

# Combination of Interoperability Registries with Process and Data Management Tools for Governmental Services Transformation

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## Abstract

*Digital government applications are providing more and more electronic services on-line, for citizens and businesses worldwide. However, the new services are in many cases an exact electronic equivalent of existing manual services, thus failing to significantly reduce administrative burden and provide the promised productivity gains – both for the administrations and the final users.*

*Interoperability Registries, as fully electronic repositories of the flow, the input and output documents and relevant standardization, pose as an infrastructure that can support electronic services composition and publishing. In the presented approach, the use of such registries is extended to cover the optimization of manual or electronic services towards citizens and businesses, through the use of Business Process Management and XML Authoring tools.*

*Going beyond the current state of the art, the approach implies a model-driven transformation of service provision. The resulting infrastructure can then become a ubiquitous system, supporting service composition, automated execution and optimization.*

## 1. Introduction

Common repositories of definitions and standards for electronic government have been attracting more and more attention during the last years, in an effort of administrations to create and share semantically rich information on services and documents. Such repositories are usually prescribed by eGovernment Interoperability Standards and Frameworks [12] or Government Systems Architecture definitions [30], in the form of infrastructures assisting the definition of truly interoperable, one-stop services.

However, most such infrastructures currently play the role of information containers for the definition and retrieval of XML data templates, failing to effectively assist in service transformation and execution. Based

on recent analysts' reports, Interoperability Registries have to play a more active role in service execution within the oncoming landscape of new eGovernment services [11]. In the present paper, new, high quality e-Government services are perceived as efficient, one-stop services provided through multiple channels and with the minimum resources, information requirements and cost for all the stakeholders (i.e. citizens, businesses and public organizations)

Furthermore, Interoperability Registries, if extended to include formal ways of describing and restructuring governmental processes, can also assist in the transformation of services provided to citizens and businesses, from manual to electronic [18], [23].

In the present paper, an approach for combining the descriptive power of Interoperability Registries with Business Process Management and XML Authoring tools is proposed, filling the gap between static representation of services and dynamic, automated service transformation. The core ingredients of the proposed approach lie in the utilization of Interoperability Registries as the cornerstones of service and document definitions, to be constantly available within the whole public sector, coupled with:

- Tools for the formal modeling of the process flow that is behind each service provision, in Business Process Modeling Notation (BPMN) format [25].
- Tools for the coordinated management of data definitions, allowing for the incorporation of UN/CEFACT Core Components Technical Specification (CCTS) methodology and available, reusable components [34], in an effort to provide common, standardized definitions across hundreds of governmental service forms and documents.
- A step-by-step method for utilizing the provided systems, towards the managed transformation of services and documents.

The structure of the present paper is as following: Section 2 describes the current state of the art in eGovernment registries, analyzing the main elements contained in most implementations worldwide. Section 3 presents the proposed extension of the registry functionality towards service transformation and the underlining methodologies and tools. Application scenaria are presented in Section 4, providing extensive information on population and usage of the Greek Interoperability Registry. Conclusions upon the merits and limitations of the approach, as well as next challenges to be tackled are contained in Section 5.

## 2. The Ingredients of Interoperability Registries

The need for Interoperability Registries was first recognized in the area of eBusiness [10]. The most well-known initiatives in the field, ebXML [9] and RosettaNet [27], present today a series of success stories in their portfolio, propose solutions and set guidelines in an environment with many similarities compared to eGovernment.

In eGovernment, implementation standards for eGovernment Services are specified and guided by eGovernment Interoperability Frameworks (eGIFs). However, interoperability registries, although necessary for eGovernment adoption [18], [8] have not been effectively supported and tend to focus only on the semantic aspect of interoperability with XML schemas for the exchange of specific-context information throughout the public sector within the country borders without dealing with service descriptions or web services deployment. Current frameworks in this direction are [12], [36]:

- In the United Kingdom, the e-Government Interoperability Framework [3] and its relevant specifications (e.g. the e-Government Metadata Standard [4] and the Schema Guidelines [5]) as issued by the e-Government Unit are supplemented by the GovTalk XML Schema Library [6] with approximately 78 XML Schemas (coming up to 102 with all versions taken into account).
- In Germany, the Standards and Architectures for e-Government Applications (SAGA) [19] by the KBSt will soon be accompanied by XRepository, a registry that will contain a small number of XML Schemas and a set of more than 50 codelists.
- In Denmark, the latest version of the Interoperability Framework [21] has been

released by KIU since 2006. InfoStructureBase [20], the Danish collaboration tool promoting interoperability, includes an international standards repository containing business process descriptions, datamodel descriptions, interface descriptions, complex XML schemas and schema fragments (information objects) from public and private organizations and an UDDI repository containing information on web services.

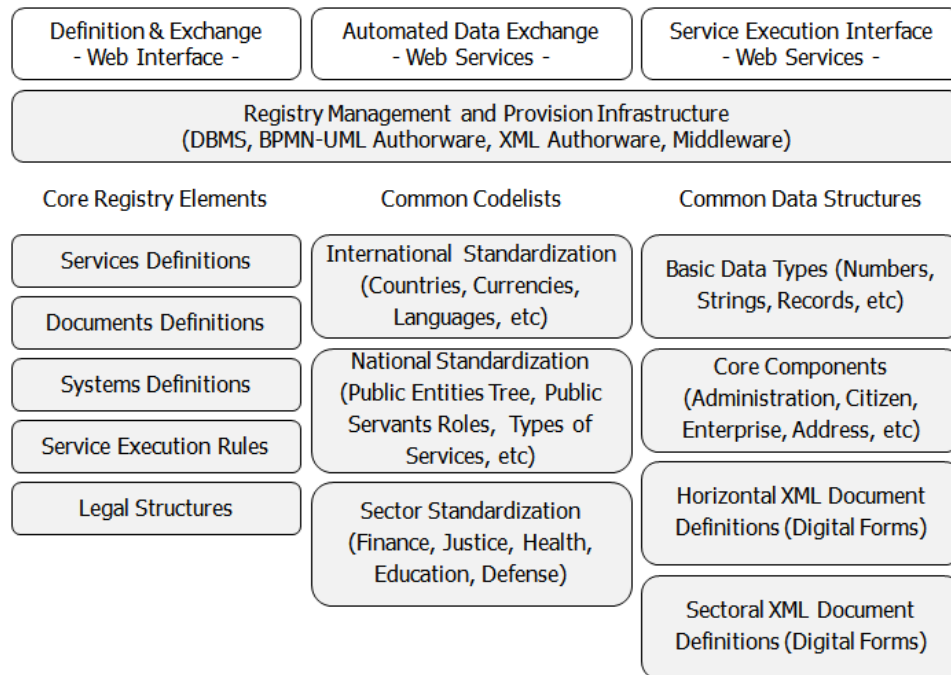
- In Hong Kong, the Information Technology Services Department (ITSD) (The Government of the Hong Kong Special Administrative Region (HKSAR)) has established the HKSARG Interoperability Framework (Version 5.1) [13] and publishes Common Schemas on the XML registry [14].
- In Italy, Arianna project [2] has defined an ontology for e-Government public services and deployed a repository containing service descriptions mainly at local level.
- At a pan-European level, the European Interoperability Framework [15] which is currently being revised by IDABC [11] is met. As far as the Semantic Interoperability aspect is concerned, EU-Project SEMIC.EU (Semantic Interoperability Centre Europe) [29] has also been launched in order to support the data exchange for pan-European eGovernment services. A Working Group in CEN/ISSS [7][28] has also been established in order to investigate the discovery and access to eGovernment resources, yet its results are under preparation today.
- In the United States of America, the National Information Exchange Model (NIEM) [24] is designed to develop, disseminate and support enterprise-wide information exchange standards and processes that can enable jurisdictions to effectively share critical information in emergency situations, as well as support the day-to-day operations of agencies.

As depicted in Figure 1, an Interoperability Registry that can support service transformation and execution should consist of:

- A Database Management System handling the transactions with the data storage level
- A Business Process Management Suite supporting service modeling in BPMN and / or UML notations, as well as service simulation

- An XML Management and Authorware Platform for the formal documents' and messages' definitions in XML.
- A Web Interface for the definition and the presentation of eGovernment knowledge.

A middleware infrastructure that provides the functionality of automated exchange of eGovernment knowledge between information systems and supports the service execution at runtime with the help of the web services technology [26].



**Figure 1: The Contents of the extended Interoperability Registry**

The contents of the Interoperability Registry extend over:

- Core Registry Elements including services, documents and systems definitions, service execution and legal rules. Such elements are detailed according to their particular nature [22] on the basis of metadata schemas, like the Dublin Core.
- Common Codelists that include predefined values to be communicated and be mutually understood among information systems. Such codelists originate: a) from international standardization organizations, such as the ISO 3166-1 country codes [16], the ISO-4217 as the currency code list [17], the UNECE Units of Measure used in International Trade [35], b) from national standardization efforts, targeting, for example, at public entities, service types, government category list (GCL), c) from

vertical standards in sectors, such as finance, justice, health, education and defense.

- Common Data Structures harmonizing governmental documents and promoting reuse of existing libraries and internationally accepted standards (i.e. the UN/CEFACT Core Components Technical Specification, also known as ISO 15000-5 standard [34]). Managing and transforming such governmental data structures involves not only horizontal and sectoral XML Schema definitions, but core components as generic data components and their core data types, as well.

The gaps in the current state of the art presented in this chapter that the proposed approach for eGovernment Interoperability Registries attempts to fill mainly lie in the adoption of the service-oriented or follow-the-service approach, in the parallel exploitation of BPM and XML tools along with the registry and in the binding between service and

service-relevant definitions, workflow models and execution approaches.

### 3. Interoperability Registries supporting Service Transformation

In order to achieve the vision of one-stop service provision, most governmental administrations need to perform some kind of transformation in their services, an activity that usually happens in parallel with the digitization process. Usual objectives for service transformation include the embellishment of organizational, semantic or technical interoperability, within the provision of such services. In parallel with this transformation need, most administrations in European Union currently implement specific projects for the reduction of administrative burdens and minimization of overall service cost for administrations and users [33].

Within this framework, Business Process Management (BPM) has been a recent trend in public administrations worldwide, following a relevant adoption by large enterprises. Although BPM in enterprises has enough challenges, its application in public sector processes reveals important specificities and issues that need to be tackled, as:

- Public sector organizations offer a large number of service types, usually being at the range of a few thousand, if we count local, regional and national level administrations. Furthermore, the documents needed as inputs, or are produced as outputs of the above services (applications, certificates, permits, etc), are also counted at the range of several thousand [30]. These vast numbers of processes and documents exceed any relevant complexity usually found in private sector enterprises and require much more efficient management mechanisms.
- Business Process Reengineering (BPR) in public sector organizations has to follow “longer and deeper circles”, since the time needed for adoption and application of changes is usually larger than in a private sector enterprise. This is shown by rates of governmental projects that fail, when time is limited or management systems cannot support this need for constant change [28].
- Legal issues have often to be considered when a significant process change is to be performed in a set of public services, requiring the interconnected management of the legal

elements and structures that affect the targeted services.

Based on the above, there is a need for systems that can support the inherent complexity of public sector processes, provide for constant management of the process steps and documents, together with all the related information concerning legal issues. This is why an Interoperability Registry, by nature providing global and interconnected information on services, documents, organizations and systems is an important asset for service transformation.

#### 3.1 Registry-driven eGovernment transformation methodology

For the transformation of governmental services, processes and documents, a multi-phase methodology is proposed, that will ensure proper information flow among diverse stakeholders, such as public sector administrations at national or local level, eGovernment practitioners and consulting firms. In this method, as depicted in Figure 2, the Interoperability Registry serves as a ubiquitous infrastructure for storing and retrieval of standardized components. The phases of this approach cater for initial modelling, transformation and final (re)implementation of the needed software elements, as described in the following paragraphs.

##### Phase A: Modelling

In this phase, the processes and documents behind the execution of each service are being modelled. Formal methods and tools used at this phase can be selected from a large variety of existing standards, but BPMN and Unified Modelling Language (UML) Activity, Class and Sequence Diagrams are certainly prevailing notations used for analytical process and data models. Important methodology elements in the modelling phase are the following:

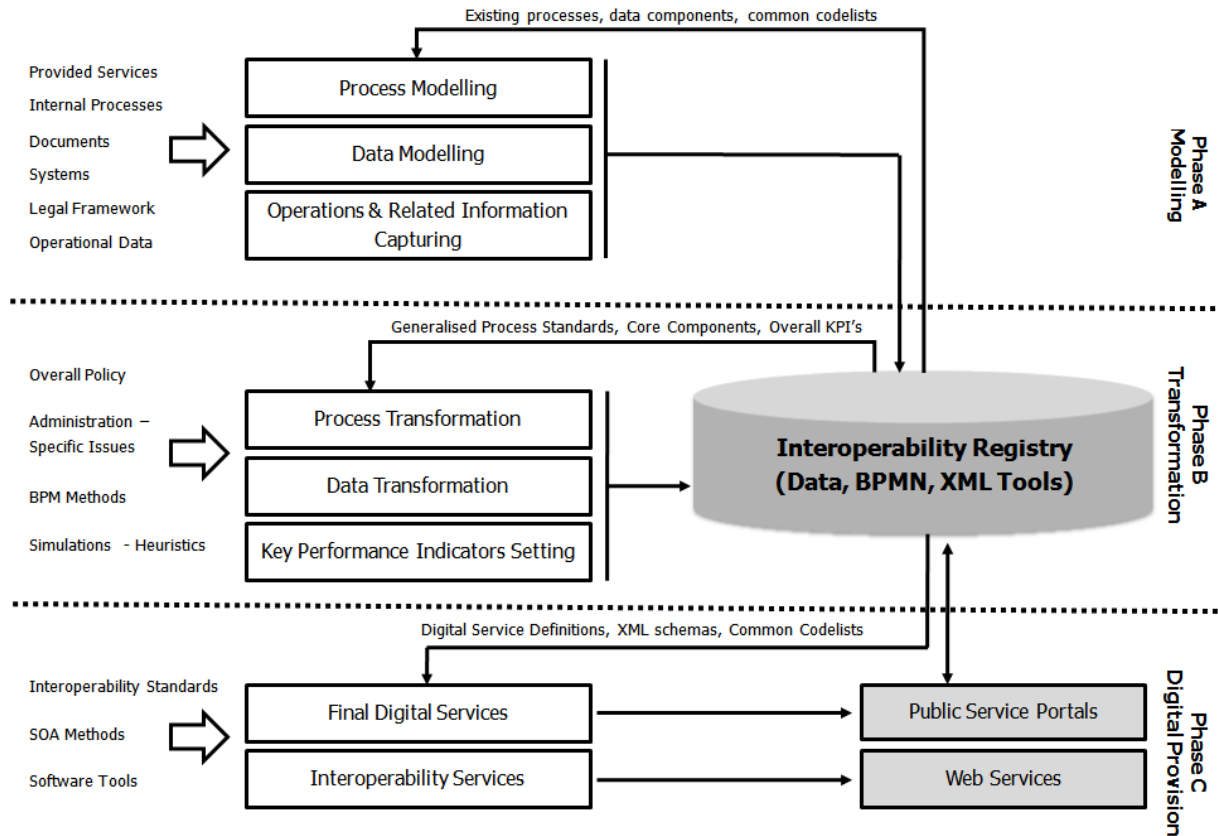
- i. Since a service to be modeled might already exist in the registry, a query is done before any modeling step is performed. The same applies for documents modelling, as many forms are common across public sector organizations. All the metadata information contained in the registry, as described in Section 2, plays an important role when searching for process or data components.
- ii. When a service cannot be located as existing, a new model is created, depicting the “as-is” status. In this modelling activity, all existing elements have to be properly reused or interconnected with the new process or data

definition (e.g. inserting a new swimlane in a BPMN diagram for an administration usually implies just selecting the pre-existing administration from the registry data base).

- iii. When a governmental document does not exist in the registry, the document is modelled, using UML Class Diagram notation, at field level.
- iv. Additional information is inserted for the service or document being analyzed, so as to

assist proper categorization, interrelation with existing elements and retrieval.

- v. Additional metadata information is entered for the context of the service or the document, if that context is not already modelled and existing in the registry (e.g. information on providing administrations, systems, legal elements, etc.)



**Figure 2: Registry-driven Process and Data Transformation**

- vi. Finally, operational information on the service is entered in the proper registry data containers: service frequency, service or activity effort needed by the administration or the citizen / business, other costs to be covered by the administration or the users of the service. Such elements will then be very valuable in the transformation phase.

At the end of Phase A for a process or document, the registry contains all the necessary “as-is” information for that element and its context. This information is already of high reusability for the whole public sector as, through the registry publication

mechanisms, can now reach every administration or practitioner willing to find information about that, either for transforming it, using it as a pattern or even using it for composing higher level services to be offered in a manual or digital manner.

**Phase B: Transformation**

In this phase, the already modelled processes and documents, together with their corresponding descriptions and metadata, can now be shared with a variety of stakeholders within the public administration aiming at somehow modifying or transforming governmental service provision. The usual objectives

of this phase are either the transformation of a manual service to digital (achieving a level of on-line sophistication, typically from 1 to 5), or the improvement of the service, by means of reducing the overall cost, reducing citizen input through enhancing interoperability within the public sector systems.

In any case, the Interoperability Registry is providing patterns and guidelines for systematically transforming service and document definitions, while also giving all the necessary contextual information on organizations, legal issues or technical standards. As shown in Figure 2, typical steps in the registry-driven transformation include:

- Altering a process, by applying BPR methods or heuristics – e.g. for the reduction of unnecessary activities, minimization of citizen turnarounds, minimization of queues and bottlenecks.
- Modifying data definitions, by means of applying the UN/CEFACT CCTS methodology for creating ubiquitous descriptions of core data elements, or reusable Business Information Entities – e.g. for having a unique definition of the address, across all public documents and forms.
- Setting Key Performance Indicators (KPI's) on services or public organizations, that will be used as decision making factors for later transformations and alterations.

The contribution of the Interoperability Registry in service and document transformation is also greatly assisted by its ability to provide quick and systematic answers to a large number of complex queries, such as:

- Which are the most important services, regarding their frequency and overall effort and cost for the administrations or the citizens?
- Which are the most needed services by other services?
- Which are the needed documents and their XML definitions for issuing environmental permits?
- Which services pertaining to civil registries are already electronic at level 3 or 4?

But, most importantly, a ubiquitous registry is providing all the needed information on the current status of services for all public sector organizations, that as soon as it is also organizationally feasible, it allows transformation to be a coordinated task and not an isolated attempt for each organization or unit.

### **Phase C: Digital Provision**

This phase of transformation relates to the reorganization of a process and to the development or modification of the necessary software and hardware components, in order to achieve digital provision of a service towards citizens or businesses.

Through having a formal description of all the service steps within the registry, but also already “solved” digitization examples of service of the same category (e.g. environmental permits), stakeholders and practitioners can now have a systematic foundation for achieving correct transformation of a service into its digital equivalent.

In order to support this phase, the Interoperability Registry provides access to already made XML schemas or reusable components for the creation of electronic documents, atomic Web Services, already operating within public administration, to support complex service creation and so on.

The resulting, newly created electronic services, Web Services or XML descriptions are, apart from implementing the real service execution through governmental portals and gateways, incorporated again in the registry for further usage.

## **4. Implementation and use**

An extended Interoperability Registry [37] has been developed and applied within the Greek eGovernment Interoperability Framework. The architecture that implements the Interoperability Registry comprises of three layers: (a) the Web-based and UDDI (Universal Description, Discovery and Integration) interfaces for various groups of users, (b) the tools layer including ontology management, process and data modelling and (c) the information repository for interconnected data elements, process models, XML schemas and Web Services descriptions. These three layers are integrated through a relational database engine (based on Microsoft SQL Server) and common access control and application engine integrating the tools level with the various interfaces.

The front-end components are as following:

- The Interoperability Framework Web Site found within the Greek eGIF Web Site [32], which publishes the various documents of the eGovernment Framework but also gives access to citizens and businesses for publicly available data.
- The Services Registry, accessible to authorized users that gives access to the Registry Tools

(meta-data management, process and data modelling, complex queries and reports).

- The Registry UDDI interface, where administrations publish their Web Services or find existing, available Web Services to use through their information systems, constructing truly interoperable, one-stop services.

The Tools layer comprises:

- The process modelling facilities, based on ADONIS modelling engine [31]
- The XML Management facilities, based on ALTOVA XML Authorware [1].
- The custom-developed ontology management, data entry and reporting tools that integrate all representations and models.

Finally, the Data Storage layer incorporates a database for all instances of eGovernment elements, Service descriptions in Web Services Definition Language (WSDL), process models in BPMN and various XML schemas.

**Table 1. Elements of the Interoperability Registry in Greece**

Entity	Population
Public Administration Organizations	1,797
Services Definitions	1,009
IT Systems Definitions	76
Service Types	11
BPMN Models for Services	321
Web Services Definitions	35
Government Category List	166 service categories
Documents Definitions	1,106
Document Field Definitions	1,434
XML Schemas for Documents	169
Core Components	36
Business Information Entities	109

#### 4.1 Population of the Registry

Initial Population of the Services Registry has been greatly assisted by the existence of data in electronic form, through the Greek Ministry of Interior and was achieved through the following automated and semi-automated activities, summarised in Table 1:

- Automated import of 1,797 public bodies including ministries, prefectures, districts, municipalities and public sector organizations.
- Automated import of 1,009 governmental service definitions, with core metadata descriptions and frequency indications, stemming out of 3,000,000 service requests by citizens and businesses during the last year
- Analytical modelling of 321 governmental services in BPMN models (including all i2010 services and the services amounting to 95% of the yearly service requests). For more than 100 governmental processes, transformational scenaria have been created, with standardized digitization steps (creation of web services, organizational and semantic interoperability guidelines).
- Analytical modelling of 1,106 documents, at field level, resulting in the identification of more than 1,000 different field types.
- Design of more than 200 Business Information Entities, Core Components and XML schemas for governmental documents, following the UN/CEFACT CCTS methodology. This process involved transformation and unification of data elements, so that unique definitions now exist in all XML documents for 109 reusable Business Information Entities (e.g. person, address, organization, enterprise, etc).

#### 4.2 Application Scenaria

A version of the proposed Interoperability Registry has been applied for the last two years within the Greek Public Administration. Experience shows that this enhanced registry can serve a variety of usage scenaria, as depicted in Figure 3. Being available through the governmental service gateway (the Greek HERMES portal) the Greek Interoperability Registry can support the following needs:

- Service discovery, acting as a unified but federated global directory for all manual or electronic services at local, regional and national level.
- Service execution, by providing codelists for common values, to be dynamically bound with electronic forms during service provision.
- Service or data transformation, including complex services composition, through the

provision of ready-made templates, standard definitions or guidelines.

Service interoperability with registries deployed in other countries with a view to facilitating the pan-European e-Government Services (PEGS) design and provision, through the registry's middleware infrastructure.

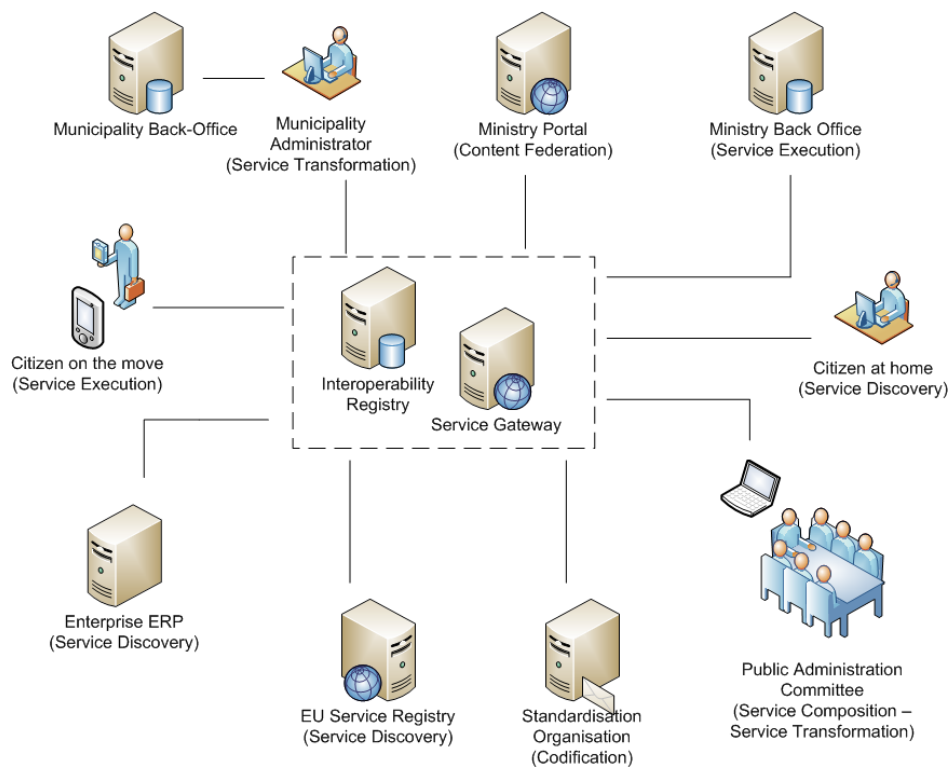
## 5. Conclusions and Further Work

The presented methodological framework focused on the key challenges of unified process and data management and transformation in eGovernment, for

the provision of interoperable, one-stop shop services to citizens and businesses.

Utilizing practices and standardisation from the eBusiness domain, the presented approach is claiming novelty in conceptualization and overall coherence in the eGovernment domain, being one of the very first approaches internationally to bring the power of BPMN and UN/CEFACT CCTS structure into a real-life application.

Applied at large scales within the Greek eGovernment Interoperability Framework, the approach presents a sound collection of reusable principles and tools for other Governments and practitioners of the field, as following:



**Figure 3: Interoperability Registry applications in eGovernment**

- An overall approach compatible with national eGIFs, going beyond paper-based standardisation to live systems and service / document Interoperability Registries.
- A concise methodology to tackle the problem of creating unified, structured XML schemas and coherent service descriptions for Governmental documents and services, respectively.
- Standardised Core Components, reusable BIEs and XSD files, reusable Service definitions and patterns, freely available within the Greek Interoperability Registry.
- More than 10 adopted or developed standard codelists for the most common values appearing in public forms and documents.
- A set of prototype tools that can be adapted to other cases and Governments' needs.

Problems faced during implementation and application were not trivial and have to be taken in mind during relevant attempts by government officials and practitioners. Tools development or integration is usually such an issue in relevant attempts, the present one not being excluded from this de-facto rule: significant effort has to be devoted to the development of the registry application that forms the central repository for governmental services and documents – as no commercial, ready to apply tools are generally available. Furthermore, integration of enterprise modelling tools and XML authoring tools with the core registry should be performed with caution and supported by high-level technical support from the vendors. On the metadata creation field, language issues are extremely important as all the relevant descriptions should be in local language – for the government officials to understand, modify and approve) and at least in English (for easiness of communication with other governments and practitioners). One of the best ways to tackle this requirement is the creation of a glossary early in the process. Finally, adequate time and effort should be spent for communicating and working together with government officials at various levels, since resolving organizational and legal issues is a strong precondition for the actual agreement on the schemas and for the final adoption of the registry.

Future steps of the team in the direction of the presented approach and also within the adoption phase of the Greek eGIF, are the following:

- Tackling of the legal issues for the formal adoption of the new electronic documents in everyday practice, since most of the governmental services are ruled by specific laws and decrees – a case which is common in many European countries. Towards this goal, the legal elements ontology (already defined in the Interoperability Registry [37]) has to be fully populated with all the legal elements affecting and ruling services and then processed by mixed teams of public administration legal counsels and modelling engineers.
- Further applications of the transformation steps, in order to cover more services and documents, as still a fraction of the existing manual services and their documents have been modelled. This task is specifically going to interfere with the so-called “vertical standards”, that is document standards for Health, Banking, Telecommunications or Defence.

- Extension of the collaborative and participative functionalities of the Interoperability Registry, in an effort to accommodate the work of several committees in an electronic, ubiquitous platform.

Finally, application of the methodology has already been agreed with the Lithuanian eGovernment Interoperability Framework and discussions are being held with a number of European Union and Associated countries governmental organizations – in an effort to further adapt and test the principles, the tools and the assumptions.

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