

Cloud Computing Adoption: Challenges and Possibilities in Developing Countries



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Salim Ahmad¹, Sanjeev Kumar², & S. P. Singh³

Abstract— Cloud Computing is an innovative technology that transforms businesses all over the world and help in so many developmental strides in the Enterprise Information Technology in Developed countries. Users and enterprises are gradually changing the way and manner in which data and information are been stored, the processes of storing/retrieving data and information traditionally using standalone Computers programs are no longer sustainable due to high cost of peripheral devices. Therefore, enterprise and users are now considering migrating and adopting the Cloud computing technology since it serves as a major driver in consumer-oriented business because of its ease of use, availability, scalability and other functions of delivering computing services – server, storage, databases, networking, software and more. But many enterprises are little more cautious in its adoption due to security challenges related to it, which causes law adoption and implementation. This paper investigates and reviews the challenges (i.e. reasons for low implementation) and possibilities of cloud computing adoption in Developing Countries. The paper is a review research to explore some of the reasons for low adoption of cloud computing technology in developing countries; it further addresses the possibilities of overcoming these challenges with recommendations on improving the level of adopting cloud computing technology in the Developing Countries.

Keywords—Cloud Computing, Virtualization, Adoption, Challenges and Possibilities, developing countries.

I. Introduction

Cloud computing sets the giant stride for a new era of computing globally [1]. Cloud computing actually changes the way and manner applications are developed and maintain as well as the processes in which infrastructure are run by users. Cloud computing, which is also refers to as “on-demand computing”, is the type of web-based computing, where by resources and information are shared and alsodelivered to computers and other peripheral devices on request. Cloud computing served as an idealtechnology that allow for universal, on-request access to a collectivegroup of configurable computing resources [2]. Clouds computing as a new way of data storage provided clarifications to users and organizations with several abilities to store data as well as process a particular data in a different location provided by cloud service providers. The new innovative technology alsodepends ondistribution of resources to accomplishconsistency and economies of scale andeffectiveness (like the electricity system) through a

¹Department of Information Technology, Federal University Dutse - Jigawa State Nigeria.

(Research Scholar, Department of Information Technology, Nims University Rajasthan – Jaipur, India)

²Department of Information Technology, Nims University Rajasthan – Jaipur, India.

³Department of Computer Engineering, Nims University Rajasthan – Jaipur, India.

¹salim_mgr@yahoo.com, ²sanjeev_solanki@live.in, ³drsp Singh2511@gmail.com

network. The establishment of cloud computing is the wider theory of joined infrastructure and collective services. The “Cloud” in simpler term, accents on exploiting the usefulness of the collective resources. Cloud resources are generally not only connected by several users but are also vigorously rearranged based on demand; the process also work for distributing resources to cloud users. This approach helps maximize the use of computing power while reducing the overall cost of resources by using less power, air conditioning, rack space, etc. to maintain the system. With cloud computing, several users can a permission to access a particular server in order to recover and modernize their data without acquiring new authorizations for different applications. The Cloud Computing also permits the usage of information technology on the basis of effective functionalities on-demand by users. The cloud technology offers lots of possibilities to businesses and organization having an inadequate capital, lack of human resources, and also lack access to marketing network.

The rapid development of cloud technology indicates certainly non reduction in terms of adoption and frequent utilization from different sectors by developing countries like India, Singapore, America and others. According to 2016 BSA Global Cloud Computing Scorecard, estimates that by 2019 global market will exceed US\$130 billion, The Scorecard positions the “IT infrastructure and policy environment – or cloud computing readiness – of 24 countries that account for 80 percent of the world’s IT markets”, that Cloud computing as a current IT invention, has further supplement innovative measurement to that significance by increasing access to technology that pushes for economic growth generally at all levels.

But upon all these underlying possibilities the cloud technology brought into businesses in developing countries a lot of challenges were faced that results to low implementation and will be discussed and recommend ways so as to improve the level of implementing the technology.

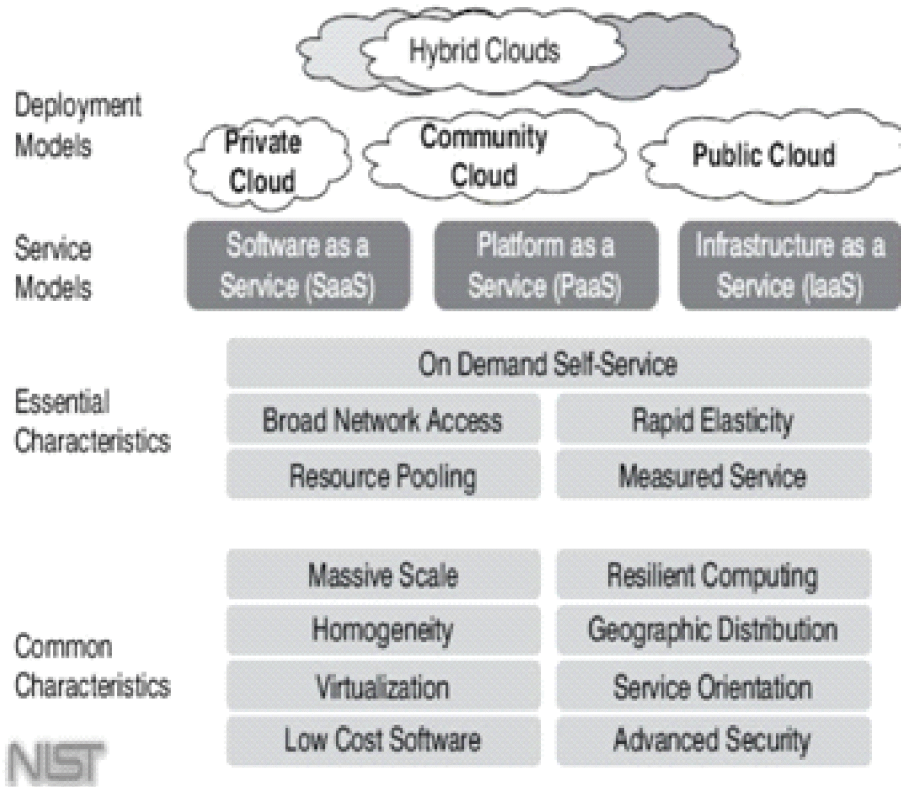
II. Literature Review

Cloud computing advanced from numerous technologies and business methods that is developed through years [3] the basic concept of Cloud Computing is separating the application from the operating system as well as the hardware its self. This processes of separation brought about the underlying technology of cloud computing called Virtualization. Virtualization plays a vital role in cloud computing processes [4]. It is a method of installing and organizing computing properties. It splits the dissimilar levels of the application scheme comprising the hardware, software, data, networking, storage etc. It also analyses the separation concerning the data centre, servers, storage, networking, data and the physical devices, by identifying vigorous architecture, then accomplishes the objectives of establishing an integrated and making use of vigorously the physical properties and essential resources, enlightening the elasticity of the system, decreasing the budget, enlightening the service and reducing the threat of management. The Cloud computing adoptions generally are attractive in planning businesses for more profitability, success and cost management. Most developing Countries are not an exceptional role in the service delivery sector thus making some enormous attempts and cumulating their determinations to create more responsiveness and contribute significantly in facilitating migration of corporations to the cloud [1] highlighted that the cloud technology avoidswasteful spending for both servers and storage, provides speed in processes and restructures application distribution without much investment, that is why several organizations are now considering adoption of cloud computing in their organizations to offer more effective and less cost network services while other are afraid of the challenges. For those countries to overcome the challenges that lead to low adoption some obstacles need to be addressed.

However, it is no coincidence that business many managers in developing countries have developed aim measurable want and aspiration for technology in order to determine and change their businesses. [5] Business and technology are inseparable that makes it problematic to decide which one can work without another where profit growth (revenue increase / cost reduction) is an important performance pointer upon which commercial achievements are measured.

III. Cloud Computing Concept

According to National Institute for Standards and Technology (NIST) [6]–the concept of Cloud Computing allows for appropriate on-request network authorizations to a collective group of configurable computing resources comprising of network, server, storage, applications and services that can be speedily provisioned and free with least management determination of service provider collaboration. Distinctive Example of Cloud Computing Technologies are: Google Search, Web based Email (electronic mail, be it Gmail, yahoo mail), Google Documents (create Doc, Spread sheet, presentation and edit online) and others. Cloud computing can be access in various ways Public, Private, Community and hybrids models, available in services like the SPI services model as *Software as a Service (SaaS)*, *Platform as a Service (PaaS)* and *Infrastructure as a Service (IaaS)* [6].



Cloud Computing Concept [6].

Dissimilar Models of cloud computing have several ways of revealing their principal infrastructure to the clients. This affects the level of uninterrupted control over the management of the computing arrangement and the dissemination of tasks for management of its security.

- **Software as a Service (SaaS)** most of the duty for security aspect depends largely with the cloud providers, SaaS offers a numeral of techniques of controlling entrance to the Web Gateway, like the managing of user uniqueness, application level structure, and the capacity to limit access to precise IP address collections or characteristics.
- **Platform as a Service (PaaS)** permit users to undertake additional tasks for managing the structure and security for the middleware, database software, and application runtime locations.
- **Infrastructure as a Service (IaaS)** permit users with numerous control, and concern for security, from the cloud service provider to the clients. In this particular service model, entrance is accessible to the operating system that maintains virtual images, networking, as well as storage.

CLOUD COMPUTING ADOPTION

Cloud Adoption is the procedure of partly or fully deploying an organization's digital assets, services, IT resources or applications to the cloud, [7]. The migrated assets are easily reached at the cloud's firewall. Cloud migration is sometimes refers to as Business Process Outsourcing (BPO), which may possibly involve transferring a total organizational infrastructure, where computing, storage, software and platform services are moved to the cloud for ease of access. Cloud computing is accepted to several organizations because to its scalability, ease of management and little costs expenditure. Cloud migration enables the implementation of flexible cloud computing.

An organization's cloud migration procedure sometimes comprises merging an on-site IT infrastructure through a hybrid cloud solution, which may be retrieved through the Internet for a specific charge. Hybrid cloud solutions move among one or many cloud service providers and commonly offer on-demand and provisioned server space, applications and services.

Cloud migration/adoption is significant for attaining real-time, up to date performance and efficiency. As a result, cloud migration needs thoughtful exploration, planning and execution to guarantee the cloud solution's compatibility through organizational requirements.

The terms "Cloud Migration" also relates to situations whereby an organization is migrating away from Capital Expenditure traditions that is buying the dedicated hardware and devalue it over a particular period of time to the Modern Operational Expenditure model using a distributed cloud infrastructure and pay per use. Advocates assert that cloud computing lets companies to avoid wasteful infrastructure costs, and focus on developments that distinguish their businesses as an alternative of several other infrastructures. An advocate also assert that cloud computing lets organizations to get their applications active and processes faster, with enhanced manageability and less maintenance, that supports IT to more speedily modify resources in order to satisfy changeable and irregular business demands.

Cloud Security Challenge: The Main Reason for Low Cloud Adoption in Developing Countries

Moreover, the usual problem of evolving secure IT systems, cloud computing offers an additional level of threat because significant services are frequently outsourced to a third party (Cloud Service Provider) [8]. The expressed characteristic of outsourcing makes it challenging to uphold data integrity and privacy, upkeep data and service availability, and establish compliance. As a result, cloud computing moves considerably the control over data and processes from the user organization to cloud providers. Even simpler responsibilities, such as patches application and installing firewalls, can become the obligation of the cloud service provider, not a particular user/client.

There are several other challenges or reasons for low cloud adoption, all of which state to the challenges that any major paradigm shifts or new adoption can run in to [9]. The major issues that will need to be addressed to in order facilitate the adoption and their possibilities are as follows:

- Difficulty in moving/migrating existing workloads to a Cloud. Although, new tools and techniques are already in place that addresses the issues of cloud migration.
- Expensive Equipment that comprises the Hardware and software are expensive to users. Therefore, making it difficult for smaller enterprises with little capital to adopt, cheaper equipment is needed to address the issue.
- The service providers' high expectations in revenue generation as a business to their legacies which make several businesses fear the exorbitant prices resulting to low or no implementation at all, should devise means of generating revenue and make Services affordable.
- Security concerns about the Cloud, generally the security aspect need to be improved so as to increase adoption.

Even though, there are some general discomfort regarding migrations and adopting Cloud, these discomforts will begin to change once the benefits and or possibilities of the Cloud are taken into consideration. Cloud storage is the future of many businesses and Information Technology in general, and with enterprises producing new tools and techniques to streamline both the migration process and the Cloud experience, adoption should begin to intensely increase in the near future.

Apart from the reasons highlighted for low cloud computing adoption in developing countries, some challenges are discussed by many scholars but [2] added that technical challenges like availability of service and data lock-in, shortage of accessible storage, performance irregularity and data transfer blocks are also trials that could deter the development of cloud computing adoption in most developing countries. Moreover, [2] highlighted that Poor quality of internet service can obstructs speedy accessibility of data, threats of hackers, Privacy Concerns, Deficiency in technical skills in the distribution of cloud computing services, Nonexistence of flexible policy or permissible framework for cloud computing is depressing a number of corporations to implement cloud computing, unfamiliarity of the cloud computing technologies, lack of Information and Communication Technology infrastructures and common facilities needed to institute cloud computing datacenters across the country as well as Insecurity challenges that obstructs cloud technologies providers from participating in most developing countries among many other challenges.

Cloud Computing Possibilities in Developing Countries

Cloud computing is a quite elastic technology method, cost-effectiveness, and recognized distribution platform for providing corporate or consumer IT services through the Internet [10]. Cloud properties can be speedily positioned and effortlessly scaled, with all developments, applications, and services provisioned on request, irrespective of the user position or peripheral device use. As a result, cloud computing provides organizations the prospect to escalate their service delivery competences, restructure IT management, and better support IT services with vibrant business requirements. In other ways, cloud computing offers a firm's sustenance for core business purposes with the capability to improve new and inventive services in businesses.

Countries like India, Singapore, and America who are technologically advanced now established their whole multi-billion dollar business simulations on placing information on the internet, and keeping the data in the cloud. Cloud computing offers universal admittance to virtually limitless processing power, new storage competencies and much more but left countries like Nigeria which is among the underdeveloped or developing nation from possibly attaining this possibilities and boasting business opportunities like measuring of used resources for smaller companies that is payment based model (Pay per use), cost reduction, easing of Information Technology complexities and increasing the accessibility of update technology.

IV. RESEARCH METHODOLOGY

This research paper depends mainly on intuitive data and reviews which are derived from previous literal works done on the research paper topic obtainable from textbooks, journals, newspapers and from the internet resources. in order to investigate and examine some of the challenges that lead to low adoption or implementation of cloud computing in developing countries.

V. CONCLUSION

In conclusion, we discussed how developed countries are using cloud computing to achieve scalability, agility, automation, and resource sharing. Cloud computing can provide an efficient, scalable, and cost-effective way for business in most developing countries if fully adopted and implemented. Varieties of different cloud computing services models are obtainable, provided that firm provisions for core business purposes and the elasticity to provide new services. However, the elasticity and directness of cloud computing models have generated a security challenges that hinders or result to low adoption in those countries. IT resources are collectively distributed among several users, and security procedures are frequently secret behind layers of generalization and services are provided online so control over data and processes is moved to the cloud service providers.

In this paper, we presented and examine various challenges that lead to low adoption and as well possibilities of cloud adoption in developing countries. The major issues that need to be addressed in order facilitate the adoption and their possibilities are discussed by given some guidelines for the implementation and adoption of cloud computing. We further recommend that the Ministry of Science, Technology and Communication in Nigeria should set up a committee and find out ways on how to improve the cloud computing adoption in developing countries, taking into consideration the challenges that cause low implementation of the cloud computing technology.

ACKNOWLEDGEMENT

All praises are due to God for all the Knowledge, blessing, mercies and favors He bestowed upon all of us to come up with this research paper. We also wish to acknowledge the Nims University Rajasthan, Jaipur, India for providing us with the necessary materials to conduct this Review Research by enabling us access to the digital Library, Books and other Journals Available. The National Institute for Standard and Technology (NIST) will also be acknowledge for the tremendous work they are publishing with regards to Cloud Computing and all the Authors who have contributed in the Field of Information and Communication Technology and Cloud Computing that we had accessed their manuscript And lastly, my colleague and brother Mr. Abubakar Muhammad for the guidance and advices rendered.

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