Denial of Service (DoS), which also known as Distributed Denial of Service (DDoS) or flooding attack has become one of the most common concern issues in cloud computing and a major trouble to the services availability. Although the network security experts have been putting efforts for decades to solve this attack, DoS attack continues to grow and have more impacts recently (Wang, Zheng, Lou & Hou, 2014). Masudur and Wah (2014) and Vidhya (2014) highlighted the types of DoS attack such as smurf attack, SYN Flood attack, PING of Death attack, Tear Drop and IP Spoofing attack.

c. **Data Privacy**: In cloud computing, data will be accessed in unencrypted form by different organizations. According to Waleed (2016), data privacy risks can be illustrated from different perspectives such as insufficient user control and

regulatory compliance. Some organizations will upload files to cloud for sharing purposes. However, this would lead to confidentiality and data privacy issues such as protection of personal or organizations' business information.

d. **Malware Injection Attack**: The hackers will try to damage the applications and websites hosted on the cloud. Usually hackers will find the vulnerabilities of a web application or website and make some changes to it thus change the normal execution. Hackers will program a malicious application and use the virtual machine to inject the malware into the cloud services.

e. **Authentication Attack:** Authentication attack is also a type of attack that occurs in a cloud environment. Subashini and Kavitha (2011) and Young, Hyo, and Young (2012) stated that authentication is always a weak point in web server and always become a target to attack especially the one with ineffective encryption system. In the same vein, Aakash (2017) also pointed out various security concerns in a cloud computing environment which are: access to servers and applications, virtual machine security, network security, data security, data privacy, data integrity and data location.

Ways of Overcoming Cloud Computing Challenges

Cloud computing brings conveniences to the organizations, but there are some risks threatening organizations too. In order to provide a better quality of services, the providers have responsibilities to ensure that cloud environment is highly secured.

a. **Solution to Data Stealing**: Angadi and Gull (2013) noted that the attackers will try to steal users' account credentials.
To prevent this, a special and distinct number should be generated at login session. Every time
the session ends, the users are required to send an email about the usage and duration together
with the unique number for the next login. Through this, the users will be more aware of the
usage and unique number to be used for every login.

b. **Authentication Attack Solution**: According to Sumitra, Pethuru and Misbahuddin (2014), authentication is always a weak point, especially in a cloud environment. Also, Young, Hyo and Young (2012) highlighted the ways to enhance authentication on cloud. They said it is necessary to use a stronger authentication and ID management for both cloud providers and users.

c. **Denial of Service Attack Solution**: One common way to overcome this attack is to enhance the security of networks. Several approaches such as filter-based, firewall-based and signature based can be used to eliminate the attacks (Subramaniam & Deepa, 2015).

d. **Malware Attack Solution:** In cloud computing, the users' requests are processed based on authorization and authentication and these will be done between web servers and web browsers. Hackers will try to inject harmful code to the cloud environment. To prevent this, cloud service providers need to store the information about the Operating

System (OS) the users use during the first-time registration (Xue & Xin, 2016).

Conclusion

The advancement of cloud computing is changing the horizon of information technology. It provides a large array of benefits which are necessary in revamping the economy. Cloud computing brings conveniences and benefits to the organizations such as business flexibility, cost reduction, automatic hardware and software upgrade, agility and scalability. The main benefit is it helps to reduce the unnecessary costs such as purchasing and maintaining hardware and software. Besides, the workers working in IT are reduced. However, like all other technologies, there are some issues with cloud computing. The biggest concern is security, especially data stealing. Some solutions have been suggested to overcome these issues. Cloud service providers should provide regulatory compliances that the users may be concerned about. Also, security policies should be provided with details regarding access control, risk management, system backup and recovery.

Recommendations

In order to make the best usage of cloud computing technologies in revamping the economy, the following recommendations have been made:

The providers should ensure that cloud environment is highly secured.

Companies should consider cloud computing for managing and maintaining systems.

Organizations should consider the nature and needs of their businesses to select the model of cloud computing ideal to them.

Organizations should make the best from the scalability, collaboration and data protection associated with cloud computing.

The users should also use stronger authentication and ID management tools.

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