CLOUD COMPUTING AND E-GOVERNANCE: CURRENT ISSUES AND DEVELOPMENTS

ODUN-AYO Isaac, MISRA Sanjay, GBEREVBIE Daniel, OMOREGBE Nicholas & ASITE Ovakporoye
Covenant University, Ota, Nigeria

Abstract
Cloud computing is an IT paradigm that aggregates computing resources across data centres in different location for use at a cost to cloud consumers. Cloud providers are making software application available on their platform for cloud users, making access possible anytime anywhere on a platform. Cloud providers also allow user to leverage on their operating systems to design and develop applications. In both instances mentioned, users have no control of the cloud providers’ operating system, but they can always run applications at affordable cost. Infrastructure is also available in terms of storage. Storing large volumes of data makes the cloud amenable to e-governance. E-governance deals with online services made available to its people by a government. Government is involved with several ministries, department and agencies generating information and also requiring information themselves. The aim of this paper is to discuss the convergence of cloud computing and e-governance. It examines the utilization and benefits of e-governance on the cloud. It also discusses current issues and prospects of cloud e-government. The paper is an explorative work that examines qualitatively trends in e-governance and cloud computing. As a result, the paper therefore recommends that local, state and the federal government take advantages of the huge benefits of cloud computing to improve service delivery and government activities.

Keywords: Cloud Computing, e-governance, government, infrastructure, Information Technology

INTRODUCTION
“Cloud computing is a model for enabling universal, on-demand and convenient network access to a shared pool of configurable computing resources such as servers, applications, storage, networks and services, that can be quickly provisioned and released with little to no management effort or service provider interaction” (Mell & Grance, 2011). Cloud computing provides elastic, scalable and on-demand services to users on the Internet. Cloud service
providers with the relevant infrastructure allow access to services on a pay-as-you-go basis using agreed conditions. The core concept is virtualization that enables users on a multi-tenant basis, utilize compute and storage infrastructure. The services provided are in three categories: Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS) and Infrastructure-as-a-Service (IaaS). In SaaS, the cloud service provider (CSP) is responsible for running and maintaining application software, operating system and compute resources (Singh & Singh, 2011). Applications are hosted online by the CSP for users to utilize. Users do not have to bother about installing or maintaining such software. In addition, users do not need to bother about upgrades and license fees. PaaS provides the user with a platform to create and deploy an application. The CSP provides, runs and maintains the operating system and the computer resources, while the user has full control of his application (Singh & Singh, 2011). PaaS providers may use APIs, website portals or gateway software installed on the user’s computer (Shahzad, 2013). PaaS also supports collaborative effort among members of a project team (Singh & Singh, 2011).

In IaaS, the CSP provides the network bandwidth, storage and computing resources to enable a user outsource operation from a traditional data centre. This operation is carried out in a virtualized, multi-tenant environment. It is the responsibility of the cloud user to run and maintain the operating system and the software application on these virtualized resources (Singh & Singh, 2011). The CSP provides metered services to the consumer on a pay-as-you-go. For example, Amazon Web Services provides server instance API to start, stop, access and configure their virtual server and storage (Shahzad, 2013). Apart from the various cloud services, there are also different deployment types. These are the private, public, community and hybrid clouds. Private clouds are usually owned by an organization with the infrastructure utilized by in–house staff. The organization has full control of the facility; hence the security of private clouds is better. The infrastructure could be hosted on-premise or off-premise. Public clouds usually belong to particular well–established cloud service provider and the infrastructure is hosted and fully owned by them. Various services are provided to users on-request and on a pay as you go basis. Public clouds are considered less secure than private clouds. Community cloud is based on several organizations pooling their infrastructure together because of shared common interest. Hybrid cloud is a combination of private, public or community cloud. Hybrid clouds take advantage of the benefits in the various cloud types.

E-Governance is the application of infrastructure and communication technology to transform the efficiency, effectiveness, transparency, and accountability of infrastructural and transactional exchanges within government, between government and government agencies of national, state, municipal and local levels, citizens and business and to empower citizens through access and use of information (Bansal et al., 2013). E-Governance refers to the use of information and communications technologies (ICT) to improve the efficiency, effectiveness, transparency and accountability of government. E-Government can be seen simply as moving citizen services online, but in its broadest sense it refers to the technology-enabled transformation of government
E–Governance utilizes the facilities provided by ICT to perform government processes such as digitalizing records, tax collection, information dissemination and general administration (Mukherjee & Sahoo, 2010). It can also be seen as using ICT to provide public services by government to the citizens, business and other government agencies. Efficiency and effectiveness of public organizations are two main objectives of e–government. E-government can leverage on the benefits of cloud computing such as broad network access, resources pooling and metered services. In a document that layout a digital Japan formulation project, known as the ICT Hatoyoma plans, Japan’s Ministry of Internal Affairs and Communications disclosed plan to engineer an enormous cloud computing infrastructure to aid government IT system. “Government information systems are making use of cutting edge technology such as cloud computing to develop the Kasumigaseki Cloud, in stages by 2015. The Kasumigaseki cloud will facilitate various ministries to cooperate, create and integrate platforms for shared functions and consolidate hardware” (Dash & Pani, 2016).

The focus of this paper is to discuss cloud computing and e–government and establish the relationship between e–government and cloud. The likely benefits of cloud computing and e–government will also be discussed. In addition, the paper will contribute to the understanding of the relevance of cloud computing to government and its agencies. The remaining part of this paper is structured as follows. Section 2 examines related work. Section 3 discusses the applications of cloud computing to e–government. Section 4 highlights industry insight into e–government. Section 5 contains the conclusion and suggestion future research.

RELATED WORK
In Mukherjee & Sahoo (2010), cloud computing: the future schema for e-Governance is proposed. This framework for e-governance is proposed based on Hadoop to facilitate a variety of activities. Active and idle commodity hardware was also introduced in conjunction with Hadoop. In Bansal et al. (2013), impact of cloud computing in implementing cost effective e-governance operations is presented. The paper concentrates on the utilisation of cloud computing for e-governance in India. The paper discusses the challenges and benefits of the use of cloud in e-governance. In Vijaykumar (2011), role of ICT in e-governance; impact of cloud computing in driving new initiatives is proposed. The main focus is the application of ICT in governance. Government has a lot of initiatives that can be deployed using ICT. This could be enhanced further with the utilisation of cloud computing in terms of Software as a Service. In Shahzad (2013), cloud based e-government: benefits and challenges are presented. The approach is to consider the lowered cost of ICT utilisation as a result of cloud computing. This is expected to help reduced the cost of e-governance by taking advantage of the resources available on the cloud. In Singh & Singh (2011), e-governance: information security issues is presented. The focus is on the security of information generated and place online in e-governance. Various security measures were discuss that could enhance security in e-governance. In Aveek & Rahman (2011), implementing e-governance in Bangladesh using cloud computing technology is proposed. The paper examined e-governance and various approaches that could be used to implement it on the cloud. The model was implemented on
the Google Cloud platform. In Vats, Sharma, and Rathee (2012), a review of cloud computing and e-governance is presented. The paper discusses e-governance in some countries which also apply cloud computing. The challenges e-governance and cloud computing was also examined.

In Ahmed (2012), exploring cloud computing services and applications is presented. Various cloud services and applications were examined. A model of services provided by e-governance cloud was also presented. In Sharma and Sadhana (2011), G-cloud (e-Governance in cloud) is proposed. The focus was on how to utilise cloud computing in e-governance. The benefits of cloud computing in e-governance were also discussed. In Stoicaa, Pitic and Mih (2013), a novel model for e-business and e-government processes on social media is proposed. The paper observes that key technologies like cloud computing drives a lot of activities. It created business models in e-government. In Dash and Pani (2016), e-governance paradigm using cloud infrastructure: benefits and challenges is proposed. Various deployment and service models were examined. The nature of e-government and the cloud benefits is also discussed. In Smitha, Thomas and Chitaranjan (2012) cloud based e-governance system: a survey is presented. The main focus was to examine e-governance in terms of the benefits that is available using the cloud.

E-Governance and Cloud Computing
E-Governance is used to strengthen the communication between government and other sectors of life. E-Governance applications are divided into four broad categories (Ahmed, 2012).

- Government to government (G2G). E-Governance support the use of information, shared services, revenue and law enforcement, decision making, and fund transfer between the inter-organizational government departments.
- Government to Business (G2B). E-Governance provides service like registration, tax filling, transaction and payments. Businesses could be appraised and also use, the services provided by government through a secure mechanism.
- Government to Citizen (G2C). E-Governance support services like registration, land, resume, services and others for the benefit of the citizen.
- Government to Enterprise (G2T). E-Governance supports some enterprises like water board, electricity board that are controlled by government where some policies and standard are to be enforced. Notwithstanding the challenges, cloud–based e–governance can take advantage of services rendered by the cloud for better effectiveness and efficiency.

Benefits and Challenges of Cloud Computing to E–Governance
Cloud computing can significantly improve the way a government functions, and the service it provides to its citizens and government institutions. The major advantage of cloud computing is the multi-tenancy shared environment that enhances the delivery services over the Internet. The cloud provides an attractive alternative for the citizen to transact and do business online. The key benefits for using cloud for the hosting of e – government applications is as follows (Saleh & Shahzad, 2013; Dash & Pani, 2016; Vijaykumar, 2011; Aveek. & Rahman, 2011)
Accessibility. The greatest advantage of a cloud environment is its accessibility to users, because the Internet is always available. A user with the required equipment can access a cloud application anytime.

Availability. Applications hosted on the Internet are available anytime, anywhere and can be accessed even by people with mobile platforms. The cloud is assembled on an infrastructure that assures the availability of resources. All vital elements are clustered and single points of failure eliminated.

Scalability. E–Governance is distinguished by uncertainty in demand and workload. There could be an increase in demand during certain periods of the year and relatively low loads and constant demands in other periods of the year. At peak periods of government activities, the platform should provide extra resources dynamically to meet excess request. Cloud offers this capability because of elastic and dynamic services available on the cloud. Technologies like high availability, clustering, virtualization and load balancing ensure scalability. There are current technologies that can be used to increase computing resources without disrupting software or hardware operations.

Services Orientation. Cloud is engineered on the idea of service orientated framework. The provisioning of services in the entire cloud process, tends to keep the ultimate consumer in mind. The model often guarantees ease of operation for a service receiving citizen and a service providing enterprise. This includes some of the value added services provided by external partners in adding to government services. This promotes customer centricity and also value added services that enhance e–governance.

Inter-operability. E–Government is about diversified departments and agencies providing services to the consumers. With various set of autonomous applications in different department, cloud computing will enable e–governance make these application available to citizens. This also implies that the IT infrastructure should sustain several sets and versions of applications and technologies to bring about inclusive governance. Cloud computing supports inter-operability because of its core characteristics of virtualization and platform independent services.

Cost Saving. In cloud based e–governance, public organizations do not need to acquire and install IT equipment and software on their premises, as it is in traditional e–governance. The public sector will use applications provided for them by the CSP through government interventions, which reduces cost on infrastructure. The cost of ICT services for government agencies and individuals also reduce in a cloud based e-government systems because they loan IT resources and service according to demand instead of investing in these resources. The cloud advantage of pay–as–you–go also decreases the operating cost for public sector organizations.

Efficiency. Providing public services efficiently and effectively to citizens and businesses is one of the major characteristics of e–governance. Cloud based e–government system makes this easy. It’s also possible to create new services in a cost effective manner using the readily available resources on the cloud infrastructure.
Governance and Public Service Delivery in Nigeria: The Role of Information and Communication technologies

CUCEN2017

Odun-Ayo et al.

- **Cloud Option.** The cloud service types and deployment models provide the flexibility needed for e-governance. The government can take advantage of any cloud deployment type or service to render efficient service to the citizens and business alike.

Traditional e-governance has different challenges as discussed below that can take advantage of the benefits of cloud computing (Singh & Singh, 2011).

- Resources cannot be scaled up or down with the demands that change over time. This may result in insufficient or redundant service to both enterprises and citizens alike.
- Software and hardware have to be frequently upgraded and maintained which costs time and money, including other auxiliary IT infrastructure.
- New software licenses are required and systems may not be available always.
- Lack of accountability and limited storage.
- Need to provide a secure environment with secure access.

**ADOPTING SOFTWARE–AS–A–SERVICE CLOUD SERVICE FOR E–GOVERNMENT ON A HYBRID CLOUD TYPE**

Cloud computing employs three basics service types, the SaaS, PaaS and IaaS (Vijaykumar, 2011). In SaaS, cloud consumers use software application provided by the CSP, but have no control over the infrastructure being utilized. In PaaS, consumers use platforms provided by the CSP to develop and deploy an application. In IaaS, cloud users utilize basic computing resources such as networking processing power, storage and VMs provided by the CSP. The private cloud is utilized by an organization with the infrastructure on-premise or off-premise and controlled by the organization. Public cloud is operated by a CSP, with control of the entire infrastructure while community cloud is operated by the organization with a common interest sharing the same infrastructure managed by them or a third party. Hybrid cloud is a combination of any of these three cloud types. Clearly, e – government can operate on all the cloud service and deployment types in varying degrees. However, as shown in Table 1, SaaS tends to suit the provisions of e–governance most.

SaaS provides a platform through which users can access software online. The software installation and operation is the responsibility of the CSP and already available by using IaaS and PaaS abstractions (Sharma & Sadhana, 2011). This is typically end user applications delivered on demand over a network on pay–per–use basis. Typical examples of SaaS application include Google apps, Microsoft office 365, Onlive, GTNexus, Marketo, Trade Card, CRM etc. (Sharma & Sadhana, 2011).

These applications are hosted online and can be used for a wide range of activities by both individuals and government agencies alike. By using cloud services the government does not need to procure hardware and software. Required application can either be developed by government or provisioned by the CSP and deployed online for all agencies, individuals and businesses to access simultaneously anytime, anywhere and anyhow. Management of these applications is done by the CSP at a relatively cheap cost. The government can also take
advantage of utilizing a hybrid cloud. Core, vital and strategic government, businesses information can be securely located on a private cloud, while auxiliary services are migrated to either a community or public cloud.

<table>
<thead>
<tr>
<th>Model</th>
<th>Characteristics</th>
<th>Services offered</th>
<th>Applicability to e-Governance</th>
<th>Relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>SaaS</td>
<td>Software application is tendered as a service</td>
<td>e-Governance services (G2B, G2C, G2G)</td>
<td>Actual G2X services as offered to end customers, accessible through Internet</td>
<td>HIGH</td>
</tr>
<tr>
<td></td>
<td>Pre-built applications that can be deployed on demand</td>
<td>Value added services</td>
<td>Easy to deploy and rollout</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Service virtualization</td>
<td>Gateway services (e.g., payment gateway)</td>
<td>Similar applications for different departments can be provisioned faster</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reduces TCO as the application is available off the shelf</td>
<td></td>
</tr>
<tr>
<td>PaaS</td>
<td>Provides required platform to develop and customize applications</td>
<td>Plain or pre-configured application stack</td>
<td>Pre-configured stack and middleware elements available, facilitating faster application development and rollout</td>
<td>LOW</td>
</tr>
<tr>
<td></td>
<td>Exposes service components &amp; APIs</td>
<td>Workflow and message queue services</td>
<td>Consistency and repeatability—helps re-deploy multiple instances quicker</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Integration platform</td>
<td>Application instances (e.g., middleware containers)</td>
<td>End customer does not have to buy the software licenses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Choice of different platforms</td>
<td>Application clustering</td>
<td>Reduces maintenance and management overheads</td>
<td></td>
</tr>
<tr>
<td>IaaS</td>
<td>Provides hardware infrastructure (servers, OS, storage, network) on demand</td>
<td>Slices of hardware (server, storage instances)</td>
<td>Pre-configured hardware instances that can be provisioned faster</td>
<td>MEDIUM</td>
</tr>
<tr>
<td></td>
<td>Virtualized environments and hence are highly scalable</td>
<td>Data backup and restore services</td>
<td>Resource augmentation easier to support burst of demand</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High availability</td>
<td>Clustering solutions</td>
<td>Uniformity of the environment configuration thereby ensuring consistency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Choice of different platforms</td>
<td>Disaster recovery</td>
<td>End customer does not have to buy hardware and OS licenses thereby reducing the TCO</td>
<td></td>
</tr>
</tbody>
</table>

**Information Security for Cloud E-Governance**

Any e–governance initiative will remain vulnerable to security breaches in the absence of a well-articulated security policy. Personally identifiable information (PII) and confidential health information can be breached if not properly secured. There are three aspects of security that may affects e–governance.

- **Confidentiality.** This refers to protection of information from unauthorized disclosure to anyone or group of persons that should not have access to such information.
Integrity. This entails protecting information from unauthorized modification and ensuring that the information remain reliable and accurate.

Availability. This precludes that information is made available wherever it is needed for either use by the government or citizens.

Security attack against any e–governance information system will be the same for all attacks on the cloud infrastructure. The threats will be similar and the solutions will be the same for all attacks on the cloud. Thus, the networks providing data to end users of the e–government remain vulnerable to some of the following attacks (Bansal et al., 2013).

- Packet Sniffing. A malicious packet sniffer can monitor a network illegally leading serious breaches in security.
- Probe. The attacker scans the network to gather information and find vulnerabilities that affects security of information.
- Malware. Malware is a short form for malicious software which consists of programming designed to deny or disrupt operation, gather information that leads to loss of privacy or exploitation, gain unauthorized access to system resources or other abusive behaviour (Bansal et al., 2013). Malware include Trojan horses, viruses and worms. These sorts of programs lead to serious data loss, downtime and denial of service.

There are several other security threats associated with cloud computing such as the recent ransomware, but relevant solutions keep emerging to counter these threats. Security and compliance issues no longer top the concern users have in respect of adopting cloud computing. However, a list of useful security practices is as follows:

- Ensure all account have password possibly a one-time password system.
- Use secure programming technique to develop or deploy on application.
- Regularly monitor network activities, and utilize intrusion prevention and detection techniques.
- Regularly check with vendors for fixes, patches and upgrades.
- Conduct regular audit of system and networks and check logs.

**CURRENT TRENDS IN CLOUD COMPUTING AND E-GOVERNMENTS**

E-Government uses ICT to provide services to the people, by serving as a platform for citizens to access government activities. Through e-Government, the process of making decisions and the outcome of those decisions are available to the citizen through technology (Gberevbie et al., 2016). There are several countries in the world that have adopted e-government and among these countries three stand out for the adoption of cloud e-governance. Across Europe e-governments progress is shown in the cluster of ‘registrations’ which consists of services related to business start-up. The fact that these services appear to be increasingly online could be caused by smarter re-use of data in the back-office that allows to automate and/or reduce obligatory registrations (e-Government Benchmark, 2016).
Governance and Public Service Delivery in Nigeria: The Role of Information and Communication Technologies

Odun-Ayo et al.

E-Governments and Cloud Computing Trends

- **Singapore.** Singapore government currently has a whole-of-government infrastructure (SHINE) to provide shared computing resources to government agencies on an “as-a-service” subscription model. Central G-cloud is next generation infrastructure which will replace SHINE (Shahzad, 2013)

- **Japan.** A nationwide “Kasumigaseki Cloud” in figure 1 is being developed to enable ministries collaborate at local levels. “Jikhitai cloud” is being built to provide interoperability and local government (Shahzad, 2013)

![Figure 1. The Kasumigaseki Cloud (Saleh & Shahzad, 2013)](image)

- **India.** The Jammu and Kashmir State Governments in India have adopted cloud computing for its e-government services. The government data center located in Madhya Pradesh is provisioning e-government services such as birth certificate and trade licenses through the cloud.

- **Australia.** As reported by the GAP Task Force in Cloud Computing Final Report 2011; Australian government agencies are moving rapidly to adopt cloud computing. At the national level agencies such as the Department of Immigration and Citizenship, the Australian taxation office and Australian DBCDE are all migrating to the cloud environment. The task force considers that the use of cloud computing combined with high speed connectivity, presents major opportunity to dramatically improve the speed, availability and quality of services across all levels of government. The cloud has great potentials to improve efficiency in local government as it will allow sophisticated solutions to be used by small and cash-poor local government organization. The report further said that cloud computing can allow government to source computing services in a more cost effective and efficient manner. Cloud computing can offer government agencies the ability, for instance, to deal with abrupt burst of huge demands usually experienced shortly before lodging deadlines or in times of civil emergencies. Existing systems have not been built with the redundancy required to handle such rates, and spikes in user demands, which cloud computing provides obvious solutions.
• **Colombia, Uruguay and Panama** (Bilbao-Osorio et al., 2013). The use of ICTs must be state policy. Connectivity as a state policy that seeks to expand the use of ICTs in Colombia to increase the competitiveness of the productive sector, modernize public institutions, and socialize access to information (Bilbao-Osorio et al., 2013). E-government must reflect and respond to the concerns of citizens. Colombia soon discovered that it was essential to focus on the citizen to succeed in e-government. The country became a pioneer of the concept of apropiación—a Spanish comprehensive concept that refers to access, adoption, usage, and sense of ownership—and created an office dedicated to this matter within the Government Online program. This citizen adoption-ownership vision is understood as the need to listen to citizens; to communicate with them before, during, and after the implementation of e-government solutions; to seek and attract them to e-government through modern marketing tools; and to ensure a minimum level of connectivity and a basic knowledge of how to use the tools. It was the creation of the Agency for Electronic Government and Information Society (AGESIC) in 2007 that provided the basis for Uruguay’s recent rapid progress in e-government. AGESIC is physically near the Office of the President, and it became the institutional space for careful strategic thinking focused on the digital agenda of the country, as reflected in the Uruguay Digital Agenda 2008–2010 (Agenda Digital Uruguay is now in its second, 2011–2015, version). focuses on the building blocks of e-government, establishing elements such as a public key infrastructure, an interoperability platform, a computer emergency readiness team (CERT), and a mechanism for online payments. It also sets up operational initiatives that introduced Uruguay to the knowledge-based international arena. The most important factor for success is the political support of the highest authority in the country. In all three cases analysed, the support of the president has been instrumental in mobilizing other critical elements, such as legislative changes, institutional strategy, and budgetary allocation. Another common ingredient in these e-government success stories is the attention paid to the qualification of human resources. All three IT leaders in these countries, for different reasons, are able to communicate directly with the highest authority in the government and know how to interact in their country’s political sphere. At the same time, they are each very knowledgeable about ICTs, after having had successful careers in the private sector. A third factor—usually a consequence of the previous two—is the availability of financial resources.


• **In with the new.** To build effective digital government services that are consistently used by citizens, governments must avoid the trap of simply replicating and digitizing old processes that are inherently ineffective. Instead, when going digital, governments must take a holistic look at existing processes and build online services with a differentiated approach that takes into account, and full advantage of, the entire spectrum of benefits of the online channel.

• **Mind the gap.** While many citizens are connected today, the digital divide is still a critical concern in countries as diverse as the United States and India. The majority of survey
respondents are aware of this issue—56 percent think that digitization of government will create a service gap for those without Internet access or for citizens who have not yet embraced digital interactions. Governments have a lot of work to do here. Digital government must be about fostering greater inclusion with programs that go beyond implementation to account for driving lasting adoption among target audiences with unique demographic profiles.

- **Knowledge is power.** Many governments have understandably moved toward digital government as a means to work more efficiently and effectively. Clearly, this is a fundamental benefit. However, governments should not lose sight of the fact that the best digital programs give citizens what they want. The more that governments understand their citizens’ needs, preferences and intent, the more relevant their digital programs will be. This includes strong communications efforts focused on educating citizens about the availability of and how to access these services.

Citizen satisfaction to a large extent depends on how well and how fast services are delivered by an agency. Analysing the nature of these services will provide us better insights into critical factors to be considered while devising an IT strategy to streamline these services and ensure speedy and effective service delivery. Typically these services are highly process centric and involve high volumes of document exchange as shown in figure 2. Process-Centric Nature E-Governance services typically involve the following steps Newgen (2013):

- **Application Submission:** To avail government services, citizens/businesses are generally required to submit application forms, with supporting documents, to the respective departments.

- **Application Acceptance & Acknowledgement:** Once submitted, the application is cross-checked for completeness against a checklist of mandatory fields and supporting documents and an acknowledgement proof is provided to the applicant.

- **Application Review:** The application is then routed to the respective official for review. This step might involve multiple sub-steps and communication between the department and the applicant, for exception resolution.

- **Application Approval:** Post review, the application is routed for approval to the concerned authority. Document Generation: After the application has been approved, the department generates the final output document – certificate, license, grants approval note, etc., and dispatches it to the applicant's mailing address. Document-Intensive Nature Document handling is a critical component of government service delivery.

Government operations involve extensive exchange of documents, such as forms, correspondence, proofs of identity and address, certificates, etc., between the applicants and the government agencies as shown in figure 2. These documents play an important role in government decision-making, and need to be archived for long term, as per applicable retention policies. For certain decisions government departments need to refer to historical data and documents submitted in the past.
E-Governments and Cloud Computing Likely Trends for developing Countries (Craig et al., 2009)

Cloud Computing for Developing Countries Regional and Local Governments will deliver benefits more pronounced in developing countries that have not yet achieved high levels of public sector computerization, lack people with adequate ICT skills, or do not have firm legal or cultural requirements regarding data security and privacy. On the positive side, developing countries face less of the entrenched resistance to new computing paradigms that government agencies in developed countries often exhibit. Cloud computing may enable them to leapfrog a whole generation of government computing, bypassing many of the costly and debilitating challenges of traditional computing. A similar logic applies at subnational levels of government in developed countries where many agencies are small enough to qualify as small and medium-sized businesses (SMBs). Given their generally greater financial and human resource constraints, these organizations may find the low capital and in-house skill requirements of cloud computing models particularly appealing. Also, many regional or local governments work closely with SMBs as a major part of their economic development efforts. If cloud computing offers a way for these SMBs to be more efficient and effective, these governments should consider facilitating the use of cloud computing by SMBs to accelerate economic development.

Figure 2: Newgen e-Governance Framework (Newgen, 2013)
ANALYSIS OF ACTIVITIES AT ADO ODO/OTTA LOCAL GOVERNMENT SECRETARIAT

Departments and their Functions in Ado Odo/Otta Local Government

Under the Ado Odo/Otta Local Government Authority (LGA) Secretariat, there are 9 Departments with several units under them carry out different functions. They are listed below:

- **General Service and Administration**: the various units under this are
  - Legislative: responsible for votes and proceedings. Members are mostly Counsellors.
  - Management services: responsible for all management meetings, decision making and street naming.
  - Marriage registry.
  - Chieftaincy and Litigation.
  - Database of all staff members.

- **Finance and Supplies**: this department is responsible for all financial activities, several accounts such as DVRA, DVEA etc. estimates, revenue collection, allocation of funds and salary payment. This department houses the cashier and sub-cashier.

- **Planning and Statistics**: responsible for budgeting, control of vouchers and annual financial statements.

- **Community Development, Education and Sports**: responsible for taking services to communities such as sub-towns under the LGA, project the needs of various communities and work closely with grassroots governance.

- **Information**: this is the media house of the LGA. It is responsible for public relations, image making and repairs, general coverage of LGA activities and events.

- **Works and Housing**: responsible for infrastructure projects in the LGA. They work mostly on capital projects and oversee all aspects of such projects.

- **Agriculture and Natural Resources**: this department deals with agricultural products and farmers. They organize seminars/workshops for farmers, provide tools and resources to farmers. This is one of the major source of Internally Generated Revenue (IGR)

- **Primary Health Care**: Medical department of the LGA, responsible for all health issues.

- **Water and Environmental Sanitations**: responsible for the hygienic condition of the LGA and citizens. Generally ensuring a clean environment.

Services Offered and the Processes in Ado Odo / Otta Local Government.

- **Birth Certification**
Governance and Public Service Delivery in Nigeria: The Role of Information and Communication technologies

Odun-Ayo et al.

- A form requiring a Passport photograph and detailed Biographic Data is filled.
- An oral interview is conducted.
- The sum of N1000 is paid.
- Certificate is issued.

- **State of Origin Certification**
  - A sum of N4500 (N3500 for Certificate and N1000 Tenement Rate) is paid to a Bank and Teller Brought Forth.
  - Teller is then changed to Receipt.
  - A form requiring a passport photograph and personal detailed information is filled.
  - Certificate is issued.

- **Marriage Certification/ Marriage Registry**
  - Couple files a Notice for 21 days (including weekends) and pays a Sum of amount (undisclosed).
  - Notice will be pasted for 21 days, and if no objections from the public then couples proceed.
  - Intending couples either pick a date for solemnization at the LGA Registry, or obtain Form C authorizing a registered church to perform the Marriage.
  - Solemnization is carried out and Certificate is issued.

- **National Identification Identity Number**
  - A form is filled at the NIMC office OR a form is filled online.
  - Attach a means of identification to the form.
  - Capture of Biometrics and Passport photograph.
  - Card is issued.
  - Is a free Service.

- **INEC Card**
  - A form is filled requiring passport photograph and biographic data.
  - Form is tendered to Registrar.
  - Card is processed and Issued.
  - Is a free Service.

- **Revenue Collection (Finance)**
  - Any License except for club license is obtained at the establishment.
  - Revenue officers go around to different establishments.
  - Establishments pay for license and are issued a receipt (GRR-General Revenue Receipt, TR- Treasury Receipt etc.).
  - For a club the token sum of N5000 is paid to the finance office.
  - An interview is conducted and License granted.
DISCUSSION OF SERVICES AND THE PROCESSES IN ADO ODO / OTTA LOCAL GOVERNMENT

From the foregoing, most of the functions and processes are amenable to the practice of e-governance. Some activities are already being conducted online and such activities can leverage on the benefits of cloud computing. Applications can be developed for use by most of these processes. The massive storage ability available on the cloud can be utilized to store the various data being collected and the files being generated. In the most simplistic of manner Google Docs and Google Drive can be immediately used for these purposes. There are several other applications that can be used, but it’s better to keep it simple and make gradual progress. The forms in figure 3 can be design for completion on the cloud and it can be accessed by anyone, at anytime and anywhere. The Birth Registration Form in figure 4 was created with Google Docs and can be accessed on the cloud by hospitals with the link. The researcher is mindful of the electricity situation and the access to Internet facilities. It is fair to conclude that if thousands of students are able to register for JAMB annually, it’s possible to achieve some results if attempts are made to adopt cloud computing for some processes of government. Moreover, cost would not be an issue since most of the CSPs including Amazon Web Services offer free tier services to attract customers. The free tier services has an option which offers one year free trial on all Amazon Cloud computing services.

The Affordability, Business Usage, Government Usage and Economic Impacts pillars from The Global Information Technology Report 2016 as shown in Table 2 indicates that Nigeria is making steady progress in the promotion of ICT that could impact effectively on e-governance. The Business usage pillar in Baller et al. (2016) captures the extent to which businesses in a country use the Internet for business-to-business (B2B) and business-to-consumer (B2C) operations, as well as their efforts to integrate ICTs in their operations. It also measures the capacity of firms to come up with new technologies. The Government usage pillar in Baller et al. (2016) assesses the leadership and success of the government in developing and implementing strategies for ICT development, as well as in using ICTs, as measured by the availability and quality of government online services. Clearly for Nigeria, there are prospects for growth in the utilisation of e-governance and the opportunities available on the cloud could enable various levels of governments to leap frog in the accomplishment of desired objectives.
Table 2: The Networked Readiness Index (Baller et al., 2016)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Rank/139</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>4th Pillar: Affordability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.01 Prepaid mobile cellular tariffs, PPP $/min.</td>
<td>33</td>
<td>0.13</td>
</tr>
<tr>
<td>4.02 Fixed broadband Internet tariffs, PPP $/month</td>
<td>113</td>
<td>70.87</td>
</tr>
<tr>
<td>4.03 Internet &amp; telephony competition, 0–2 (best)</td>
<td>1</td>
<td>2.00</td>
</tr>
</tbody>
</table>
Governance and Public Service Delivery in Nigeria: The Role of Information and Communication Technologies

Odun-Ayo et al.

<table>
<thead>
<tr>
<th>7th Pillar: Business Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.01 Firm-level technology absorption* ...................................................................91 ......4.3</td>
</tr>
<tr>
<td>7.02 Capacity for innovation* ..................................................................................82 ......3.8</td>
</tr>
<tr>
<td>7.03 PCT patents, applications/million pop. ................................................................111 ......0.0</td>
</tr>
<tr>
<td>7.04 ICT use for business-to-business transactions* ............................................91 ......4.4</td>
</tr>
<tr>
<td>7.05 Business-to-consumer Internet use* ..................................................................92 ......4.0</td>
</tr>
<tr>
<td>7.06 Extent of staff training* ..................................................................................62 ......4.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8th Pillar: Government Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.01 Importance of ICTs to gov’t vision* ..................................................................104 ......3.4</td>
</tr>
<tr>
<td>8.02 Government Online Service Index, 0–1 (best) ...............................................98 ......0.31</td>
</tr>
<tr>
<td>8.03 Gov’t success in ICT promotion* ........................................................................103 ......3.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9th Pillar: Economic Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.01 Impact of ICTs on business models* ..................................................................82 ......4.2</td>
</tr>
<tr>
<td>9.02 ICT PCT patents, applications/million pop. ..................................................98 ......0.0</td>
</tr>
<tr>
<td>9.03 Impact of ICTs on organizational models* ....................................................101 ......3.6</td>
</tr>
<tr>
<td>9.04 Knowledge-intensive jobs, % workforce .........................................................n/a ......n/a</td>
</tr>
</tbody>
</table>

CONCLUSION
Cloud computing provides elastic, scalable, on-demand services through CSPs to consumer over the Internet. The cloud provides applications online that can be directly utilized by users, including platform and infrastructure for delivering services. There are clouds that can serve an organization, a dedicated group or a combination of groups. E-governance aims at delivering effective and efficient services through government to business, citizen and other government agencies. The cloud provides the enabling environment and infrastructure to handle the enormity of E-governance activities. E-governance can leverage on the cloud to offer services using the different cloud services types, in particular the SaaS. Several countries are using the concept of E-governance and some have adopted cloud computing in government. The cloud will continue to be relevant to individuals, businesses and government. Further work can be done in terms of Therefore, the paper recommends that various agencies of local, state and the federal government leverage on the advantages of cloud computing to improve service delivery and enhance the performance of government.
REFERENCES


Odun-Ayo et al.


