Adopting SOA in public service provision

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Abstract. Ensuring accessibility of utility and social services is one of the public obligations of governments. Today, nations make use of the notion of e-government to expose such services to citizens. In line with this, many public organizations in Ethiopia are automating their workflows, and the Ministry of Communication and Information Technology (MCIT) is attempting to unify certain services as part of its e-government initiative. However, the architectural patterns in use generally lack the required flexibility, and scalability for future expansion needs and business models with respect to the option that latest technologies such as SOA can offer. Literature shows that the loosely-coupled nature of SOA addresses the above-mentioned limitations and many e-government initiatives are exploiting its potential. Thus, it is apparent that SOA can address the e-government needs in Ethiopia too. In this paper, we conducted an SOA e-readiness assessment against the available e-readiness frameworks and found out that the infrastructural, legal, government, customer, and human resource requirements are met. Thus, we recommend that SOA be applied to incrementally and loosely integrate the existing (and upcoming) systems and realize "ubiquitous" public service provision.

Keywords: E-Readiness; SOA; E-Government; Ubiquity; Incremental; Software Integration.

1 Introduction

Literature shows that that ICT plays important role to socio economic wellbeing of nations [4, 5]. Thus, the Federal Democratic Republic of Ethiopian (FDRE) launched ambitious initiatives by establishing national ICT Development Agency in 2003 with proclamation no. 360/2003 which was later upgraded into a ministry level, namely, MCIT in the year 2010 with proclamation no.691/2010. Hence, the use of Service-Oriented Architecture (SOA) for "ubiquitous" public service provision could be dealt as part of such initiatives.

The SOA is an emerging computing paradigm since the past few years. Research such as in [1, 2, 3] witnesses that there is a rapid progress in SOA adoption which represents a paradigm shift following the mainstream object-oriented approach.

According to [1], this paradigm shift is changing the way we develop and use software and hardware; and the central themes of conferences, journals, books, research, experimentation, tools, and products. Principles such as the SOA, service-oriented enterprise, and web services and the associated protocols and standards have emerged and solid foundation of SOA is grounded.

Khanbabaei *et al.* [2] describes SOA as an evolutionary distributed computing paradigm based on request /response for synchronous and asynchronous applications (see Fig. 1). This implies that SOA can be applied in situations where legacy systems require upgrading with more functionality and/or when different chunks of legacy systems require integrating with each other.

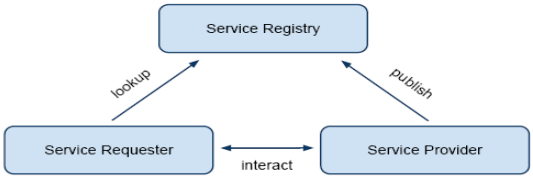

Fig. 1. SOA Components and Interactions

IT managers, business managers, designers and implementers of systems have different perspectives on SOA. As discussed by Michael Bell [3], IT managers perceive SOA as a style of architecture that includes patterns and rules which culminate in the development of characteristics like modularity, loose coupling, and reuse; business managers perceive it as a set of services that organizations wish to provide for their clients or partners; and developers perceive it as a style of programming which uses unanimously agreed and technology-independent standards and supports the intractability between software elements regardless of their platform and implementation technology.

SOA is a set of software engineering principles and methodologies used for the development of well-defined business functionalities called services that are interoperable. These set of software engineering principles include reliability, standardized service contract, loose coupling, hiding of internal implementation, service compose-ability, service autonomy/statelessness, discoverability and possessing virtual framework [2] which is a huge promise to facilitate seamless integration between stakeholder systems.

Governments and the public sector organizations around the world, on the other hand, are facing challenges to reform their public service organizations and deliver more efficient and cost effective services, as well as to provide better information and knowledge to their stakeholders. To this end, many governments [4, 5, 6] are attempting to exploit the potential of e-governance. For example, the AgriNet, WoredaNet, SchoolNet, RevenueNet, and EthERNet are among the ICT initiatives launched in Ethiopia [6] aiming at implementing the e-government.

E-governance is defined as the support for digital interrelationships between government and the stakeholders - citizens, businesses, employees, and other governments [7]. It is the use of ICT such as the Internet, local area networks, wide area networks, mobiles, etc., by governments to improve effectiveness, efficiency, and service delivery to citizens and promote transparency through seamless interaction of the stakeholders. E-governance is thus at the heart of the interoperability characteristic of SOA.

Literature such as [7] indicates that SOA is being implemented to foster the interoperability requirements of e-government initiatives by creating automated and seamlessly integrated systems. However, there is no evidence that the existing hardware infrastructure in Ethiopia [6] is being utilized enough to deploy automated software systems and content, nor is on the utilization of SOA for "ubiquitous" public service provision such as payment of utility bills, taxes, and contributions; social security; and health insurance.

In addition, citizen-centric organizations like the "kebelle", microfinance centers, *etc* lack to provide "one-stop" or "no-stop" collective public services except that some utility service providing organizations just started a unified billing for telecom, electric, and water supply bills to be paid in certain payment centers; and the Ethiopian radio and television agency has attempted to (manually) delegate microfinance centers to collect payments of bills for television broadcasting services.

However, the issue of public service provision is critical when we consider the large number of service categories, and the possibility of involving private customer service centers as part of the notion of public-private partnership. For example, with payment alone, we can see categories such as pension tax, sales tax, value added tax, land use tax, water bill, electric bill, telecom bill, television bill, and government house rent bill and linking all these to the banking system. On the other hand, a service provider may need to outsource or delegate some of its services to two or more independent customer service centers which in turn work for multiple service providing organizations with certain service-level agreements (SLA). Such e-government integration needs require high level system's flexibility (join or leave centers as needed) and scalability that SOA implementation can easily address [2].

In this research work, we investigate the e-readiness level in Ethiopia for the implementation of SOA principles and practices to integrate software systems of government agencies and corporations thereby enabling "ubiquitous" public service provision. We also put forward a set of recommendations in this regard.

This paper is organized as follows. In the next section, the research methodology used is discussed. The subsequent section discusses related work on the application of SOA principles for e-governance and is followed by a discussion section on SOA based e-governance readiness. The last section concludes the paper by recommending SOA principles, methodologies and web service technologies to be applied to incrementally integrate the existing (and upcoming) systems thereby realizing "ubiquitous" public service provision.

2 RESEARCH METHODOLOGY

As mentioned in the introductory section, the objective of this research work is to investigate the e-readiness for the application of SOA principles and technologies to implement "ubiquitous" public service provision in Ethiopia. Thus, we adopt the methodology proposed by Dzhusupova *et al.* [20] which directly maps into our research context, and the current status in Ethiopia is analyzed against this framework.

Based on the framework [20], we conducted a review of related work focusing on the implementation of SOA based e-government systems and analyzed government policy documents, strategic documents, regulations, annual reports, and experts' views on issues related to the deployment of IT and telecom infrastructure, citizens' grievances on governments' service provision, and government's commitment. In addition, IT and telecom experts in the MCIT were consulted to reflect on the issue.

The current state of affairs of the IT and telecom infrastructure is explored by assessing the different islands of automated systems owned by the different government owned service providers in the Ethiopian governance system; the servers and local area networks of the respective owners; the extent of connectivity into the Internet and or national communication backbone; and the level of automation of the business processes in the citizen-centric organizations.

3 RELATED WORK

The aim of e-government is to allow seamless interaction between governments and citizens (G2C), governments and business enterprises (G2B), and inter-agency relationships (G2G). Through e-government these interaction scenarios can be made friendlier, convenient, more transparent, and less expensive with the goals of providing better services to citizens, leverage transparency and accountability, empower people through information, improve efficiency within governments, and improve the interface with businesses and industry [22]. Figure 2 depicts the components of the e-government framework and their interaction.

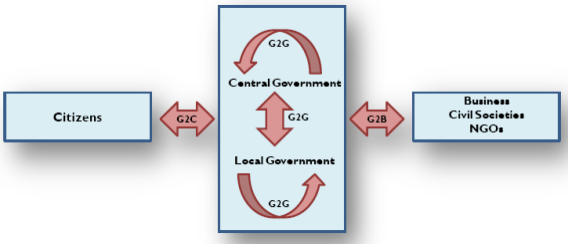

Fig. 2. E-Government Project Framework

Researchers in [10] indicate that successful implementation of e-government has actually improved the efficiency, accountability and transparency of government processes, and achieved better public service delivery, accountability, and cost reduction thereby better empowerment of citizens.

An e-government implementation project life cycle requires core activities such as survey, training, development of services and infrastructure, dissemination (or deployment), and continued support based on research [21]. Figure 3 describes the constituents and interactions of these core activities.

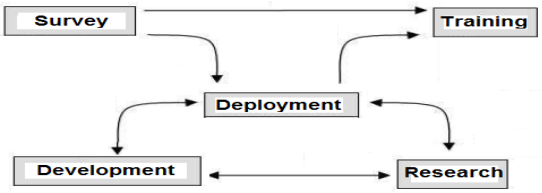

Fig. 3. E-Government Project Framework

The success of an e-government implementation is measured according to a phased model of adoption. Gartner [13] describes these phases as providing information, interaction, transaction, and transformation services to citizens. Each successive stage represents an increased capability to provide information and services (added value) and the cost and public demand forces the government to move from the previous step to next.

At earlier stages of the e-government adoption, citizens can have access only to government information through one way communication but at later stages they can have two way communications with government bodies thereby leading to integrated services provision [12]. These stages are not dependent on each other nor need one phase be completed before another can begin [12]. Instead one can simply jump into a desired stage by deploying the necessary resource to do so. Literature [14] shows that e-government initiatives are being challenged by multi-dimensionality and complexity issues. Some of the main challenges are related to IT and telecom infrastructure, computer literacy, legislation support, education and training level of users, change management, partnership, strategic thinking, and leadership support.

The problem of providing “ubiquitous” public service provision fits somewhere between the transaction and transformation phases in which complete transactions can be done without going to an office and citizens can get services at one counter using integrated information systems respectively [13]. Although developing countries in general are supposed to be at the early stages of e-government development [15], Ethiopia has aggressively launched considerable e-government development initiatives over the past few years [6]. However, to the best of the knowledge of the authors, there is no work like this, in Ethiopia, that attempts to explore the possibility of implementing SOA based “ubiquitous” public service provision.

In addition, many e-government initiatives in developing countries are reported to fail mainly because of the diving of project leaders into such risky business of introducing "big thing" from scratch where there is no sufficient understanding of the socio cultural setting of the deployment environment [17]. Moreover, today's business requirement is changing dynamically. To this end, some e-government models [12] incorporate additional phases to move from access to integrated services into dynamically adopting demand driven services across enterprises.

Behara *et al.* [19] explain that SOA enables different government units to reuse existing assets, reduce the dependency of the backend applications, and promote collaboration of citizens and government departments irrespective of delivery models. Accordingly, the implementation of "ubiquitous" public service provision can adopt the evolutionary software development methods and SOA principles to reduce the risk of software project failure in terms of quality, budget, and time [16] through demand-driven, scalable and interoperable characteristics of SOA.

However, the evolutional adoption of SOA based e-government does not happen straightforwardly. Instead, major factors such as IT/telecom infrastructure readiness, stakeholders' awareness level, economical viability, and political commitment [15] must be explored. Thus, in the next section, we provide analysis on e-readiness in Ethiopia with respect to the attributes of e-readiness framework [20].

4 READINESS

This research utilizes government policy documents, strategic documents, regulations, and annual reports gathered from the utility service providing organizations and government authorities as primary sources of information. These documents are analyzed as per the requirements of the e-government readiness framework [20] and with a focus on the enabling environments, e-government demand, e-government capabilities, stakeholders' technology possession, and perceptions and challenges pillars.

Thus, the infrastructural, trained manpower, government, and customer attributes (see table 1 below) are considered and interpreted in terms of the affinity of government organizations and citizens towards "ubiquitous" public service provision and the availability of the necessary IT infrastructure.

All the organizations that are affiliated with the provision of utility and social services are government owned and they provide services such as telecom, water, electric, services related to immigration and nationality; and collection of taxes, and collection of contributions.

In addition, government authorities that are responsible to the IT infrastructure expansion and quality citizen-services (good governance) are included. Thus, the government, citizen, infrastructural and human e-readiness [20] in Ethiopia for the realization of SOA based public service system is described as below.

4.1 Infrastructural readiness

The reports from the MCIT, and Ethio Telecom (see table 1) indicated that the Internet penetration index in Ethiopia is improving. Thus, many public and private organizations, and individuals are able to subscribe wired as well as wireless broadband Internet connection; and infrastructural development initiatives such as the AgriNet, SchoolNet, WeredaNet, RevenueNet and EthERNet has contributed to the overall accessibility.

The development of national computer network expansion master plan has also leveraged 19 FDRE offices to be hooked into the national network backbone in the first round. According to the reports, step by step, all FDRE offices will be part of the network. In addition, government authorities and government owned service providing organizations like the Ethiopian Electric Power Authority (EEPCO), Addis Ababa Water and Sewerage Authority (EWSA), Ethiopian Immigration and Nationality Affairs, Ethiopian Revenues and Customs Authority (ERCA) and Ethio Telecom have deployed their own automated systems and all have access to the broadband Internet.

Thus, it can be generalized that the availability of IT/telecom infrastructure with respect to the expectation of SOA based implementation of "ubiquitous" public service provision systems is met.

4.2 Government's readiness

The readiness of the FDRE government for the implementation of SOA based system for "ubiquitous" public service provision is twofold. On the one hand, MCIT took the initiative to launch an automation project for the provision of unified billing service in one window [11]; on the other hand, government owned service providing organizations have implemented customer service improvement initiatives and also planned to further enhancing customer satisfaction.

In addition, the government is deploying the necessary financial resource for the implementation of e-government projects. For example, thus far government has financed the unified billing system project to establish 41 such technologically equipped and interconnected service centers each having 3-11 service windows.
Moreover, MCIT has the plan to scaled-up to all areas by adding more services including registration for student matriculation, and placement of students in universities. The report indicates that there is a plan to establish "government cloud".

Table 1. Categorizing primary data sources per the e-readiness criteria [20]

E-readiness criteria	Category	Organization	Remark on the content of organization's plan (or report) with respect to the e-readiness criteria
Government			
	Strategic plan 2010 - 2015	MCIT	Ambitious IT/telecom infrastructure expansion plan, and backed by legal support.
	Strategic plan 2010 - 2015	Ethiopian Water & Sewerage	Goals, indicators, and initiatives are set for enhancing customer satisfaction
	Strategic plan 2010 - 2015	Ethiopian Electric Power Authority	Enhancing customer satisfaction on services delivery
	Strategic plan 2010 - 2015	Immigration & Nationality Authority	Extending immigration services to localities
	Strategic plan 2010 - 2015	Revenue & Customs	Enhancing customer satisfaction on tax collection
Citizens			
	Annual report 2011/12	Ethiopian Electric Power Authority	All reports of these organizations illustrate that accessibility of their services (including payment) is one of their organizational weaknesses and they pledge to capitalize on their resources to address the issue.
	Annual report 2011/12	Ethiopian Water & Sewerage	
	Annual report 2011/12	Immigration & Nationality	
	Annual report 2011/12	Ethio Telecom	
	Annual report 2011/12	Revenue & Customs	
Infrastructure			
	Annual report 2011/12	Ethio Telecom	Internet penetration index getting enhanced
	Annual report 2011/12	MCIT	Describes an ever increasing infrastructure and e-government expansion activities and outputs
Human resource			
	Annual report 2011/12	Ministry of Education	Statistical data on the availability of trained manpower in the area of IT.

Thus, it is possible to assert that the government's readiness for the implementation of SOA based "ubiquitous" public service provision systems is achieved.

4.3 Citizens' readiness

We attempt to portray the citizens' readiness using the customer grievances that the government owned service providing organizations came across. Accordingly, Ethiopian Electric Power Authority, Ethiopian Water & Sewerage, Immigration & Nationality Affairs, Ethio Telecom, and Revenue & Customs Authority in their annual reports (see table 1) indicated that they have acute limitations on accessibility as compared to

the demand of customers. Thus, we can clearly see that the citizens' readiness attribute for the implementation of SOA based "ubiquitous" public service provision systems is met.

4.4 Human resource readiness

In the academic year 2010/11, over 7000 students were enrolled in the areas of ICT such as Computer Science, and Information Technology in government owned universities alone in Ethiopia. Moreover, the trend continued with improvement [18]. Adding the number of enrollments in (and graduations from) graduate schools, and private colleges; it seems to outweigh the demand. Thus, the e-readiness from human resource requirements perspective is met.

Table 2. Summary of conformity with the required e-readiness criteria [20]

Readiness criteria	What is required?	What is available?	Remark
Government			
	Government's readiness (commitment) to satisfy citizens	Strategic level concern	Eg. Strategy is set, finance & manpower deployed, etc for e-government expansion
Citizens			
	Citizens' aspiration for ubiquitous public service systems	Acute demand	Eg. Customers appreciate small service improvements, express aspirations, etc
Infrastructure			
	Islands of automated systems, and Internet connectivity possibilities	The required minimum is available	Eg. Wired and wireless broadband Internet subscription, corporate databases, etc
Human resource			
	Trained manpower to deploy, maintain & use	Sufficiently available	Eg. Many graduates in IT related fields, end-users working on legacy systems, etc

In general, the current status in Ethiopia according to the four e-readiness criteria (as used in this study) are found to be that the government's readiness is at a level of strategic concern, citizens have acute demand, and the minimal required human resource and infrastructure is sufficiently available (see table 2).

In addition, once the legacy systems of the above listed organizations are integrated, new automated systems (possibly SOA based) can be incrementally integrated using the SOA techniques with flexibility and scalability thereby minimizing project risks.

5 CONCLUSION

In this research, our review of literature indicated that the minimal e-readiness criteria for the implementation of SOA based "ubiquitous" e-government systems for public service provision is determined by the commitment of the government and citizens, and availability of IT infrastructure and trained manpower. We applied these e-readiness framework attributes as pillars in our e-readiness evaluation criteria for the implementation of SOA based "ubiquitous" public service provision system.

The current e-readiness status in Ethiopia for the selected service providing organizations demonstrates that citizens are in acute need of "ubiquitous" public services and this is a strategic level concern of the government as well. In addition, the minimal required legal support, trained manpower, and infrastructure are available and the SOA technologies will leverage the flexibility and scaling to seamlessly incorporate more service providers into such a system.

Considering the above mentioned findings, we put forward the following conclusion. The SOA principles, methodologies, and Web service technologies can be successfully implemented in Ethiopia. The existing (and upcoming) software systems of the government service providers would loosely and incrementally integrate their services thereby realizing an integrated automated system for "ubiquitous" public service provision.

Our future work will be on the economic feasibility of addressing detailed functional and non-functional requirements of domain specific SOA based applications. We will focus on specific service providers and with respect to certain software development methodologies and technologies; and the legacy systems.

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