

Cloud Computing: An Avenue for Enhancing E-Government System

Mbanzabugabo Jean Baptiste, Phd ^[1], Bizimana Theoneste ^[2], Uwitonze Gilbert ^[3]

Faculty of Business and Technology ^{[1] & [3]}

University of Tourism Technology and Business Studies (UTB)

School of Post Graduate Studies ^[2]

University of Kigali (UoK)

Kigali, Rwanda

ABSTRACT

This paper aims at identifying the factors leading to the slow performance of E-government system compared to the use of Cloud technology in supporting E-government implementation; also it examines the main factors affecting the adoption of Cloud computing technology and argues that Cloud computing technology can be recommended as new avenue to support E-government implementation taking Rwanda as case study.

Keywords:- Cloud Computing, E-government, Sustainable System Implementation, Virtualization, SOA, Unified Computing System

I. INTRODUCTION

Cloud computing is novel technology settled from the mixtures of diverse technologies such as grid computing, service oriented architecture, and so forth (Sajjad, Khalil and Masdari, 2013). Those technologies are functioning behind the cloud computing platforms for making Cloud computing flexible, reliable, and usable (Ürgen et al., 2014; Tutorialspoint, 2016). In many countries nowadays, most of services the government to citizens are available on a web portal platform (EGM, 2011). This illustrates where technology can help e-government implementation which is born to create transparency and services delivery for citizens and businesses (Group, 2011). E-government illustrates the way citizens obtain public services through the internet so that they could gain the services provided by government (Mohammed and Steve, 2010). Rwanda as developing country needs to benefit from IT as planned that all government services will be online by 2018 (MYICT, 2013). The improvement of IT in Rwanda provides the public services delivery to the people and these services set to be available and easily to get not later than 2018 (MYICT, 2013; Minecofin, 2013). The previous studies proved that Cloud computing has the quality of enhancing e-government

system while it removes the major problems that e-government implementation faced (Sajjad, Khalil and Masdari, 2013). Western countries like United States of America, UK, Japan and Australia supported Cloud computing technology for the sustainable of e-government system so that citizens can easily have access to government's services through internet (Gopakumaran et al., 2015). In this way, Government of Japan established Kasumigaseki Cloud in which it is intended to connect ministries and other parts of administrative units while reducing expenses go through hardware and software and also to help to share government information to the public from bureaucracy into open e-government (Noriko, 2016). In this regards, this paper illustrated how Cloud computing can support e-government system sustainability in Rwanda. It is in this way, Cloud computing for e-government can be applicable in many countries also in Africa since Cloud computing designed to resolve the problem of shared resources and provides rapid services with unlimited scalability and also resolves the problem of power consumption and cost of data storage (Thuwaini, ALMutairi and Shebaib, 2015). Figure 1 illustrates how Kasumigaseki Cloud of Japan is helping in many ways such as National Government, Local Government and also in private sector.

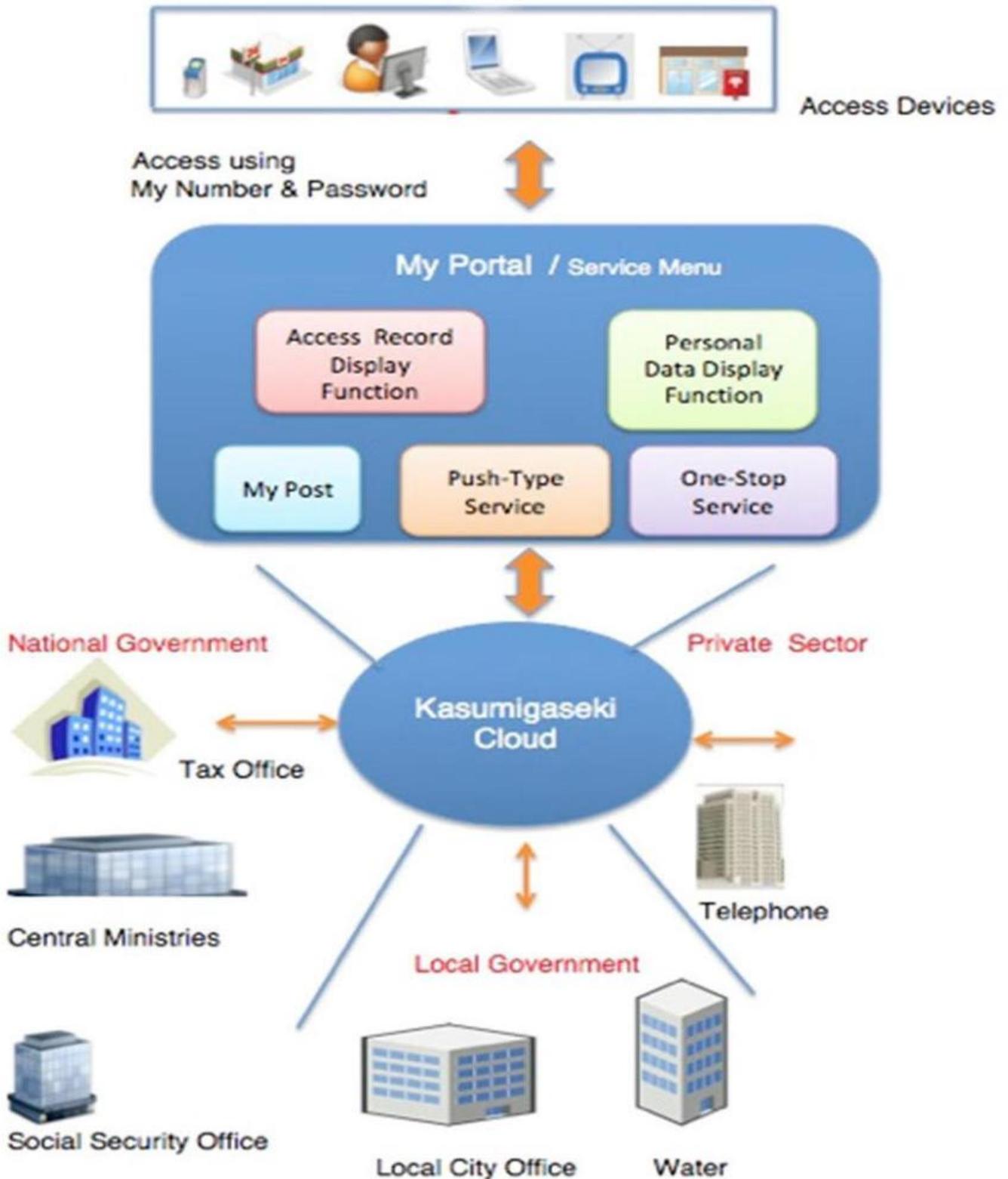


Figure 1: Kasumigaseki Cloud in supporting e-government in Japan (Noriko, 2016)

Government of Rwanda (GoR) is in partnership of RwandaOnline Platform Limited which is one of public private partnership for a long time (RDB, 2016). Utilities Regulatory Authority (RURA) showed that internet subscribers as numbered 3,140,310 in Rwanda so that the penetration rate has grew up and estimated to be 28.1% which is good to accelerate the sustainable e-government system Implementation (RURA, 2015). RwandaOnline launched new web portal irembo that enables service critical to citizens and businesses (RwandaOnline, 2015). The influence of RwandaOnline in IT sector illustrates its important role of helping e-government systems implementations where e-government services such as Tax declaration, National ID/Passport services, Land, Courts, and so forth are available on irembo portal. Africa Olleh Service (AoS) as a part of Korea Telecom in partnership with Government of Rwanda is provide reliable internet services and it is official Cloud Service provider which is managing Government Cloud (AoS, 2016). AoS uses different advanced equipments from big companies such ECM and Cisco (AoS,2016). The common technology used from cisco such as Unified Computing Systems (UCS) is on among equipments used by AoS. The AoS deployed many technologies with Government of Rwanda such as E-procurement and soon to develop e-learning platform (AoS, 2016). Unified Computing Systems (UCS) explained as the most advanced technology from Cisco used by AoS (AoS, 2016). UCS is an integrated computing infrastructure with embedded management that automates and accelerates deployment of applications you would need to deploy (Cisco, 2016).

This paper is based on the main objective which is to argue that Cloud computing is an avenue for enhancing E-government system in Rwanda. This paper focus on the four specific objectives which are following:

- i. To examine the available profits of Cloud computing while it uses to boost E-government System implementation in Rwanda
- ii. To identify the factors affecting E-government performance in Rwanda.
- iii. To examine the main factors, affect the adoption of Cloud computing technology.
- iv. To advise whether Cloud technology can be recommended as new avenue to support E-

Government implementation.

II. CLOUD COMPUTING DEFINITION AND ITS AFFILIATES

2.1 Definitions of Cloud computing

Before cloud computing launched, Software as service was invented to serve as Network based subscriptions to applications where users can have access through web portal (Ürgen et al., 2014). After SaaS reached to its contributions in computing technology, the Service Oriented Architecture (SOA) launched as ubiquitous in advanced computing technology and named as Cloud computing as it can be available anytime and accessible anywhere (IBM, 2015). Virtualization is remained important in cloud computing and its role is not something to ignore (Durairaj and Kannan, 2014). According to the 2nd IEEE International conference on cloud and big data defined Cloud computing as the fusion and development of grid computing, distributed computing, parallel computing, utility computing, network storage technologies, virtualization, load balancing and other traditional computer technologies and network technology (EEE, 2016). In simple way, Cloud computing is a model that illustrates the higher level of the delivery of the shared of computing resources such as hardware, software and data as service that you can access on demand via internet connection.

2.2 Cloud Computing affiliates

Most important affiliates of Cloud computing are **deployment models, Essential Characteristics and Cloud Service Models**. Cloud Deployment models divide in four types which are Public cloud, Private cloud, Community cloud and Hybrid (Security, 2011; Guallagher, 2013). In **Public Cloud**, the infrastructure is available to the public and it can be managed by an organisation which is selling cloud services such as Google, Amazon, and so forth. In **Private Cloud**, you can operate alone for a single organization and it can be managed by the organisation or a third party. In **Community Cloud** Model, the cloud infrastructure is shared by several organisations and supports a specific community that has shared businesses. In **Hybrid Cloud**, the cloud model is a composition of two or more clouds such as private, community or public (Guallagher, 2013). **Essential Characteristics** of Cloud

computing are five important elements which are on demand-self-service, Broad Network Access, Resource Pooling, Rapid Elasticity and Measured Service are defined below (Security, 2011). These characteristics illustrate the major benefits of Cloud computing for e-government implementation. **On-demand-self-service:** User can have an access on provision computing capabilities like server and network storage without any other interaction. **Broad Network Access:** The standard mechanisms approved and there is an availability of capabilities over network. Personal Digital Assistant and personal computers, mobile phones are major clients platform (Gallagher, 2013). **Resource Pooling:** The resources pooling included are those from network bandwidth, memory, virtual machines, storage and processing (Gallagher, 2013). **Rapid Elasticity:** The services may be rapidly and elastically provisioned for consumers and in other cases with automatically so that it can be scaling out with fast scale in it (Gallagher, 2013). **Measured Service:** The systems in cloud computing are automatically controlled and resources are optimized use to be monitored and well controlled. The resources usage must provide a metering capabilities to the appropriate type of services such as storage, active user account (Security, 2011).

Cloud Service Models divided among three fundamental classifications which are Software as Service (SaaS), Platform as Service (PaaS) and also Infrastructure as a Service(IaaS). Researcher explained them as the following (Security, 2011): **Software as Service (SaaS):** It is for this capability where the consumer can have an access to use the provider's applications. Those applications are running on a cloud infrastructure (Security, 2011). **Cloud Platform as a Service (PaaS):** For this type of service, consumer does not control cloud infrastructure but has the control over the deployed applications and application hosting. The capability provided to the consumer is to deploy onto the cloud infrastructure (Security, 2011). **Cloud Infrastructure as Service (IaaS):** For this type of service, the capability provides to the consumers is based to provision processing, storage, networks, and other fundamental computing resources where the consumer is capable of deploying and running software such as operating systems and applications (Security, 2011). Additionally, consumer in this type of service has limited control to the certain networking components like host and firewalls (Guallagher, 2013).

1. E-government Definition and Types

Electronic Government (E-Government) is not something too new for society as many different countries from different continents started to use it for almost two decades ago (UN,2016). Researchers estimated that e strategy started in 2002 in Europe (Almarabeh, Majdalawi and Mohammad, 2016). E-Government refers to the exercise of political, economic and administrative authority in the management of a country's affairs, including citizens' articulation of their interests and exercise of their legal rights and obligations (Nilotpal, 2013). In simple way, an e-government is a capability of transformation of government electronically to provide an efficient, convenient and transparent services delivery to the citizens and businesses. Many studies discussed about four important types of E-government. Kuldeep, Shravan, and Amit (2012); Nilotpal (2013) and (Almarabeh, Majdalawi and Mohammad, 2016) have proved more about e-government and they have classified it into four main categories which are Government-to citizen (G2C), Government to business (G2B), Government to employee (G2E), Government to government (G2G). **Government-to-citizen (G2C):** In G2C, customer (citizen) relationship management, the business (government) can provide the needs products and services accomplish the needs from customer or citizen (Nilotpal, 2013). **Government-to-business (G2B):** G2B initiatives and encompass all activities of government which impose upon business organizations (Kuldeep, Shravan and Amit, 2012). **Government-to-employee (G2E):** G2E refers to the relationship between government and its employees only. In this type, employee can have access to training, e-learning also they may have authorization to access database so that they complete what they need through online (Almarabeh, Majdalawi and Mohammad, 2016). **Government-to-government (G2G):** This type supports government administration; inter government enterprises and monitor, control and distribution. This refers to the online communications between government organisations, departments and government's institutions based on a super-government database and resources (Almarabeh, Majdalawi and Mohammad, 2016).

2. Methodology used

The data collection instrument was questionnaire and played an important role (Baskerville, Richard and Pries, 2010). The visits, observation and interviews were also

conducted to this research paper (Stewart et al., 2008). In population of 6439, the sample size calculated by using Slovin's formula with accuracy of 10 % (Gay and Airasian, 2000; Israel, 1992). The 98 responders participated in this study are from government's institutions. Some are IT experts, Network and System Administrators, Database and System Administrator, Director of ICTs, Director of Information System, Network and system analysts, and others occupies positions in ICT sectors especially in e-government from country's district (Gasabo, Ngororero, Gicumbi, Bugesera, and Kamonyi) and Purposively the remaining data collected from the Ministry of Youth and ICT (MYICT), Rwanda Development Board (RDB), Rwanda Governance Board (RGB), Rwanda Revenue Authority (RRA), Rwanda Social Security Board (RSSB), Ministry of education (MINEDUC), Ministry of Trade, Industry and East African Affairs (MINEACOM), National Identification Agency (NIDA), Rwanda Utilities and Regulatory Authority (RURA), Ministry of Finance and Economic Planning (MINECOFIN), Ministry of Public Service and Labour (MIFOTRA), Ministry of Infrastructure (MININFRA) and Rwanda Public Procurement Authority (RPPA). The selection of the sample of responders required to have enough knowledge in ICT domain and working in government's institution selected. As the study went through explanatory design where it involved the collection and analysis of quantitative data

followed by the collection and analysis of qualitative data and in this way the priority is given to the quantitative data and that is why questionnaires used in this research (Baptiste, 2000; Baskerville, Richard and Pries, 2010).

III. FINDINGS BASED ON OBJECTIVES OF THE RESEARCH PAPER

51. Available profits of Cloud computing while it uses to boost E-government

System implementation in Rwanda.

Cloud computing provides many benefits when it is used for e-government system. In our research, the seven benefits of Cloud computing when it is used to boost e-government implementation sustainability have been examined. As shown in Figure 2, the study examined the available profits use of Cloud computing to support e-government where the Better quality of service and products ranked at **94%**, Better access to services that are offered online ranked at **95%**, easier data recovery ranked at **97%** and Operational Software, Hardware cost savings ranked at **83%**, Green IT or Green Technology ranked at **91%**, Reduced IT staff needed for systems support ranked at **89%** and Availability and easy access to hardware and software ranked at **97%**. These benefits illustrate the relationship between Cloud computing and e-government system implementation

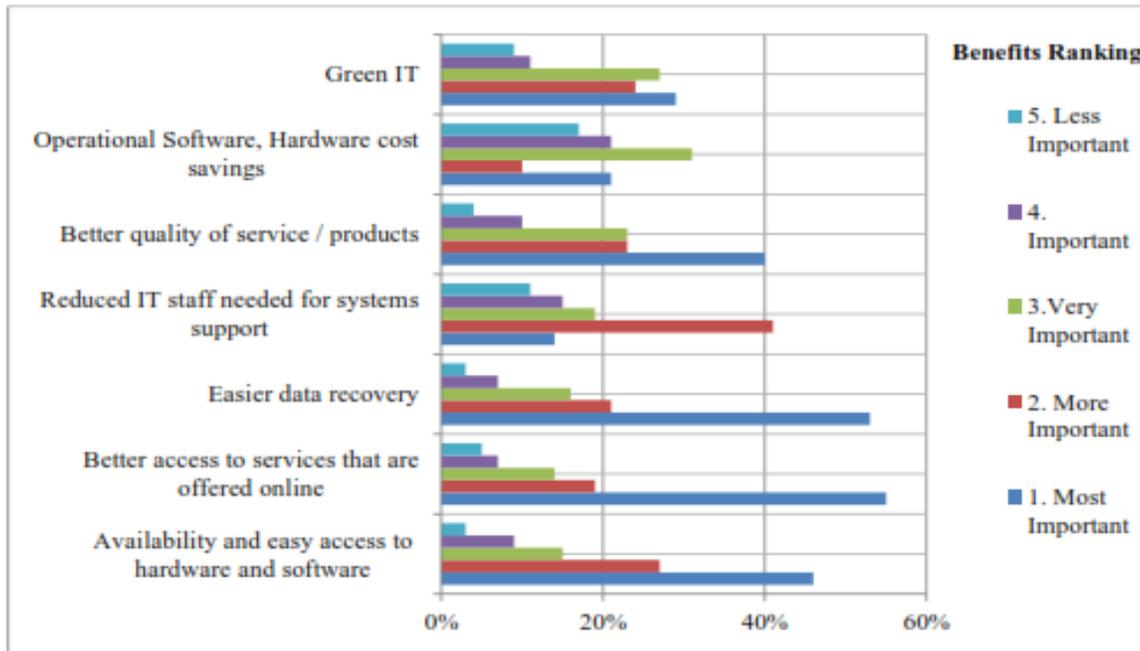


Figure 2: Cloud computing benefits for e-government in Rwanda

52. The main factors affecting E-government performance in Rwanda

The common factors or challenges identified in Rwanda, may also be available in all developing countries of Africa such as lack of Internet Accessibility, Insufficient skills and usage and also challenges may come from economic and financial facts. Firstly, researchers grouped Access, skills and usage as the main factors affecting E-government performance in Rwanda and grouped them in six categories during research and the findings are in Figure 3.

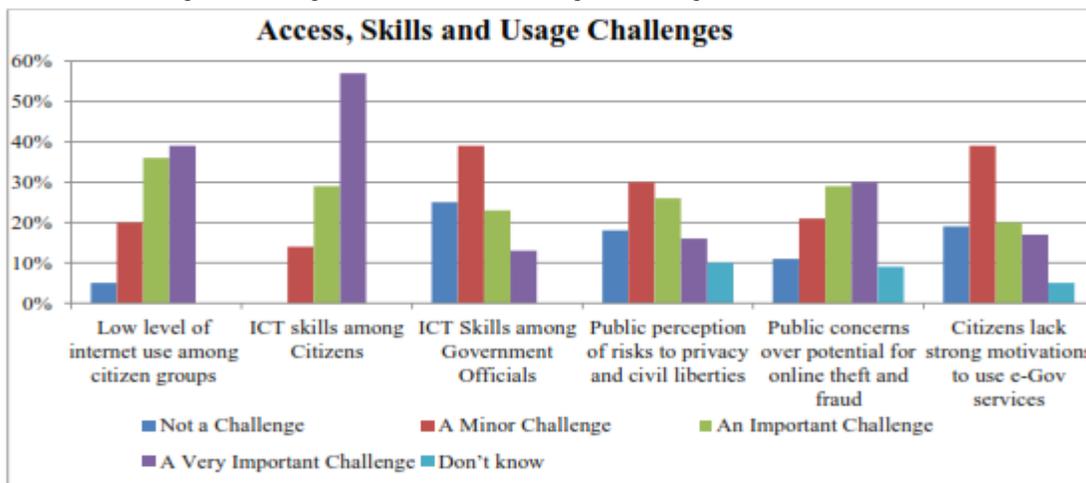


Figure 3: E-government challenges (Accessibility, Skills and Usage)

Based on research questions and objectives of the study, all factors that are affecting e-government performance in Rwanda have been examined in details where the research findings revealed that the most factors affecting e-government performance are the Low level of internet use among citizen groups ranked at higher level of 39% as a challenge, ICT Skills among Citizens ranked at a 57%, ICT Skills among Government Officials ranked at 23% as a challenge, Public perception of risks to privacy and civil liberties ranked at 16% as a challenge, Public concerns over potential for online theft and fraud ranked at 30%, and Citizens lack strong motivations to use e-Government services ranked at 17% as a challenge.

In this paper, economic and financial challenges examined as also in 5 categories and analyzed each one as challenge from the responders. Figure 4 showed that cost for providing e-government services ranked at 15 %, cost for developing e-government

services is rating **14%**, cost for governments of meeting laws and regulations relating to e-government ranked at **3%**, Demonstrating the long term cost benefits of e-government initiatives ranked at **13%**, and Creating Special Fund for e-Government Implementation ranked to **17 %**.

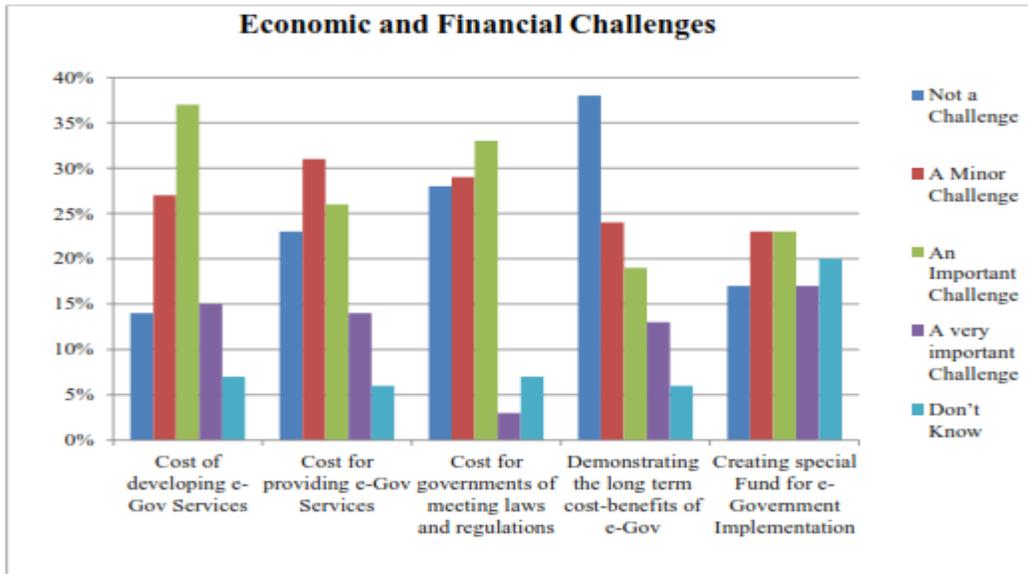


Figure 4: Economic and financial challenges

53. *The main factors affecting the adoption of Cloud computing technology*

The study also examined Cloud computing technology as the official avenue to enhance e-government system in Rwanda and it is in this way, the most factors affecting cloud computing adoption have been examined in details and the findings showed that cost rated at level of **20%**, the data sovereignty and privacy rated at level of **46%** and existing infrastructures rated at **26%**.

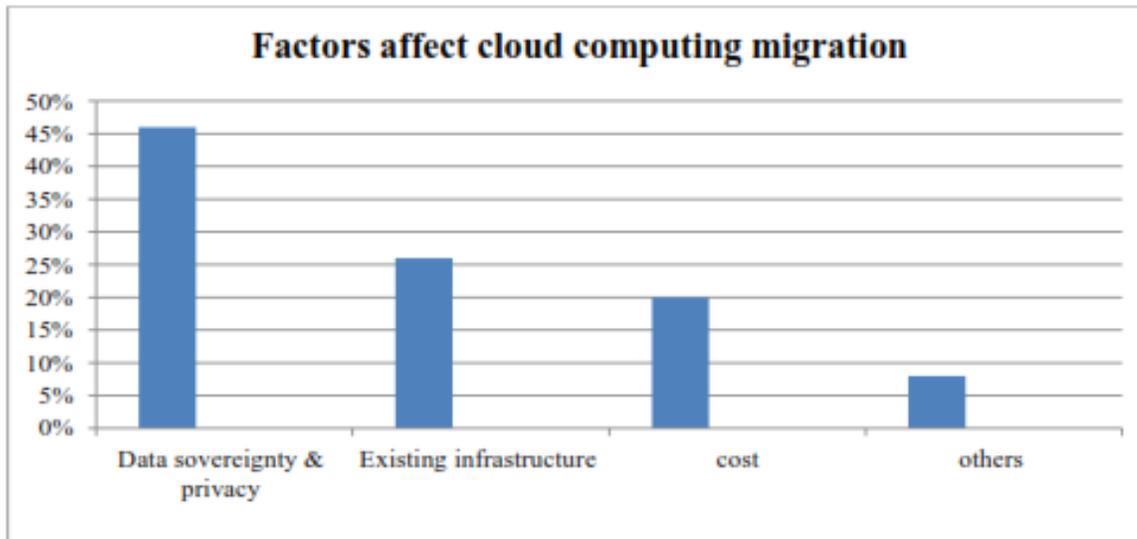


Figure 5: Most Factors affecting Cloud Adoption in Rwanda

IV. CONCLUSION

The main objective of this research paper was to arguing that Cloud computing is an avenue for enhancing e-government system in Rwanda. For the purpose of this research, the quantitative and qualitative methods were both used and that is why questionnaire, interviews and observations intervened in this research paper. IT Experts from different government's institutions selected to participate in this research. Cloud computing showed its important role to accelerate in action the sustainable e-government system in Rwanda where for instance most of the Rwandan Government Services have been implemented and accessed using the Internet such as Taxes payment, e-Procurement, Driving license, Land registration, Birth certificates, etc just to mention few. This paper also investigated the main factors that are affecting Cloud computing adoption in Rwanda and highlighted the major problem which are facing an e-government system implementation in Rwanda. The study also examined the available profits use of Cloud computing to e-government in Rwanda. As examined in this paper, Cloud computing technology illustrated undoubted quality to support e-government system implementation with small infrastructures (hardware and Software). Researchers concluded and recommended that with Cloud Technology Software, hardware and infrastructure can be used as service, just an internet connected to any device will yield to a quick and higher performance speeding the implementation of e-government System in Rwanda which is said to be available at anywhere at any time. The cloud system showed that the e-Government services in Japan, Australia, USA and UK has been so productive for their citizens. This paper also shows that Rwanda is in a good position of implementing e-Government and using the Cloud Computing as Infrastructure and policy is available and established. In this way, the researchers recommend other African countries to establish Technology Infrastructure and Policies to facilitate the E-Government Services implementation. As seen that the privacy and security of data in Cloud is major aspect in Cloud adoption, this matter can be resolved by Cloud Services Providers. The customers would choose a good Cloud Services Provider to work with.

Rwanda is on a good track in adopting Cloud Computing.

Future Work

The future research will focus on the Security pillars and trust when migrating to the Cloud Technology.

REFERENCES

- [1] Almarabeh, T., Majdalawi, Y. and Mohammad, H. (2016) Cloud Computing of E-Government. *Communications and Network*, 8(1), pp.1-8.
- [2] AoS (2016) Cloud/IDC Services. [Online] Available from: HYPERLINK "<http://www.aos.rw/cloudidc-services/>" "<http://www.aos.rw/cloudidc-services/>" [Accessed 4th October 2016]
- [3] AoS (2016) Government of Rwanda introduces an innovative e-Procurement System. [Online] Available from: HYPERLINK "<http://www.aos.rw/latest-news/>" "<http://www.aos.rw/latest-news/>" [Accessed 5th December 2016].
- [4] Baptiste, I.(2000) Qualitative Data Analysis: Common phases, strategic differences. *fqs: Forum Qualitative social research*, 2 (22), pp.11-16.
- [5] Baskerville, Richard, L. and Pries,H. (2010) "Explanatory Design Theory".*Business & Information System Engineering*, 2 (5), pp 271-282, Research Paper.
- [6] Cisco (2016) Cisco Unified Computing System: UCS Manager. [Online] Available from: HYPERLINK "<http://www.cisco.com/c/en/us/products/servers-unified-computing/ucs-manager/index.html>" "<http://www.cisco.com/c/en/us/products/servers-unified-computing/ucs-manager/index.html>" [Accessed 29th September 2016].
- [7] Durairaj, M. and Kannan, P.(2014) A Study On Virtualization Techniques And Challenges In Cloud Computing. *International Journal of Scientific & Technology research* 3(11), pp.147-51.
- [8] EGM (2011) E-Government and New Technologies: Towards better citizen engagement for development. *United Nations Publication: Report of the Expert Group Meeting, Geneva: 13-14 May 2010.*
- [9] Gallagher, P. (2013) NIST Cloud Computing Standards. NIST Special Publication 500-291, Version 2
- [10] Gay, L. and Airasian, P. (2000) Educational Research: *Competencies for Analysis and Application.*

- [11] Gopakumaran et al. (2015) *Cloud Computing - A market Perspective and Research Directions I.J. Information Technology and Computer Science*, 1(1) pp 42-53.
- [12] Group, E. (2011) E-Government and New Technologies: Towards better citizen engagement for development. *United Nations Publication*. Geneva: United Nations Report of the Expert Group Meeting.
- [13] IBM (2015) Cloud computing news: Five steps to a Cloud readiness assessment. [Online] Available from: HYPERLINK "<https://www.ibm.com/blogs/cloud-computing/2015/08/five-steps-to-a-cloud-readiness-assessment/>" <https://www.ibm.com/blogs/cloud-computing/2015/08/five-steps-to-a-cloud-readiness-assessment/> [Accessed 16th September 2016].
- [14] IEEE (2016) The 2nd IEEE International Conference on Cloud and Big Data Computing. [Online] Available from: HYPERLINK "<https://cbdcom2016.sciencesconf.org/>" <https://cbdcom2016.sciencesconf.org/> [Accessed 29th September 2016].
- [15] Israel, D. (1992) Determining sample size. [Online] Available from http://sociology.soc.uoc.gr/socmedia/papageo/meta/ptysiakoi/sample_size/samplesize1.pdf [Accessed 14th September 2016].
- [16] Kuldeep, V., Shravan, S. and Amit, R. (2012) A Review of Cloud computing and E-governance. *International Journal of Advanced Research in Computer Science and Software Engineering*, 2(2), pp.40-45. Research Paper.
- [17] Minecofin (2013) Sector strategic plan / ICTSSP_SMARTRwanda Master Plan.
- [18] Mohammed, A. and Steve, D. (2010) E-government fundamentals. *Iadis International Conference ICT, Society and Human Beings 2010*, pp.35-42.
- [19] MYICT (2013) Rwanda Steps Up E-Government Efforts. [Online] Available from <http://www.myict.gov.rw/press-room/latest-news/latest-news/> [Accessed 23rd September 2016].
- [20] Nilotpal, C. (2013) Using Social Networking Services Effectively for a Successful e-Governance in India. *International Journal of Advanced Research in Computer Science and Software Engineering*, 3(2), pp.72-77.
- [21] Noriko, A. (2016) Development of Japan's e-Government: My Government as a Step Towards a Ubiquitous G2C Networked Society. *Library and Information Science Program, University of Hawaii at Manoa, USA Asian Conference on Society, Education & Technology 2016*, pp 5-13
- [22] RDB (2016) Rwanda's ICT Competitive Advantage. [Online] Available from: HYPERLINK "<http://www.rdb.rw/departments/information-communication-technology.html>" <http://www.rdb.rw/departments/information-communication-technology.html> [Accessed 14th September 2016].
- [23] RURA (2015) Statistics and Tariff Information in Telecom Sector. *Report of March 2015*. Kigali-Rwanda.
- [24] RwandaOnline (2015) Overview: Transforming Service delivery simpler, faster and less costly. [Online] Available from: HYPERLINK "<http://www.rwandaonline.rw/>" <http://www.rwandaonline.rw/> [Accessed 2nd September 2016]/
- [25] Sajjad, H., Khalil, M. and Masdari, M. (2013) Using Cloud computing for E-Government. *International Journal of Computer, Electrical, Automation, Control and Information Engineering*, 7, pp.3-5.
- [26] Security A. (2011) Cloud Security Alliance: Initiatives Guidance [Online] Available from: HYPERLINK "<https://downloads.cloudsecurityalliance.org/initiatives/guidance/csaguide.v3.0.pdf>" <https://downloads.cloudsecurityalliance.org/initiatives/guidance/csaguide.v3.0.pdf> [Accessed 18th July 2016]. pp 13- 177.
- [27] Stewart et al. (2008) Methods of data collection in qualitative research: interviews and focus groups. *British Dental Journal* 204, 291 - 295 (2008).
- [28] Tutorialspoint (2016) Cloud computing Delivery Models: SaaS, PaaS, IaaS. [Online] Available from: HYPERLINK

- "https://www.tutorialspoint.com/cloud_computing/cloud_computing_software_as_a_service.htm"
- [29] https://www.tutorialspoint.com/cloud_computing/cloud_computing_software_as_a_service.htm [Accessed 5th September 2016].
- [30] Thuwaini Naser N., ALMutairi & Shebaib, F.(2015) Cloud Computing Uses for E-Government in the Middle East Region. International Journal of Business and Management, 10 (4), pp 1-7.
- [31] UN (2016) UN-E-Government Survey 2016 REPORT. [Online] Available from: HYPERLINK "<https://publicadministration.un.org/egovkb/en-us/Reports/UN-E-Government-Survey-2016>" [Accessed 9th August 2016].
- [32] Ürgen et al. (2014) SOA and Cloud Computing. [Online] Available from: HYPERLINK "<http://www.oracle.com/technetwork/articles/soa/ind-soa-cloud-2190513.html>" "<http://www.oracle.com/technetwork/articles/soa/ind-soa-cloud-2190513.html>" [Accessed 20th September 2016].