

The Need to Accelerate Cloud Adoption in Developing Countries of Africa

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ABSTRACT

Cloud computing is an emerging computing paradigm that has been made very easy to use and adopt as a result of complex technological abstraction. It increases the economic benefit of individuals and organizations by reducing cost of system operation and maintenance. This has made some countries to embrace the technology in order to compete in the global village. The consequences of slow adoption of this promising technology in African countries need to be addressed. This study shifts ground from slow adoption to strategies of rapid acceptance of cloud computing in African developing countries. It compared the cloud readiness and level of Information and Communication Technologies (ICTs) of four Non-African developing countries (China, India, Brazil and Mexico) against four African developing countries (Nigeria, Tunisia, Kenya and Ghana). Results indicated that African developing countries are lagging behind. This places them in a competitive disadvantage in the economy of the information age. The study suggests that African developing countries need to invest and give proper legislative attention to cloud economy in order to close the digital divide that keeps on widening as time passes by.

KEYWORDS: *Cloud computing, adoption, developing countries, Africa*

INTRODUCTION

Cloud computing is a computing paradigm that has been envisioned as a utility computing right from its inception in the early 1950s during the era of mainframe computers [1]. It is increasingly gaining popularity in the global village [2]. And the rate at which organizations are migrating to the cloud is fast bringing the vision to reality.

Cloud computing is characterized with: absence of upfront cost, on-demand access, scalability, ubiquity, little or no managerial effort etc. [1, 3]. These characteristics also describes the benefits of cloud computing.

Cloud computing allows equalization of economic opportunities [4]. The most evident benefit of cloud computing is increased economic benefit as a result of reduced maintenance and operational cost

of IT related software and hardware [1]. It provides a common ground for individuals and organizations, small and large enterprises, developed and underdeveloped countries.

Developed countries like Japan, US, UK, Germany have occupied the global cloud market place. These countries are still competing and striving very hard amongst themselves to completely dominate the cloud economy [5]. This can be attributed to their high level of infrastructure, education, and per capital income. On the other hand, developing countries are often characterized with either inadequate ICTs, low income, electric power outage, high level of illiteracy, etc. Despite the challenges, some non-African developing countries like China, India, Brazil, South Korea, Mexico, Vietnam and Indonesia are gaining popularity in the cloud market place [5]. However, African developing

countries such as Nigeria, Ghana, Tunisia, and Kenya cannot boast of the same level of adoption against their counterpart non-African developing countries.

The aim of this study is to compare the level of cloud adoption by African developing countries (Nigeria, Ghana, Tunisia and Kenya) with other non-African developing countries (China, India, Brazil and Mexico) based on their cloud readiness and adoption.

This paper contains six sections, including this introductory part. The next section review related works and it is followed by research methodology. Evidences of cloud computing adoption in developing countries across the globe were presented. This formed the basis upon which discussions were formulated, suggestions were proffered and conclusion was reached.

RELATED WORKS

Lack of standard cloud computing definition has led to different definitions by scholars, researchers and IT administrators [1]. Today, US National Institute of Science and Technology (NIST) is the most widely accepted definition and it is defined as: “ a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [6].”

Cloud computing has been the subject of much research over the last decade [7, 8]. Many have directed their dimension towards defining cloud computing for better understanding [9, 10]. Some have taken the challenge to investigate issues regarding the adoption of the complex technology; part of them are focusing on

the cloud economy; many also discuss on security, privacy and trust issues in cloud computing [2, 11– 18].

Previous study analyzed how cloud-computing economy fits into broader ICTs in Africa [6]. The study highlighted the key market trends, benefits and the perceived risks associated with the adoption of cloud computing in African countries. The study suggested the need to have locally trained cloud computing experts.

The major challenge impeding the fast adoption of cloud computing in developing countries and some first adopters is infrastructure [12]. There have been efforts by Telecommunication giants, such as Seacom to bring fiber optic cables via undersea into African countries allowing communication with the rest of the world, but the inland work is still a concern for consumers’ data upload, download, and latency. In addition, transparency is an issue as there is no any benchmark for cloud providers [12, 19].

In 2014 up to 60% of the workloads of the world’ s servers took place on virtualized servers [20]. Gartner posited that, by 2016 there will be a marginal investment in Information technology budget into cloud computing globally [12]. The study suggested (1) broadband networks; (2) the unrestricted flow of information; and (3) the freedom to scale data centers; as technological requisites for moving into the cloud for India, Mexico and South Africa in order to bring increased intellectual, economic and social inclusion in a global scale.

Statistical data from the World Bank showed that Small and Medium Enterprises (SMEs) are the key contributors to GDP and generate employment opportunities [20, 21]. It is in this regard a study compared the adoption

issues of cloud computing between UK and Sub-Saharan African SMEs [22]. Though UK is more advanced than African countries, finding from study revealed two classes of factors: Exciters that facilitate adoption and Inhibitors that impede it. These factors could also have similar or dissimilar effect on the two environments. Security, privacy, trust and fear of data loss were identified as the areas that need to be addressed by government policy makers, cloud vendors, and professionals.

In recent years, there has been an increasing amount of literature that investigated cloud computing development and adoption in African developing countries and non-African developing countries [23–36]. However, the study revealed considerable gap of low adoption between African developing countries and non-African developing countries despite the fact that they are all developing countries.

In this plight, this study aim at comparing two groups of countries: non-African developing countries (China, India, Brazil and Mexico) and African developing countries (Nigeria, Ghana, Tunisia and Kenya) in order to find out the possible way to close the gap between them, and at the same time minimize the wide gap among the developed and developing countries in the world.

RESEARCH METHODOLOGY

According to Creswell, qualitative research is most suitable when little detail of a phenomenon is available and there is a need to critically explore its true essence [37]. Summative content analysis was used because it allowed for subjective interpretation of text data through systematic classification and identifying themes or patterns [38]. It also depends heavily on the credibility of data [39]. In this regard, articles from conference

proceedings, journals, books, dissertations, and empirical reports are used to review, explore and identify key information regarding the subject of discussion.

Four (4) non-African developing countries (China, India, Brazil and Mexico) and four (4) African developing countries (Nigeria, Ghana, Tunisia and Kenya) have been chosen as basis for comparison because they have persistently appeared in the reports and literatures.

EVIDENCE OF CLOUD COMPUTING IN SOME DEVELOPING COUNTRIES

Cloud computing has evolved to the extent of being noticed in the national economy [40, 41]. Developed countries are the pioneer adopters and have constituted the larger shares of cloud computing both in the sides of demand and supply.

Developing countries are recently investing in ICTs to fuel economic growth. Economic growth in this era is linked to digital economy. Digital economy is basically cloud economy because it allow firms and individuals to participate in the economy like never before [2].

Digital economy is estimated to 13.8% of all sales flowing through the world economy [2]. Cloud computing which is a global phenomenon is expected to grow at a remarkable rate of 30% Compound Annual Growth Rate (CAGR) by 2020 [42].

These are indications that cloud economy is one of the current and the future of the envisioned global digital economy. Evidences indicate that some developing countries are emerging among the top gainers of cloud computing. These countries are but not limited to China, India, Mexico and Brazil [5, 19, 43].

Measuring cloud computing in the national economy is the harder part as there is no a generally acceptable framework to measure the technology [12]. Nevertheless, some organizations have courageously come up with some parameters to be used as blueprint to produce comprehensive cloud reports. The data from these reports are presented in Tables 1–4.

Business Software Alliance (BSA) Global Cloud Computing Scorecard

BSA is a leading advocate for the global software industry representing a number of the world’s largest software makers. It is also a member of International Intellectual Property Alliance (IIPA). BSA report ranks the top cloud-ready countries in the world. It consists of 24 major players in the cloud based economy, accounting for 80 percent of the world digital economy.

TABLE 1: BSA GLOBAL CLOUD COMPUTING SCORECARD[5].

Rank	Economy	Data privacy	Security	Cybercrime	Intellectual Property Right	Support for Industry standard	Promoting free trade	ICT Readiness & broadband	Overall score
1	Japan	8.8	8.4	10.0	17.2	8.8	9.2	21.7	84.1
2	Australia	7.9	6.4	10.0	17.6	10.0	7.0	21.0	79.9
3	US	6.5	7.6	8.8	16.6	10.0	8.0	22.2	79.7
4	Germany	6.6	6.4	10.0	16.8	9.8	9.2	20.3	79.1
5	Singapore	7.6	3.6	9.0	18.0	8.8	8.6	22.9	78.5
6	France	6.5	7.6	10.0	16.8	9.6	8.8	19.0	78.3
7	UK	6.9	8.0	6.8	17.8	9.2	6.8	21.4	76.9
8	Korea	9.3	6.0	4.8	17.6	9.6	7.0	21.9	76.2
9	Canada	8.1	6.8	6.2	15.6	10.0	9.6	19.5	75.8
10	Italy	6.2	7.6	9.6	17.0	9.8	8.8	16.5	75.5
11	Spain	6.5	6.4	8.8	15.2	9.8	9.4	17.6	73.3
12	Poland	6.8	5.6	8.8	16.8	9.8	8.4	15.8	72.0
13	Malaysia	7.1	5.6	7.2	17.4	10.0	5.8	16.4	69.5
14	Russia	5.4	5.6	6.8	14.4	6.8	5.2	14.9	59.1
15	Mexico	7.5	4.8	8.6	12.4	9.2	3.0	11.4	56.9
16	Argentina	5.0	6.0	8.8	12.4	4.6	5.8	13.9	56.5
17	India	4.1	4.4	7.4	12.0	10.0	6.4	8.8	53.1
18	Turkey	3.5	4.0	6.4	14.0	8.6	2.8	13.1	52.4
19	China	4.7	2.8	4.6	13.6	7.8	4.8	13.2	51.5
20	S. Africa	2.8	3.2	9.8	13.6	9.8	1.8	10.3	51.3
21	Indonesia	6.4	3.2	7.0	11.2	8.2	2.0	10.4	48.4
22	Brazil	4.7	3.6	8.0	8.8	3.4	2.2	13.4	44.1
23	Thailand	3.5	1.6	7.4	8.0	8.8	3.0	11.7	44.0
24	Vietnam	4.1	2.8	5.0	9.2	7.0	1.4	10.6	40.1

Table 1 has reported the cloud computing readiness of top 24 countries in the world. It was dominated by developed countries, and a few non-African (Malaysia, Russia, Brazil, India, China, Vietnam, and Mexico) developing countries. ICT readiness and broadband deployment constituted larger percentage of the overall score.

US Top Market Reports on Cloud Computing

US cloud vendors are the leading cloud services providers. They constituted 17 out of the top 20 in the world. In another research, Gartner showed that 2 out of every 15 providers are US based [43].

TABLE 2: US PROJECTED TOP MARKETS FOR CLOUD COMPUTING EXPORTS [43 p.5].

RANK	COUNTRY	RANK	COUNTRY
1	Japan	11	Switzerland
2	United Kingdom	12	South Korea
3	Canada	13	China
4	Netherlands	14	Mexico
5	Germany	15	Sweden
6	Brazil	16	Italy
7	Australia	17	Spain
8	India	18	Singapore
9	Ireland	19	Belgium/L.
10	France	20	South Africa

Table 2 showed that Brazil, India, China, and Mexico are also top non-African developing countries.

The Global Information Technology Report (GITR)

A report with the theme “ICTs for inclusive growth” that was developed as a result of the collaboration of two giant

industries (World Economic Forum & INSEAD) [44].

It ranks 143 economies constituting 98.4 percent of world GDP. It measures the network readiness index to find out the extent to which countries can embrace cloud computing and other IT based innovations [44].

TABLE 3: GLOBAL INFORMATION TECHNOLOGY REPORT [44 p. 30-34].

Country/ Economy	Sub-indexes / Pillars						Rank
	Network Readiness Index	Operating Environment	Infrastructure, Affordability and Skills	Individual, Business and Government Usage	Economic and Social Impacts		
China	4.2	3.9	4.7	4.1	4.0	62	
India	3.7	3.6	4.6	3.2	3.6	89	
Brazil	3.9	3.5	4.3	4.0	3.6	84	
Mexico	4.0	3.9	5.0	3.7	3.6	69	
Nigeria	3.2	3.4	3.0	3.2	3.1	119	
Ghana	3.5	4.1	3.5	3.4	3.0	101	
Kenya	3.8	3.9	3.8	3.6	4.0	86	
Tunisia	3.9	3.6	4.8	3.6	3.5	81	

From the data in Table 3, it can be seen that there is a gap between the two groups of countries. The first group (the non-African developing countries) which is the upper part has done considerably well to exist between 60th to 90th positions. While the lower part of the table consisted African developing countries found between the 80th and 120th of the overall 143 countries.

United Nations (UN) World e-Government Survey

One of the UN’s global authoritative projects to measure how public administration provides electronic and mobile public service to the citizens [45]. The survey reported the national income in relation with e-Government Development Index (EGDI) of all the member countries. For the purpose of comparison in this

study, some selected developing countries both in Africa and non-Africa are extracted.

TABLE 4: UN E-GOVERNMENT AND NATIONAL INCOME [45].

Country	National Income	Very High EGDI	High EGDI	Middle EGDI	Low EGDI
Brazil	Upper Medium		X		
China	Upper Medium		X		
Mexico	Upper Medium		X		
India	Lower Medium			X	
Tunisia	Upper Medium		X		
Ghana	Lower Medium			X	
Nigeria	Lower Medium			X	
Kenya	Low			X	

Table 4 is quite revealing in several ways. First it showed the relationship between per National income and the e-Government Development Index (EGDI) level. Secondly, it revealed that Brazil, China, Mexico and Tunisia are on the high side of using cloud computing to deliver e-Government related services. Lastly, Kenya with low national income has struggled to maintain middle EGDI.

RESULTS

This study aimed at comparing the cloud adoption level of two set of countries bearing the same title as “developing countries”. Except that, one set is from Africa and the other is from the other part of the world. The sources used in the study are data generated from cloud computing related reports.

Table 1 evidently showed that Mexico, India, China and Brazil are benefiting from cloud computing due to their level of preparedness. The report also indicated that the seven indexes were major policies that the governments of the countries have given considerably attention. No African developing country was able to make the list (Except South Africa which is a developed country). This clearly suggests that African developing countries need to address some policies on major drivers of cloud computing adoption in order to reap from its benefit. As cloud is described as a data center insensitive technology, the concern is to

access the services via Internet connected device. This has allowed many countries to outsource IT infrastructures from cloud services providers in other countries (for example US which houses Microsoft, Google Inc, Oracle, Salesforce.com vendors). From Table 2, non-African developing countries (Brazil, India, China and Mexico) are among the top 20 patronizers of their cloud computing services. The absence of African developing countries showed that little have been done to outsource cloud services in order to cut cost and reap immense benefits from the cloud computing.

Networked readiness in Table 3 indicated the ability of countries to leverage ICTs for development in individual, corporate and national level. The divide between the two set of countries can be noticed in terms of infrastructure, affordability and usage. Infrastructure especially, is a pre-condition for cloud adoption. ICTs in non-African developing countries are increasingly becoming affordable, but African developing countries are still lagging behind.

e-Government consists of underlying infrastructure, human development and online services advancement [45]. These are basically cloud computing features and hence, e-Government is a cloud computing application. A relationship exists between per capital income and cloud adoption in

Table 4. This stress that the better the national income the larger the chances of cloud computing in developing countries.

SUGGESTIONS FOR AFRICAN DEVELOPING COUNTRIES

The following suggestions were drawn from the study:

- That government of developing countries especially in Africa needs to give legislative attention to cloud economy. To capitalize on its benefits, there is need to make proper and coordinated policies that will ensure privacy, promote security, battle cybercrime, protect intellectual property, ensure data portability to promote openness and interoperability, promote free trade, establish necessary IT infrastructure and facilitate broadband access.
- The relationship between national income and cloud economy is directly proportional. This however, suggests that African developing countries should strive hard to improve their national income; this will in turn serve as catalyst for cloud computing development in the country.
- Developing countries can still benefit massively from cloud computing despite resource constraints by outsourcing from vendors in other countries.
- Governments of African developing countries need to invest in ICT industry. Because it has the potential to classify winners and losers of the information age, support economic growth, and create opportunities.

CONCLUSION

This paper discussed cloud computing adoption in developing countries. It analyzed and compared the level of cloud readiness of some non-African developing countries (China, India, Mexico and Brazil) against African developing countries (Nigeria, Ghana, Tunisia and Kenya). Evidences have shown that non-African developing countries have embraced cloud computing and

benefiting from it. With the rate at which cloud economy is growing, no country can afford to be left behind. If other developing countries can make it, so are Africandevolving countries.

FUTURE WORK

As future work, there is a need to explore more studies that report cloud computing adoption in more developing countries. Also, research can be carried out to compare performing developing countries with developed countries in order to close the digital divide.

REFERENCES

1. R. Buyya, C. Vecchiola, and S. T. Selvi, "Mastering Cloud Computing," *Mastering Cloud Comput.*, pp. 71– 109, 2013.
2. E. Oxford, "The New Digital Economy How it will transform business," pp. 1– 34, 2011.
3. A. Abdollahzadehgan, A. R. Che Hussin, M. M. Gohary, and M. Amini, "The Organizational Critical Success Factors for Adopting Cloud Computing in SMEs," *J. Inf. Syst. Res. Innov.*, vol. 4, no. 1, pp. 67– 74, 2013.
4. H. Marquis, "The Impact of Cloud Computing on Staffing," pp. 29– 30, 2010.
5. Bsa, "BSA Global Cloud COMPUTING Scorecard A Clear Path to Progress," pp. 1– 28, 2013.
6. A. Gillwald and M. Moyo, "The cloud over Africa," 2014.
7. H. Trivedi., "Cloud Adoption Model for Governments and Large Enterprises," *Mit*, no. May, p. 82, 2013.
8. I. O. Adam and A. Musah, "Small and Medium Enterprises (SMEs) in the Cloud in Developing Countries: A Synthesis of the Literature and Future Research Directions," *J. Manag. Sustain.*, vol. 5, no. 1, pp. 115– 139, 2015.
9. A. Shawish and M. Salama, "Inter-cooperative Collective Intelligence: Techniques and Applications," in

- Studies in Computational Intelligence*, vol. 495, 2014, pp. 39– 68.
10. T. Hartman and C. T. Officer, “ Defining the Business Value of Cloud Computing,” pp. 1– 9, 2009.
 11. I. T. U. Sectors, S. Group, S. Group, and D. Recommendation, “Access to cloud computing : Challenges and opportunities for developing countries,” pp. 3–5.
 12. E. Mashandudze and B. Dwolatzky, “Major Challenges Impeding the Fast Adoption of Cloud Computing : A Case Study of South African Organisations and Emerging Economics,” vol. 2, no. 1, pp. 1–20, 2015.
 13. E. Union and A. For, *Secure Use of Cloud Computing in the Finance Sector Good practices and recommendations*, no. December. 2015.
 14. Shuaibu Hassan Usman, Mohammed Abdullah bawazir, and A. M. Kabir, “Cloud Computing: A Strategy to Improve the Economy of Islamic Societies,” *Int. J. Comput. Trends Technol.*, vol. 9, no. 7, pp. 387– 392, 2014.
 15. J. F. Gantz and S. Minton, “ Cloud Computing ’ s Role in Job Creation,” 2015.
 16. S. Nepal and M. Pathan, *Security , Privacy and Trust in Cloud Systems*. Springer, 2014.
 17. B. R. Kandukuri, “ Cloud Security Issues,” pp. 517– 520, 2009.
 18. C. Saravanakumar, “ Survey on Interoperability , Security , Trust , Privacy Standardization of Cloud Computing,” pp. 977– 982, 2014.
 19. T. Fredriksson, *Information Economy report 2013: The Cloud Economy and Developing Countries*, no. December. 2013.
 20. P. Cowhey and M. Kleeman, “Unlocking the Benefits of Cloud Computing for Emerging Economies,” *Inf. Technol. Innov. Found.*, 2012.
 21. B. West, “ The Contributions of Small and Medium Scale Enterprises to Economic Growth : A Cross-Sectional study of Zebilla in the,” vol. 7, no. 9, pp. 262–275, 2015.
 22. A. A. Dahiru, C. Science, and D. Media, “CLOUD COMPUTING : A COMPARISON OF ADOPTION ISSUES BETWEEN UK AND SUB-SAHARAN AFRICA SMES,” vol. 2014, no. 2010, pp. 1–12, 2014.
 23. K. Muhammed, K. Rumana, and A. M. Turaki, “Cloud Computing Adoption in Nigeria : Challenges and,” vol. 5, no. 7, pp. 1–7, 2015.
 24. R. K. A. Member, L. O. Odia, and S. I. Omofonmwan, “Factor Analysis of the Adoption of Cloud Computing In Nigeria,” *J. Soc. Sci.*, vol. 7, no. 1, pp. 81–86, 2014.
 25. A. R. Muhammad, “Towards Cloud Adoption in Africa: The Case of Nigeria,” *Int. J. Sci. Eng. Res.*, vol. 6, no. 1, pp. 657–664, 2015.
 26. F. M. Dahunsi and T. M. Owoseni, “CLOUD COMPUTING IN NIGERIA : THE CLOUD ECOSYSTEM PERSPECTIVE,” vol. 34, no. 1, pp. 209– 216, 2015.
 27. C. E. NNADOZIE, “ Cloud computing in Nigeria,” 2013.
 28. M. S. Maaref, “ Cloud computing in Africa - Situation and perspectives,” *Telecommun. Dev. Sect. - ITU*, p. 70, 2012.
 29. O. G. Nwabuonu and N. J. Nwachukwu, “ Cloud Computing: Key to IT Development in West Africa,” *West African J. Ind. Acad. Res.*, vol. 9, no. 1, pp. 115– 122, 2014.
 30. P. T. M. Waema and B. Omwenga, “ Cloud Computing in Kenya University of Nairobi,” no. April, 2014.
 31. EUSME, “ The ICT Market in China The ICT Market in China,” 2015.
 32. N. Kshetri, “ Diffusion and Effects of Cloud Computing in China: Economic and Institutional Considerations,” in *PTC 2013 (Pacific Telecommunications Council conference)*, 2013, pp. 20– 21.
 33. E. & Young, “ Cloud adoption in India,” 2010.

34. Confederation of Indian Industry CII, “The Indian Cloud Revolution.”
35. C. Dahlman, “Technology, globalization, and international competitiveness: Challenges for developing countries,” *Asdf*, pp. 29–83, 2007.
36. N. Kshetri, “Cloud Computing in Developing Economies,” *Computer (Long. Beach. Calif.)*, vol. 43, no. April, pp. 47–55, 2010.
37. C. Williams, “Research Methods,” vol. 5, no. 3, pp. 65–72, 2007.
38. F. Rapport, “Summative analysis: A qualitative method for social science and health research,” *Int. J. Qual. Methods*, vol. 9, no. 3, pp. 270–290, 2010.
39. H.-F. Hsieh, “Three Approaches to Qualitative Content Analysis,” *Qual. Health Res.*, vol. 15, no. 9, pp. 1277–1288, 2005.
40. Kpmg, “Modelling the Economic Impact of Cloud Computing,” p. 52, 2012.
41. TechSoup Global, “2012 Global Cloud Computing Survey Results,” 2012.
42. Internet world stats, “Africa internet users, facebook and population statistics,” *Miniwatts Marketing Group*, 2014. [Online]. Available: <http://www.internetworldstats.com/stats1.htm>. [Accessed: 02-Feb-2016].
43. D. Archibald, O. Boonyalug, A. Choi, C. Defranchi, T. Ford, D. Groot, P. Hammerstein, M. Koeckeritz, S. Maini, P. Marega, I. Rocchia, R. Saito, J. Shen, R. Stanbridge, T. Verthein, and S. Xiao, “2015 Top Markets Report Cloud Computing,” no. July, 2015.
44. F. Pivec, *The global information technology report 2003–2004*, vol. 8, no. 4. 2003.
45. C. One, “World e-government rankings,” pp. 9–35, 2012.