Life-event Modelling Framework For E-Government Integration

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Abstract: Ability to offer a citizen-centric view of government model is the key to a successful e-government service. Life-event model is the most widely adopted paradigm supporting the idea of composing a single complex e-government service that corresponds to an event in a citizen's life. Elementary building blocks of Life-event are based on atomic services offered from multiple government agencies. This study found that methodological mechanics of service integration and in particular the requirements engineering for composite services has been overlooked. Purpose of this study is to define obstacles of achieving e-government service delivery integration, and suggests a framework based on ontological analysis and modelling. Proposed framework that shall be called E-Service Integration Modelling (E-SIM) is based on the extensive use of Life-event concept. This paper proposes a top down abstraction approach in requirements elicitation and modelling to define and implement the phenomenon of Life-event in context of e-government.

Keywords: E-government Integration Framework, Life-event Modelling Process, Meta-modelling, Semantic Ontology.

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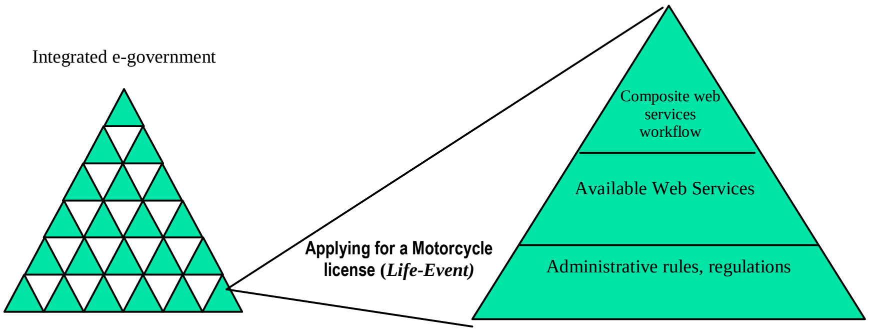
1. Introduction

Fast growing presence of government agencies in the Internet has created an unmanaged and unregulated congestion of similar and often duplicated web services, this problem has prompted governments to start planning for service integration. However e-government service delivery integration has always been a mystical phenomena for both academics and practitioners, mostly because of structural and conceptual uniqueness of governments that makes them deferent from each other and from private sector (Sanati & Lu 2007). Therefore conventional integration solutions that could easily be applied to other businesses have proven to be of very little help in providing comprehensive solutions for public sector. Hence a widely accepted paradigm called "Life-event" model has been introduced that affectively supports e-government service integration task in all its uniqueness and complexity (Vassilakis et al. 2005). It combines basic services offered from multiple public authorities into a single composite service that corresponds to an event in a citizen's life. We use the concept of Life-event as building blocks of integrated e-government service delivery system as it is illustrated in Figure 1.

Figure 1 Life-event as building blocks of integrated e-government



If it is properly modelled and implemented, Life-event has the capacity to revolutionize the way government web services are analysed, modelled and composed to provide a citizen-centric view of the government model. This study considers the concept of *Life-event* to be of almost equal to concept of *composite service* within the scope of this paper and uses the words *Life-event* and *composite service* interchangeably.

Emergence of Service Oriented Computing (SOC) and consequently the Service Oriented Architecture (SOA) has greatly influenced Information and Communication Technology (ICT) industry towards the design of integrated service delivery architectures. Current ICT industry trends indicate a moving towards the decomposition of legacy complex processes into atomic and simpler components to handle ever increasing complexity of current information systems (Huhns & Singh 2005). This trend has led to a two-step solution. Step 1 is to transform gigantic architectures into constructs consisting simpler building blocks called services. Step 2 is to recompose those services in to *composite services* in order to achieve added value. This study is concerned with the second step of this theory. Prior research introduced E-Service Integration Modelling (E-SIM), where current practices and theoretical models of e-government service integration was analysed (Sanati & Lu 2007). Further to that, the objective of this paper is to extend our prior research work to shade light on the role of Life-event in e-government service delivery integration and propose a technical framework for this propose. Therefore this paper is making the following contributions: (1) Introduce Life-event as the fundamental building block for constructing an integrated e-government body, so it could be used as the unit of requirements for e-government service integration projects. (2) Proposes a generic and repeatable framework for modelling automated e-government service composition projects.

Other research works have also identified the importance of interoperability in e-government integration (Guijarro 2007) Where Gottscalk & Solli-Saether (2008) suggested 4 stages of e-government interoperability in details. In this paper we define the problem space of e-government service delivery integration, and identify ontology analysis and modelling as one of the essential requirements for modelling Life-event that supports such integration. We propose a top down abstraction approach in requirements elicitation and modelling to define and implement the phenomenon of Life-event in context of e-government. This study uses graphically illustrated logical steps along side the clear definition of all the key steps on using the concept of Life-event in its proposed integration modelling process (E-SIM).

The rest of this paper is organised as follows: Section 2, provides research literature survey on current state of e-government service composition to critically analyse and unveil the problem space of this study. Section 3, analyses the results of an online industry survey that support the definition of problem space arguments. Section 4, explains the methodological approach analysis to e-government service delivery integration, nature of Life-even, and its role in e-service composition. Section 5 is discussing the theory of ontology analysis & modelling and its place in developing automated e-government composite services, it argues why and how ontology analysis should be considered an essential part of the requirements engineering for such systems. We also propose an evolutionary model for Life-event requirements engineering, which is tightly coupled with the three stages of its life cycle. In Section 6 a Life-event construction example is provided to illustrate the implementation mechanics of our proposed Life-event abstraction model using the Integrated E-Service Delivery (IESD) platform. In conclusion, Section 7 discuses the main contributions and limitations of this paper in line with the future research plans.

2. Literature Review

The importance of Life-event in e-government service composition is recognized by recent research work (Wolf & Krcmar 2008). Other research works identified the importance of requirements elicitation and critical factors in adopting e-government models (Shareef et al. 2009), although they mostly focus on one aspect of e-government. For example, model presented by Wolf and Krcmar (2008) seem to be very specific application only designed for Business to Government (B2G), it suggests a model of features and phases that might not be sufficiently analyse and provision the further development of such model. One of the most related works to our research in e-government integration (Chiu, Cheung & Kafeza 2007) argues that in new interaction devices, the context in which a service is being used becomes an integral part of the activity carried out with the system. This argument confirms the urgency of calls for more research work on system requirements elicitation and design for integrated e-government as a relatively new paradigm in requirements engineering. There are many research papers discussing and suggesting e-government development strategies and implementation frameworks ranging from highly intelligent multi-agent implementation frameworks (Mellouli & Bouslama 2009) to device dependent mobile e-government development (Sheng & Trimi 2008), and to conceptual frameworks for measuring public value of enterprise applications used to develop e-government systems. However as sophisticated as these frameworks may be, seems that very little is done and said on repeatability of their design.

Research publications as early as the start of this century have been emphasising on the role of ontology in e-government integration such publications by B. Grosof (2004) and R. Lara (Grosof et al. 2004; Lara et al. 2003). Study carried out by Stojanovic and Apostolou (2006) where more interested in practical implications of ontology in e-government integration, and they analysed interoperability issues in e-government domain. The aforementioned later work seem to have only listed a set of functional requirements for ontology building, and seem to overlooked the overall qualitative criteria that ontology should be addressing. This study addresses e-government ontology building qualitative criteria in section 4.2.

Information in Table 1 is the categorisation of some recently published relevant literature that collectively illustrate our point of view on how current state of research in e-government service composition is consumed with technology and tools for tactical implementation rather than methodologies and strategies. The literature review results shown in Table 1 are categorised in three main interest groups based on their areas of concerns. As we already pointed out between the lines of these literature, there is very little or no discussion about the process model of their development or any concerns regarding aspect of managing the process of e-government integration.

Our survey of many other recent e-government integration solutions (Madhusudan 2006; Umapathy & Purao 2007) also (Beer, Kunis & Rünger 2006; Dijkman & Dumas 2004; Liu, Husni & Padgham 2007; Lu, Zhu & Chen 2004; Medjahed et al. 2003a; Meneklis et al. 2005; Peng, Yanzhang & Xuehua 2006) indicates that most of the efforts have mainly relied on enabling technologies in order to achieve the desired outcome with a very little or in some cases no attention to any methodological approach. Considerable work is done in designing e-government implementation frameworks some of which (Chircu 2008) covering multidimensional aspect of e-government development, others paid more attention on planning the e-government development mainly from project and resource management viewpoint (Ghapanchi, Albadvi & Zarei 2008). As far as this study is concerned, the aforementioned fact is an indication of inadequate attention to methodological models in order to define repeatable processes for e-government development frameworks. This study defines a repeatable process for e-government integration in Section 4 of this paper that enables a gradual integration of e-government services in an organised and voluntary base as apposed to a big-bang integration project.

Analysis of other relevant literature (Trochidis, Tambouris & Tarabanis 2007) recognises two main approaches for modelling life-events. The first approach suggests modelling life-events as workflows of related public services and actions (Trochidis, Tambouris & Tarabanis 2006). Second approach suggests modelling life-events using ontology (Peristeras & Tarabanis 2006) thus capitalizes on the idea of semantic representation of knowledge. The later model describes ontology as the network of connections between concepts of a particular domain with the aim to provide a well-structured model. This study is based on the design assumptions of the second approach.

Table 1 E-government research literature survey

Category	Citation	Comments
1- Technical service orchestration and workflow design, mainly the use of technology and architecture in e-government.	(Skokan & Bednar 2008)	This article is a technical implementation of service orchestration process model.
	(Vassilakis et al. 2005)	Technical implementation of a blackboard architecture in SOA that can be used to deliver life-event oriented services.
	(Castellano 2005)	A new framework based on the Enterprise Service Bus model and on the Web Services technology.
	(Hu, Cui & Sherwood 2006)	Proposes a framework for creating an institution structure for supporting effective collaborations among autonomous agencies participating in an e-government initiative.
	(Medjahed et al. 2003b)	A detailed specification of an e-government service delivery system based on web services technology.
	(Ding, Sun & Hao 2007)	Proposes a method for web service emergence by designing a bio-entity as an autonomous agent to represent Web service. The proposal is in a very fine-grained technical and theoretical state.
	(Orriens, Yang & Papazoglou 2003)	They propose the construction of dynamically built business processes to compose web services. They analyze the basic elements in business modelling and how they relate to the web service composition process by introducing 5 composition phases.
	(Wong, Tam & Cheng 2006)	Purely describing the state of the technology with in the web services architecture and service oriented computing.
	(Beer, Kunis & Rünger 2006)	Technical implementation of a component base workflow management system for e-government procedures.
	(Bhattacharya 2006)	This book is pointing out the problem of technology misuse in government often as a fashion statement and advocating the proper use of appropriate types of technology based on scientific and experimental facts.
	(Hull & Su 2005)	Provides a brief tour of several composition models including semantic web services, the “Roman" model, and the Mealy/conversation model. In the context of technology stake and techniques.
	(Anthopoulos et al. 2006)	Very technical modelling detailed down to sequence diagrams.
	(Meneklis et al. 2005)	Web Services based platform that is built as a holistic service framework for the deployment and delivery of e-government enterprise services.
2- low level theoretical algorithms and argument on intelligent design of e-government	(Varavithya & Esichaikul 2004)	Intelligent Service personalisation techniques in aiding to improve the service usage experience by the citizen.
	(Sabol & Mach 2004)	An overview of ontology languages, formalisms for modelling web services, and frameworks and tools for Semantic Web Services.

	(Goudos et al. 2007)	This paper presents generic government domain ontology by defining a formal model for a Public Administration service on the basis of the Web Service modelling ontology.
	(Peng, Yanzhang & Xuehua 2006)	In this paper, techniques of Multi-Agent and computer supported cooperative work are used as the key technology to realize the integration among units at different levels.
	(Mugellini et al. 2005)	Purely technical implementation of an application called eGovSM based on the *"Marketplace"* metaphor, using a Document Engineering approach (based on XML Schema technology).
	(Luis Alvarez & Luis Anido 2006)	Generic technology and use of Life-event to over come inter- operability.
3- Conceptual integration of e-government from organisational view point	(Mecella & Batini 2001)	Argues to establish an overall architecture that coordinates information exchange among various government information systems while maintaining each organization's autonomy.
	(Lü 2007)	In this paper, a distributed information-sharing model is proposed and the technique standard support of the model is analysed.
	(Yu & Hu 2007)	Advocating that institutional framework could be re-designed to cater for conflicting objectives and facilitate the development and operation of E-Government infrastructure in a cost-effective manner.
	(Jeong, Gary & Ling 2007)	This case study discusses practical implications and suggests future research areas. Findings of the study include the alignment of technology and business processes.
	(Stojanovic et al. 2006)	The down side of ad hoc e-Gov service change management and how semantic technologies may improve this.
	(Dias & Rafael 2007)	Argues that Life-event can be divided to two implementations (weak and strong) and they have invented some requirements for each type.
	(Wetzel & Klischewski 2004)	They propose the combined use of a goal-oriented requirements language (GRL) and a scenario-oriented notation Use Case Maps (UCM) for representing design knowledge of information systems.

3. Industry Online Survey Analysis

Recent online industry survey by "DECIDE" laboratory in University of Technology Sydney (UTS) has gathered and analysed information from practicing software engineers, project mangers and developers to determine the common practices and tools used in performance of their jobs. This survey was designed to evaluate and compare the trend of academic literature with current industry practices. This survey was particularly interested in discovering the tools and methodologies used in web services integration for Service Oriented Development (SOD). It also determines how these methods defer from Object Oriented Development (OOD) methods. The information obtained in this survey is used to direct further research into development and fine-tuning of E-SIM process. Total of 40 survey participants selected from entirely different industries, areas of work and responsibilities within ICT. These organizations are as follows:

- Department of Education and training - state of New South Wales, Australia
- Attorney Generals Department - State of New South Wales, Australia
- Department of CentreLink - Australian Federal government
- IT Development and Infrastructure, KAZ group, Australia
- OPTUS - National telecommunication carrier, Australia
- Woolworth IT division - Retail industry, Australia
- Australian Administration Services (AAS) - Superannuation industry, Australia
- Genworth Financials - Investment banking industry, Australia
- ING Australia IT division - Insurance industry, Australia

The statistical graphs produced from the results of this survey are published at http://decide.it.uts.edu.au/home/Members/fsanati/. According to these statistics with the exception of few, seems that most of ICT industry in Australia is lagging far behind the most of the ideal software engineering practices. Statistical results of the survey points to a higher degree of methodological uncertainty and in some cases an experimental evaluation of deferent methodologies by the industry in order to find the most suitable one for their needs, even though in most cases such experiments prove to be a very costly practice. Followings are some statistics from the survey to illustrate the above facts:

- Close to 35% of participants believe their organisation is not following any specific methodology in software development.
- One out of 10 developers say they have no or very little documentation on their development practice.
- Where 57% believed their organisation is developing e-services only 4% were familiar with Service Oriented Architecture.
- Only 27% of the people who were developing web services were actually conducting interoperability analysis for service composition.

Brief analysis of aforementioned industry survey, specifically the last two points in conjunction with the literature review, are indicators of an urgent need for further research in the area of service composition. We specifically stress the need for more research on methodological modelling of Life-event and interoperability analysis.

4. Life-event Analysis & Modelling

This section is describing the approach and principles used for modelling Life-event. The phenomenon of Life-event is often described as guiding metaphor for customer-centric public service provision. However from e-government integration view, Life-event is a collection of actions including at least one public service, which executed in its designated workflow to fulfil request of a citizen arising from a new real-life situation (Trochidis, Tambouris & Tarabanis 2007). However this study argues that the requirements of Life-event as a workflow must be much more than the collective requirements of its individual components.

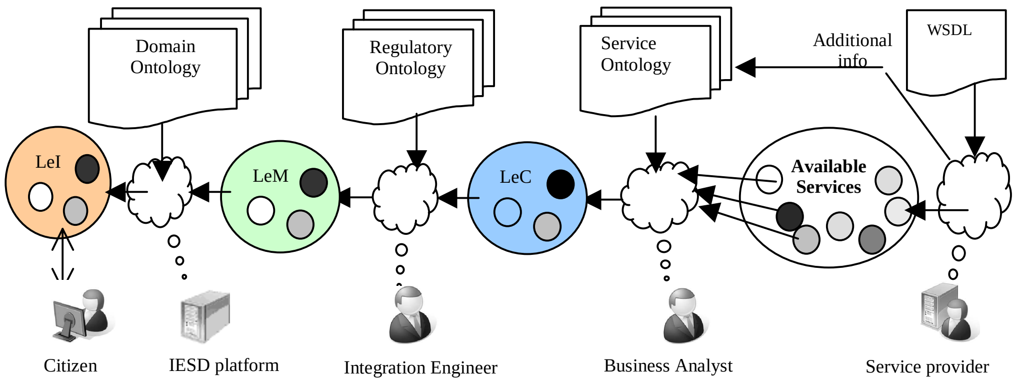
4.1 *Life-event Abstraction Concept*

It has been argued that classical software engineering processes such as Object Oriented Analysis and Design (OOAD), Business Process Modelling (BPM), and Enterprise Architecture (EA) frameworks are not well equipped to handle the analysis and design of service oriented semantic applications (Sanati & Lu 2007). This study is using the concept of abstraction borrowed from object-oriented paradigm used to represent complex data structures. Abstract objects or data structures can form hierarchical representations to provide easy to understand solutions for complex models. Abstraction is the means by which only certain level of details is exposed by the entity, depending on the level of representation intended for that model. This study invokes the principle of data abstraction in context of e-government service delivery integration to represent Life-event as a composite service in different levels of granularity, from very little detailed abstraction to higher level of details about its underlying service structure and business rules in deferent levels of granularity.

In order for atomic services to become available for a Life-event, they need to be registered in IESD platform. Service providers such as a government agencies or private businesses nominate their web services for Life-event participation by registering them. During the registration service owners provide additional semantic information about the nominated services to help construct service ontology in later stages. Stage 1 is the first level of Life-event abstraction and mostly reviles business related details and very little about its underlying technical structure.

In Stage 2 of Life-event life cycle, as far as an Integration Engineer is concerned Life-event must expose a greater deal of technical details in order to construct its workflow schema or what is called here Life-event Meta-model (LeM). Further to the left in Figure 2 we can see the *Dynamic Reasoner* component of IESD platform as another stakeholder in E-SIM process using additional information in form of domain ontology to perform rule base reasoning on a LeM and construct alternative workflow instances based on user preferences. *Dynamic Reasoner* must see every business rules and technical details of the life-event in order to be able to perform run-time reasoning, instantiation and execute of the Life-event Instance (LeI).

Figure 2 Life-event users perspective



From the integration point of view it is important to identify services and their attributes used in an SOA construct in order to drive Life-event requirements in smaller granularity. We proposed E-SIM process model in our prior work that incorporates essential additional tasks for optimising service integration projects, and our follow up publication

(Sanati & Lu 2008) explained the central role of Life-event specification in modelling composite services.

4.2 E-government Ontology Qualitative Criteria

Our view of Requirements Engineering definition for automated semantic software applications is slightly deferent than the one that is currently defined in most traditional development processes. Traditional software development processes more or less agree with Nuseibeh and Easterbrook (2004) stated: "The context in which RE takes place is usually a human activity system, and the problem owners are people". However there are increasing number of cases that other software components or remote systems are stakeholders. Therefore this study argues that there is a need to incorporate the semantic and ontology analysis in to RE for automated service composition projects, and to achieve that, first we need to understand the reasoning criteria that ontology should address.

This paper argues that ontology analysis (for example domain ontology) is an important activity prior to creation of LeI, as it enables the target system to define its own vocabulary based on existing domain concepts to enhance semantic interoperability, similar to the situation explained by Pan (2007). This study uses the Ontology Web Language (OWL) (McGuinness 2004) as the descriptor of such ontological catalogue to provide reasoning capability for *Dynamic Reasoner* engine. Government regulatory ontology is also one of the most important areas of ontological analysis discussed in this paper. These regulations organized in an ontological tree binding the semantic correlation of all requisite government regulations in order to achieve a correct order of execution and an acceptable legal outcome.

For the purpose of this research we would like to mention the related research work (Sabou et al. 2005) that suggests, all the various categorization of government related ontology seem to be falling into two main types each with their own requirements criteria:

1) Generic Ontology; this is a type of ontology to capture the domain independent aspect of Life-event such as workflow execution rules. They need to be rich axioms to facilitate creating formal descriptions for reasoning purposes.
2) Domain Ontology: This type of ontology contains domain specific knowledge that is used to complete the generic descriptions. The importance of this type of ontology is more evident when dealing with developments of automated composite services in a specific domain such as e-government.

4.2.1 Essential E-government Ontology Analysis

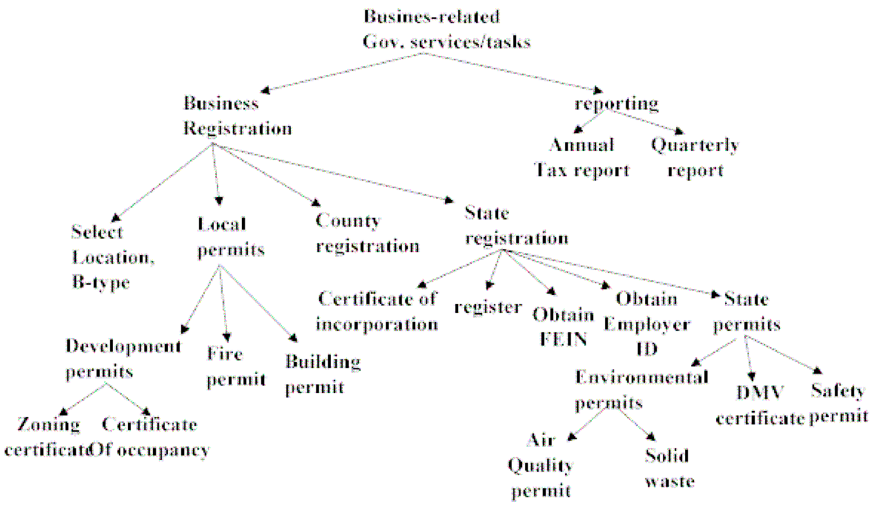
Our E-SIM framework is making use of three types of ontology analysis, in order to achieve more comprehensive requirements elicitation for modelling targeted life events:

1) E-government Domain Ontology is cataloguing semantic schema of government specific terms (i.e. technical or organisational). This type of ontology contributes domain semantic knowledge to Life-event requirements specification. The use of OWL profile to bind together service and domain ontology allows standard semantic searching by travelling throughout concept branches of particular domain ontological models (Bell et al. 2007). Semantic search over several models grounded in real world "things" provides a greater scope for matching to a requestor's concept.
2) E-government Regulatory Ontology; As it is strongly acknowledged by other research literature (Lytras 2006), the diversity of structures, regulations and procedures affecting networks of heterogeneous administrative units represents a challenge for semantic integration. Every service participating in any Life-event may

imply or be influenced by one or more regulation. Therefore this type of ontology seems to be specifically important for e-government service integration. Regulations are the governing rules of composite services, specifically because regulations are one of the integral parts of interagency processes (i.e. where Life-event process flow crosses multiple agencies). Ontology analysis of governing rules and regulations is an essential step towards better understanding of complexity of these rules in order to incorporate them into composite service workflows at their run time. Some earlier research literature have also acknowledged the importance of categorisation of such regulations in great details (Soon 2002). Australian government services are available in federal, state, and local levels, each enforcing their own regulations. Therefore regulatory knowledge required for designing an inter-agency workflow that crosses the boundaries of local, state, and federal agencies. Other research work have also acknowledged the importance of regulatory ontology (R. Holowczak 2001). A segment of regulatory ontology is illustrated in Figure 3.

3) E-government Service Ontology is required for building semantic web service descriptions, and to automate the acquisition of those services. It provides service specific semantic knowledge such as availability, service type, service profile, and required communication parameters to the run-time workflow construction process. All semantic information of every service are obtained and stored in the form of OWL descriptors. Service ontology descriptors could also connect to other ontology descriptors to obtain semantic information required by the workflow.

Figure 3 partial regulatory ontology constructs.



4.3 *Life Cycle of Life-event*

E-SIM requires Life-event to go through three distinct stages in its life cycle before reaching the service consumers. These three steps are summarised as follows:

- *Stage 1:* LeC is proposed and service ontology is created within the scope of the candidate. Requirements of this stage consist of participating service specifications, Quality of Service (QoS) requirements (i.e. WSDL) and complementary semantic information about the service. These information is needed to form an ontology schema. The main stakeholders of this stage are:

a) Web Service providers (Web Service owners),
b) A business analyst that creates the first level abstraction of a Life-event. Outputs of this stage are: LeC and service ontology schema.

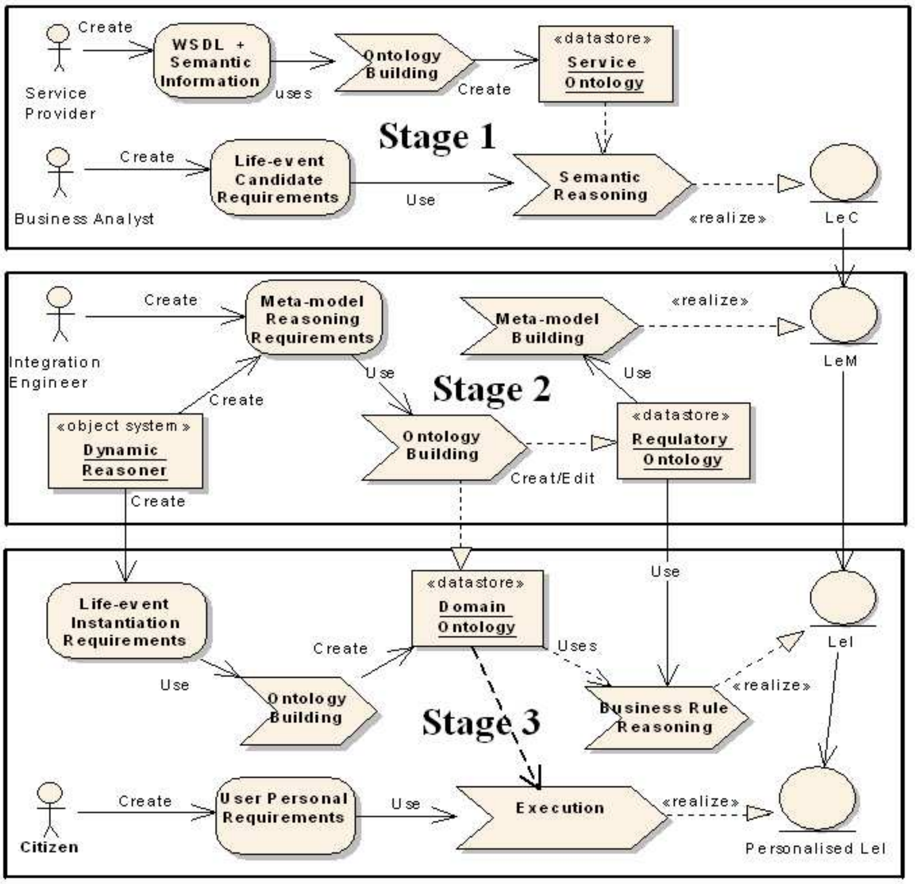
- *Stage 2:* In this stage LeM is created based on LeC specification from Stage 1. Requirements of this stage are:
  a) Regulatory specification that provides the governing rules for the workflow of LeM,
  b) Flowchart of the LeC runtime workflow. One of the main stakeholders of this stage is an integration engineer that performs analysis and modelling to create the second level abstraction of a Life-event. The outputs of this stage are regulatory ontology schema, and the Meta-model specification called LeM.

- *Stage 3:* This is the Life-even execution stage; in this stage the third level abstraction of Life-event is created. Executable Life-event Instance (LeI) is created based on its LeM upon Life-event consumer request. One of the important stakeholders of this stage is the *Dynamic Reasoner* component in IESD platform. This software component has great interest on reasoning upon regulatory ontology in order to deduce the alternative logical execution pathways. The requirements of this stage consist of but not limited to user preferences data, domain information, and QoS. The input of this stage is Meta-model specification from Stage 2 and domain ontology schema that is required for run time reasoning. The output of this stage is a personalised executable instance of the LeM.

Three stages of E-SIM model illustrated in Figure 4 demonstrates the logical life cycle of Life-event from candidate initiation to the proposed Meta-model and execution of the Life-event instance, separated in deferent levels of abstraction. This model displays different types of stakeholders and their requirements, also demonstrates how could a software component or a remote system (i.e. *Dynamic Reasoner)* become one of the main stakeholders of the system. Interests and expectations of this type of stakeholders are determined by the specific task assigned to them in every stage of Life-event life.

Requirements engineering process within E-SIM is of control-oriented type. This method emphasizes on synchronization, deadlock resolution, exclusion, concurrency, and process activation & deactivation (Thayer & Dorfman 1977). This study found flowcharting to be the best suitable modelling techniques to model the requirements of predictive and process control oriented applications.

Figure 4 E-SIM process for Life-event Life Cycle



5. Life-event Design and Implementation

The cost of data and process integration has always been one of the well-known obstacles of service integration. We propose an automated dynamic process to enable a gradual integration of government services in an intelligent way. This is important especially because the system would not know for example: what services are available prior to the construction of LeI at run-time. Automated nature of E-SIM is intended to reduce the cost of data and process integration by allowing gradual and incremental integration of web services in to IESD platform, where government agencies can decide when and which web services to integrate.

5.1 Integration Automation Design

There is a narrow but fundamental deference between the implementation of traditional software and the implementation of Life-event. A Life-event is not just another software written in a certain language then tested and installed for the end-user. As we discussed earlier Life-event is a description of the mechanism of how to assemble a composite service from already existing web services, although it would require testing and delivery.

A unified and repeatable e-service composition methodology must make use of the best practices of modelling techniques to increase its reusability in deferent scenarios even if scenarios are in deferent domains. We also argue that the goal of modelling and design in e-service integration must help the visualization of Life-event technical design. This design document clearly describes the specification of Life-event candidate for the delivery platform to create a Meta-model and consequently an executable workflow (LeI). Some research suggests that workflow modelling and design could further be divided in to two stages of generation and specification. However workflow specification and generation model described by (Liu, Husni & Padgham 2007) are only suitable for statically designed workflows. They are only generated at compile time (not in run-time), where as the model proposed in this study including our prior publication (Sanati & Lu 2007) allows for designing Meta-models, which then instantiated by an intelligent *Dynamic Reasoner* engine, resulting in one or more alternative instances.

Designing predicative applications that could make independent decisions or provide effective information for humans to make such decisions requires the use of specific design & modelling techniques. Predicate calculus is one of the best design tools for formalizing ontology and deriving intelligent algorithms. OWL has proven to be a very powerful tool of this type, enabling semantic reasoning in web applications. OWL currently is the main technology for implementing semantic web applications, therefore the capabilities of semantic software engineering (Sheu & Kitazawa 2007) are required to handle semantic reasoning design problems.

5.2 Meta-modelling Technique

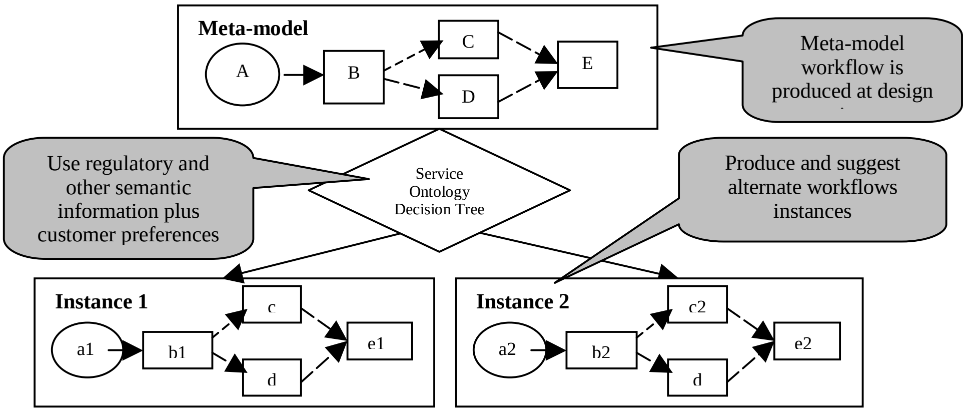
Our design strategy is to facilitate seamless evaluation of the composition candidates (atomic services) to improve compose-ability for run-time workflow construction. A Meta-model workflow indicates the type of an atomic service to be used in the composition process as well as the order of execution. The specification of the instance of individual services will be configured dynamically at run-time. Dynamic reasoning engine of IESD platform can use available semantic information to decide which specific service can be used at run-time, given the customer requirement parameters and current state of execution.

Design specification of dynamic workflow models differ from those of static models, where in designing a dynamic workflow model the designer is to produce a model that only describes the type of the services, their regulatory rules, and the order of execution. Where as static models are designed and assembled in compile-time, this means that they can’t be changed, repaired or replaced at execution time. A dynamic workflow model, which is called Meta-model retains semantic information that dictates the terms and conditions of the Life-event execution. It determines if it is the right time to execute a particular service and how the results of its execution would affect the overall state of the Life-event workflow. The Meta-model is instantiated by the *dynamic Reasoner* component to generate executable instances of Life-event (LeI) suitable for different scenarios.

The diagram in Figure 5 illustrates a Meta-model and its run-time instantiation by IESD platform. Our top-down approach in this stage will require us to elicit a Meta-model from a proposed LeC. E-SIM process uses Meta-model mechanism to instantiate and executes a specific Life-event on demand based on service user (i.e. citizen) requirements and availability of atomic services. Government regulations are the main contributors to the execution order and runtime specification of LeM and LeI, therefore E-government service integration must pay specific attention to the use of ontology regulatory rules.

Life-event as a unit of requirement plays an important role in validating the specification and design strategy in E-SIM. This strategy is making use of Life-event concept as a fundamental unit of requirements for dynamic web services composition. Dynamically configured composite services then can be executed using an intelligent composite service delivery platform called IESD.

Figure 5 Composite e-service execution Meta-model



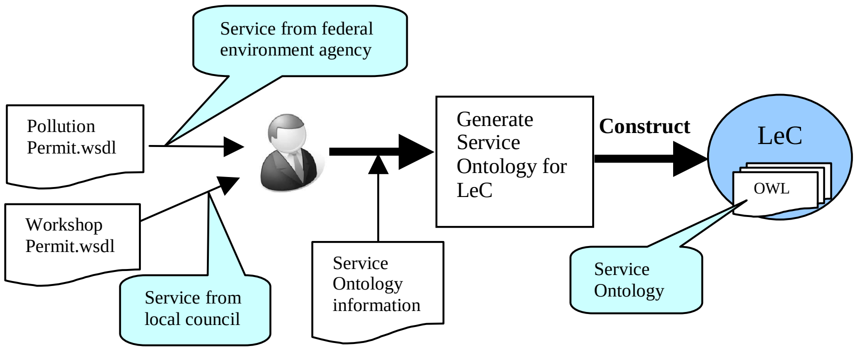
6. Life-event Implementation Example

In this section we explain a practical example of using the three stages of life-event life cycle that is also illustrated in Figures 6,7 and 8 from technical viewpoint. This section demonstrates how our proposed IESD platform facilitates the voluntary participation of government agencies by nominating their already developed web services. Then a Life-event candidate is proposed based on availability of existing services then a generic workflow called Meta-model is designed to represent a lower level abstraction of the candidate Life-event, and finally the meta-model is instantiated and executed based on the citizen request and preferences. The example in Sections 6.1 through to 6.3 illustrates the Life-event life cycle of “apply for workshop permit” for a panel beater shop.

6.1 LeC Proposal

Prerequisite of starting the process of creating a Life-event is the simple fact that government agencies must have nominated their web services for participation on this process. Diagram in Figure 6 illustrates the example of how a business analyst is performing a fusion of static data provided by WSDL and semantic information in ontology catalogue to construct a LeC for “apply for workshop permit” in OWL format. In this example system user (business analyst) who is acting as LeC designer, interact with the IESD platform to combine 2 web services provided by local council and federal environment agency to propose a LeC. He combines the syntactic information from WSDL with semantic information to produce an OWL document that wil be used as the life-event service ontology.

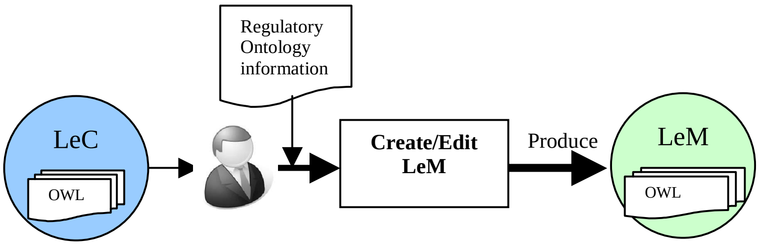
Figure 6 Service ontology and LeC construction



6.2 LeM construction

According to the E-SIM framework next stage is to design a Life-event Meta model. In this activity, an integration engineer interacts with the IESD platform to construct a LeM. This activity heavily relies on regulatory ontology and the LeC specification data produced in Stage 1. Figure 7 illustrates the activity where an integration engineer is to create or edit the Meta-model using automation functionalities available in the IESD platform.

Figure 7 LEM creation and editing

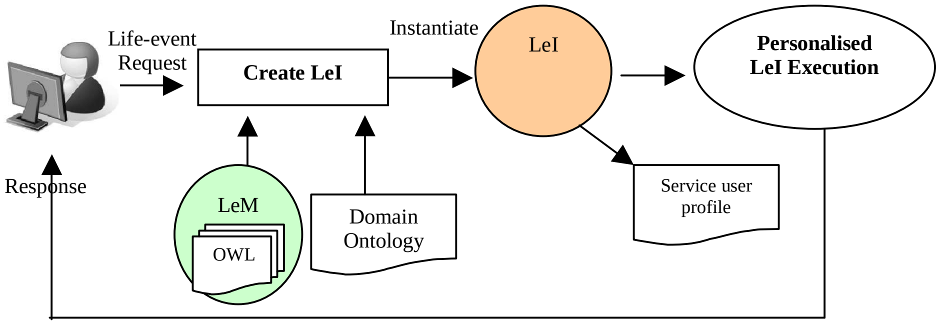


6.3 LeI Instantiation and Execution

The final stage of Life-event life cycle is illustrated in Figure 8, where e-government service users request the execution of a Life-event. In this stage the IESD platform analyses the user's life-event request specifications in conjunction with LeM workflow requirements and domain ontology specifications to deduce the execution decisions. In this stage:

1) Appropriate available services are selected,
2) Regulatory rules are applied and,
3) A Service user profile is constructed in order to instantiate and executes a personalised composite service workflow or what we call here "Personalised LeI".

Figure 8 Runtime workflow construction and LeI execution



7. Discussion, Implication and Conclusion

The main motivation for this study have raised from the question that, why governments are so slow in response to the necessity of service delivery integration in order to avoid the information overload and duplicate services resulting in wasted effort and resources? Our ongoing literature review including this paper and industry survey have pointed to some interesting facts that have led us to some possible answers to this question, thus leading to our suggested solution. This study pointes out that the lack of unified common practices for e-service composition projects is clearly visible in e-service development research domains, and consequently e-government service integration is particularly suffering from this problem. This study proposes the evolutionary concept of using Life-event as abstract unit of requirement for composing e-government services, and introduces a model that illustrate the roll of Life-event within the process of e-government service composition. One of the main proposes of this paper is to critically analyse the current trend of service integration modelling techniques to support the argument, that some service integration practices and classifications of e-service composition strategies are not covering all aspects of service oriented design paradigm. However, the main target of this paper is to illustrate the practical implications of using Life-event as an abstract unit of requirements in service composition projects specifically in e-government domain.

The scope of this study does not include the mechanics of internal management of e-government services and organisational implication of implementation this study. It also does not deal with the question of, how and which government body is going to manage the implementation of such solution. The approach used in this study is not limited to suggesting only some enabling tools and technologies but also to introduce an innovative approach towards the whole process of e-government integration. E-SIM is an e-service integration model capable of solving the e-government integration problem in a methodological and gradual manner, therefore responding to the problem of managing the participation complexity of many different government bodies in integration solution.

However we recognise that more research is required to specify the types and the details of documentation for our proposed model. At the other hand in addition to modelling and implementation of ontology applications, future research will also be needed to focus on how semantic attributes of service components can be technically modelled. Such model deeds to be expressed in service descriptors in order to enable automatic discovery, integration, reasoning and verification of services using regulatory, domain and service ontologies.

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