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IT Perspective of Service-Oriented eGovernment Enterprise

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***Abstract*—**The focal aspire of e-Government (eGovt) is to offer citizen-centered service delivery. Accordingly, the citizenry consumes services from multiple government agencies through national portal. Thus, eGovt is an enterprise with the primary business motive of transparent, efficient and effective public services to its citizenry and its logical structure is the eGovernment Enterprise Architecture (eGEA). Since eGovt is IT oriented multifaceted service-centric system, EA doesn't do much on an automated enterprise other than the business artifacts. Service-Oriented Architecture (SOA) manifestation led some governments to pertain this in their eGovts, but it limits the source of business artifacts. The concurrent use of EA and SOA in eGovt executes interoperability and integration and leads to Service-Oriented e-Government Enterprise (SOeGE). Consequently, agile eGovt system becomes a reality. As an IT perspective eGovt comprises of centralized public service artifacts with the existing application logics belong to various departments at central, state and local level. The eGovt is renovating to SOeGE by apply the Service-Orientation (SO) principles in the entire system. This paper explores IT perspective of SOeGE in India which encompasses the public service models and illustrated with a case study the Passport service of India.

***Keywords*—**Enterprise Architecture, Service-Oriented e-Government Enterprise, Service Interface Layer, Service Model.

I. Introduction

THE e-Government (eGovt) intends to offer transparent, efficient and effective public services to its citizenry [5]. Thus the citizenry act as service consumers and multiple government agencies are the service providers in the eGovt system. A national portal is acting as a platform for provision and accession of public services [21]. Thus government is a multifaceted enterprise with its business requirements as effective public service delivery [32], [19]. Enterprise Architecture (EA) and Service-Oriented Architecture (SOA) manifestations led enterprises to convalesce from the interoperability and integration issues of eGovt System (eGS) [11], [22]. IBM proposed concurrent use of EA and SOA is most beneficial [14]. While these are applying to the eGovt system leads to a Service-Oriented eGovt Enterprise (SOeGE) and an agile eGovt system becomes a reality [7].

The eGovt is an automated enterprise system. Thus, it has many confronts like any other automated enterprise, due to the duplication, heterogeneity, communication, adaptability, and granularity of application components [18]. The organizations overcome these constraints by applying the Service-Orientation (SO) principles in the automation [15]. It is through the new manner in which they represent, view, model, and share the entire enterprise logic as services [27]. These results units of software partitioned into operational capabilities and each designed to solve an individual concern as services. It means that an organization or entity based on on-demand services. Subsequently the enterprise transformed into SOE [10]. IT perspective of automated enterprise logic consists of Business logic and Application logic [28]. Accordingly, eGovt has the centralized public services with the existing application logic belong to various departments at central, state and local level. The eGovt enterprise is renovating to SOeGE by the SO in the entire eGovt logic. Since SO is a design paradigm to build computer software in the form of services, it exists in a vacuous realm of abstraction. The services are establishes and realizes through the Service Interface Layer (SIL), which consists of service representations of entire enterprise logic [28]. This paper explores IT perspective of SOeGE in India which encompasses the public service models. 'Passport Service' is a citizen-friendly eGovt public service provided by GOI to its citizen. This paper presented the service model of Passport service of India.

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II. Service-Oriented eGovernment Enterprise (SOeGE)

A. Enterprise Architecture (EA)

EA supposed to manage the increasingly complex information system in a better, faster and cheaper way [23]. An Enterprise is a cross-organizational entity supports a defined business scope and mission. The interdependent entities like people, process, and technology are work together and share information for a common mission [6][30]. The motive of an enterprise is to give services to their consumers and its structural design is the Enterprise Architecture (EA). A logical structure for classifying and organizing complex information systems of an enterprise called its Enterprise Architecture Framework (EAF) [16], [9]. It is a means for structuring and classifying information of an enterprise in the form of architecture models and views [30]. The framework does not contain the EA itself, EA is distinct from EAF. Many organizations can use the same EAF, but each EA with its content is organization-specific. EA comprises the enterprise components or business components with its properties and relationship [17]. It mainly focuses on defining business components, addressing integration patterns, and deals with infrastructure including servers, databases etc., of an enterprise [17].

B. Service-Oriented Architecture (SOA)

Currently SOA is one of the hyped words in the IT as new software architecture (SWA) style [8][26] for constructing complex software-intensive systems. It promotes loosely coupled architecture, interoperability, reusability, and extensibility [29]. Due to the globalization of economic environment, business processes are becoming more and more complex, which makes enterprise information systems more and more complex. Ali Arsanjani defines SOA as "*SOA is not a product- it's about bridging the gap between business and IT through a set of business aligned IT services using a set of design principles, patterns and techniques*" [4]. For most businesses, a SOA offers considerable flexibility in aligning IT functions and business processes and goals. An SOA decouples reusable functions and it is the ability to deploy and control the services. The definition by Thomas Erl is, "*SOA is a form of technology architecture that adheres to the principles of service orientation. When realized through the web services technology platform, SOA establishes the potential to support and promote these principles throughout the business process and automation domains of an enterprise.*" [28]. Service Oriented Architecture is the policies, practices, and frameworks that enable application functionality to be provided and requested as sets of services published at a granularity relevant to the service Requestor, which is abstracted away from the implementation using a single, standards based form of interface.

There are different views of SOA as technical, non-technical and transitional [20], [33]. The functionality implementation in the SOA is a technical view, the actors with its socio-economic concerns include in the non-technical view and transition related to the message based communication between loosely coupled components [25]. Even though SOA is a SWA, it is different from the normal development of software and is more than deployment of software. SOA process is an incremental shift in how the typical applications architect and compose. SOA affects the entire business and all processes in the business must be viewed as services. Services are set of universally interconnected and interdependent building blocks. SOA is governed by the service-orientation principles such as abstraction, autonomy, composability, discoverability, formal contract, loose coupling, reusability, and statelessness. Due to the benefits SOA promises increased return on investment, organizational agility, interoperability, better alignment of business and IT better customer relationship and new development methodology by analysis and design techniques.

C. Service-Oriented Enterprise (SOE)

Enterprise systems need renovation with adaptable, flexible, and reusable architectures due to the frequently changing business requirements and the rapid development of technology. To reduce coupling, SOA has been applied in many SW systems by assembling loosely coupled services that can be used within multiple business domains. Service Oriented Enterprise (SOE) is a view of the enterprise in which everything is seen in terms of services with its interactions and interdependencies [31]. The enterprise itself is a service. Janssen and Joha defined as "SOE is an enterprise that is modularized in business domains" [12]. SOE is business-driven architectural framework that defines and exposes an organization's core business processes to the external market through the use of standardized open technology in the form of services [31]. SOE is an ultimate future state of service-oriented integration. From a technical perspective, a SOE can be viewed as standardized infrastructure, and SOA is part of this standardization. It's having an Enterprise infrastructure that provides an EA and security foundation to be able to run these services consistently across the enterprise. SOE is defined by three essential layers: the enterprise performance layer, the business process management (BPM) layer, and the underlying SOA [24].

SOE covers whole of enterprise. It is an organization whose business and IT are converged based on the enterprise business service model to gain business goals in the most efficient way in the given market. SOE is really connecting business processes in a much more horizontal fashion. By becoming an SOE, organizations establish new organizational forms based on shared service centers [12]. The Services Paradigm has to be adopted by the Enterprise to structure the Enterprise in terms of Services. SOE brings the concept of SO from the IT architecture to whole-of enterprise by service oriented business operations. So the Enterprise aspect areas have to be decomposed in terms of functional Services. The enterprise is a collection of services and processes. SOE is an environment that can respond to business requirements with unprecedented agility. This allows the business model itself to evolve in new (more service-centric) directions. Since an SOE provides a carefully designed, service-oriented view of the enterprise. Building an agile SOA is in minimizing the dependencies each service has within its own processing logic. This brings efficiency, re-usability, non-redundancy, citizen friendliness, rapid service delivery, and citizen's active participation in governance process.

D. E-Government as a SOE

The focal aspire of e-Government (eGovt) is to offer citizen-centric public services to its citizenry. Accordingly, the citizenry act as service consumers and multiple government agencies are the service providers in the eGovt system. A national portal is acting as a platform for provision and accession of public services. Like any other enterprise the entire eGovt system is also works together and share information for its business requirements [16]. Hence, eGovt is an enterprise with the primary business motive of citizen-centered service delivery. The logical structure of eGovt is known as Government Enterprise Architecture (GEA) [32]. A suitable conventional EAF will meet the business goals in an interoperable eGS and many countries have progressed in this direction [17], [2]. It doesn't do much on an automated enterprise other than the business artifacts, since eGovt is IT oriented multifaceted service-centric system [13]. Hence, EA alone is inadequate for the interoperability and integration issues of the eGS [3]. The SOA manifestation led some

governments to pertain this in their eGovts. While SOA is software architecture model and has no provision to find business services from business artifacts of an enterprise. IBM proposed the concurrent use of comparable technologies EA and SOA in an enterprise system that channeled to the evolution of enterprises as SOE. Thus, the mutual use of EA and SOA in eGS leads to a Service-Oriented e-Government Enterprise (SOeGE). This brings efficiency, re-usability, non-redundancy, citizen friendliness, rapid service delivery, and citizen's active participation in eGovt processes and an agile eGovt system becomes a reality [7].

III. IT Perspective of SOeGE

In an automated enterprise, the ever-evolving entity the entire logic that defines and drives are constantly changing in response to external and internal influences. From an IT perspective, this enterprise logic can be divided into two important halves Business logic and Application logic [27]. Business logic originates from an enterprise's business areas and is a documented realization of the business requirements. It is normally structured into processes that express the business requirements, along with any associated constraints, dependencies, and outside influences. Application logic is an automated implementation of business logic organized into various technology solutions [24]. This expresses business process workflows through purchased or custom-developed systems. The primary constraints are technical capabilities, organization's IT infrastructure, security issues, and vendor dependencies [29]. The government enterprise logic consists of the business processes as centered public services and existing application logic of various departments at central, state and local level and is presented in Fig. 1.

The renovation of eGovt to a SOeGE is doable by pioneering SO principles [28]. From the SWA's perspective, this introduces new concepts in eGovt systems that augment the manner in which this logic is represented, viewed, modeled, and shared. The SO concepts established and realized in a SOeGE through the introduction of a Service Interface Layer (SIL) [28], which consists of service representations of the entire eGS. Consequently, IT perspective of SOeGE represents three layers: Business Process Layer (BPL), Service Interface Layer (SIL) and Application Layer (AL). SIL is located within the overall structure of automated organization wedged between traditional business and application layers. It is presented in Fig. 2. When positioned here, services encapsulate physical application logic as well as business process logic. This is where service connectivity resides and is therefore the area of our enterprise wherein the characteristics of SOA are most prevalent.

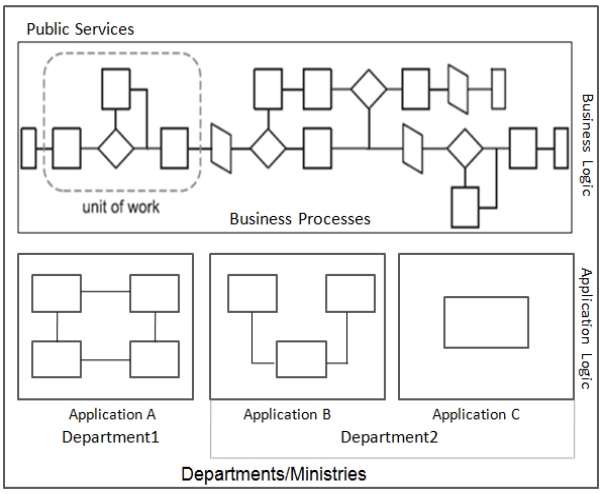

Fig. 1 IT Perspective of a Government Enterprise

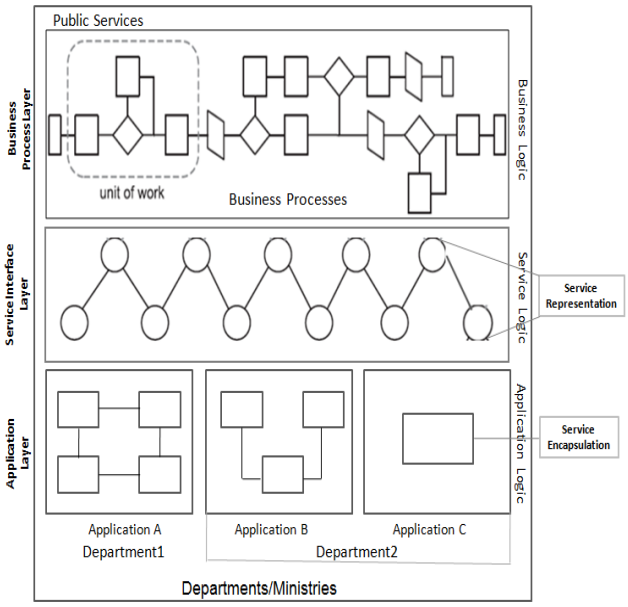

Fig. 2 Service Interface Layer in a SOGE

A. Service Layer Abstraction

In an automated organization a high form of abstraction is executed through the SIL. The principles behind SO exist in a vacuous realm of abstraction and theory, SIL is necessary counterpart. Hence the organizations require guidance and structure to survive with the SO. Services are modularized in the SOeGE and structured standalone units of logic that subsist within a common interface layer. The services can be layered so that parent services can encapsulate child services. This allows for the SIL to consist of multiple layers of abstraction as in Fig. 3. The SIL consists of the following layers:

1) Application Service Layer (ASL)
2) Business Process Service Layer (BPSL)
3) Orchestration Service Layer (OSL)

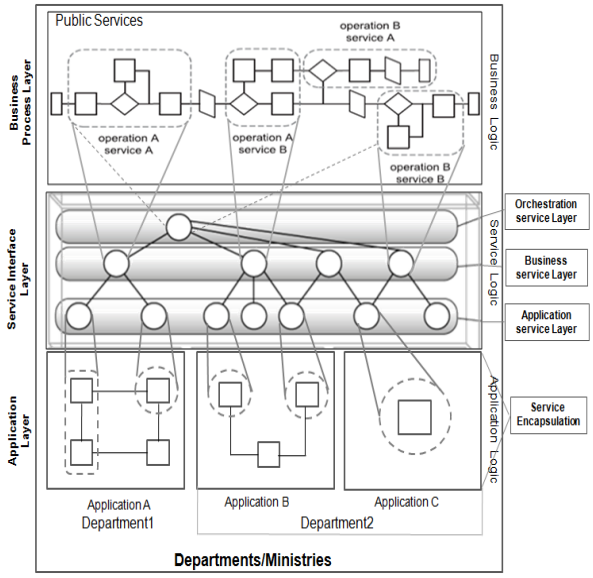

Fig. 3 Services Layer Abstraction in Interface Logic

In a SOE, the existing legacy application logic needs to be exposed via services. On physical level specific application logics individually encapsulated into services. Applications are developed in proprietary SW and deployed in different environments. Services designed specifically to represent application logic that exists in the application service layer. Fig. 3 shows how application service interfaces represented by individual services which are originating from different platforms. An organization's business models and business processes are represented in Business logic. The services models to represent business logic ensure that are alignment with existing business models. These service models belong to the business service layer and this supports the SOA characteristics service-oriented business modeling [28]. Orchestration service layer is a parent controller layer on top of the service layers. It allows a centralized location for business rules and composition logic for sequencing and executing services. Controller services compose other services developed dependencies on the composition structure. This layer establishes the Process services that are composing other services to execute a business process according to predefined workflow logic.

Agile SOA brings when minimizing the dependencies among each service within its own processing logic. The services to be utilized outside of environments require the act of business rules at runtime. Business agility must be purposefully designed into each organization's EA, IT Governance, and IT Policy framework and implemented incrementally with each step tied to delivered business value [6]. OSL increases organizational agility. Thus, all forms of service abstraction resulted with an agile enterprise. Hence, SOA characteristics are implementing by creating separate application, business, and orchestration layers.

B. Service Design in a SOE

The SOE is a collection of services and processes. Thus the business model evolves in service-centric manner. Services are set of universally interconnected and interdependent building blocks. Components of SOE are processes, services, and operations. Hamid Tohidi suggested an approach for modeling SOE by modeling business services used in service oriented business [10]. This includes two phases as:

- Componentization of Business
- Service Orientation of Business

Componentization and service orientation are two activities for converting the enterprises to on-demand business. The key elements are business components and business services. This varies according to different platform perspectives. In the authors understanding the terms used for various building blocks are presented in Table I. The steps for modeling business services are business Component Identification, Business Component Modeling, business Service Identification, Business Service Specification and Business Service Realization. The first two steps are used in componentization of business phase and rest of them is for service orientation of business phase [10].

Service is an abstract representation of resource like business process, person, organization etc., in the form of related tasks of specific service roles [18]. Service identity and its invocation logistics are defined in the SIL, and main functional activities of the service are executed during the service implementation. The service interfaces are platform independent and sustaining the service actors with diverse communication devices operating in various computational platforms, programming languages or operating systems. Service development is a repeatable process-oriented method to build up and deploy a specific real time task similar to a typical SW development life-cycle. In this development process, design phase has prime importance and design artifacts are implemented as service logics of SIL [18].

IV. Case Study: Passport Service of India

An interoperable e-Government system is a core target to meet every governments Worldwide. To leverage e-Governance in the country, Government of India has taken numerous initiatives with high importance given to citizen-centric service delivery. India step forwarded with various initiatives in the eGovt interoperability arena. So India has all the supporting amenities for a SOeGE. Paul et.al proposed a conceptual framework for Interoperable eGS in India [1]. Passport Service is a citizen-friendly eGovt public service provided by GOI to its citizen. The central administrative government agency Passport Department of India, established under the Ministry of External Affairs provides this service. Local Police Station which comes under the Ministry of Home Affairs verifies citizen's identity and has no direct control by the central Department. The passport will issue as per the status of Police verification. It takes months to complete all the processes.

TABLE I
DIFFERENT PERSPECTIVES OF FUNCTIONAL CONSTRUCTS

Enterprise Views	SOA View	eGovt View	IT View
Business Process	Services	Government Service	Application
Business Service	Service Composites	Government Process	Modules
Business Activity	Atomic Services	Government Activity	Sub modules
Business Action	Work	Sub Activities	Functions
Constructs Build-ups			
Workflow Management	*Service Composition*	*Service Integration*	*Dependency Management*

In this section we presented a service model for the Passport Service for the proposed conceptual SOeGE in India. In a SOeGE system, the passport can issue timely after completing all the formalities of issuing a Passport. This is possible by a single window service delivery system, with the coordination of the concerned departments involved in the process under the monitoring of the central eGovt system.

The activities involved in the SOeGE system for this service will initiate by the citizen's requirement for issuing a passport. The Passport Application Process Activities are as follows:

1) Submission of filled application form by applicants
2) Applicants scrutiny and data entry
3) Police verification of application facts
4) Granting issue of passport
5) Preparation of passport
6) Passport dispatch

The approach for modeling a service-oriented business service in a SOE has discussed in the above section. As per the mentioned approach, the public service 'Passport Service' is modeled into a service-oriented service in a SOeGE platform. We are considering the Passport service is a business process that composed of various business services and business activities. First step of our modeling is the componentization of business service by identifying the components. Passport service composed of different business services, business activities and business actions. These are the building blocks of service-oriented Passport service with SOeGE in India. These service modeling elements and their relations are presented in Table II. The service model elements are composed and aligned into abstract model of business activities and its corresponding business services. This formulated a service model for Passport service of SOeGE in India and exhibited in Fig. 4.

The Passport service is formalized into business services and business activities. The processes such as application processing, identity verification and issuing passport are the composite services which are represented the abstracted business services and structured in BPSL of SIL. Application processing is a composite service which is composed by the activities such as application submission and application scrutiny. These activities are the atomic services in the SOeGE that are abstracted application services ordered in ASL of SIL.

TABLE II
SERVICE MODEL ELEMENTS IN PASSPORT SERVICE

Business Process	Business Services	Business Activities	Business Actions
Passport Service	Passport Application Processing	Application Submission	Fill and Submit Application File Application ACK Application Data Entry of Application
		Application Scrutiny	Application form verification Carry out verification
	Citizen Identity verification	Police Verification	Inquire Status Update Status Details of Applicants to be verified Status of Verification
	Issuing Passport	Passport Granting	Update status of verification
		Passport Preparation	Printing of Passport Dispatch of Passport

The inter-relation between activities and processes are designed as per the workflow logics of the departments. These are controlled by the orchestration logic and structured as OSL of SIL. The businesses activities are encapsulated with the actions which are exists in the operational layer and are owned by the different departments as shown in Fig. 3. Similarly, all the business services in a business process are orchestrated by its componentized activities and actions. This design artifact is the service model of a business process as in Fig. 4. The service model is a prerequisite for service development process in the SOE environment. Thus our developed service model is a prerequisited designed artifact for developing a service-oriented passport service in the SOeGE environment of India.

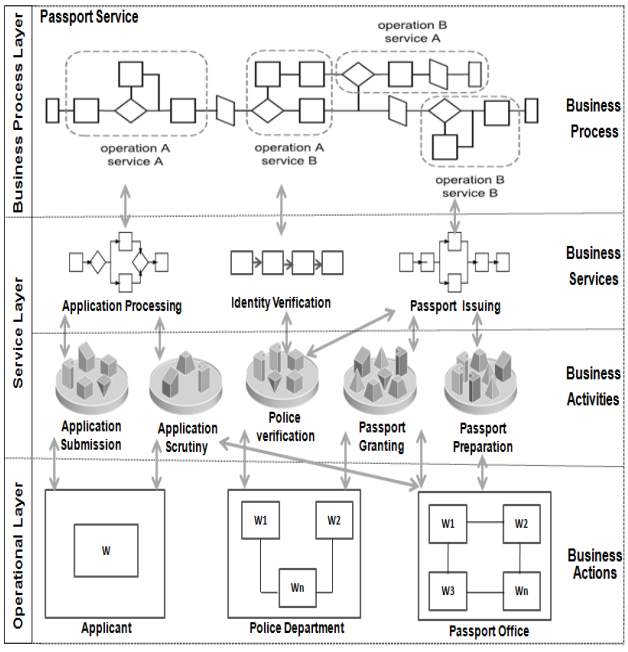

Fig. 4 Service Model of Passport Service

V. Conclusion

The eGovt is intent to offer citizen friendly public services to its citizenry. The eGovernment system faces many constraints in duplication, heterogeneity, communication, adaptability, and granularity of application components as an automated enterprise system. To solve these issues in the enterprise system, enterprise research community establishing the SOE by combining two paradigm EA and SOA for bringing an agile enterprise to cope with frequently changing business requirements. In this paper we tried to bring these enterprise concepts in the eGovt system to get agile eGovt system by a SOeGE. A service model of a public service within the SOeGE has been presented.

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