# Integrated Public Service Delivery in Agile e-Government System through Service Oriented Enterprise Model in the Context of India

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**Abstract.** The efficient public administration becomes a universal phenomenon in developed and developing countries. It aims better, faster, convenient, and cost-effective services to citizens, business, and employees. The revolution of ICT with the citizens changing demands enforced e-Government (EG) researchers and practitioners for developing new skills, competencies, capabilities, and knowledge to respond to changes in its service delivery environment. This requirement rooted to achieve an agile EG system (EGS). Since the business environment of enterprises is undergoing rapid changes, researchers are trying to find an appropriate approach toward the creation of an enterprise agility to cope with this vicissitudes. Transforming the traditional enterprise model to Service-Oriented Enterprise Architecture (SOEA) is one of the best state-of-the-art solutions for an organization to get agile. It is the evolution of Enterprise Architecture style and it integrate the business and IT logic to create an agile enterprise system. This research adopted this philosophy and applied in the EGS. The researcher proposed a Service-Oriented e-Government Enterprise Architecture to achieve agile EG system in view of Indian context. Government of India has taken various EG initiatives with high importance given to citizen-centric service delivery, but they are islands of attempts in the absence of interoperability. The proposed approach is capable to solve the interoperability and integration issues of EGS and is illustrated using a public service provided by Government of India.

**Keywords.** E-Government Development in India, Interoperability and Integration, Agile e-Government System, Service Oriented e-Government Enterprise Architecture, SCA, DSM.

## 1. Introduction

The e-Government (EG) is defined as the application of electronic means in transactional exchanges of government services and information between government, employee, citizen, and business [25]. The focal aspire of EG is to offers better, faster, convenient, and cost-effective services to citizens, business, and employees in a single window [3]. This necessitates the EG become a seamless government or matured EG. It is evolving through four different maturity stages emergence, interactive, transactional, and then connected or integrated. I.e., it is a transformation from disseminate the digitized

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information of each government agencies to the integration these information silos. The final stage requires Integration (INT) of governmental departments across the country and it is apparent with the EG Interoperability (EGIOP). The entities of EG System (EGS) work together and share information for the business motive of citizen-centered service delivery. Accordingly, the citizenry act as service consumers and multiple government agencies are the service providers [16]. The national portal is acting as a platform for provision and accession of public services [25]. Hence, EG is an enterprise and its logical structure is the EG Enterprise Architecture (EA) [21][24]. Universally, many countries have viewed EA as a solution for EGIOP [2][12][21].

The revolution of ICT with the citizens changing demands enforced EG to develop new capabilities to respond to the changes in its service delivery environment. Universally it is a big challenge for governmental organizations to keep abreast with citizens changing demands. Information is scattered across organizations and leads to conflicts of value, goal, and culture exist between partners. Since EG is an automated enterprise with IT oriented multifaceted service-centric system, EA confines the integration requirements of software components [26]. Service-Oriented Architecture (SOA) manifestation led some governments to pertain this in their EGs, but it limits business artifacts of an enterprise [9]. The concurrent use of EA and SOA in EGS is most beneficial for integration of business requirements [9][26]. As an automated enterprise logic consists of Business Processes (BP) and application logic, EGS should comprises of centralized public service processes with the existing application logic that belong to various departments at central, state and local level. This is pragmatic only when the EG is viewed as a Service Oriented Enterprise (SOE). This concept leads to an agile EGS resulted the efficiency, re-usability, non-redundancy, citizen friendliness, rapid service delivery, and citizen's active participation in governance process [16]. This is an evolutionary movement than a revolutionary [5].

The agility of EGS is defined as the quality that determines its responsiveness, competency, quickness, and flexibility [1][27]. These capabilities enable EGS to respond proactive and innovative changes of the citizens needs on a timely basis. It is the provision to permit adding or removing independent systems from the integrated structure without major modifications that increases the time-to-market of new services. The EGS agility is based on the flexibility, adaptability, reactivity, robustness, and integration [27]. Information sharing and integration is one of the crucial approach for increasing organizational efficiency and performance [29]. The challenges are encountered when achieving cross-boundary information sharing and integration and it increases the complexity of Enterprise System (ES). A centralized SOE architectural style is one of the state-of-the-art tool for enterprise information system integration [10][11][29]. Since EG is viewed as an enterprise, the agility in EGS can be achieved in the same way as the ES progresses towards service-oriented direction [27]. This research studies how cross-boundary information sharing and integration are carried out in EGS using the service-oriented mechanism. It explores how EGIOP&INT issues are solved in view of an agile EGS through a Service-Oriented e-Government Enterprise Architecture Framework (SOeGEAF) [11] in Indian context and then modeled public service integration in a more pragmatic way. The researcher progressed with a practical solution for the proposed framework and models by the Service Component Architecture (SCA) standards which is a programming model for service creation and implementation [4][30], and the Dependency Structure Matrix (DSM) methodology [28][8] to integrate the service components (SCs) from disparate platforms. Thus the public services within SOeGEA would be instantiated by the SCs in a frame of SCA.

## 2. Research Background

### 2.1. Context and motivation of Research

Globally, the EG Development (EGD) is similar in countries, but in India it is more complex due to the multi-tire administrative structure, diversity of culture, and different process management methods in various governmental departments. There are several EG initiatives across the country at the center, state and grass-root level. The diverse governmental agencies are developing their own systems to provide better services to their stakeholders, without knowing other department's systems and also without considering the integration. They are islands of attempts and many of them providing excellent services, but some are still using legacy systems as manual process. These application silos caused multiple similar software systems with duplication of data and efforts. The ventures of EG departments are designed, developed, and implemented independently by the line departments. This caused the duplication of design artifacts, application assets, data archives, and human efforts which increases the secure storage requirements of confidential data and its density, redundancy, cost due to man hours, and deliberate responses due to slow decision making process. In the existing context, the citizen need to interact with each governmental departments to get their public services. The government processes are inter-linked by the multiple government agencies, and poor performance in service delivery due to deprived coordination among these agencies. Because of its inherent organizational fragmentation, citizen have several obstacles to access single window e-services. This context leads to our research problem.

### 2.2. Research Problem

The main objective of this research is to develop a solution for EGIOP in order to get integrated public services in Indian context using the state-of-the-art paradigms. To reach the research objective we present the following main research question, "How to provide single-window public services to citizenry in an agile e-Government system?" Single-Window access is meant for the interactions between government and citizens done 24X7 from anywhere through a national portal of centralized EGS. Agile EGS meant for the efficient, reusable, non-redundant, integrated, and rapid service delivery with citizen friendliness. The following sub-questions help us to answer the main research question.

- RQ1 - What are the existing e-Government Development scenarios in India?
- RQ2 - What are the possibilities of EA and SOA adoption in Indian EGS?
- RQ3 - How to solve the Interoperability and Integration issues of EGS in India?
- RQ4 - How to integrate the public services in the agile EGS perspective?
- RQ5 - How to manage the service dependency of service components?

Single-window public services provision in an agile EGS is the most innovative stage of EG while traditional government transformed to EG through different maturity stages. To attain a solution of the research question, the researcher has done a profound exploration by the five aforementioned sub-questions for the existing context, up-to-date developments, and current stage of EG in RQ1; then the need and possibility of the proposed elucidation by RQ2; how to achieve matured EGS by existing developments in RQ3; options of advanced tools to get agile EGS and also to manage the service dependency by RQ4 and RQ5.

## 2.3. Research Approach

The objective of the research were achieved through the Design Science Research (DSR) methodology. The research process begin with the review of the literatures which provides context for the importance and meaning of the research topic and questions. The DSR method is concerned with the construction and evaluation of an IT artefact [7]. Hevner et al. list guidelines that DSR should follow, it is presented in Table 1. In addition to the literature review, the researcher accomplished three phases such as analysis, framework formulation, and prototyping.

**Table 1**. Application of design science guidelines in this research.

| Guideline name and description | Meeting the guideline in this research |
|---|---|
| Guideline 1:<br>Design as an Artifact | The produced artifact such as framework and models are fruitful for EGIOP&INT issues in view of an agile EGS of India. |
| Guideline 2:<br>Problem Relevance | EGIOP&INT is one of the most essential matter in research and also in practice to the evolution of EG maturity. Since the findings and conclusions are based on Indian context, it is applicable for policy makers globally to guide them towards taking correct strategic decisions towards a mature EGS. |
| Guideline 3:<br>Design Evaluation | The constructed artifacts were evaluated by prototyping a public service in EG domain. |
| Guideline 4:<br>Research Contributions | The research has sound contributions and the subsequent section conferring them. |
| Guideline 5:<br>Research Rigor | EG as a multidisciplinary area of research rises the volume of literature that hasten the convolution of literature survey. Prototyping is comparative when modelling in view of transformation of an automated enterprise into the SOE. |
| Guideline 6:<br>Design as a Search Process | Due to the extensive research process, the resultant artifacts are completed in iterations. Each iteration results in the inclusion of new practical concept and is one step closer to finding solution for EGIOP&INT issues, as well as reuse of public service processes by managing its dependency. |
| Guideline 7:<br>Communication of Research | The framework and models in view of EG in India has been presented in the National Conference on e-Governance (NCeG) in India which is a platform for policy makers, practitioners, industry leaders and academicians. The other perceptions also has been communicated to the appropriate audience. |

## 3. Related Work

Many countries have realized the need to develop a national EGS to deliver integrated public services as a part of EG transformation. This is concerned with the solutions for EGIOP&INT issues which have been studied for years (Scholl, H., 2007; Scholl & Klischewski, 2007; Janssen, M., 2007; Guijarro, L., 2007; Lallana, E. C., 2007; Estevez, E., 2007; Kubicek, H., 2008; Gottschalk, P., 2009; IDABC, 2010; Saha, P., 2010; Chourabi, H., 2011; Janssen, M., 2011; Scholl, H., 2012). It requires systems integrated across different functions in both information and service and also real one-stop service for citizens and businesses (Wimmer, M., 2002; Estevez, E., (2007); Dias, G. P., 2007; Apostolov, M., 2008). Numerous literature attested the globally widespread use of EA and SOA for EGIOP&INT issues. Literature proposes the concurrent use of comparable

technologies EA and SOA in an administrative system is most useful (Scott J. Dowell, 2007, B. Chakravarti, 2008; M.Ibrahim, 2009). Many literature specifies the successful use of agile capabilities in large scale ESs. There is already much work in the use of SOA in enterprise integration and also to create agility in systems, especially in the EG domain (Sweden, E., 2006; Votis, K., et.al., 2006; Grant, G., 2007; Soumia, A., 2011; Weerawarana, S. H., 2012; Soumia, A., 2013; Almahamid, S. M., 2013; Budiardjo, E. K., 2013; Ramtohul, A., 2014). The literature disclosed that SOA is prerequisite for enterprise agility, but it confines the business artifacts of an enterprise.

The concurrent use EA and SOA leads to view an enterprise in a new perspective SOE and is required to solve the EGIOP&INT issues along with the effective governance process in order to increase agility in ESs. Thus it need to be restructured in a service-oriented way by the transition of enterprise into SOE models (M. Mircea, 2011a). Many literature discloses the service and service-oriented modeling of systems (Arsanjani, A., 2008; Engels, G. and Assmann, A., 2008; Assmann, M., 2009; Lee, J., 2010; Tohidi, H., 2011; Hulstijn, J., 2011; Rafati, L., 2012; Mircea, M., 2012; Afsarmanesh, H., 2012; Fazlollahtabar, H., 2013; Juric, M. B., 2013; Yousef, R., 2014; Al-Khanjari, Z., 2014). But, these attempts are conceptual frameworks and architectural models that describes principles for services structuring with publishing methods to facilitate enterprise integration. It doesn't state practical solution for service creation and integration. This research modeled SOeGEA in a more pragmatic way to achieve agile EGS by specifying a programming model SCA to create, implement, compose, and reuse public services that are defined in multiple languages, deployed in multiple container technologies, with multiple service access methods (Chappell, D., 2007; Fiadeiro, J., 2012; KejriWal, M. K., 2014) along with DSM for representing and analyzing (T. R. Browning, 2002; Jacob, J., 2011; Brown, N., 2011; Jacob, J., 2012) public service integration. Though, this is based on Indian context, it is valid towards a mature EGS for countries globally.

## 4. Outcomes

In the first phase of the research, three analysis were conducted to explore the EGD in India. The first study investigated key EG initiatives across the country by a content analysis method of secondary sources. This study concluded that India have developed all the amenities which facilitate GEA to solve the EGIOP&INT issues in perspective of a centralized EGS [13][14]. The EGD methods and programme management approaches of the country [22][23][19] were scrutinized in the second analysis by direct interview method and content analysis of primary source materials. This investigation revealed the earnestness of EGIOP to the integration of department wise information silos [18][17]. The third analysis evaluates the global position of India based on the surveys carried out by the United Nations during 2003 to 2014 by documentary research method and it uncover the lacking for further development to reach at a matured EGS [20][15].

This research proposed a framework for EGIOP by using the existing amenities of India [21][18][17] in the second phase. Figure 1 shows this Government Enterprise Architecture Framework (GEAF) that comprises SOA based portal as a platform for all the stakeholders to interact with EG agencies in the role of service providers. Service Delivery Gateways are acting as the Government Service Bus instead of an Enterprise Service Bus that is the heart of GEAF. In view of EG as a SOE, GEAF turned into a SOeGEAF this bring agility in EGS [11]. Thus the public services can be instantiated by the SCs in a frame of SCA [30][4], this research modelled a service architecture in this

perspective [17][16]. Business functions of SOE are provided as a series of business services and are assembled together to create a particular business need [6]. Thus, integration of SCs to form a business services requires the establishment of relationships between them and the flow of deliverables among them should be coordinated. This is very challenging process and we proposed DSM method [28][8] to overcome this in the case of public services. This approach offer a view of architectural conformity of SC dependency management while integrating public services using SCA.
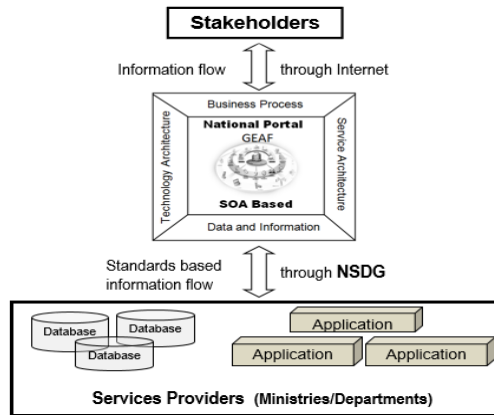


**Figure 1.** Government Enterprise Architecture Framework

The third phase prototyping, illustrate our approach using a citizen-friendly public provision 'Passport Service' provided by GoI in the EG domain. The researcher anticipated public services are the BP in SOeGE system [18][17][16]. Passport is delivered by central administrative government agency 'Passport Department of India', established under the Ministry of External Affairs. The applicant's identity is verified in local Police Station which is come under the Ministry of Home Affairs and has no direct control by central Department. These departments should be coordinated to issue passport. According to the componentization of BP into SCA modelling elements [6], passport service is decomposed into 3 business services, 5 corresponding composites and its SCs. Figure 2 shows SCA model and it articulates integration of related business functions by the configuration and administration of service elements. Then researcher proposed and designed a dependency model of these SCs using DSM to integrate the business service of passport service. In the proposed SOeGE system, the passport can deliver in time by completing all the formalities with the coordination of the concerned departments involved in the process under the monitoring of the central EGS.

## 5. Conclusions

The EGIOP&INT is a searing research problem for many researchers universally. The changing demands of citizens enforced agile EGS and it brings EGIOP&INT. Transforming the traditional enterprise model to SOEA is one of the best state-of-the-art solutions for organizations to get agile system and this research applied this philosophy towards the EGS in the perspective of India. A centralized structure for interoperability across governmental agencies in a country is a rapport for public service integration, will

increases efficiency of one-stop service delivery to citizen and also eases evolution to the EG maturity. In view of EG as a multidisciplinary area of research, this encompassing the advanced proficiencies such as SOE, SCA and DSM that belongs to various fields such as ESs, Software Architecture and System Engineering respectively.
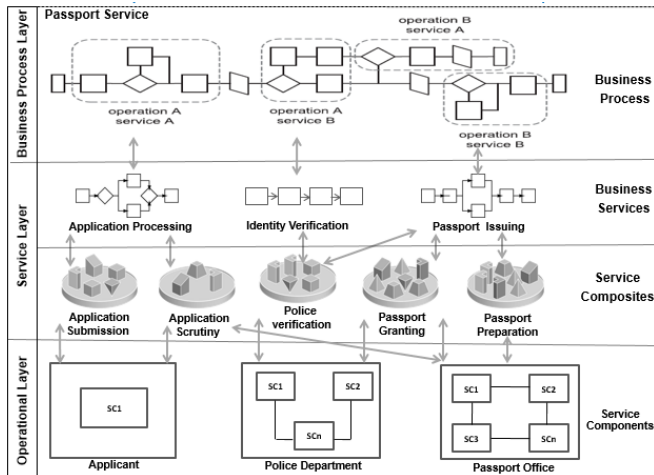


**Figure 2.** Service Architecture Model of Passport service in SOeGE System

Researching a solution for EGIOP&INT by constructing a framework and models is very complex and inconsistent, but quite relevant. This study has several limitations as it considers only the functional features of EGS in the perception of IT and the illustration is using only one public service. It doesn't considering the non-functional facts such as workflow management, taxonomy and ontology of services, management style, organization culture, political issues, practical difficulties as EGS of India such as loathe in the supremacy of center over the states in terms of decision making, etc. Despite the above limitations, this study is quite rare in related research universally and it is a first attempt to make a link between SOE, SCA and DSM to achieve an agile EGS so as to solve the EGIOP&INT issues. Therefore, the aforementioned limitations are the opportunities for future research.

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