

Towards a Government Public Cloud Model: The Case of South Africa

Promise Sthembiso Mvelase¹, Innocentia Zamaswazi Dlamini², Happy Marumo Sithole³, Nomusa Dlodlo⁴

Centre for High Performance Computing (CHPC)

^{1,3,4}*Meraka Institute, Council for Scientific and Industrial Research, 627 Meiring Naudé Road, Pretoria, South Africa*
²*Defence Peace Safety and Security, Council for Scientific and Industrial Research, 627 Meiring Naudé Road, Pretoria, South Africa*

¹pmvelase@csir.co.za, ²idlamini@csir.co.za, ³hsithole@csir.co.za, ⁴ndlodlo@csir.co.za

Abstract. *Worldwide governments are actively looking into cloud computing as a means of increasing efficiency of service delivery and reducing infrastructure costs. As a result of introducing cloud computing, interoperability issues arise and yet it is vital for e-government services to be efficiently achieved; this is also a challenge for the South African government. Systems providing e-services in different organizational units are usually incompatible; hence integration of different units is required. Interoperability therefore becomes one of the main issues for successful e-government development. In response, this project aims at developing a South African government-public cloud model that can be used to address the interoperability issues and further enable the government to benefit from other cloud computing advantages. However, modelling a multidimensional social problem as complex as the public cloud for a national government requires time, knowledge and experience from a wide range of specialization disciplines. This is therefore a long-term project consisting of three main phases. Phase 1 investigates international countries that are already using the public cloud for their government services and illustrates the design from a South African perspective. Phase 2 presents the design and the implementation plan of the SA public cloud. Phase 3 presents the monitoring and evaluation plan to assess the quality and impact of this work, against our action plan. This paper discusses Phase 1 of the project, which is the investigation and design of the public cloud. Cloud computing has been identified as a technology development tool that can be used to address this issue. It is therefore envisaged that a government public cloud will be developed by building a cloud business model to suit the case of South Africa. Key differentiating points between public and private cloud will be realized. The success of the South African public cloud relies on the cooperation of different stakeholders from government, private entities, and academics to citizens. The result of this phase will be used as an input into the second phase*

Keywords

e-Government, Cloud Computing, Public Cloud, Private Cloud.

1 Introduction

E-government entails transforming government to be more citizen-centred. ICT is a significant enabler for this. E-government successes require changing how government works, how it deals with information, how officials view their jobs and interact with the public. Inside the South African context e-government splits up into different sectors such as e-health, e-education, SMMEs (Small and Medium Enterprises) and local content [16]. The State Information and Technology Agency (SITA) is an arm of the government that has been formed to streamline existing technologies and to implement new systems in all government departments. SITA is a company providing Information Technology (IT), Information Systems (IS) and related services to the South African government [17].

Cloud computing is making headlines and South African businesses and organisations are starting to look for ways to integrate it into their operations [10]. Part of this recent growth in interest could be attributed to its cost-effectiveness in that application development, maintenance, data storage and IT infrastructure in the cloud are in the hands of the

third party service providers and the service is completely scalable according to an organisation's needs. With all these advantages, this could also benefit the public society through the government cloud if properly planned. Public cloud services are available to clients from a third party service provider through the internet [11]. The term public does not always mean free, even though it can be free or fairly inexpensive to use. A public cloud does not mean that a user's data is publicly visible. Public cloud vendors typically provide an access control mechanism for their users. Public clouds provide an elastic, cost effective means to deploy solutions. According to the NIST definition of cloud computing, in a private cloud, the cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise.

In the South African context, the public cloud is more suitable for small enterprises who cannot afford ICT infrastructure due to financial constraints. It is therefore attractive to business owners as it eliminates the requirement for users to plan ahead for provisioning, and allows enterprises to start from the small and increase resources only when there is a rise in service demand.

Governments are facing serious challenges that affect their economies and their abilities to deliver core services to their citizens. They are faced with the harsh realities of growing city populations that demand more services, aging infrastructure, declining budgets and increasing threats. As such, they are constantly looking to adopt ways and technologies that can help them address these challenges. Cloud computing benefits for e-governance are clear but one cannot deny the challenges that government cloud can create. Cloud computing for e-governance can:

- Reduce IT labour costs
- Improve capital by significantly reducing license costs
- Provides much needed scalability.
- Cloud architecture is built on service-oriented architecture (SOA) principles
- Cloud computing offers unlimited supply of central processing unit (CPU) capacity, storage and bandwidth
- Application designers are free to focus on features and usability and not hardware aspects.
- While e-governance applications face data outburst, cloud computing can scale better.
- Cloud-computing-supported e-governance can provide efficient management and disaster recovery.
- The cloud helps to increase the number of resources dynamically to maintain quality of service intact even at the times of high load, which generally happens in e-governance.
- With cloud, e-governance applications can manage the policies well by providing security and adoptability.
- Various e-governance applications can be integrated easily.

This paper proposes the design of the public cloud model for the South African government. This is done through the review of the international countries (such as the UK, Canada, Australia, Hong Kong, China and India) that have cloud initiatives strategies in place and have perhaps already implemented government clouds. The proposed design on a South African perspective is established and presented in detail. This work is intended to encourage extensive discussion among different stakeholders in South Africa.

2 Related works

Global adoption of cloud computing in the public sector is steadily growing. A number of countries have developed government cloud strategies; hence they are moving some departmental work to the cloud. Chandrasekaran & Kapoor review the business case for cloud computing in the Government sector and offers an overview of the initiatives by governments across Asia Pacific[15]. The National Institute of Standards and technology (NIST) is in a continuous mission in support of the United States Government's (USG) secure and effective adoption of the cloud computing model to reduce cost and improve services [8]. NIST aims to make it substantially easier to buy, sell, interconnect, and use cloud environments in the government. South Africa's SITA is committed to leveraging Information Technology as a strategic resource for government [20]. It states that ICT provides an opportunity to bridge the government service delivery divide through e-government implementation. E-government strategic framework should embody a citizen centric approach by addressing areas of leadership, finance, shared resources and technology to effectively address key environmental challenges. The author goes on to state the importance of involving multiple stakeholders to address key challenges to implementing e-government.

SITA has enabled various successful e-government initiatives within South Africa. Development maturity models of e -government have been designed and implemented in some cases. The differentiation between these models is based on the nature of the analytical study, and therefore different countries adopt a model based on their countries' scope. Following is a list of the e-government maturity models the authors identified [18].

1. Gartner's four stage model 2.

2. Deloitte's six stage model
3. 3. Accenture five stage model
4. 4.UN's five stage model
5. 5. World Bank's three stage model
6. 6. Asia Pacific six stage model
7. 7.Layne and Lee's four stage model
8. 8.Siau and long Synthesize e-government stage model
9. Moon's five stage model
10. West's four stage model
11. Public sector process rebuilding (PPR) model
12. Howard's three stage model
13. Chandler and Emanuel's four stage model
14. The 61 model to evaluate the e-services in the government
15. Hiller and Belanger's five stage model.

Many developing nations are demonstrating that they are taking cloud computing seriously by engaging in pilot projects and even awarding contracts to operate some part of their business in the cloud.

2.1 Existing Government Cloud Strategies

International governments such as the United States, the United Kingdom, Canada, Australia, Hong Kong, China, India and New Zealand, like Australian governments, see cloud services as an opportunity to improve business outcomes through eliminating redundancy, increasing agility and providing information and communication technology (ICT) services at a potentially cheaper cost [19]. These countries are in different stages of forming a cloud strategy and implementing it and they are determined to run centralized government clouds, leveraging public clouds where appropriate. In this section we look at some of the countries who are early adopters of cloud computing.

2.1.1 Canadian Government Cloud

The Canadian government plans to deploy a government cloud, that is, a document on cloud service specifications that can be used by external commercial providers as well as internally by shared services Canada users. They provide technical design blueprints for security configurations to ensure cloud environments are compliant with Government of Canada standards. Primarily they can be used as industry-wide product specifications because they're based on the NIST models that are now universally recognized as the default Cloud Best Practices, and relate to how service providers define and deliver their services [10]. Canada ranks ninth among 24 nations whose laws and regulations encourage cloud computing, according to an association of some of the biggest names in information technology [11].

2.1.2 Australian Government Cloud

The Australian Government Cloud Computing Strategic Direction paper describes the whole-of-government policy position on cloud computing. The Australian government primary objective of the Australian Government Cloud Computing Strategic Direction paper is to develop a principles and risk-based pathway for agencies to rationalise their ICT asset base and to adopt cloud computing where appropriate. Migrating some or most of an agency's service delivery to the cloud will involve a major change to the procurement, supply, and security of ICT. Modification to the skill set required of agency ICT personnel to accommodate these changes will be required. The understanding and mitigation of a new set of risks will be necessary to accommodate this new sourcing model. Issues such as these may increase the risk at this time for agencies wanting to rapidly implement cloud computing arrangements [9].

Listed are some agencies that have taken the first step in trying cloud computing services in Australia [15]:

- **Australian Taxation Office (ATO)** has moved eTax, Electronic Lodgement System (ELS) and the Tax Agent Board administrative support systems into the cloud.
- **Australian Bureau of Statistics** has implemented a virtualization solution to enable transition to a private cloud environment.
- **Treasury / ATO** has migrated Standard Business Reporting (SBR) and Business Names projects into the Cloud.

- **Department of Immigration and Citizenship (IMMI)** initiated a proof of concept for the provisioning of an end-to-end online client lodgement process on a cloud platform.
- **Australian Maritime Safety Authority** has implemented a Public Cloud for software-as-a-service (SaaS) and platform-as-a-service (PaaS) deployments from Salesforce.com.
- **Department of Immigration and Citizenship (DIAC)** has implemented a Hybrid Cloud for infrastructure-as-a-service (IaaS) as a proof of concept.
- **West Australian Health** has adopted a private cloud for the IaaS deployment.

2.1.3 US Government Cloud

The NIST, consistent with its mission, have a technology leadership role in support of the United States Government (USG) secure and effective adoption of the Cloud Computing model to reduce costs and improve services. This role is described in the 2011 Federal Cloud Computing Strategy³ as (a central one in defining and advancing standards, and collaborating with USG Agency CIOs, private sector experts, and international bodies to identify and reach consensus on cloud computing technology & standardization priorities). This NIST Cloud Computing program and initiative to develop a USG Cloud Computing Technology Roadmap is one of several complementary and parallel USG initiatives defined in the broader Federal Cloud Computing Strategy referenced above [8]. The NIST roadmap is designed to:

- Foster adoption of cloud computing by federal agencies and support the private sector;
- Reduce uncertainty by improving the information available to decision makers; and,
- Facilitate the further development of the cloud computing model.

The AWS cloud is uniquely positioned to provide scalable cost-efficient solutions for the US Federal Government to find ways cloud services can be employed to meet mandates, reduce costs, drive efficiencies, and increase innovation across its Civilian agencies and the Department of Defense. AWS provides cloud services a pay-as-you-go model, delivering access to technology resources that are managed by experts. The AWS GovCloud (US) Region is an AWS Region designed to allow US government agencies and contractors to move more sensitive workloads into the cloud by addressing their specific regulatory and compliance requirements [14].

2.1.4 Hong Kong GovCloud

Atos in Hong Kong is driving the GoCloud initiative. Their task is to implement and operate the Government Cloud Platform (GovCloud).

GovCloud is a large-scale central IT infrastructure for hosting e-government services for shared use by bureaus and departments, such as electronic information management. Atos will provide a range of services covering project management, system implementation and integration, operations management and data centre hosting for Hong Kong government.

In Hong Kong, GovCloud is the Government's first major private cloud initiative that aims to capitalize on cloud computing for a more agile and cost-effective delivery of e-government services to meet both the rising demand and the expectations of government departments and the public. GovCloud will bring economies of scale and drive down the cost of hosting e-government services with the use of shared central infrastructure.”

The adoption of a centralized private cloud approach to building GovCloud will increase cost-savings, time saving and agility in meeting dynamic public demands for e-government services [13].

2.1.5 India Government Cloud

The Government of India is already working towards using cloud in multiple e-governance projects. It has five pilot cloud computing cities and, according to its 12th Five-Year Plan, cloud computing will be a chief driver of the IT industry. The Indian government has a plan to convert the data centers currently built for each of the country's state governments into privately run private clouds [12].

3 The Design of the South African Government Cloud

3.1 South African e-Government

E-government is often thought of as “online government” or “internet-based government,” Some non-internet forms include; telephone, fax, SMS text messaging, MMS, wireless networks and services, Bluetooth, CCTV, tracking systems, RFID, biometric identification, road traffic management and regulatory enforcement, identity cards, smart cards and other NFC applications; polling station technology (where non-online e-voting is being considered), TV and

radio-based delivery of government services, email, online community facilities, newsgroups and electronic mailing lists, online chat, and instant messaging technologies.

E-government is sometimes referred to as digital government or online government. This is the governmental use of information communication technology in exchanging both information and services with its citizens and the corporate world [23]. In simple terms, e-government is the use of information technologies together with the new business processes in transforming the government's interaction with its citizens and the corporate world [24].

Moosa and Alsaffar believe that e-government should be customer-centric, and must emphasize the coordinated network building, together with external collaboration and customer services [5].

E-Government can also be viewed as an enabler to service delivery by maximising the use of ICT to improve the productivity of the public service and convenience to access to services by the citizens through a connected governmental technology enhanced systems [22].

South African e-government has a particularly significant historical and social context due to its former occurrences. The development of e-government and access to e-services in South Africa is progressing at a snail-pace. Too little has been done regarding the implementation of e-government applications. There exist different unrelated e-services, as different departments are yet to be integrated and are currently not interoperable. This resulted in the development of a ten year e-government implementation plan based on tested best practices, such as Gartner's e-government maturity model [10] not progressing as planned. One of the major challenges with progress of the SA e-government is integration of various departmental services and its governmental three- sphered structure (shown in Fig.1), that is National, provincial and local government. The other challenge is that, the policy and actual work contradict.

The South African government departments that are actively using the e-services, includes: South African Revenue Service (SARS); Department of Home Affairs (DHA); South African Police Service (SAPS); Department of Justice (DoJ) including National Prosecuting Authority (NPA), Department of Correctional Services (DCS) and Department of Social Development (DSD); South African Defence Force (SADF), and Department of Human settlements (DHS) [21].

The South African e-government consortium and steering committee, includes: Department of Communications (DoC), whose responsibility includes the development of information infrastructure and security policy; Electronic Communications Security (ComSec) is responsible for securing national and governmental communication mechanisms and infrastructures. State Information Technology Agency (SITA) on the other side is in charge of e-government services delivery and secure implementation. DHA and SARS are regarded as the major departments in utilizing e-government services. The DPSA is mandated to promote the use of Information Technology (IT), Information Management and to improve IT service delivery to the public service within the country. The complete e-government road map have four stages, i.e. Connected Government (cgov), Mobile and Multichannel Government (mgov), Ubiquitous Government (ugov), and Transformed Government (tgov) [22].

Fig.1 depicts the currently existing services from different three-spheres of South African government that is national, provincial and local government together with five enablers; including, the available infrastructures, capability development, information and communication literacy, stakeholder conversion and adoption as well as governance for each sphere. These are some of the e-services that can be provided on a governmental cloud.

Enablers	National Government	Provincial Government	Local Government
Infrastructure	National Infocomm Infrastructure GWEA Availability of bandwidth	Government Infrastructure and Services GWEA	Shared Services Centre
Capability Development	e-Government Champions Project Managers OGCIO, GITO, CIO's & SITA	IT Manpower in Information and Communication Industry	Skills Education training Authorities (SETA)
Information and Communication Literacy	Public Sector PALAMA	Public Sector PALAMA	Thusong Centers Citizens and Business
Stakeholder Conversion and Adoption	Change Management	Customer Adoption Change Management	Customer Adoption
Governance	IT Legal Framework IT Governance and Management	IT Governance and Management	Integrated Governance and Management

Fig. 1. South African e-government stakeholders (adapted from SITA[23])

The adoption of e-government policy in 2001 resulted in the establishment of the Government Information Technology Council (GITOC), consisting of government information officers (GIOs) from all South African departments [4].

3.2 Proposed South African Government Cloud Framework

The proposed South African Government Cloud Framework has five characteristics, including:

- Cloud Program Management officer (CPMO)
- Cloud Consumers
- Cloud Provider
- Cloud Auditor
- Security and Data Privacy

Fig.2 illustrate the proposed design of a public cloud on a South African perspective. The above characteristics are further discussed in detail on the following subsections.

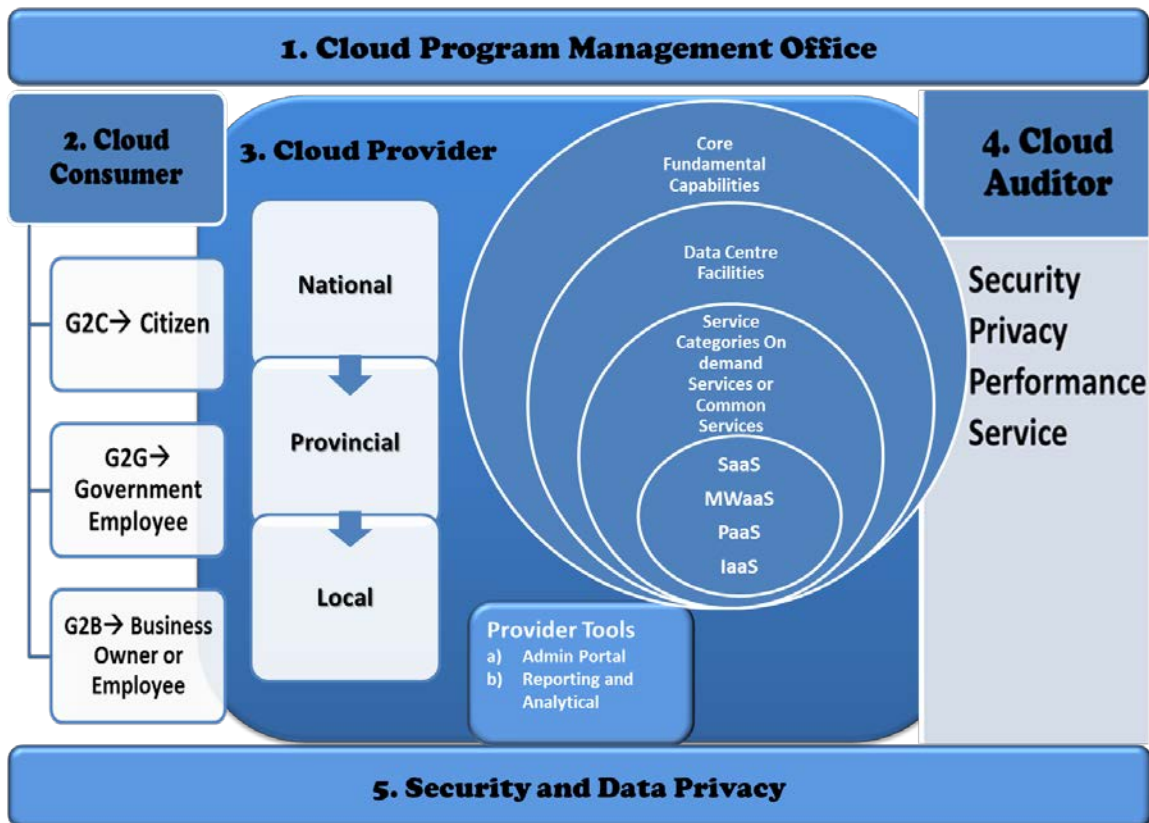


Fig. 2. Proposed South African Government Cloud Framework

3.2.1 Cloud Program Management officer (CPMO)

The cloud programme management office is an organisation or the department which is responsible for the cost incurred by using the system. In actual fact, this is the cloud service provider's site, which in South African government could be South African State Information Technology Agency (SITA), since SITA is currently an Agency responsible for consolidation and coordination of the South African state's information technology resources, while ensuring that cost savings is achieved through scale, increased delivery capability and enhanced interoperability [16]. The proposed SA government cloud will enhance the recommended SITA's (as a CPMO) role in public services delivery.

3.2.2 Cloud Consumers

The cloud consumer (also known as cloud service consumer) is usually the principal stakeholder who uses cloud computing services. These are divided into three: i.e. by Government to Consumer (G2C), whereby a consumer is a citizen; Government to Government (G2G), where the consumer is the government employee; and Government to Business (G2B), in which case a consumer could be the business owner or the business employee. These are all the

cloud consumers who will use the cloud to access various services (whether it is Software, Platform or Infrastructure as a Service) available or provided by the Cloud Provider.

3.2.3 Cloud Provider

The main role of the cloud provider (or cloud service provider) is to manage the infrastructure and platforms that run the applications and to devote resources to solving security issues that many consumers cannot afford. South African government can both own its private cloud and manage it, in turn to be accessed by the public, hence the term public government cloud. The South African e-government sector is divided into three sectors, that is, national, provincial and local government. In terms of access rights, national government is authenticated to view and edit provincial and local data but provincial and local government sector do not have such privileges. Permissions to edit and view data can be given where necessary by the internal administrators. In a same way provincial government sector has rights to view and edit systems for the local government but not for the national government. In essence, the administration rights are granted on a top-down approach, but it is not applicable on a bottom-up approach.

3.2.4 Cloud Auditor

The purpose of cloud auditor is to provide a common interface that allows government departments to streamline their cloud audit processes i.e. the cloud computing provider (SITA) to automate the Audit, Assertion, Assessment, and Assurance of the government cloud infrastructure (IaaS), platform (PaaS), and application (SaaS) environments. The cloud auditor is responsible for assuring that, privacy, security, and performance services are implemented according to standards.

3.2.5 Security and Data Privacy

Although this aspect of cloud computing is still a challenge, personal and private information is frequently recommended not to be included or stored on the cloud. Some countries use the cloud for storing public service and for the access, while using other means for private information storage. This is one method SA can adopt.

4 Conclusion

In this work we proposed a framework for developing a public government cloud for South Africa to support e-government. There are some clouds already in existence in South Africa., e.g. IBM's VMware's 'Cloud OS', and the use of cloud computing for medical research by the University of Pretoria, therefore local expertise exists. Appointing a dedicated team to draft a government cloud strategy for South Africa will be of advantage as a preliminary stage of this development. Thorough research and development on this initiative is therefore needed from different stakeholders.

References

- [1] South African Government, (2002) Overview on Government's Programme of Action. South
- [2] Africa Yearbook. Available online at: <http://www.gov.za/yearbook/2002/overview.htm>.
- [3] DPSA, (2001) E-Government Policy. Second Draft, Version 4.13. Available online at: <http://www.gov.za/>
- [4] DPSA, Batho Pele Frequently Asked Questions. Available online at: <http://www.dpsa.gov.za/projects/batho-pele/faqs.htm>.
- [5] GITOC (2011b). Towards a government-wide ICT strategy. Unpublished GITOC working paper, June 2011, accessed 31 August 2012 from <http://www.gitoc.gov.za/index.php/the-news/51-towards-a-government-wide-ict-strategy>.
- [6] Mawson, N. (2012). Govt IT fails SA. ITWeb, 20 January 2012, accessed 09 February 2013 from http://www.itweb.co.za/index.php?option=com_content&view=article&id=50767:govt-it-fails-sa.
- [7] Mawson, N. & Rasool, F. (2012). DPSA fails to deliver, accessed 31 January 2013 from http://www.itweb.co.za/index.php?option=com_content&view=article&id=51079:dpsa-fails-to-deliver.
- [8] Badger, L. Bernstein, D. Bohn, R. de Vault, F. Hogan, M. Mao, J. Messina, J. Mills, K. Sokol A. Tong, J. Whiteside, F. & Leaf, D. (2011). US Government Cloud Computing Technology Roadmap Volume 1: High Priority Requirements to Further USG Agency Cloud Computing Adoption.
- [9] Australian Government (2011). Cloud Computing Strategic Direction Paper
- [10] McEvoy, N. Canadian Government Cloud computing: A Canadian Best Practices Guide to Implementing Cloud Services in the Canadian Public Sector
- [11] Solomon, H. (2013). IT World Canada, Accessed 01 May 2013 from <http://www.itworldcanada.com/news/canada-9th-in-cloud-regulations-industry-group/146849>

- [12] Marthur, S. (2013) Accessed on 12 March 2013 http://articles.economictimes.indiatimes.com/2013-05-07/news/39091309_1_cloud-computing-public-cloud-cloud-strategy
- [13] Atos. Atos Awarded Hong Kong's first government Cloud contract worth around HK\$127 million (2013) Accessed 11 May 2013 http://atos.net/en-us/Newsroom/en-us/Press_Releases/2013/2013_05_06_01.htm
- [14] AWS. (2013) accessed 17 march 2013 <http://aws.amazon.com/govcloud-us/>
- [15] Chandrasekaran, A. & Kapoor, M. (2011) State of Cloud Computing in the Public Sector- A Strategic Analysis of the Business Case and Overview of Initiatives Across Asia Pacific
- [16] Farelo, M. & Morris, C. The Status of E-government in South Africa, Accessed on 7 April 2013 http://researchspace.csir.co.za/dspace/bitstream/10204/966/1/Farelo_2006_D.pdf
- [17] Kroukamp, H. 2005. E-governance in South Africa: are we coping.
- [18] Othman, A. Galal-Edeen, G. H. (2012) : Proposed Development Model of E-government to appropriate Cloud Computing, *International Journal of Reviews in computing*, 9(7):47-53, 1984.
- [19] EGA, accessed on 6 April 2013 http://www.ega.or.th/Content.aspx?c_id=486
- [20] Meerman, S. (2010), Opportunities and Challenges for e-Government in South Africa: *Strategy, Intervention and Plans for e-Government, SITA*
- [21] Department of Public Service Administration, available online from: <http://www.dpsa.gov.za/>, accessed on the: 23 April 2013
- [22] SITA Strategy, (March 2010), available online from: http://www.google.co.za/#hl=en&q=sita+e+government+2010&meta=&aq=f&aqi=&aql=&oq=&gs_rfai=&fp=e0435f80f5e44ad9, accessed on: 21 April 2013
- [23] Wikipedia, eGov, <http://en.wikipedia.org/wiki/EGov>, accessed on the: 19 April 2013.
- [24] Ryan, O. Building the Infrastructure for eGov, available online from: <http://unpan1.un.org/intradoc/groups/public/documents/apcity/unpan004277.pdf>, accessed on the: 23 April 2013
- [25] Moosa, A. and Alsaffar, E.M., 2008, Proposing a hybrid-intelligent framework to secure eGov web applications, available online from: <http://delivery.acm.org/10.1145/1510000/1509109/p52-moosa.pdf?key1=1509109&key2=8279471721&coll=GUIDE&dl=GUIDE&CFID=86971269&CFTOKEN=10481693>, accessed on: 19 April 2013