Egyptian Computer Science Journal (ISSN-1110-2586)
Volume 41– Issue 2, May 2017

MASA Architecture Development for Smart Government Non-functional Requirements

Nevine M. Labib and Ahmed E. Sabry
Computer and Information Systems Department, Faculty of Management Sciences,
Sadat Academy for Management Sciences, Cairo, Egypt
Tel. (+2012)3521145, Fax.(+202)23782324
E-mail: nevmakram@gmail.com , aesmat@hotmail.com

Abstract

The research paper aims at proposing a framework for architecture design which addresses smart government non-functional requirements (NFR). In order to achieve this, the strategies, trends, standards, technologies, and guidelines related to smart government are explored. In addition, modern architectures including MASA, event-driven, service-oriented, and enterprise architecture are discussed in detail. Success stories of selected countries that applied relevant practices are studied from architectural view. Finally, the proposed framework is developed through using the architectural best practices and novel added intelligence tier. It is composed of seven main tiers and is applying the MASA architecture in order to have a smart government national services' architecture. It also utilizes and applies all the basic concepts of cloud computing, agile development, SOA, reusable API's, and EDA.

Keywords: *Non-functional requirements (NFR), Smart Government Services (SGS), Service Oriented Architecture (SOA), Mesh App and Service Architecture (MASA), Data Mining (DM)*

1. Introduction

A smart vision aims at achieving citizens' happiness through providing efficient and enhanced services. As for smart government strategy, it is mainly based on people since it is not only about using latest technologies but rather about developing a framework that contributes to productive and innovative citizens. Smart government approach is mainly based on providing efficient systems and processes, consolidated information systems, and communication networks. All of these systems should make use of new technologies such as cloud computing, big data, mobile apps, and integrated voice and data networks [1]. The study discusses non-functional requirements (NFR) for smart government architectures, highlights different technologies used, explores various strategies and architectures and studies standards and guidelines. All of these aspects are studied in order to address drawbacks of currently-used architectures and use a recent architecture, namely Mesh App and Service Architecture (MASA), so as to work on NFR of smart government.

1.1 Problem Definition

In many countries, governments have implemented e-government measures and some of them started smart government initiatives. All these trials aim at providing e-services to citizens that result in citizen satisfaction. However, governments are faced by many challenges, such as fragmentation and coordination challenges, whereby the lack of standards and integration lead to problems related to work duplication and interoperability, Agility challenges since government should be able to comply with new trends such as mobile and cloud technologies, and cost challenges that may be solved by sharing common business processes [2].

Hence, implementing e-government and smart government might be faced by the previously-mentioned challenges. However, many of these challenges may be avoided by adapting the suitable architecture.

The study tackles the following problems in an attempt to solve them using a proposed architecture:

1.1.1. Lack of Integration and Information Sharing among Governmental Bodies.

One of the main problems faced by governments is the lack of integration among the different governmental bodies in addition to the difficulty of information sharing that eventually affect the coordination between e-government entities.

1.1.2. Lack of Unified Standards and the Overlap Among Service Providers.

Since there is a lack of standards, the citizens may get different answers, which eventually may lead to inconsistency. This is due to the lack of both a common database and a communication network for all governmental agencies, so as to allow proper data and information exchange.

1.2 Research Objectives

Based on the previously discussed problems, the research paper has as a main objective to develop a MASA-architecture for smart government NFR. As for the detailed objectives, they are as follows:

1. To define a set of NFR for smart government architecture, and
2. To propose a framework claim to address non-functional requirements.

1.3 Research Originality

The importance of the paper lies in developing a robust architecture, for non-functional requirements, that enables consistency and multi-dimensional analysis. It makes use of a recent architecture, MASA in order to address NFR of smart government, and adds the intelligent layer to the architecture.

2. Smart Government

This section discusses smart government in detail, in terms of trends, technologies, architectures and services.

2.1 Concept of Smart Government

E-Government initially aimed at improving the relationship between government and citizens, by providing efficient and accountable web services [3] to citizens, businesses and other governmental entities.

As for Smart government, it is regarded as 'the implementation of a set of business processes and underlying information technology capabilities that enable information to flow seamlessly across government agencies and programs to become intuitive in providing high-quality citizen services across all government programs and activity domains' [4]. Hence, it includes innovative policies, business models and related technologies [1].

Therefore, interoperability, which is "the ability of systems and machines to exchange, process and correctly interpret information", is an important factor for providing open data, and flexible services. It will eventually contribute in better use of resources and better delivery of services [4].

Accordingly, it is found out that the main factor that led to the transformation from e-government to smart government is open data that enable consolidated information systems and communication networks. Following are some technology trends that characterize smart government.

2.2 Strategic Technology Trends for Smart Government

A strategic technology trend may be defined as "one with substantial disruptive potential that is just beginning to break out of an emerging state into broader impact and use or which are rapidly growing trends with a high degree of volatility reaching tipping points over the next five years" [5]. Following are some of these technology trends:

2.2.1 Technologies that Deal with Intelligence and Data Science

- Artificial Intelligence and Advanced Machine Learning: Artificial Intelligence (AI) and machine learning disciplines aim at embedding intelligent characteristics such as, learning and adaptability, into machines (robots and autonomous vehicles), as well as, apps and services (virtual personal assistants) in order to make them act intelligently.

- Intelligent Apps: Intelligent systems aim at performing the functions of a human assistant, whether generic or specialized, in order to facilitate tasks and as in the case of VCAs (Virtual Customer Assistants). It is expected that nearly all of the applications will make use of AI in a certain way.

- Intelligent Things: It is expected that intelligent things, or things that make us of AI and machine learning in order to 'behave' in an intelligent way, will have a new collaborative model [5].

2.2.2 Technologies that Deal with Digital World

- Virtual and Augmented Reality: Both virtual reality (VR) and augmented reality (AR) can provide relevant applications and services to citizens, especially if combined with IoT.
- Digital Twin: A digital twin may be defined as "a dynamic software model of a physical thing or system that relies on sensor data to understand its state, respond to changes, improve operations and add value". Organizations may benefit from digital twins in various tasks related to product development and planning.

- Blockchain and Distributed Ledgers: Blockchain is regarded as "a type of distributed ledger, where value exchange transactions are grouped into a chain of blocks" [5]. Hence, blockchain and distributed ledgers may be utilized in different types of services.

2.2.3 Technologies That Deal With Platforms And Services Needed To Deliver The Intelligent Digital Mesh

- Conversational Systems: Nowadays, the digital mesh includes an expanding set of endpoints used to access applications and information, or interact with people, social communities, governments, and businesses. As for the device mesh, it includes multiple devices to incorporate the full range of endpoints with which humans might interact. It is expected to provide cooperative interaction between devices that will eventually lead to a new digital experience.

- Mesh App and Service Architecture (MASA): MASA architecture links different apps such as mobile apps, web apps, desktop apps and Internet of Things (IoT) apps to a broad mesh of back-end services so as to create what users view as an "application." It is said that "it encapsulates services and exposes APIs at multiple levels and across organizational boundaries balancing the demand for agility and scalability of services with composition and reuse of services". It also allows users to have an optimized solution for targeted endpoints in the digital mesh such as desktop, smart phone, and automobile.

- Digital Technology Platforms: These platforms provide the basic building blocks for a digital business. Gartner has identified the five major focal points to enable the new capabilities and business models of digital business, which are namely, information systems, customer experience, analytics and intelligence, the IoT, and business ecosystems. It is concluded that every organization will have some mix of these five digital technology platforms.

- Adaptive Security Architecture: The previously discussed architectures and platforms will lead to enhanced security technologies that will secure Internet of Things (IoT) platforms, since it needs monitoring for both users and entity behavior.

2.3 Success Stories

In this section, success stories of some governments who have applied smart government are discussed.

2.3.1 Dubai

The vision of Dubai is to "'make Dubai the happiest city on Earth" and its mission is to "world-class smart services and infrastructure to create happiness". It is mainly based on six key pillars, namely, people, society, experience, place, economy, and government. The most important of these pillars is 'people' since they are the main focus of smart government. As for the society, it is considered an extension of citizens.

Accordingly, Smart Dubai or the city-wide initiative to achieve its vision, makes use of Smart Dubai Government Establishment (also known as Smart Dubai Gov or SDG) as a technology arm. SDG has different tasks related to smart transformation process such as, the strategy; processes budgets and legislation. SDG started to work on smart city solutions in 2000 as part of e-Government in Dubai. This has been changed to Smart Government in 2013. Other changes include new laws issued in 2015, and a rebranding in 2016. All of these changes should lead into transforming Dubai into 'the world's smartest and happiest city" [6].

2.3.2 India

India is one of the countries that aim at achieving competitiveness in the global economy through providing e-government services as part of its strategy. As for applying Smart Government in India, it is the responsibility of the National Institute for Smart Government (NISG) which is a non-profit company established in 2002 by the Government of India and The National Association of Software and Services Companies (NASSCOM), which is a trade association of Indian Information Technology and Business Process Outsourcing industry that was established in 1988. NASSCOM is a non-profit organization [7]. NISG aims at enhancing web services provided in India through a public-private relationship.

2.3.3 United Kingdom.

UK is currently adopting a vision for its transformation strategy 2017-2020 that aims to "transform the relationship between citizens and the state - putting more power in the hands of citizens and being more responsive to their needs."[9]. The strategy focuses on five main blocks, which are, delivering enhanced digital services, developing people' skills and competencies, improving processes, using data for transformation and developing shared platforms and standards [8].

3. Technological Issues for Smart Government

In order to implement smart government initiatives, IT professionals, in the governmental entities, should consider ways to adopt the following strategic technologies efficiently.

3.1 Personal Use of Devices in the Workplace

Government IT organizations are trying to put regulations to control the usage of personal information and applications. However, it is obvious that employees make use of owned

devices in the workplace in different ways. This usage should be used for the benefit of Smart Government.

3.2 Usage of Mobile and Social Software

New technologies related to mobiles and social software present an opportunity for government to deliver services to citizens using these technologies. Nevertheless, there are many factors that influence providing the services on mobiles, such as frequency, recurrence and urgency of use [5].

3.3 Big Data and Actionable Information

Big data present a challenge for government IT companies because they cannot determine which data should be integrated. Hence, governments are trying to find suitable ways in order to be able to benefit from big data, and analyze it to extract actionable information.

3.4 Dealing with Open Data

Governments are concerned with both open data and public data while consumers focus more on open data, provided by governments and businesses. These data need to be tackled using new technologies in order to develop new services and processes based on it.

3.5 Data Operated by Citizens

Citizen data may be stored in a way to provide more freedom by accessing other data outside the government transaction and by providing control over when and how data can be accessed. Although this is very important since it provides more freedom in providing control of privacy rights and integration between government services, it requires a way to deal with interoperability, availability, reliability and security issues.

3.6 Cloud Computing

Many governments have shifted from to public cloud so as to reduce costs and provide speedy procurement and deployment. Moreover, vendors like Microsoft and Google have changed email service in a number of agencies from public to government clouds.

3.7 Internet of Things (IoT)

IoT may be used to help governments increase public safety and quality of life. Therefore, smart city are trying to consider processing data issued from various devices such as video cameras and parking sensors.

3.8 Data Interoperability

Smart government makes use of data obtained from both external and internal sources for planning business operations in order to get interoperable information. In addition, it needs to work on standardization through their enterprise architectures. Therefore, government architectures should take into consideration the interoperability issue.

3.9 Using Business Process Management (BPM) for Case Management

BPM may be used to deal with both decision-centric and investigative cases. They both rely on information whether semi-structured or unstructured information. Choice of BPM is based on workflow and data type.

3.10 Using Gamification for Citizens' Motivation

Since humans enjoy games, gamification may be used to motivate citizens engage employees, which should have a positive impact on the usage of governmental services. In order to embed games in governmental systems, there are some factors to be considered such as target audience behavior in addition to ways to assess their motivation and engagement.

All of the previously explored are technological issues to be considered when dealing with smart government, models. One of these models developed by the Innovation group at FreeBalance [9], consists of five layers: smart characteristics that aim at measuring the level of smartness of policies and processes, smart goals: such as financial goals and environmental sustainability goals, smart solutions to achieve goals such improving services through digitization, technology platform linking and integrating technology with previously defined goals, and technology: that aim at achieving citizen engagement and motivation. These technologies are summarized in SMACT, which is Social, Mobile, Analytics, Cloud and the Internet of Things, in addition to gamification, which influence citizen behavior.

The previous model emphasizes the fact that a smart government is not only achieved by applying new technologies but rather by embedding all of these technologies into the political, economic, social and cultural aspects [10].

4.Web Services for Smart Government

4.1 Web Services Versus Electronic Services

The internet enables software exchange among different and distant software providers and consumers, hence providing web services. A web service, as defined by the World Wide Web Consortium, is "a software system designed to support interoperable machine-to machine interaction over a network" [11].

Therefore, web services are not the same as web-enabled electronic services or e-services although both types of services are available on the web. However, an electronic service has a user interface while a web service has a programmatic interface. In addition, electronic services are not necessarily developed using web service technologies and can be used by anyone while web services require programmers [11]. Finally, the main focus of web services is to integrate different systems such as resource planning and customer management. In the following section, two types of web services are discussed in detail.

4.2 Operations-Based Web Services

They are concerned with the operations provided for clients; the parameters operations receive and return; and the ports used for communication [11].

4.3 Resource-Based Web Services

Resource-based services, also called REST Services are web services that deal with applications and make use of both Representational State Transfer (REST) architecture and web specifications. REST is "an architecture style for designing distributed applications, which uses the set of well-known HTTP operations GET, PUT, POST, and DELETE to change the state of remote resources" [11]. It aims at making use of simple protocols like HTTP to deal with resources. This type of communication is called stateless, hence REST services are called "stateless" too [11]. REST architecture focuses on the behavior of web applications in terms of users' navigation through links.

4.4 Cloud Services

Cloud services may be defined as "Web services provide a technological infrastructure that enables organizations to outsource computing resources as a service to support their business operations, including data storage, hardware, servers, and networking". They make use of cloud computing technology in order to provide ubiquitous access to shared resources [11].

4.4 Service Engineering

Service engineering may be defined as "an approach to the analysis, design, implementation, and testing of service-based ecosystems in which organizations and IT provide value for others in the form of services"[11]. It provides methodologies concerned with dealing with the service development and deployment. However, it faces many challenges related to the management of services in terms of modeling, validation, and verification.

5. Architectures of Smart Government

Enterprise Architecture may be defined as "the inherent design and management approach essential for organizational coherence leading to alignment, agility and assurance" [12]. It focuses mainly on the planning and implementation of efficient and effective transformation initiatives so as to improve quality of services and overall performance of the organization's activities.

EA consists of a hierarchy of architectural domains, including business architecture that which focuses on the required business processes and outcomes for achieving business strategies, data / information architecture, which focuses on making the information aligned with the organization's needs, application architecture, which focuses on the system's structure and used technology, and technical architecture, which focusess on the IT environment.

Therefore, EA is considered to be an effective tool used for governments in order to improve both interoperability among governmental entities and services provided to citizens.

Following are several architectures used for e-government:

5.1 Zachman Enterprise Architecture Framework (ZEAF).

This architecture may be considered the first EA framework introduced and has been widely adopted by the architecture community and is incorporated into other architectural

frameworks. It is mainly concerned with EA analysis and modeling, as well as perspectives of constructing an information system. It determines the information and data, function and process, location of hardware and software, people in terms of allocation of work and authority, timing requirements of business process and motivation [2].
However, it has a drawback, which is not defining any architecting process of system development. Therefore, a new version, 'Zachman ontology', was released in 2011, and added new features, such as cell integration lines, in order to overcome the drawbacks.

5.2. Federal Enterprise Architecture Framework (FEAF).

FEAF was basically developed in order deal with sharing information among federal agencies and other governmental entities [2]. It is based on five reference models[2], namely Performance Reference Model (PRM) aiming at measuring the performance of IT investments in order to explore improvement opportunities, Business Reference Model (BRM), that focuses on the functions of the business operations, Service Component Reference Model (SRM), focusing on reusing applications, components and business services, Data Reference Model (DRM), which deals with different types of exchanges between entities, hence focusing on standards, and Technical Reference Model (TRM), which focuses on standards for service delivery.

5.3 The Open Group Architecture Framework (TOGAF).

TOGAF is defined as" an architectural framework which provides a comprehensive approach for designing, planning, implementation, and governance of enterprise information architecture" [new reference]. TOGAF deals with EA in terms of business processes, applications design, data organization and hardware and software infrastructure. It makes use of Architecture Development Method (ADM) that includes several phases dealing with different aspects and ArchiMate, an enterprise modeling language that supports enterprise architects [2].

5.4 Treasury Enterprise Architecture Framework (TEAF).

TEAF, based on the Zachman Framework, focuses mainly on the business processes development so as to cope with the technology changes [new reference]. It relies on four architectural views, namely functional, information, organizational, and infrastructure, from four perspectives, which are planner, owner, designer, and builder [new ref]. Hence, it represents Enterprise Life Cycle (ELC) that focuses on the enterprise management and decision-making approach, such as investment decisions, in order to accomplish its goals.

5.5 Service-Oriented Architecture (SOA).

This architecture focuses on services for application development; it deals with both software clients, regarded as service consumers and software providers regarded as service providers.

As for service-oriented computing, it is based on composition and decomposition of existing services. It was found out that some small functions are used many times in business applications. Therefore, it is better to handle these functions separately by keeping them in a service repository and making use of these services based on the application need. Hence, it focuses on developing applications by means of composition of stored services [12].

SOA may be also used for decomposing applications into small services, in case of a little interaction between the components and keeping into consideration the functionality of the service and the coherence within the components.

Accordingly, SOA has contributed to developing applications and adapting existing ones to a certain business environment in a rapid manner. These advantages made several companies keen to apply this architecture, regardless of the applied standards and technologies since this architecture is independent from any standard [12].

5.6 Mesh App and Service Architecture (MASA)

This architecture is “the extreme evolution of a SOA based on API exposed at multiple levels and across organizations, and on the capability of advanced analysis of the massive volumes of data streams originated by IOT and mobile” [13]. In the mesh app and service architecture (MASA), mobile apps, web apps, desktop apps and IoT apps link to a broad mesh of back-end services to create what users view as an "application“. MASA makes use of various technologies such as Cloud computing, Agile, Service Oriented Architecture (SOA), Software Componentized (API’s), and Event Driven Architecture (EDA).

As for microservice architecture, it deals with distributed applications based on agile development, whether they are on-premises or in the cloud. In addition, mobile computing and IoT makes it possible to create a comprehensive model to address back-end cloud scalability and front-end device mesh experiences. These architectures will provide a way to deliver agile, flexible and dynamic cloud-based applications, which makes it a perfect choice for building MASA services.

The device mesh, used in MASA, may be regarded as the expanding set of endpoints that people use for accessing applications and information or to interact with people, social communities, governments or businesses. It includes several devices such as mobiles, electronic or environmental [13].

One of the applications of MASA is the evaluation in the mobile traffic app using road sensors, weather applications and GIS mapping. It also enables best use of the devices in range.

6. Non-Functional Requirements for Smart Government

Functional requirements consist of services the system should provide and what the system should not do.
They could vary from one group of users to the other and from one domain to the other. There can be multiple applications and multiple modules within an application to cater to various usage scenarios. As for non-functional requirements, they define system properties and constraints such as reliability, response time and storage requirements, and although they are logical, they are sometimes implicit and need to be clearly defined. Non-functional requirements may be more critical than functional requirements because if they are not met, the system may be useless.

In the case of smart government, NFRs are considered a very important factor for its success. Examples of NFR are customizability, cloud-ready architecture, scalability and security. Other important NFRs may be notification such as for email, event-based schedulers, auditing for services and usage levels, and logging and exception management.
Developers deal with NFR using different approaches. They should be handled at the architectural and framework level. An efficient solution would be constructing a strong foundation stack or framework (NFR Stack or Engineering Stack) and maintaining it independently so that developers can focus on building domain specific functionalities [14]. The NFR stack / framework should be loosely coupled with the functionality layer.

In this section relevant NFR are explored then an evaluation of the existing architectures is made from NFR's point of view, since these requirements play an important role in the development of e-government initiatives.

6.1 Interoperability

It is one of the most important NFR for e-government since it focuses on proper exchange of services. E-government interoperability has three dimensions, Organizational interoperability which focuses on the coordination and alignment of business processes and information architectures for collaboration, semantic interoperability concerned with efficient information processing, and technical interoperability that deals with technical aspects and standards to achieve information exchange.

6.2 Agility

This NFR deals mainly with managing the process of change management in order to accommodate various changes of the environment. This need has become crucial as it assures the proper operation of enterprises in current environments. TEAF was able to deal with this requirement by applying an iterative enterprise life cycle that deals with changes. This was achieved by means of adding new aspects for business processes, technology, and capabilities [2].

6.3 Integration

This NFR deals with linking all of the components so as to assure proper functioning of the subsystems. It focuses on consistency and alignment with the enterprise scope and goals.

6.4 Reusability

It discusses the possibility of making use of various components in more than one system, so as to reduce time and cost required to development of new components. It assures better quality since the reused component have been already tested and debugged.

6.5 Evaluation of Architectures from NFR Perspective

A recent study [2] has performed an evaluation of current architectures, namely ZEAF, TOGAFF, FEAF, and TEAF from the previously discussed NFR. It was found out that these architectures either do not support or support partially these NFR. The results are based on survey and experience in the domain. The following table, table 1, shows this comparison.

Table 1.Architectures' Evaluation According To Non-Functional Requirements [2]

Criteria	ZEAF	TOGAF	FEAF	TEAF
Organizational Interoperability	1	2	2	1
Semantic Interoperability	1	1	1	1
Technical Interoperability	0	1	2	1
Agility	0	2	1	2
Integration	1	1	2	1
Reusability	0	1	2	1
Score	3	8	10	7

0: Does not support, 1: Partially Support, 2: Support Explicitly

Based on the previous evaluation, it is obvious that there is need to develop a new architecture that deals with the studied weaknesses and copes with the new trends such as mobile technology and cloud computing.

After discussing the different architectures form NFR perspective, it is found out that there is a need for a new architecture that makes use of recent trends such as MASA, in order to deal with the drawbacks of the actual architectures by adding new layers, hence new features.

7. Description of the Proposed Framework

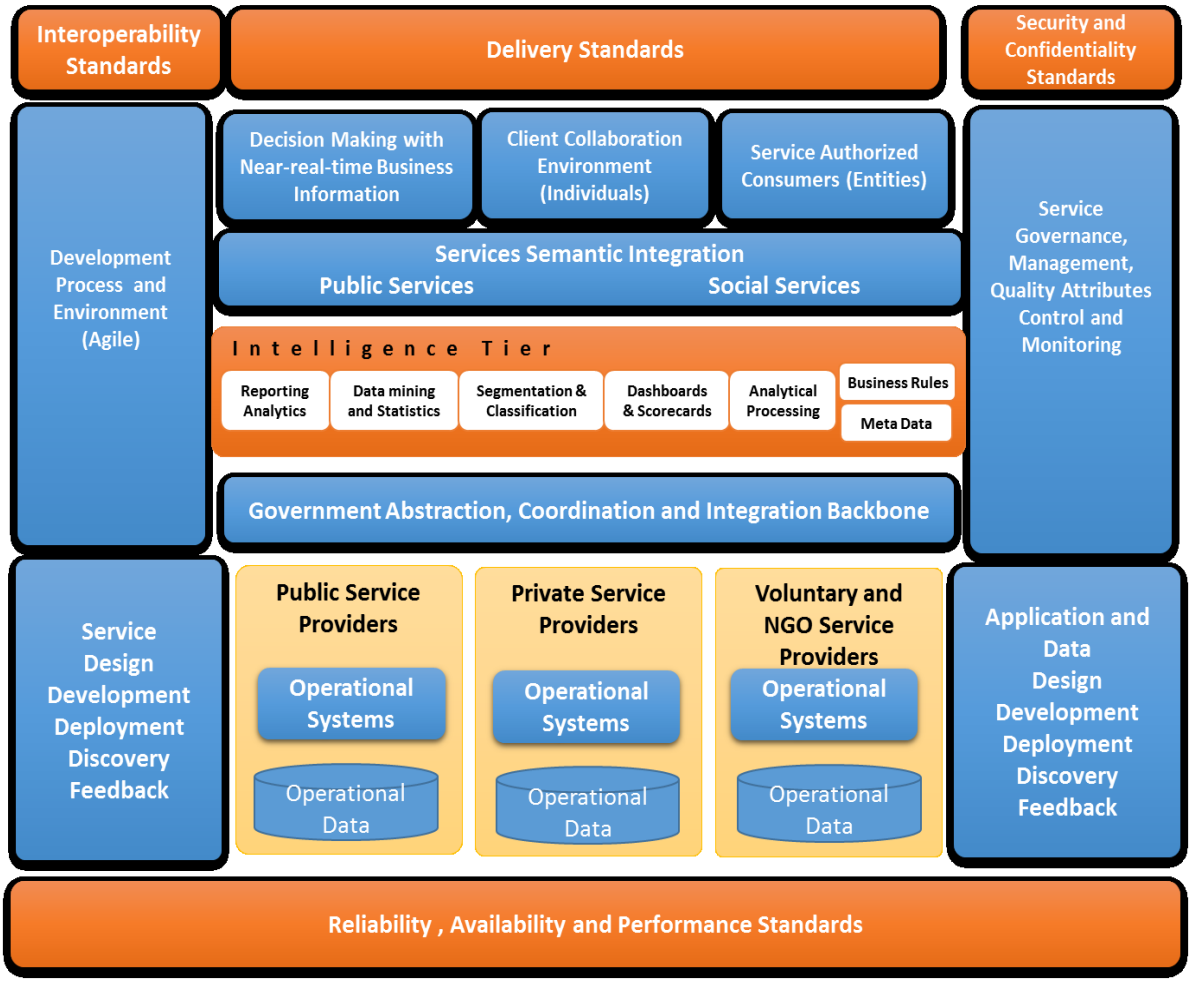

Fig. 1 Proposed Smart Government Architecture

The proposed framework is composed of seven main tiers and is applying the MASA architecture in order to have a smart government national services' architecture. It also utilizes and applies all the basic concepts of cloud computing, agile development, SOA, reusable API's, and EDA. Following is the description of each of the seven tiers.

The first tier deals with consolidating the delivery of all services, means that it shall be used to deliver a service to a citizen or customer whether it interfaces with a human, a system, or a thing.

The second tier represents the current and targeted applications that are considered as the present status of the applied government level SOA orchestrated services and intelligence conducted over the orchestrated services. This tier aims to provide government services' stakeholders such as individuals, entities, as business or public agencies, and decision makers with the appropriate level of visibility, collaboration, and visualizations.

The third tier is concerned with service semantic integration including public and social services that can be integrated semantically regardless of the service structure, whether it is structured, semi-structured, or unstructured.

The fourth tier, which represents the most important contribution of the research, is concerned with providing intelligence capabilities within SOA-based context including statistical, artificial intelligence, data mining, and other intelligence capabilities added to the government services.

The fifth tier is the government national integration service hub or backbone that should utilize all discussed SOA concepts.

The sixth tier illustrates all the existing applications and services components that are in operation.

As for the seventh tier, it is concerned with all data sources that can be extracted, prioritized then transformed into a unified national data model that covers public, private and voluntary services and applications data.

8. Discussion and Conclusion

The paper discussed NFR for smart government and architectures currently used. It proposed a framework based on addressing common NFR requirements that have been mandated by reviewed SOA and e-Government standards, in addition to exploring new trends in the field. It mitigates most of addressed issues and obstacles faced within previously-constructed architectures.

In addition, it addressed the well-defined problem of having an architecture framework that satisfies a set of non-functional requirements towards smart government implementation. The reviewed recent literature combined with technical experience and architectural design techniques were conducted to conclude the best suitable architecture proposal. As revealed, MASA-based architecture is mandated for satisfying currently-faced e-government challenges in addition to the intelligence requirements that have been introduced and employed through a multi-tiered architecture layers.

It employs MASA novel architectural aspects including Agility, Service Orientation, Cloud Enablement, API componentization, and event-driven design. In addition, the proposed framework addresses the alignment issue with government strategies including technology strategic objectives and trends.

9. Future Work

The future studies can be characterized into the following main points:

- A more concrete design for implementation shall be developed, and implemented through proof of concept plan.
- Establishing technology architecture including technological decisions for implementing such proposed architecture.
- Conducting deeper research regarding applying DevOps within the MASA architecture's development and operations environments.
- Applying data mining within intelligence layer to empower Smart Government Services.

References:

[1]. A. Harsh and N. Ichalkaranje, "Transforming e-Government to Smart Government: A South Australian Perspective," Intelligent Computing, Communication and Devices, Advances in Intelligent Systems and Computing, Springer India, L.C. Jain et al. (eds.), Vol. 308, 2015, DOI 10.1007/978-81-322-2012-1_2.

[2]. M. A. Mohamed; Galal Hassan Galal-Edeen; H. A. Hassan; and E. E. Hasanien, "An Evaluation Of Enterprise Architecture Frameworks For E-Government", IEEE Explorer.ieee.org, 2012.
[3].T. Rubel, Vice president of IDC Government Insights, "Smart Government: Creating More Effective Information and Services" research, 2012.
[4].The European Commission, "The European e-Government Action Plan 2011-2015, Harnessing ICT to Promote Smart, Sustainable & Innovative Government," Brussels, 15 December 2010, 743.
[5]. Gartner, "The Top 10 Strategic Technology Trends for 2017", 2017. Retrieved on May 2, 2017, from web link: http://www.gartner.com/newsroom/id/3482617.
[6]. Smart Dubai Government Establishment, "About Smart Dubai Government". Retrieved on May 7, 2017, from web link: www.dubai.ae/en/AboutDubaieGovernment/Pages/default.aspx,.
[7].Gehlot, "IT An Effective Tool of Administration", The times of India, September 9, 2010. Retrieved on May 8, 2017, from web link: http://timesofindia.indiatimes.com/city/jaipur/IT-an-edffective-tool-of-administration-Gehlot-/articleshow/6521619.cms.
[8] IDC Community, "The UK Government Transformation Strategy 2017". Retrieved on February 6, 2017, from web link: https://idccommunity.com/government/smart_government/the_uk_government_transformation_strategy_2017_2020_what_the_future.
[9]. FreeBalance, "What Is The Smart in Smart Government?". Retrieved on November 29, 2016, from web link: http://freebalance.com/open-government/what-is-the-smart-in-smart-government-2/,
[10]. H. Maya, "Smart Government Strategies To Drive Measurable Success". Retrieved on March 23, 2017, from web link: www.digitalistmag.com/.../smart-government-strategies-drive-measurable-success-049,.
[11]. J. Cardoso, and H. F. Karlsruhe, "Fundamentals of Service Systems", Service Science: Research and Innovations in the Service Economy, Springer International Publishing Switzerland, 2015, DOI 10.1007/978-3-319-23195-2_2.
[12]. P Saha, **"**Enterprise Architecture as Platform for Connected Government," 2010**,** NUS Institute of Systems Science, unpan1.un.org/intradoc/groups/public/documents/unpan/unpan041801.pdf.
[13] "Mesh App and Service Architecture", Central and Eastern European Software Engineering Conference in Russia CEE-SECR 2016, Moscow, October 28-29 (30) 2016. Rretrieved from secr.ru/lang/en/program/program-overview/mesh-app-and-service-architecture.
[14]. R. S. Ramkumar, "Non Functional Requirements of Government SaaS". Retrieved on April 21, 2017, from web link: https://cloudbestpractices.files.wordpress.com/2012/07/non-functional-requirements-of-a-government-saas-3.docx .