

Challenges of IoT based Smart-government Development

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Abstract—Smart governments are known as extensions of e-governments both built on the Internet of Things (IoT). In this paper, we classify smart governments into two types (1) new generation and (2) extended smart-government. We then put forth a framework for smart governments implementation and discuss the major challenges in its implementation showing security as the most prominent challenge in USA, mindscaping in Kuwait and investment in India.

Keywords: *Internet of Things (IoT), Internet of Everything (IoE), Smart Cities, e-Government, Government 2.0, Smart Government, User study.*

1. Introduction:

Internet of Things (IoT) has revolutionized the 21st century through its applications in smart cities. According to Gartner Inc. the market nowadays for IoT is geared towards smart cities and governments with an estimated 3.3 billion connected smart things in 2018 [8, 11]. Smart cities involve establishing sustainable technological processes for managing cities from utility control, electricity, housing, to transportation. The ultimate goal is to provide a safer, better quality of life all the while reducing costs [2, 12]. Smart city usage of IoT is expected to climb to 9.7 billion by 2020, in comparison to its 1.1 billion investment in 2015 according to Gartner report [4].

Smart-governments are though to be the next generation of e-governments [9, 15]. Despite its infancy, smart-government initiatives have been made in Dubai, Australia, Singapore and Moldova with promising results [10, 5]. These governments involve innovative operations, communications and technological infrastructures across multiple

domains to provide sustainability and serve the needs of the public [4]. By realizing the numerous benefits, governments across the world have started allocating budgets worth billions towards moving from e-government to smart-government [5].

In this paper we argue that smart governments are not a direct extension of e-governments by and propose a state-of-the-art framework for smart governments that illustrate the various players, relationships, processes used and challenges. We conclude with an analysis of a survey highlighting the challenges with implementations in USA, Kuwait, and India.

2. Overview of Smart-Governments:

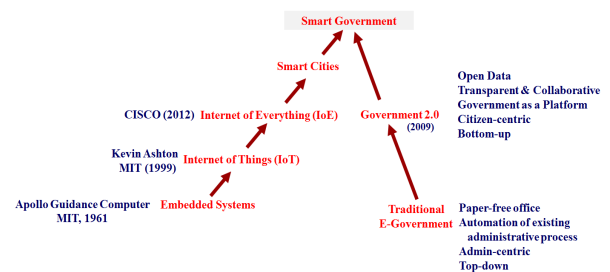


Figure 1: Smart-government:

The evolution of technology towards smart-government is shown in Figure 1. Since the birth of embedded system at MIT the evolution of technology has resulted in all smart cities that are all built on IoT enabled networks.

Traditional e-governments are considered the automation of administrative processes towards

paper-free offices, data maintenance, information retrieval, inter-departmental communication, and work-flow automation. It is normally closed, non-transparent, and admin-centric. Government 2.0 on the other hand provides the public with open and transparent data (right for information), is praised for being community-engaged, decentralized or federated, and citizen-centric [8, 9, 15].

3. Smart-government vs. e-government

Smart-government is a technological union of e-government and smart cities. As shown in Figure 2 we identify two types of smart-government. The first type is called an “extension – smart government” which refers to an extension of traditional e-government. This is the technological union of traditional e-government and smart cities drawing on the prime benefits of both but still admin-centric and not transparent. The second type is “next generation – smart government” which is a combination of Government 2.0 and smart cities [9, 15]. This government is the ideal type many countries aspire to establish. It involves the public in all its affairs, open and transparent.

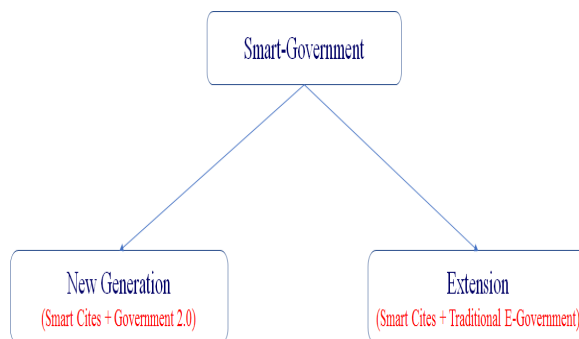


Figure 2: Two types of smart-government

3.1 Smart-Government case study

India is a good example that portrays the difference between the two types of smart-governments shown in Figure 2. India was ruled by Congress Party lead by Dr Manmohan Singh between 2004 and 2014. Since 2014 India has been lead by BJP Party Mr. Narendra Modi. In the first period Dr. Singh government was promoting traditional e-government. To implement of traditional e-government, Dr Singh’s government launched an

Aadhar Project that issued much-needed unique identity cards to all 1.2 billion Indian citizens. Prior to this ensuring official identity cards per citizen has no succeeded. During implementation, Dr Singh’s government noticed unprecedented resistance from the public for some time, including the opposition parties. When the current president Mr. Modi took office, his government was keen in promoting a smart-government. He called it “small-governance and smart-governance”. As a first step, his government launched a smart city project in June 2015. While e-government initiatives of Dr. Singh’s government noticed resistance, smart-government initiatives by Mr. Modi’s government were supported and welcomes whole-heartedly by the Indian people.

To understand why perceptions changed in such a short period we start with listing the objectives of both types of government e-government and smart-government. The basic objective of traditional e-government is the automation of the existing administrative processes. It is a top-down process that is a non-transparent, closed system, which benefits administrators more than the citizens. This caused an annoyance on the whole with little tangible benefits for the average citizen. However, the objective of smart-government is to provide respectful, open and sophisticated lifestyle for citizens and their governments [8, 9, 15]. The process is bottom-up and driven by the people consequently offering more benefits to the citizens than to the government administrators. Hence in India, citizens were more interested in its application than the administrators.

4. IoT-based Smart-Governments and framework

In this research smart-government are considered “new-generation smart-government”. The focus will be on the challenges in the implementation of smart-governments that integrate Government 2.0 and IoT-based smart cities. In doing so we propose a framework for smart-governments that illustrates the various phases and challenges involved.

4.1. Previous works

There have been several models and frameworks proposed for IoT [10], IoE [12], smart cities [1, 3] and smart-government [3]. Fernandez-Anez [3] provides a smart city framework that consists of 5 phases: Concept & Design, Financing, Implementation, Management and Transferability. These phases provide the framework that lays the foundation for governance and implementation of smart cities. Strohbach et al [14] designs an analytical framework for Internet of Things and Smart City that stressed on integrated big data as a fundamental aspect of modern technological systems. Anthopoulos [1] provided an elaborate literature survey on different models and frameworks for ICT based smart cities. Anthopoulos stated that “Researchers, practitioners, businessmen, and policy makers consider smart city from different perspectives and most of them agree on a model that measures urban economy, mobility, environment, living, people, and governance” [1].

4.2. A novel framework for IoT-based Smart-Governments

With the wealth of research available on smart-cities, a need for suitable smart-government frameworks is becoming more evident. Based on previous works we present an innovative framework for IoT-based smart-government as shown in Figure 3. The framework shows the actors and activities involved in implementations using a two-layer paradigm.

4.2.1. Inner-layer phases of smart-government:

Landscaping is the first stage in preparation for smart-government implementation and usually amounts to one-third of the whole project. Smart-landscaping deals with the creating brand new underlying utility networks like electricity and water, to include IoT systems.

Smart-networks involve the upgrade to 5G networks and the establishment of a four-layer lattice: sensors, networks, platform and applications [10]. This core element of smart-government is the IoT foundation and most susceptible to security attacks.

Smart-process is the government administrative process built on top off smart-networks. One of the important decisions made before system-process

implementation is whether the target smart-government is an extension of existing e-government or settle with it being a new generation of e-government.

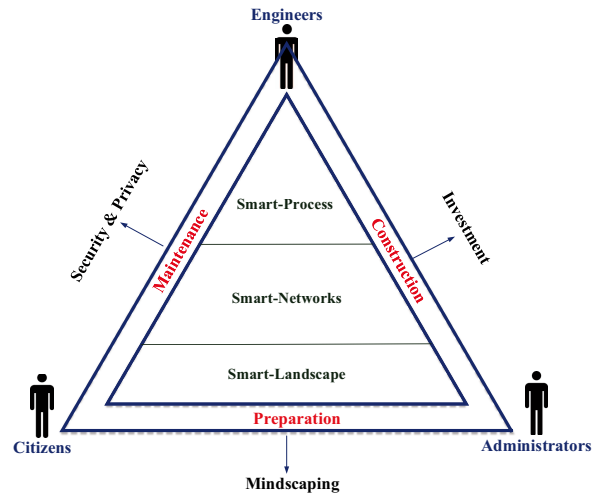


Figure 3: A Framework of smart-government

4.2.2. Outer-layer phases of smart-government:

The first outer-layer phases is preparation which includes initiation, mindset, analysis, concept, priorities, planning, budgeting and design [3, 13, 16]. It starts with deciding whether the smart-government being implemented is flat or hierarchical, open or closed, centralized or decentralized [16]. The next step involves changing the mindset of citizens and administrators to accept smart-government. This kind of preparation is carried out by seminars, brain-storm meetings, workshops, and training. Administrators play a role in convincing citizens to accept the upcoming changes and citizens have a role to press on administrators to implement the needed changes.

The construction phase begins with smart-landscape, smart-networks and lastly the development of smart-process. This is called the implementation phase of smart-government. During the maintenance phase, the infrastructure is repeatedly monitored and managed.

5. Challenges of implementing IoT-based smart governments:

Amongst the charms of Internet of Things (IoT), is its ability to transform e-governments to smart governments, and assist in making governments more transparent and responsive to peoples needs. This task comes with many challenges that delay the progress of smart-government implementation. Fernandez-Anez et al. proposed a list of 27 challenges across multiple dimensions relevant to implementing smart-cities such as: Mindscaping, Construction and Maintenance [3]. In this section we discuss three IoT-based smart governments challenges of primary concern due to their contribution to overall implementation success or failure: Mindscaping, Investment and Security and Privacy. These challenges accentuate the outer-layer phase of the smart-government framework proposed earlier in Figure 3.

5.1. Mindscaping

Asking a government to adopt a new infrastructure is not easy. The first step to migration from e-government to smart-government is eliciting the approval of the government and the people. We define Mindscaping as the process of convincing an entity to accept a change. Since smart-governments are open, transparent, collaborative, community-engaged, and citizen-centric in nature, convincing the people is a minor concern. The major concern is however changing the mindset of the government.

There are many governments that remain hierarchical and centralized. In the Middle East for example, deploying a smart-government would be highly desired by the people for a sophisticated life style, but this would require opening tightly closed and rigid administrative systems. The Mindscaping process involved here is the most prominent challenge.

5.2 Investment

In recent years, more and more governments have moved towards e-governance despite the unpredictability of the world economy. To be able to progress from e-government to smart-government existing technological resources need to be upgraded to make way for up-to-date IoT systems. Telecommunication networks are a substantial part of any government. These include porting all existing networks to 5G networks, latest sensors,

sizable storage to deal with Big Data, power supplies and much more.

5.3 Security and Privacy

One of the biggest challenges in smart-government implementations is security and privacy. Large IoT networks in smart-governments are at grave risk of security attacks. In October 2016 IoT devices such as digital cameras and DVR players controlled by multiple Mirai botnets were responsible for large, malicious, distributed denial of service (DDoS) attacks on Oracle Dyn systems. This was the largest attack of its kind requiring multiple hours of mitigation efforts until all attacks subsided [6]. An attack of this magnitude if launched effectively could immobilize a government within a few minutes causing harm to the country as a whole.

Overcoming privacy vulnerabilities and existing challenges posed by IoT are necessary for safe implementation of smart-governments. Overall corporate and individuals consumers of IoT devices alike should be tech savvy and evaluate the devices often for vulnerabilities. It is also imperative that regulations involving IoT are set by Internet Service Providers.

6. Smart-government survey and discussion:

To accentuate the state of the challenges posed by smart-government implementation we developed a survey that was distributed to an audience involved in IoT research, government and technology in three countries: USA, India and Kuwait.

6.1 The survey and procedure:

The survey included a description of the three outer layer phases of smart governments: preparation, construction and maintenance, as well as elaborate descriptions of the three challenges of implementing smart government: mindscaping, investment, and security and privacy. The question posed is “Please indicate the impact of the challenges which USA/India/Kuwait faces in the implementation of smart-governments”. The table given includes a scale of low, medium, and high for each of the challenges. The survey administrator explained the purpose the content of the survey verbally to recruited participants.

6.2 Results:

Figure 4 shows the main challenges identified per country from the study. The analysis of the results per country are shown in Figure 5.

The USA surveys were distributed to 75 participants. The analysis shows that all three challenges were relevant with security and privacy being the main challenge. The USA infrastructure is the most advanced out of the three countries. It's government is open and investments are available, leaving the threat of hacking IoT systems a big concern.

Over 470 surveys were successfully collected from India. The analysis shows that Investment is a main challenge facing India. With over 1.3 billion citizens and a developing mixed economy, developing the infrastructure from the ground up will come with high costs.

In Kuwait the surveys were distributed to 60 people. The analysis revealed a prolific response highlighting 'Mindscaping' as the main challenge facing the Kuwaiti government today. This is a not a surprising response as Kuwait has recently ventured on its first smart city project in South Saad Al-Abdullah city, which covers 50 square kilometers of land.

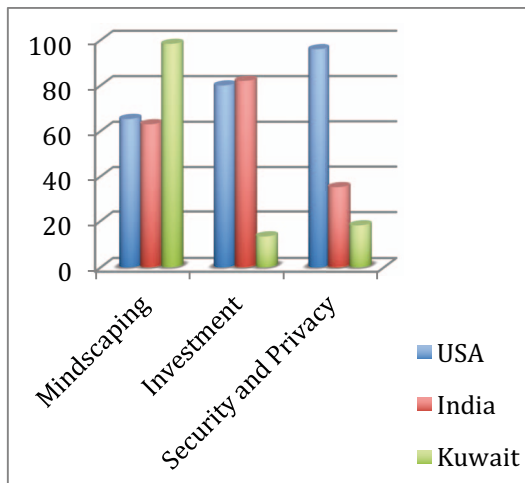


Figure 5: Outcomes of survey highlighting the challenges in three countries.

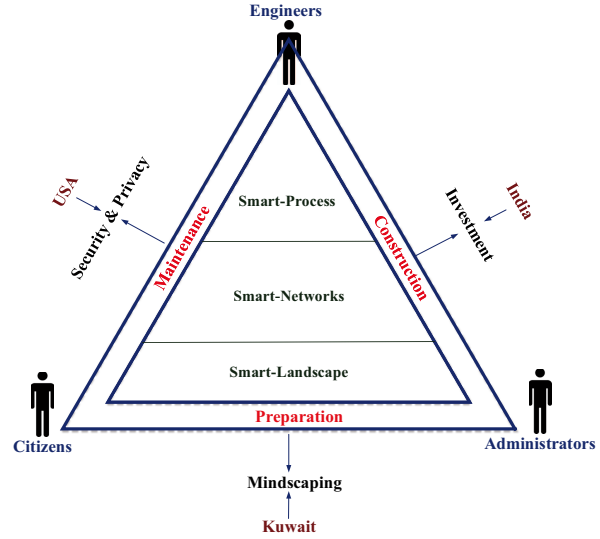


Figure 4: A Framework of smart-government with the main challenges per country identified

7. Conclusion and future work

Smart cities enable increased intelligence of security, transport, and utility, whilst smart governments aim to converge numerous cities and systems to offer a single layer communication channel that result in an open, transparent and citizen-oriented entity. In this paper we have introduced a new categorization of smart-government. The proposed smart-government framework emphasizes the challenges facing governments prior and the results of the use-study identify the major challenges in smart-government development showing *Mindscaping* as the biggest challenge for Kuwait, *Investment* as the biggest challenge for India and *Security & Privacy* as the biggest challenge facing the United States. For future work a structured survey is needed targeting government and private organizations to understand mindset and how to overcome it. In addition, this paper targeted only three of the many challenges that hinder implementation [3]. An investigation into understanding all challenges is necessary to obtain a complete picture of smart-government implementation.

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