Challenges of Technology Infrastructure Availability in E-Governance Program Implementations: A Cloud based Solution.

¹Sameer Goel, ²Manoj Manuja, ³Rajeev Dwivedi, ⁴A.M. Sherry, ¹Institute of Management Technology, Ghaziabad

¹Institute of Management Technology, Ghaziabad ²Manager, Education and Research, Infosys, Ltd. ^{3,4}Institute of Management Technology (CDL), Ghaziabad

Abstract: Implementation of large program in a governmental scenario is always a challenging work. There are many constraints which a government needs to address before offering value-added services to its citizens and other stake holders in a seamless environment. With the explosion of information over web in recent past, governments across the world face a major challenge in keeping a pace with ever changing technologies and offer an efficient, effective and transparent way of offering its services. Last couple of years has observed cloud computing taking a center stage for offering various services in a cost efficient and automated model. In this article, we discuss various challenges being faced by government in providing its services through e-governance model to all its stake holders. A cloud computing solution is proposed to address some of the e-governance challenges being faced by government. A fine grained model is discussed towards the end to highlight various benefits this solution brings along with it.

Keywords: Cloud Computing, E-governance, Technology Infrastructure

I. Introduction

In today's time, governance across the globe is getting sturdy and challenging, be it public, business or corporate governance. It is a crucial process of decision making with lot of dependency on how these decisions are implemented. We can evaluate successful or unsuccessful economies across the world just by comparing their governance indicators with each other which are published by World Bank on a regular basis [1].

Information technology (I.T.) has experienced an exceptional growth over the recent couple of decades. We can easily observe the influence of I.T. in governance of either a big corporate or a country. This electronic governance, popularly known as e-governance, is becoming the backbone of any country's growing economy in today's world of internet enabled systems and processes. The word "electronic" primarily indicates the usage of technology in all matters of governance. This includes Government-to-citizens (G2C), Government-to-Business (G2B), Government-to-employees (G2E), Government-to-Government (G2G) as well as interactions and processes happening at the back office system levels within the entire government frame work. Government tries to leverage technology to make all its services available to its different stake holders namely citizens, businesses and government itself in an efficient, effective and transparent manner.

Today, many governments across the globe are using technology to leverage the huge reach of egovernance model in their respective countries [2]. There are many ways of implementation being followed to provide a trouble-free, proficient access to most of the required information and services for the citizens. One of the most accepted and popular ways of offering e-governance services is to launch one-stop unified portal which can be accessed by the people for various governmental services.

It is observed that the developed countries spend a record budget in supporting its e-government initiatives [3]. The trend of enhanced spending on e-governance programs is catching up in developing countries and Indian government has committed large part of budget to e-governance programs [4]. It is evident after careful analysis of this expenditure that considerable part of the budget is incurred towards building hardware infrastructure. The hardware infrastructure such created struggles to sustain itself in view of the technology advancement and lot of tax payers' money is spent without making full use of this. To implement e-governance in large developing countries like India, it is important that optimum usage of resources is made and expenditure made on technology infrastructure is efficiently used. This paper explores the challenges in technology infrastructure availability and a cloud based solution for the same.

II. Methodology

A review of literature has been carried out for better understanding of the challenges and issues involved in e-governance. Based on the literature review the issues in availability of technology Infrastructure are collated. Focused group discussions were held with the experts in the area of e-governance and technology innovations. Based on the focused group discussions with these experts, a cloud based framework has been proposed for e-governance programs.

III. Literature Review

Development of e-governments is directly proportional to the IT infrastructure that is capable of supporting and enabling the execution of e-government. An e-government infrastructure in general comprises network infrastructure, security infrastructure, application server environment, data and content management tools, application development tools, hardware and operating systems, and systems management platform [5]. However, large parts of India do not have the infrastructure necessary to deploy e-government services throughout its territory.

Apart from the availability of the infrastructure, the other key challenge on this front is to design interoperable systems. Lex van Velsen [6]) describe that e-Government services often span several organizations or departments. Such a service can be offered to the citizen via one single website, supported by an interoperable system. This website should present the service as a coherent and logical whole for the user. Subhasis Ray and Amitava Mukherjee [7] in their study on development of a framework towards successful implementation of e-governance initiatives in health sector in India identify that lack of standardization of system components and services such as health information systems, health messages, electronic health record architecture, and patient identifying services may be a hindrance for Interoperability of e-healthcare systems. Jaijit Bhattacharya and Sushant Vashistha [8] discuss the challenges of not following a standardized architecture for e-governance programs. These challenges are:

- It will lead to a large pile-up of heterogeneous IT infrastructure.
- Difficulty in provisioning complete IT infrastructure for an e- Governance initiative in every department, region and state. It is going to exert a lot of cost pressures on the governments if the spikes in computing requirement are to be met in-house without creating a common back-end that smoothens out these spikes and hence maximizes the utilization of the IT infrastructure and public money.
- Interoperability issue with the different systems being required to talk with each other.
- Adapting to rapidly changing IT software and hardware technologies and "Technology Obsolescence".
- Under-utilization of the IT capacity, hence leading to wastage and ever accruing maintenance cost.

The above issues are even more critical for the developing economies where the resources are limited and hence require prudent expenditure on the part of the government.

Interoperability especially in case of G2G project should have an in-built system for seamless operations across different platforms. This is especially important in cases where different departments operating on different platforms are sought to be integrated to ensure seamless flow of information within the government.[9, 10]

IV. Analysis and Discussion

Based on the inputs from literature review, focused group discussions were held with the technology and e-governance experts. The challenges faced by governments in providing e-governance solutions on technology infrastructure front, which were highlighted in these focused group discussions were:

- 1. **Infrastructure complexity**: It is a gigantic task to put proper infrastructure in place so that all public services are made available to citizen online. We need to install hardware at different places in villages, cities, districts and state to cater to different stake holders. Linking all the installed infrastructure over a network is indeed a tedious work. Moreover, a regular updation and maintenance of hardware and software consumes lot of money on a regular basis.
- 2. **System Management**: Once the infrastructure is in place, management of the system is next critical and complex activity. There are very rapid changes and advancements in the technology which makes our hardware and software obsolete. This is a big challenge because the budgets are directly linked with this activity and huge cost is involved in replacing or upgrading the hardware / software.
- 3. **Human resource management**: The complete system and infrastructure is installed, commissioned and maintained by highly paid information technology professionals. Government is required to recruit such people and support the IT dept with a high salary cost. Also, the movement of IT professionals within the industry is very common; hence, it becomes very difficult to retain them.
- 4. **Scalability**: E-governance systems have huge variations in the demands during peak and off peak hours with demand growing manifold over the time. The systems designed most of the time are not scalable to meet the requirements and eventually customer services suffer due to this issue.

V. Cloud Computing Based E-Governance Solution

Cloud computing is like a service processing mechanism which is web-based, and the customer is almost unaware of the source of the solution he is getting from. He is just accessing a web based service available on cloud and getting the solutions or replies to his queries. Cloud computing is termed as a Web-based processing, whereby shared resources of software and data are provided to computers and other related devices (such as smart-phones, PDAs and other mobile devices) on demand over the network.

Challenges of Technology Infrastructure Availability in E-Governance Program Implementations: A

Cloud computing is a versatile technology that uses the internet based web services and remotely available central servers to maintain various applications and related databases. Cloud computing allows consumers who may be end-users or any business organization to use various remote applications without even a single installation being done at their premise. It also helps to access their business as well as personal files at any computer situated anywhere in the globe with available internet access. This resourceful, adaptable and flexible technology allows the users for much more capable computing by centralizing storage space, proper memory management, fine-tuned processing and properly utilized bandwidth [11]. Figure – 1 shows five layers of type cloud computing implementation.

Layer - 1 - Customers / end users: This layer consists of customers sitting across the globe accessing various applications through web / internet.

Layer -2 – Web Applications: Cloud application services are available on internet eliminating the need to have the application installed and being run and managed on the customer's own computer infrastructure. It primarily simplifies the required maintenance and support. This can be categorized as SaaS (Software as a Service).

Layer -3 – Platform services: The said layer provides a computing platform with or without solution stack as a service. It often consuming cloud infrastructure and sustaining *cloud applications*. This can be categorized as PaaS (Platform as a Service).

Layer -4 – Infrastructure Services: This layer primarily provides computer infrastructure for creating virtualization environment which may be termed as a platform service. This can be categorized as "Infrastructure as a Service" or popularly known as IaaS.

Layer -5 – Servers: This layer is the amalgamation of computer hardware and software that are exclusively designed for the delivery of services on the cloud. This infrastructure includes multi-core processors, cloud-specific operating systems and combined offerings.



FIGURE – 1

Cloud Deployment Models:

Different models of cloud deployment are available in the global arena [12]:

- 1. **Public Cloud**: It is also termed as external cloud which describes cloud computing in the conventional mainstream sense. The resources are dynamically provisioned on a fine-grained, self-service model over the Internet, through web applications and/or web services, by a third-party service provider who bills the customers on a fine-grained utility computing model.
- 2. **Private Cloud**: It is also termed as internal cloud which describes cloud computing as a model, where resources are dynamically provisioned on a fine-grained, private-service basis over the Intranet through web applications and/or web services, from privately managed self provider who is also the owner of the deployment. This infrastructure is being made available solely to the users within an organization. It may be managed by the company itself or it can hire a third party to host and operate it on premise or off premise.
- 3. **Community Cloud**: This type of cloud infrastructure is being shared by several businesses or organizations for a shared purpose. It supports a specific community that has shared concerns and common goals like mission, particular security requirements, general policies, and their compliance considerations. It may be

managed by the organization itself or a third party can be entrusted to operate the same on premise or off premise.

4. **Hybrid Cloud**: This type of cloud infrastructure is primarily composed of two or more clouds which may be private, community, or public. It is primarily being used when we need to bind together standardized or proprietary technology which enables data and application portability as shown in figure - 2.



Solution Framework for E-Governance Programs

A framework is suggested for a governmental e-governance.

There are mainly two types of users for this cloud based e-governance service:

a. **Government Officials:** This segment of users is primarily government officials who will be accessing the web applications available on cloud to manage and maintain the complete governance infrastructure and offer public focused services. This segment can be sub divided into three parts:

- I. Village / City level Govt officials
- II. District level Govt officials
- III. State level Govt officials

b. **General public end users**: This segment of users is primarily end users who will be accessing the web applications available on cloud to avail all the services being offered by the government through this model. Again, this segment can be sub divided into three parts:

- I. Village / City level end users
- II. District level end users
- III. State level end users

Cloud Infrastructure: As shown in figure -3, all users will be accessing the cloud through a common cloud infrastructure which offers common services.

The complete e-governance has two major stake holders namely service providers and service consumers. Therefore, the suggested framework offers a hybrid solution for the cloud implementation. The framework offers two clouds namely:

- A. Public Cloud: This cloud will be accessed by general end users who want to use an available web application to avail some governmental service. This cloud will be available on public domain where anybody and everybody can access the available services.
- B. Private Cloud: This cloud will be accessed by governmental officials who want to access the web application to manage and maintain the offered governmental services. This cloud will be available as a private cloud where secured login will be required by authorized officials to access available web applications. These officials will be the people who do add / delete / update operations on the e-governance database which is being accessed by general end users through public cloud.



www.iosrjournals.org

Challenges of Technology Infrastructure Availability in E-Governance Program Implementations: A

Advantages of Suggested Framework

- 1. **24x7 Service Availability**: The service in the pre-cloud era has been restricted to only office timings. The government officials are available between 9am till 5pm and all the work is done with personal intervention of the governmental officials. In post-cloud era, all services are available 24x7 with minimal human intervention.
- 2. **Cost effective solution**: The suggested model helps reduce the cost to provide governance services to the masses. In a non-cloud scenario, state government was forced to install so much of hardware at different places in villages, cities, districts and state to cater to different stake holders. In cloud environment, complete hardware and software support is provided by the service provider who build, install, commission and maintain the whole set-up. Government pays to service provider on mutually agreed terms and conditions.
- 3. **Easy system administration**: We can quickly obtain the benefits of the colossal infrastructure with no hassles to implement, control and administer it directly. This also allows the users to access multiple database centers situated anywhere on the globe. It also signifies that the companies can add additional services and infrastructure as and when required based upon the customers' need. It also helps the organizations to save on the cost of additional hardware in this scenario where expenditure is borne by the cloud computing vendor.
- 4. **Services on Mobile**: Cloud computing helps Government to offer all administrative services to its users through mobile devices. Employees can access work-related information from anywhere. All stake holders can access relevant data and various services wherever they are, rather than having to remain at their desk.
- 5. **Scalability:** The systems such designed are scalable and additional infrastructure can be added as the demand grows and the department pays for the infrastructure only when it has requirement for the same.
- 6. **High performance:** Systems developed on this environment are very good in terms of availability, accessibility and performance. The cloud service provider ensures that enough redundancy is built in the system, so that it can provide uptime to the tune of 99.99% and desired performance response at all times.

VI. Conclusion

The success of any e-governance model depends upon various factors. The challenges primarily focus on system availability, infrastructure complexity, application management and people management. These challenges amount to various complexity during the implementation of e-governance model by any government agency. Cloud computing has offered a lot of opportunities to corporate as well as governments across the globe. E-governance implemented on a cloud offers enormous opportunities to the government as well as end users i.e. citizens. Government scores in terms of providing 24x7 services to its citizens, effortless maintenance as the cloud systems are managed by third parties in general. Citizens get the seamless services any where any time which is a great advantage. In nut shell, cloud is the future of e-governance model which is scalable, easy to operate and maintain.

References

- Subhajit Basu, "E-Government and Developing Countries: An Overview", Pages 109–132, International Review of Law Computers & Technology, Vol. 18, No. 1, 2004
- [2] Sunny Marche, James D. Mcniven, "e-government and e-governance: The future isn't what it used to be", Page 74-86, Canadian Journal of Administrative Science, 2003
- [3] Lourdes Torres, Vicente Pina, Basilio Acerete," E-Governance Developments in European Union Cities: Reshaping Government's Relationship with Citizens", Page 277-302, Governance: An International Journal of Policy, Administration, and Institutions Vol. 19, No 2, April 2006
- [4] Rahul De, "E-Government Systems in Developing Countries: Issues and Concerns Discussion" Page 377-388, IIMB Management Review, December 2006
- [5] Subhajit Basu, "E-Government and Developing Countries: An Overview", Pages 109–132, International Review of Law Computers & Technology, Vol. 18, No. 1, 2004
- [6] Velsen Lex van, Geest Thea van der, Hedde Marc ter, Derks Wijnand, (2009) Requirements engineering for e-Government services: A citizen-centric approach and case study, Government Information Quarterly 26, 477–486
- [7] Ray Subhasis, Mukherjee Amitava, (2007) Development of a framework towards successful implementation of e-governance initiatives in health sector in India, International Journal of Health Care Quality Assurance Vol. 20 No. 6, 464-483
- Bhattacharya Jaijit, Vashistha Sushant, (2008) Utility Computing-Based Framework for e-Governance, ICEGOV2008, Cairo, Egypt
 Gregory D. Streib, Katherine G. Willoughby, "e-Governments: Meeting the Implementation Challenge", Page 78-112, PAQ Spring, 2005
- [10] Subhash C. Bhatnagar, Nupur Singh, "Assessing the Impact of E-Government: A Study of Projects in India", Page 109–127, Information Technologies & International Development Vol. 6, No 2, 2010
- [11] Manish Pokharel, Jong Sou Park, "Cloud computing: future solution for e-governance", Proceedings of the 3rd international conference on Theory and practice of electronic governance, 2009.
- [12] Ashish Rastogi, A model based approach to implement Cloud Computing in E-Governance, International Journal of Computer Applications, ISSN 0975-8887, Volume 9, No. 7, November 2010