

Solving e-Governance Challenges in India through the Incremental Adoption of Cloud Services



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Abstract

The adoption and benefits of cloud computing services in various government ministry/department projects can help support the government's decision-making processes in relation to a wide variety of issues by providing a more effective integrated working environment. Internally, it improves the operational efficiency of the government and, externally, it provides effective services to citizens anywhere at anytime. Its dynamic nature can maintain uniformity of services across the nation by providing better services in all e-governance projects. It allows people to access data and computer resources, and, in this digital economy, data is considered a nation's asset and fuel for the economy. Being one of the marvels of "Gandhi engineering", cloud computing can instantly collect and transmit data from multiple sources, from various sectors and various domains, including socio-economic aspects, health, sanitation, etc. The government or policy maker can convert this data into information and knowledge which can drive the government to make qualitative decisions and take action.



Keywords

cloud computing; Gandhi engineering; GI Cloud; Gol; big data; analytics and decision-making.

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1. Introduction

Information technology (IT) plays a crucial role in contemporary society¹. It has transformed the whole world into a global village with a global economy. Governments worldwide depend on the communication and analytical power of IT to manage their e-governance projects². In India, IT has played an important role in transforming society and the economy. In the 1980s, India was known as a rich country made up of poor people, with the economy being predominantly based on agriculture. The Indian economy had been stagnant for almost 200 years, while it was ruled by the British. Pre British India had the best universities and was a business hub. But today, following liberalization, the Indian economy has been transformed into a manufacturing and service-based economy, and is now the tenth largest developing economy in the world³. India's economy is increasingly integrating with the world economy to become globally competitive, thanks to scientific, technological, IT-based and IT Enabled Services (ITES) contributions towards its development. There is an existing impression that India has world-class IT. This notion derives mainly from the fact that there is an adequate supply of skilled labour, alongside the constant growth of Indian software industries, which meet the demands and expectations of the global IT industry. The emergence of the Indian IT sector has resulted in drastic changes to the Indian job market. The Business Process Outsourcing (BPO) and Knowledge Process Outsourcing (KPO) provided huge employment opportunities for youth, helped solve the unemployment problem⁴ and improved the purchasing power of the general populace. However, India is still struggling to manage its per capita income and its position on the Human Development Index⁵, and is working to remove social inequality and inequalities in various infrastructural facilities, such as housing, drinking water, education, health care, etc. in urban and rural areas.

Forty-nine years since India's independence, its citizens were commercially introduced to the Internet. In India, the telecom market is one of the oldest industries. In 1850 India got its first telegraph line. Currently, India is one of the fastest growing telecoms markets in the world. It has the world's second largest mobile market and the third largest Internet user base. The government of India (GoI) has undertaken the project of connecting the country's 250,000 Gram Panchayats (local self government in the villages) using Optical Fiber Cable (OFC) through the National Optical Fiber Network (NOFN)⁶. The national telecoms policy sets out the provision of high quality broadband access to all villages and dwellings by 2020⁷. The Right to Information Act (RTI) 2005 was one of India's most revolutionary pieces of legislation, providing citi-

¹ Cowhey P., Kleeman M. *Unlocking the Benefits of Cloud Computing for Emerging Economies: A Policy Overview*. San Diego, University of California Press, 2012, pp. 5–16.

² Lee K. R. *Impacts of Information Technology on Society in the New Century*. Zurich, 2002, pp. 1–6.

³ Economy of India. Available at: http://en.wikipedia.org/wiki/Economy_of_India (accessed: 20.08.2014)

⁴ Agarwal R., Syeedun N. *Knowledge Process Outsourcing: India's Emergence as a Global Leader*. Asian Social Science, 2009, vol. 5, no.1, pp. 82–92

⁵ Singh Sanjay K. *Information Technology in India: Present Status and Future Prospects for Economic Development*. 2006, pp. 5–14. Available at: <http://www.iitk.ac.in/directions/may2006/PRINT~SANJAY.pdf>

⁶ KPMG Report. *Creating Business Models for Inclusive Growth the National Optical Fiber Network*. 2013, pp. 1–52, KPMG

⁷ Annual Report 2012-13, Ministry of Communication and Information Technology, Government of India, New Delhi http://www.dot.gov.in/sites/default/files/Telecom%20Annual%20Report-2012-13%20%28English%29%20_For%20web%20%281%29.pdf

zens of India with access to records of the central and state governments⁸. The legislation ensured that the government implement a full-fledged computerization and administration system. This is one of the best examples of Information Communication Technology (ICT) facilitating a conscious attempt of bringing citizens to the centre stage. Citizens are perceived as customers and clients rather than beneficiaries. The government is planning to address the challenges, including power generation, water management, transportation, health care and public safety, in urban areas by prioritizing it as critical infrastructure through IT. Given India’s vast and robust telecommunications infrastructure, tremendous growth of IT, the introduction of the e-governance projects and the RTI, the GoI is considering cloud computing services as a viable option to serve its citizens and reduce the cost of infrastructure. Moreover, the GoI established cloud infrastructure and launched the first phase of the ‘GI Cloud,’ known as ‘Meghraj’⁹, shown below in figure 1.

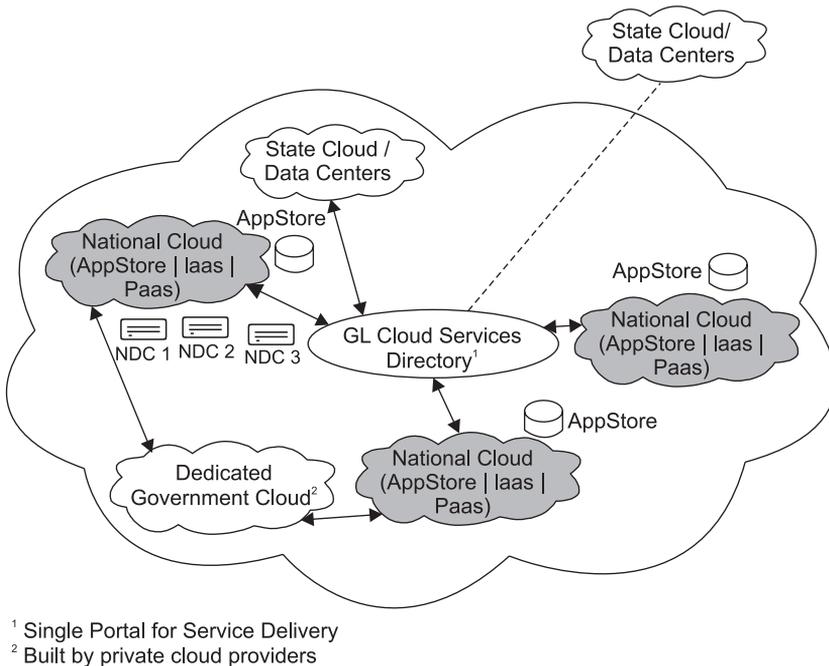


Figure 1. GI Cloud Environment

The rest of the paper is organized as follows: Section 2 introduces the challenges of e-governance projects in India; Section 3 discusses Cloud Gandhi engineering; Section 4 presents cloud computing services as a solution for e-governance; Section 5 presents the Indian government’s cloud adoption strategy for the public sector; Section 6 illustrates cloud computing in rural India; Section 7 discusses cloud computing in urban India; Section 8 explains big data, data analytics and the openness of government; Section 9 discusses the legal framework for cloud computing; and the final section concludes the work.

⁸ Right to Information Act. Available at: http://en.wikipedia.org/wiki/Right_to_Information_Act (accessed: 02.09.2014)

⁹ Government of India Cloud Initiative (Meghraj), 2011, available at: <http://deity.gov.in/content/gi-cloud-initiative-meghraj> (accessed: 14.10.2014)

2. Challenges of E-governance Projects in India

E-governance has improved the relationship between India's citizens, civil society and government. It has generally increased trust in government, reduced infrastructure cost, and eliminate corruption. In short, it provided a platform to evaluate the government.¹⁰ Some of its many advantages include enhancing efficiency, creating transparency and accountability, and providing access to services, all at a very low cost. E-governance can be the driving force behind a citizen-centric government. It reinforces innovation in public agencies and empowers people through information. However, in India, the task of delivering these benefits is poorly understood. India's problems tend to stem from important issues, such as governance and corruption. One of the solutions to these problems is to harness the potential of IT and e-governance. The presence of e-governance can provide people with the opportunity to question the government about things relevant to them, allowing transparency and accountability to be introduced. The operative word here is the government's role. It is a question of having political will. The primary flaw arises from a system which does not lend itself to being transparent. The lack of commitment and contribution from bureaucrats is the biggest obstacle to e-governance, while inefficiencies and indifferent attitudes add to further problems.

A transparent e-government initiative would expose nearly all the bureaucrats and politicians through the accountability towards the government and citizens. The e-government and other IT initiatives would act as very powerful tools to counter injustice and malpractices, which are rampant in the current bureaucracy. In government, all e-government projects are top-down, so local poor people can't utilize the technology for their development due to a number of existing obstacles. The lack of open standardization of technology, high infrastructure costs, maintenance costs and the absence of a proper process framework for e-governance affect e-governance's capacity to have an impact at village-level and prevent opportunities for resolving the problems of poverty and inequality. Currently, e-governance projects in India are run only in certain departments and do not have end-to-end integrated solutions among them. There is slow development and unsystematic improvement in the implementation and deployment processes with no reasonable timeframe in place¹¹. In its Tenth Five Year Plan, the Indian government announced its intention for India to become a 'SMART' (Simple, Moral, Accountable, Responsible and Transparent) state¹². The Indian government has already approved the policy of allocating two to three per cent of the budget to IT, yet no comprehensive central database has been put into place to provide multiplatform opportunities for dissemination and interaction with information. Some of the obstacles are the lack of encouragement from various government departments, multiple language problems, third party involvement in providing IT services to the departments and less computer security awareness with employees. There is no dedicated IT divisions in various government departments or professionals with reasonable IT skills, which must be a prerequisite for a successful implementation of an e-governance projects. Further, GoI identified 33 Mission Mode Projects (MMP)¹³ with clear measurable outcomes. Their details are shown in figure 2 below.

¹⁰ Mistry J., Jalal A. An Empirical Analysis of the Relationship between E-Government and Corruption. *International Journal of Digital Accounting Research*, 2012, no. 18, pp. 145-176.

¹¹ KPMG Report, pp. 1-52.

¹² Wright G., Sunil A., Nishant S. *Open Government Data Study: India*. New Delhi, Social Science Electronic Publishing, 2012, p. 52.

¹³ Mission Mode Projects. Available at <http://india.gov.in/e-governance/mission-mode-projects> (accessed: 08.11.2014)

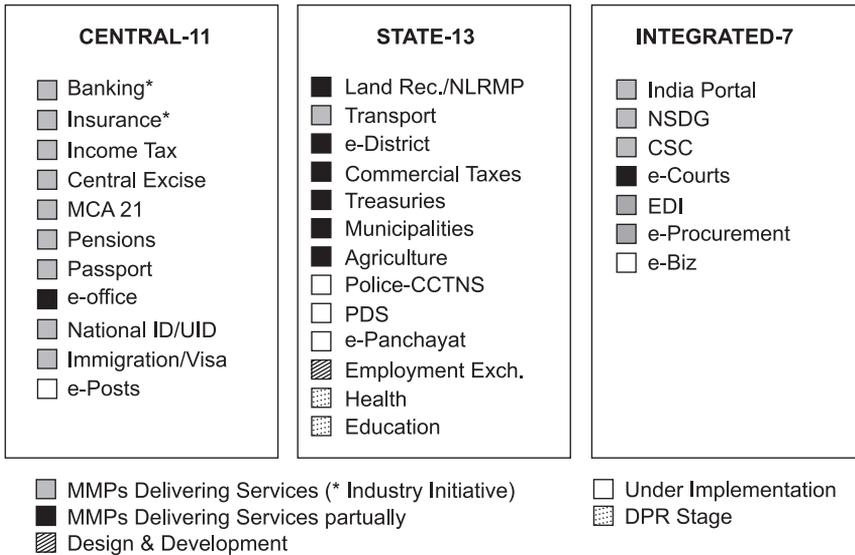


Figure 2. Status of MMPs in India

3. Cloud Gandhi Engineering

It is true that around the world the telephone took almost 70 years to reach 50 per cent of households, radio took around 28 years and the Internet took 10 years. The new technology is out-pacing the old. In the near future it may take weeks or days instead of years to adopt new technology. For instance, social media services which connects people in the virtual space such as Google plus which was launched by google it took 16 days to reach 10 million users, compared to 780 days for Twitter and 852 days for Facebook¹⁴. It took 10 years for the Internet to become a basic and essential part of daily life¹⁵. Today’s society is digitally connected, which has a direct impact on the social, economic and political aspects of the nation.

Cloud computing (CC) is considered to be the fifth generation of computing which is the underlying IT infrasrcture for all social media service. CC emerged after the mainframe, personal computer, client server computing and the web. CC is essentially a new form of distributed computing and the term ‘cloud’ generally refers to the ‘Internet’ in a broad sense but the two of them are not the same. CC allows uniting unite pools of servers, storage systems and networks into a single enormous virtual resource pool. The advantages of CC includes low start-up costs (it minimizes the deployment cost), its reliability, the fact that it’s scalable and elastic in nature, and its high operational efficiency with location independence. CC services help to reduce the huge infrastructure cost, time-consuming upgrades of software and applications, and maintenance hurdles. And it can lead to the provision of better IT services and overall economic progress of the nation. CC can be a substitute for the traditional “ownership” model of the IT system.

¹⁴ Google+ reached 10m users in 16 days. Want to know how long it took Facebook and Twitter? Availanle at: <http://thenextweb.com/google/2011/07/22/google-reached-10m-users-in-16-days-want-to-know-how-long-it-took-facebook-and-twitter/> (accessed: 28.06.2014)

¹⁵ Sabbagh K., Roman F., Bahjat E., Milind S., Sandeep G., Katz R. Maximizing Impact of Digitization. Available at: http://www.strategyand.pwc.com/media/uploads/Strategyand_Maximizing-the-Impact-of-Digitization.pdf

In its most basic terms, CC is an Internet-based service delivery model. In theory, a layman should be able to access a government service anywhere at anytime. CC can help foster a very comfortable environment for the citizen. Various e-governance cloud services may reduce the great divide between urban and rural India, and can help maintain uniformity of service across the nation. It removes the problem of interoperability with its user-friendly interface, allowing a layman access to a government service. Indirectly, CC may provide a direct, transparent and accountable service delivery system. These factors combine to make CC a marvel of Gandhi engineering (Technology). The term “Gandhi engineering” was described in a New York Times article about the world’s most affordable car, Tata Nano, as “a mantra that combines irreverence towards established ways with a scarcity mentality that spurns superfluties.” The faster, cheaper, elastic, scalable and reliable CC applications/services directly reflect the concept of Gandhi engineering.

In India, the government is observing the development and worldwide trend of CC, focusing on its widespread adoption and usage of new technologies and various features to provide a more effective integrated working environment. The modern mass digitization and explosion of digital data requires large-scale critical data storage with effective disaster recovery, workload migration and visualization, as well as the ability to offer a secure, reliable, high-performance connection. CC services appear to be the best solution to reach the country’s citizens. The GoI is further planning to introduce its own Public Sector Network, Government Cloud, and Government Application Store (App Store) to create a common, secure and flexible infrastructure for its various departments¹⁶.

According to the International Data Corporation (IDC), digital information in India will grow from 40,000 petabytes to 2.3 million petabytes over the next decade (2010-2020). This growth would be double the global rate of growth¹⁷. Presently, India still lacks an automation system for data collection, and it is unclear in what formats most of the government data is stored.¹⁸ Data collection needs a systematic and timely strategy for digitization. CC services improve the internal operational efficiency of the government, while simultaneously providing effective services to India’s citizens anywhere, anytime.

4. Cloud Computing as a Solution for E- governance

India is a country of 1.2 billion people, with 29 states, six union territories and 22 official languages.¹⁹ It is a country where caste systems, uneven distribution of resources, and gender discrimination prevail, but a belief in “unity in diversity” is fostered. Providing uniform public services to citizens on equal terms is considered to be India’s government’s biggest challenge. The GoI is continuously making an effort by launching e-governance initiatives, including projects like the Unique Identification Authority of India (UIDAI)²⁰, employment schemes under the National Rural Employment Guarantee Act (NREGA)²¹, State Wide Area Networks

¹⁶ E-Government Application Store. Available at: <http://apps.nic.in/> (accessed: 10.07.2014)

¹⁷ *Rajesh K.* Digitisation, Data Explosion will Drive Cloud Market: IDC official, 2012. Available at: <http://www.thehindubusinessline.com/industry-and-economy/info-tech/digitisation-data-explosion-will-drive-cloud-market-idc-official/article4081842.ece> (accessed: 16.09.2014)

¹⁸ *Wright G., Sunil A., Nishant S.*, op. cit., pp. 1–52.

¹⁹ *Patil M., Roopali K.* Cloud Computing Resource Management for Indian E-Governance. Computational Intelligence and Information Technology. Berlin, Springer, 2011, pp. 392–395.

²⁰ Unique Identification Authority of India (UIDAI). Available at: <http://uidai.gov.in/> (accessed: 20.12.2014)

²¹ National Rural Employment Guarantee Act 2005. Available at: <http://www.nrega.nic.in/netnrega/home.aspx> (accessed: 20.12.2014)

(SWANs)²², State Data Centers (SDCs), National Service Delivery Gateway and State Service Delivery Gateways²³. Moreover, the Department of Electronics and Information Technology (DeitY) is focusing on mobile governance and the implementation of cloud technology in the public sector, employing the GI cloud strategy and other initiatives, such as the National Knowledge Network (NKN)²⁴ and the National Optical Fiber Network (NOFN)²⁵. The initiative to provide Internet connection with speeds of 100Mbps to rural areas shows excellent progress on the government's side. This initiative allows any citizen to access a government service anywhere at anytime. CC services are device-friendly and can be accessed over mobile phones. The scalability and storage capacity of the cloud will be helpful to the ever-growing databases of e-governance projects. The big data analytic power of the cloud can help the government authorities to take decisions on the base of available real-time data for implementing various policies of the nation²⁶.

5. Indian Government Public Sector Cloud Adoption Strategy

CC has been identified as one of the important development areas in the GoI's National IT Policy. The Department of Electronics and Information Technology (DeitY) released its agenda which includes the expansion of the mobile government which will be delivering most of the public essential services to its citizens through mobile devices. The government is planning to expand mobile governance across the nation. The objectives of mobile governance include the expansion to at least 10 million transactions per month across the nation; the release of at least 75 mobile applications on the government app store; and the provision of a nation-wide mobile service delivery system and a mobile payment gateway for citizens²⁷.

The GoI aims to establish cloud infrastructure and launch the first phase of a 'GI Cloud'. Further, DeitY has revealed its plans to roll out the national cloud initiative, branding it the 'GI Cloud'. The government Cloud Initiative includes a detailed plan of the cloud strategy, cloud architecture, cloud implementation plan and roadmap. The primary aims of the government in adopting CC are to reduce costs, speed up the development and deployment of e-government applications, and to enable easy replication of successful applications²⁸. GI cloud services will be published through a single GI Cloud Services Directory or portal. It is set to become the backbone of India's national e-governance plan. In the present Indian scenario, there is an urgency to develop the rural economy and to reach 1.2 billion citizens with its uniform government service delivery system²⁹ with more accountability and transparency.

²² State Wide Area Network (SWAN). Available at: <http://deity.gov.in/content/state-wide-area-network-swan> (accessed: 20.12.2014)

²³ State Service Delivery Gateway. Available at: <http://deity.gov.in/content/introduction-ssdg> (accessed: 20.12.2014)

²⁴ National Knowledge Network (NKN). Available at: <http://www.nkn.in/> (accessed: 20.12.2014)

²⁵ National Optical Fibre Network (NOFN). Available at: <http://www.bbnl.nic.in/content/page/national-optical-fiber-networknofn.php> (accessed: 20.12.2014)

²⁶ Shreedhar K., Prasad Bhukya D., Hariom S. R&D Plan-Informatics in the Era of Big Data. Proc. of International Conference on Computing and Communication Technologies. Hyderabad, 2014, pp. 1–6, IEEE.

²⁷ Mobile Seva, <https://mobileseva.gov.in/> (accessed: 04.12.2014)

²⁸ The Indian Cloud Revolutions. Available at: <http://www.kpmg.com/IN/en/IssuesAndInsights/ThoughtLeadership/Indian-Cloud-Revolution.pdf> (accessed: 20.09.2014)

²⁹ Frost & Sullivan Report. State of Cloud Computing in the Public Sector — A Strategic Analysis of the Business Case and Overview of Initiatives across Asia Pacific. USA, Frost & Sullivan, 2011.

6. Rural India and Cloud Computing

*“India lives in its villages —
Mahatma Gandhi.”*

It is true that real India lives in its villages. Rural India constitutes about 70 percent of the country's population, with 86 percent of the rural population earning less than INR 2 per day. For 58 percent of the Indian population agriculture is the principal source of livelihood, and 61 percent of the rural population remains without bank accounts. Thirty-one percent of the rural population in India has to travel over 31 km to get necessary medical treatment³⁰. IT can play a major role in changing the social and economic status of rural India. According to the 2012 Indian Market Research Bureau (IMRB) and Internet and Mobile Association of India (IAMAI) reports, rural India has 38 million reported Internet users and 31 million active Internet users³¹. The government's various e-governance projects for rural India have showcased the role of ICT and its impact on rural development in the recent past. Several e-governance projects attempted to improve the reach, enhance the base, minimize the processing cost and time³². However, many e-governance projects were not successfully implemented for various reasons, including local language barriers, the total cost of ownership of the applications and the costs of minimum-requirement gadgets (i.e. PCs, modems, power stabilizers, printers, etc.), along with the high software license costs, high maintenance costs, the lack of trained employees, and weak back-end support for the applications. CC services have the potential to tackle the above mentioned problems through its cost effective, elastic, scalable, and location-independent characteristics.

The GoI has taken an initiative to come up with the National Fiber Optic Network with a maximum speed of 100 Mbps by investing 210 billions rupees. The government hopes that this investment will make a difference at the grassroots level. India has the ability to launch various IT services, and even an average Indian villager is able to consume various services using CC. These services are available through desktop, laptop or mobile phone access. In today's rural India, more people have mobile phones than radio sets, which makes it very convenient for them to access government services using CC. The cloud can reach around 900 millions of rural Indians, with the ability to empower them socially and financially. The cloud can provide an effective service in critical areas such as agriculture, banking, healthcare and sanitation, education, and e-Panchayath (local self government in the villages connected through e-governance). Below, we set out the benefits CC services can offer rural Indian citizens.

6.1. Education: Education is widely recognized as a powerful instrument to eradicate poverty and social inequality. The Constitution of India guarantees the right to education as one of its fundamental rights under Article 21. Still, citizens in rural India struggle to get a quality education. The rural education system faces many challenges, including poverty, low quality education in government schools, expensive private education, lack of proper infrastructure, teachers with lack of updated skill set, lack of transport facilities, lack of institutes for higher education, and limited provision for education in the local language. CC can provide access to

³⁰ WHO Report. The World Medicines Situation Global Health Trends: Global Burden of Disease and Pharmaceutical Needs. Geneva, WHO Press, 2011.

³¹ Rao R. ICT and E-Governance for Rural Development. Ahmedabad, Indian Institute of Management, 2004. Available at: <http://iimahd.ernet.in/egov/documents/ict-and-egovernance-for-rural-development.pdf>

³² Roy N.K. ICT-Enabled Rural Education in India. International Journal of Information and Education Technology, 2012, vol.2. no. 5, pp. 525–529.

quality education and skilled teachers based in urban institutions through online courses/e-learning. It can help create a better learning center environment by providing remote tutorials and training courses for teachers, made available online. The cloud can introduce a global education platform for rural students.

6.2. e-Panchayath: e-Panchayath can bridge the gap between local village populations and government authorities. The top driven e-governance projects can reach the villages directly. Through the NOFN plan, CC services can reduce the ICT cost of delivering its services without any delay and can bring transparency and accountability to the government's delivery service.

6.3. Agriculture: As the underlying infrastructure of the Common Service Centre (CSC), CC services can provide detailed updates to farmers regarding weather forecasts, crop insurance, current market prices, information about farming and seeding, government agricultural policies, agriculture loans, etc. through mobile handsets and village-level BPOs.

6.4. Banking: Cloud services can provide basic banking information and details about banking products, interest rates, micro-finance systems, loans and insurance policies, etc.

6.5. Health care and sanitation: Cloud services can help improve patient care by providing tele-medical consultations from expert urban doctors, as well as update information on vaccinations, diseases, cleanliness awareness programmes, and medicines, etc.

7. Urban India and Cloud Computing

Urban infrastructure is one of the greatest global challenges today. In fact, cities in both developing and developed countries continuously work to provide good urban infrastructure, effective transportation systems, safe and secure water networks, low-carbon energy, and efficient and scalable social infrastructure to their urban populations in order to create a smooth transition to urbanization. Massive urbanization is creating extraordinary challenges and issues for waste management and environmental pollution³³. Governments worldwide should be innovative in bringing new solutions to develop the infrastructure in this new era of urbanization.

In 2001, approximately 286 million people were living in India's urban areas. According to the Registrar General and Census Commissioner of India, India's urban population is expected to grow by 38 per cent over the next 25 years and will reach 534 million in 2026³⁴. It is estimated that India's population will grow to 1.7 billion by 2050, and that rapid urbanization will add nearly 900 million people to Indian cities. City capacity will need to grow nearly 400 per cent in less than 50 years. If we compare this urban population growth rate with currently available urban infrastructure, it becomes clear that existing infrastructure is totally inadequate to meet the growth of the urban population. It is well known that infrastructure is the basic requirement for the proper functioning of the economy. Now is the time to think about new and innovative solutions using technology. The advent of mobile connectivity, sensor systems, as well as the rising network between the government and citizens in cities, will give rise to an unprecedented amount of information regarding what people and organizations do, where and when they do it. Data collected from these sensed/measured/monitored cities comprises "big

³³ FICCI Report. Urban Infrastructure in India, 2011 Available at: http://www.ficci.com/spdocument/20122/Urban_infra.pdf

³⁴ CISCO Report. Cities in the Cloud: A Living Plan IT Introduction to Future City Technologies, 2011, available at: http://www.cisco.com/web/about/ac78/docs/Living_PlanIT_SA_Cities_iWhitepaper.pdf

data”.³⁵ Effective use of CC services can help improve the economic, social and environmental performance of urban areas³⁶. The role of ICT in urban governance and management can help convert cities to “smart cities”. Further, governments use analytics and computer power to transform data into “evidence-based decisions” for urban infrastructure. “Big data” requires uniform access with interoperable facility, significant storage capacity to preserve the data and additional computation power to process the data, as well as special processing visualizing service to analyze it in order to support decision-making. In this scenario, CC can be an excellent opportunity for the government. It can provide its on-demand services to ensure systematic information flow from data collection to analysis.³⁷ CC is, therefore, the best cyber infrastructure to manage urban infrastructure.

8. Big Data, Data Analytics and Government Openness

Over the last two decades there has been a dramatic shift regarding the notion of a citizen’s right to information. Now the right to information is considered as a right that all human beings should have access to, and ultimately government is considered as the guardian of all public information³⁸. As in other countries, the relationship between Indian citizens and government is mediated by ICT. This system introduced the concept of open government data and led to the adoption of the RTI, which provided a unique opportunity for citizens to access governmental data. This development led to an increased demand for data digitalization, with the ICT providing a digital opportunity to modernize the government and create a digital democracy. The ICT initiative the National e-Governance Plan (NeGP) and its institutional framework, shown in figure 3⁹, has been successful in providing timely service, eradicating corruption and reaching those who had previously no access, all at a much lower cost.

Data collected from social media sites, e-commerce websites, e-government online services and sensor networks comprise a significant part of data that is being stored and transmitted over the Internet using cloud infrastructure. This data is growing at an exponential rate. This huge volume of data is being turned into information, which can be utilized for both economic and social benefits of citizens, enterprises, governmental and public sector organizations. It is very challenging to manage such huge volumes of data without the “big data” framework, advanced technology and data researchers.

“Big data” refers to datasets that are too large and complex to be processed and analyzed by traditional, non-cloud, IT technologies. According to Gartner, “big data is high-volume, high-velocity and high-variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making”⁴⁰. Garner says that this high volume of data needs the best cost-effective technology. CC can process massive amounts of

³⁵ Khan Z., Ludlow D., McClatchey R., Ashiq A. An Architecture for Integrated Intelligence in Urban Management Using Cloud Computing. *Journal of Cloud Computing*, 2012, vol.1, no. 1, pp. 1–14.

³⁶ Rabari C., Storper M. The Digital Skin of Cities: Urban Theory and Research in the Age of the Sensed and Metered City, Ubiquitous Computing and Big Data. *Cambridge Journal of Regions, Economy and Society*, 2014, vol. 8, issue 1, pp. 27–42.

³⁷ News Announcement, One Year Agenda for Ministry of Communications and Information Technology, 2011. Available at: <http://www.pib.nic.in/newsite/erelease.aspx?relid=91762> (accessed: 28.07.2014)

³⁸ Puddephatt A., Zausmer R. Towards Open and Transparent Government International Experiences and Best Practice // Global Partners and Associates, 2011, pp. 1–34.

³⁹ *National E-Governance Plan*. Available at: <https://www.negp.gov.in/> (accessed: 13.06.2014)

⁴⁰ Big Data. Available at: <http://www.gartner.com/itglossary/big-data/> (accessed: 18.09.2014)

data instantly, with organizations being able to explore, report, and share their data in the cloud, being able to experience the real time analysis and boost the development of the organization with better present and future plans and decisions. David Tallan’s Venn diagram in Figure 4⁴¹ describes the three dimensions of open government.

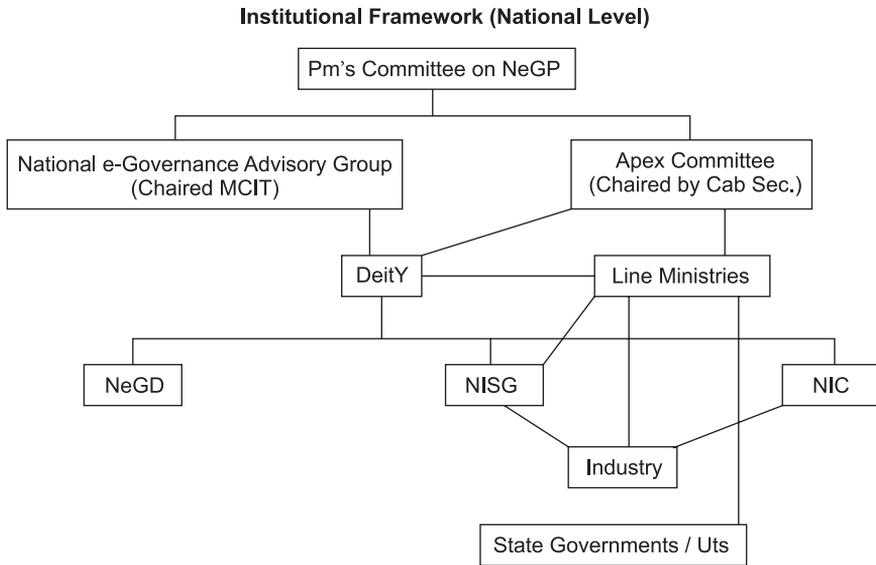


Figure 3. NeGP Institutional Framework

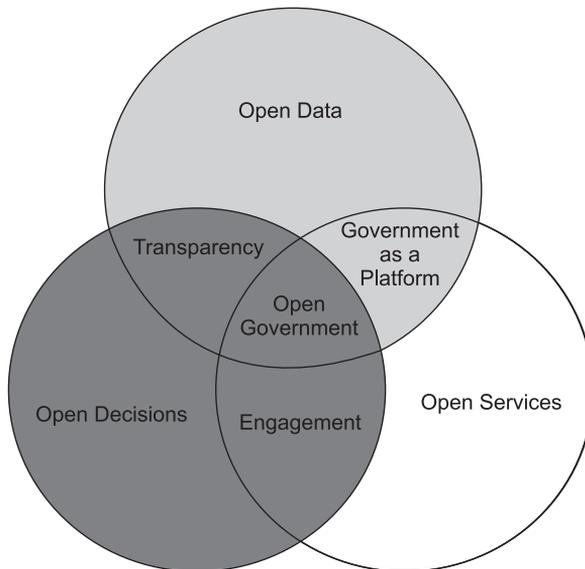


Figure 4. The Three Dimensions of Open Government

⁴¹ Three Dimensions of Open Government. Available at: <https://www.govloop.com/community/blog/three-dimensions-of-open-government> (accessed: 18.12.2014)

Below, we provide some of the traditional, as well as dynamic, benefits of using big data.

8.1. Big Data Analytics: CC can manage the dynamic nature of big data, keeping it secure while applying the correct analytical technique to use the information in the most effective way. It also has the capacity to interact with huge volumes, velocity and variety of data. With its scalable nature, it can expand the technologies that can quickly correlate data and produce actionable results.

8.2. Government's Fact-based Decision-making: The ICT is transforming governments around the world. Undoubtedly, manual data is being digitized in part due to e-governance and right to information initiatives. In India, "Aadhar" is the best example of the government's big data e-governance project. The "Aadhar" is going to provide every Indian citizen with a "unique identification number." It is set to become one of the world's largest biometric databases by the end of 2015. This is going to help the government deliver its services directly to its citizens, saving a billion dollars each year in the process. In big data, the data analysis comes from its ability to recognize patterns in a set and make predictions regarding past experiences and provide results. However, CC big data analytics⁴² can provide solutions for the government, but only if the government removes obstacles impeding its progress. It would enable policy makers to track the status of various e-governance projects, supporting high-efficiency projects and terminating or altering those with low efficiency.

9. Legal Framework for CC

Despite its benefits, CC raises a new set of legal challenges. The decentralized nature of cloud services, remote data storage systems, the use of the Internet, and distributed data storage, create potential threats to data security and data privacy. In India, the adoption of CC across various departments is still in its infancy stages; however, it is already affecting people, businesses and government transactions. In the future, the government would have to hold petabytes of critical infrastructure data in digital form, potentially making it vulnerable to cybercrime. This situation requires the updating of the legislative framework, the introduction of technology-neutral laws, and the development of an online dispute resolution system and e-courts. In India, the IT Act 2000⁴³ is the only existing legislation regulating cyber crime. On 11 April 2011, the Indian Ministry of Communication and Technology published a new set of rules implementing certain provisions of the Information Technology (Amendment) Act 2008: (a) the protection of sensitive personal data- security practices and procedures that must be followed by organizations dealing with sensitive personal data (data privacy rules); (b) due diligence for intermediaries; and (c) guidelines for cybercafes. The Personal Data Protection Bill 2006, introduced in the parliament on 8 December 2006, has now lapsed. The Cyber Security Policy 2013 provides legal assurance for the Indian government to build a secure and resilient cyberspace for citizens, businesses and government.

Conclusion

CC services, underlying e-governance infrastructure, can help bridge the gap between rural and urban India through its flexible, efficient and quality services. The GoI faces many

⁴² Russom P. Big Data Analytics // TDWI Best Practices Report, Fourth Quarter, 2011.

⁴³ Information Technology Act 2000. Available at: http://en.wikipedia.org/wiki/Information_Technology_Act_2000 (accessed: 18.01.2015)

challenges when making strategic decisions based on unstructured data, including data capture, storage and processing. This paper provides suggestions for solving India's IT challenges through the incremental adoption of cloud services. We believe that the government needs to create an effective environment to develop, retrieve and analyse big data. Secondly, the big data generated by the cloud should be used as a strategic tool for holistic decision-making for the nation's long-term plans. Thirdly, the government has to appoint a technically sound workforce since CC and big data analytics require skilful data scientists with training in data discovery, predictive modelling, open-source statistical solutions, visualization skills and business acumen to be able to frame and interpret analyses. Finally, CC and big data need a proper legal framework to protect data and critical infrastructure of cloud and individual citizen privacy. Further, the government may want to consider putting into place serious legal protections to manage the techno-legal risks of CC.



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