# Παράρτημα Ι:

# Ολοκλήρωση και Διαλειτουργικότητα στην Ηλεκτρονική Διακυβέρνηση: Επισκόπηση Πεδίου

**Τμήμα Διδακτορικής Διατριβής**

**Επιχειρησιακή Αρχιτεκτονική Διακυβέρνησης**

**– ΕΑΔ –**

**Για τον Ανασχεδιασμό της Δημόσιας Διοίκησης**

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# 1. INTRODUCTION

In this dissertation, interoperability has been identified as a central issue and a critical prerequisite for the effective functioning of contemporary PA systems. In this section, we present research initiatives focusing on this broad topic.

We present the research in this area grouped in two broad categories. Efforts emphasising on:

a. modeling for interoperability of eGovernment systems
b. deployment of interoperable eGovernment systems

In the first category, we present a wide spectrum of modeling efforts that focus on various aspects of eGovernment interoperability. The reusability, scalability and wide acceptance potential of these efforts and/or proposals have been the aspects that attracted our interest.

In the second category, we present running integrated systems, implemented by governments, research institutes or the industry either as prototypes and demonstrators or as full operating systems in actual PA agencies. The characteristics these running systems exhibit is the usage of state-of-the-art technologies.

Below, we present a complete list of all the reviewed initiatives. The underlined cases are thought as being more relevant to our work. For these reason, we present a summarizing table at the end of this part.

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## 2. APPROACHES BASED ON MODELING

Under this broad category we have grouped efforts focusing on various modeling aspects of eGovernment interoperability. The proposed models have been developed either at a national/federal level aiming at nationwide acceptance and applicability or at a lower sectoral level (e.g. ministry) aiming at describing specific public administration sub-domains. Some of these efforts have been triggered as governmental initiatives, while others are still at a research stage.

These models support public administration interoperability in an indirect though effective way: they are usually introduced as (loose) standards or blueprints to be consulted, but sometimes they become mandatory specifications to be followed. Governmental initiatives in this area can easily become de facto standards. These centrally promoted standards set a challenging option regarding the strategy for developing public administration interoperability. A similar approach is much more difficult in the private sector. Although certain obstacles do exist, it is obviously easier to apply a centrally issued standard in a country's Defence Department than for example across a free market industrial sector.

As multiple modeling efforts can be found taking a different focus, we identified four sub-categories using as criterion the modeling subject:

- Data modeling
- Process/Service modeling
- Organizational Modeling

In the following, we present each of the above categories separately.

## 2.1 DATA MODELING

Governmental agencies form the heaviest information industry dealing with a huge bulk of information, referring to numerous sets of data entities/objects, which are interrelated with complex relationship patterns.

Data modeling is probably the most popular category in the eGovernment modeling area due to the long tradition, the extended know-how and the maturity of the available supporting technologies after decades of relevant research, development and implementations. The focus of these models lies on the description of the participating entities (or objects) in the domain of interest. In the complex public administration environment, the value of documenting these entities is considered significant as through this process, a common communication language emerges amongst diverse systems.

The proposed data models for eGovernment applications vary significantly both in scope and in representation power:

- Regarding the scope, the modeling efforts may cover from a single limited domain of core interest (e.g. handicapped people) using specific and detailed descriptions (case specific view), to the global public administration system with top level (reference) descriptions reusable in several PA sub-domains, holistic view (e.g. the UK Government Common Information Model).
- The representation power of the data models refers to and depends on the semantic richness of the modeling effort and consequently the formalism used. Starting from controlled vocabularies in the domain of interest, the models' expressiveness becomes richer when we move to XML/ER schemas, RDF, topic maps and ontologies.

All information systems are based on well-documented data models. Though not all data models enhance the interoperability among systems. In our survey, we focus on data models presenting and documenting more the domain of interest and not the actual information to be handled by specific applications. The data models that enhance interoperability may be of two types:

- Domain models; these are attempts to model the basic entities of a specific PA domain (e.g. Justice) following an application-independent approach.
- Generic data models; these are more abstract models that cover the overall PA domain. Amongst other things, these models can be used for constructing lower level and domain specific models.

In the domain models category, the use of XML is already a common ground among projects from different countries: the UK GovTalk XML Schemas Library, the Hong Kong Common Schemas, the Finnish XML content management for parliamentary decisions, the US GSA eTravel project and Global Justice XML model and dictionary. More advanced modeling techniques on top of XML, like Topic Maps, have been used in the case of the IST ICONS project. While in research projects in the City of Hamburg and in the DoD Netcentric Semantic Linking project, the use of ontologies has been introduced for modeling the domain of interest.

The value of generic data models derives from their reusability and the anticipated cross-domain conformance to standardized conceptual descriptions. These representations claim to be applicable across the public administration domain. Under this category, we present the UK effort to develop a common controlled vocabulary for all public sector agencies, the UK Government Common Information Model (GCIM) and the Dublin Core based metadata national and international initiatives. The object models of GEA also belong in this category.

In the following, we present these representative cases of data modeling.

### 2.1.1 Modeling efforts based on XML schemas

Modeling with XML in order to present schemas describing specific domains of interest tends to have become a very popular endeavor in eGovernment initiatives. In countries like the UK and Hong Kong, we find national initiatives to create libraries of commonly accepted XML Schemas. In other countries like Finland and the USA, we find sectoral stand-alone initiatives focused on the representation of specific administrative areas. We briefly present these efforts below.

#### 2.1.1.1 UK GovTalk

From the year 2000, all UK public agencies can draft and propose XML Schemas describing concepts of their domain. These schemas are published in the UK GovTalk website[1], a Cabinet Office initiative aiming at "setting standard for seamless eGovernment". A consultation process takes place and after several revisions the proposed schemas are considered accepted by the UK eGov Unit. After that, all public agencies developing IT applications should remain compatible and take into consideration the published schemas.

A full library[2] of schemas grouped in 16 "subjects" (e.g. procurement) is currently available through the GovTalk website. For each subject, a number of schemas document a narrower domain of interest. The library as presented in the site can be seen in fig. 1.

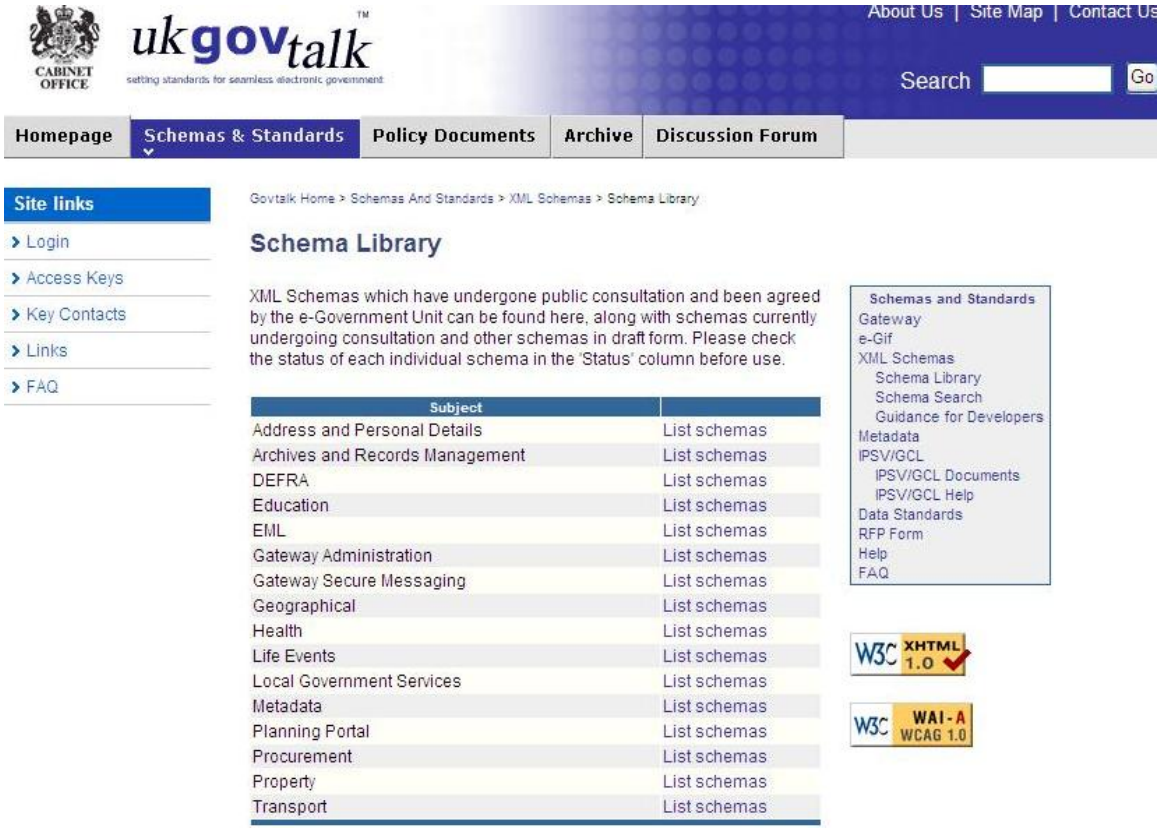


*Figure 1: The UK Schema Library*

In the following figure, a data model from the "Planning Portal" category (see the figure above) is presented that defines the data required to be submitted by Central Civil Government departments to the Office of Government Commerce (OGC) pertaining to their Civil Estate property occupations.

[1] *http://www.govtalk.gov.uk*
[2] *http://www.govtalk.gov.uk/schemasstandards/schemalibrary.asp*

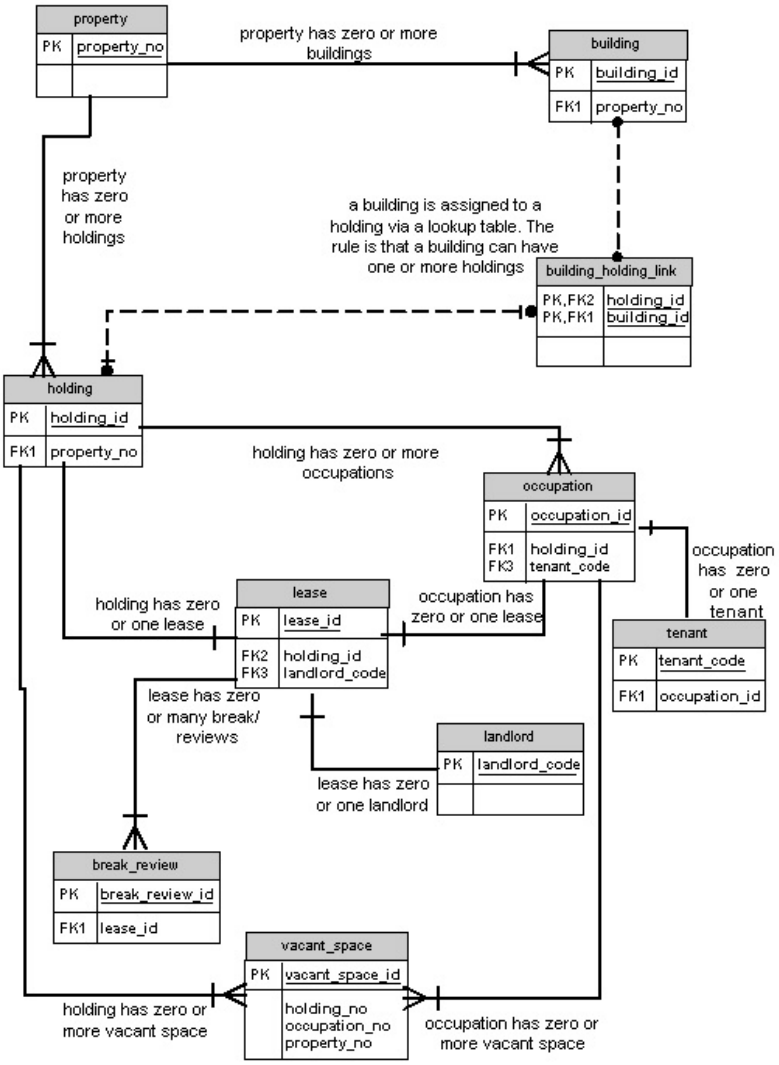


*Figure 2: Data model for property occupations*

### 2.1.1.2 Hong Kong Library of XML Schemas

Following the UK experience, Hong Kong has recently developed a similar library of XML Schemas[3]. The maturity of the proposed schemas is rated from 0 to 2, where 2 means adoption from the central HK administration. The XML Schemas are developed under the auspices of the Office of the Government Chief Information Officer and is part of the national Interoperability Framework. Examples as presented in the library follow:

- Vehicle. HK Vehicle Registration Number. Identifier
- Person. Marital Status. Code
- Person English Name. Details
- Organization. English. Name
- HK Business Registration Number. Details
- Country. Name

### 2.1.1.3 Finnish Parliament, RASKE project

A successful sectoral usage of XML Schemas can be found in the Finnish parliament. Standardization of the Finnish parliamentary documents was introduced in 1994 through the RASKE project with the use of SGML. From the beginning, the focus was not restricted to

[3] http://www.xml.gov.hk/main.htm

standardization of documents formats, but rather to the development of a holistic document management environment. Currently the RASKE2 project has the mandate to migrate the infrastructure to XML technology, provide rich metadata standards and apply the derived XML schemas to the document management system in order to upgrade it to an intelligent content management system to cover the overall parliamentary function (Salminen 2005). The metadata used and needed in the legislative process is analyzed and described. The descriptions follow as much as possible the W3C recommendations for the semantic web. The project develops a metadata standard for the legislative work and builds a basis for the future semantic web services related to the Finnish legislative process.

Below an example of an RDF process schema is given (Airi Salminen and Maiju Virtanen 2005). The example is a part of a schema describing the Finnish legislative process. The schema includes classes LegislationProject, LegislativeDocument and ProcessPhase. Properties name, identifier, date, createdInPhase and createdDuringLegislationProject apply to the class LegislativeDocument, as can be seen in the domain definition. The two last properties have range definitions, which indicate to which class the value of the property should belong.

```
<?xml version='1.0' encoding='UTF-8'?><!DOCTYPE rdf:RDF [<!ENTITY
example "http://www.legislationexample/rdf#">]>
<rdf:RDF xmlns:rdf="http://www.w3c.org/1999/02/22-rdf-syntax-ns#"
xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#">
<rdfs:Class rdf:about="&example;LegislationProject"/>
<rdfs:Class rdf:about="&example;LegislativeDocument"/>
<rdfs:Class rdf:about="&example;ProcessPhase"/>
<rdf:Property rdf:about="&example;name">
   <rdfs:domain rdf:resource="&example;LegislativeDocument"/>
</rdf:Property>
<rdf:Property rdf:about="&example;identifier">
   <rdfs:domain rdf:resource="&example; LegislativeDocument"/>
</rdf:Property>
<rdf:Property rdf:about="&example;date">
   <rdfs:domain rdf:resource="&example; LegislativeDocument"/>
</rdf:Property>
<rdf:Property rdf:about="&example;createdInPhase">
   <rdfs:domain rdf:resource="&example; LegislativeDocument"/>
   <rdfs:range rdf:resource="&example;ProcessPhase"/>
</rdf:Property>
<rdf:Property rdf:about="&example;createdDuringLegislationProject">
<rdfs:domain rdf:resource="&example;LegislativeDocument"/>
  <rdfs:range rdf:resource="&example;LegislationProject"/>
</rdf:Property>
</rdf:RDF>
```

*Figure 3: RDF Process Schema from RASKE2*

#### 2.1.1.4 Component Organization and Registration Environment (CORE), USA

In the USA, XML standardization is equally popular despite the fact that there was no federal initiative for creating and centrally maintaining "certified" XML Schemas in a manner similar to the UK and Hong Kong.

This void is to be filled at the federal level with the development of the federal CORE.gov registry. The Component Organization and Registration Environment (CORE) is a web source for business process and technical components[4]. The site provides a collaborative environment that encourages consistent use and reuse of data and process components in compliance with the Federal Enterprise Architecture (FEA) within and across federal agencies. As of August 2004, there were 1,500 registered users of the site, with 670 of these accessing the site at least twice per month. Roughly 70 registered components were available

[4] https://www.core.gov/

for reuse. Table 1 presents an example of currently available components for reuse as published in the CORE website.

| Name | Summary |
|---|---|
| cmlob | Case Management Line of Business |
| corecomponents | Listing of VCS & agency-specific core components for XML Schema. |
| doi-idat | Dept. of the Interior - Data Architecture Team |
| dolrulesengine | Dol Rules Engine |
| eauthentication | E-Authentication |
| eds | Electronic Directory Services |
| fed-xml-ndr | Federal XML Naming and Design Rule |
| gsa-ogp-schemas | GSA OGP Schemas |
| itslob | ITS Line of Business |
| nmmr | NOAA Metadata Manager and Repository |
| recreation-one-stop | Recreation One Stop |
| smartbuy | Smart Buy |
| softwarelicensemanagement | Software License Management |
| standardoverview | Standard Overview Component Project |
| usability | Usability.gov |
| workforceconnections | Workforce Connections |
| xml | Working space for XML discussions and components |

*Table 1: CORE components*

The Department of Defence (DoD) Metadata Registry and DoD XML Gallery is a similar initiative aiming at creating XML registry and repository infrastructures with an obviously narrower scope.

#### 2.1.1.5 General Service Administration, eTravel, USA

In sectoral domain specific implementations, the Government Service Administration (GSA) an agency with broad mandate on several aspect of procurement across the federal enterprise has developed a full set of metadata standards for the public sector "travel" domain[5]. The data modeling effort for the eTravel project began in January 2003 with 40 defined data elements. The purpose has been to create a common "travel" language among all public sector agencies. The project is still running and data normalization and harmonization is still in progress.

#### 2.1.1.6 The US Global Justice XML model, USA

The *US Global Justice XML model* (JXDM) is a data reference model for the exchange of information within the justice and public safety communities. The primary goal of the effort is to produce a set of common, well-defined data elements for data exchange in the justice and public safety domain, thus it serves as a broad *reference domain model*. This means it is not a rigid standard that must be used exactly as it is in its entirety. The expected result, as expressed by the projects' documents, is "… some level of interoperability that would be unachievable with the proliferation of custom schemas and dictionaries". In its current

[5] http://www.gsa.gov/Portal/gsa/ep/contentView.do?pageTypeId=8199&channelId=-13338&P=S&contentId=15813&contentType=GSA_BASIC

version, the GJXDM is comprised of a well-defined vocabulary of approximately 2,500 stable data objects[6]. An example of the "Missing Person" entity description is presented in table 2.

| **MissingPerson** | **MissingPersonType (PersonType)** | **Details about a person whose whereabouts are unknown.** |
|---|---|---|
| MissingPersonID | IDType (SuperType) | A number or string identifying a missing person. |
| MissingPersonDisappearanceTypeText | TextType | A type of disappearance of a missing person. |
| MissingPersonDisappearanceTypeCode | j-ncic:MNPType | A code identifying the type of disappearance of a missing person. |
| MissingPersonCircumstanceCode | j-ncic:MPCType | A code identifying a circumstance surrounding the disappearance of a person. |
| MissingPersonCircumstanceText | TextType | A circumstance surrounding the disappearance of a person. |
| MissingPersonDeclarationDate | j-xsd:date | A date a person was declared or legally assumed to be missing. |
| MissingPersonDeclarationTime | j-xsd:time | A time a person was declared or legally assumed to be missing. |
| MissingPersonDeclarationPerson | PersonType (SuperType) | A person who declared another person to be missing. |
| MissingPersonLastSeenDate | j-xsd:date | A date a missing person was last seen before disappearing. |
| MissingPersonLastSeenTime | j-xsd:time | A time a missing person was last seen before disappearing. |
| MissingPersonLastSeenLocation | LocationType (SuperType) | A place a missing person was last seen before disappearing. |
| MissingPersonLastSeenWitness | WitnessType (PersonType) | A person who last saw a missing person. |
| MissingPersonFoundIndicator | j-xsd:boolean | True if a missing person has been found; false otherwise. |
| MissingPersonFoundDate | j-xsd:date | A date a missing person was found. |
| MissingPersonFoundTime | j-xsd:time | A time a missing person was found. |
| MissingPersonFoundLocation | LocationType (SuperType) | A location where a missing person was found. |
| MissingPersonStatus | StatusType (SuperType) | A status of a missing person. |

*Table 2: The "Missing Person" entity description in the US Global Justice XML model*

Along the same lines, a number of USA governmental initiatives using XML technologies are currently under implementation in several domains (e.g. the Federal Student Aid XML framework[7], the IRS Modernized e-Files Project[8], the NASA XML Project[9]).

### 2.1.2 Modeling efforts beyond XML

The modeling expressiveness of XML schemas has certain limitations. During the last few years, new languages and formalisms have been developed on top of the XML stack to add modeling power to the undergoing modeling efforts. The well known W3C technology "cake" (or stack) presents the full set of currently available languages (fig. 4).

[6] *http://it.ojp.gov/jxdm*

[7] http://fsaxmlregistry.ed.gov/XMLRegistry/pages/welcome.jsp

[8] http://www.irs.gov/businesses/corporations/article/0,,id=146959,00.html

[9] http://xml.nasa.gov/

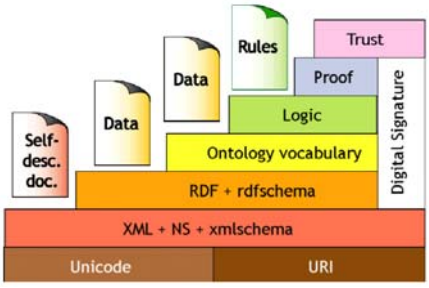


*Figure 4: The W3C stack*

All the presented XML cases have been governmental initiatives, as XML technologies are considered mature, enjoy vendor's support and many off-the-shelf solutions are available in the market. However, this is not the case with the upper levels of the W3C stack. Moving to RDF and even more to ontology-based implementations, industrial support is still weak mainly due to the novelty of these approaches, limited experience and many unresolved issues both at the conceptual design and at the technological implementation level. For these reasons, full-fledged and running governmental implementations are not readily found. Instead of this, we identify a vivid research interest, with efforts tackling various aspects and presenting some pilots and running demonstrators. In the following, we present some indicative modeling initiatives that have used advanced modeling techniques to represent the domain of interest within public administration.

#### 2.1.2.1 Policy Content at Social Security with XML & Semantic Metadata, USA

As this is an ambitious, highly innovative and quite broad project for the Social Security Administration (SSA), a very big USA governmental agency, it is considered of particular interest, and thus it is presented in more detail. The challenge for SSA regarding information management is how to make the wide range of available content more relevant and targeted to user needs (Hynes T. and Degler D. 2004).

At the heart of the system is a metadata engine based on semantic technologies, born out of more than two years of work using Topic Maps technology. Semantic metadata uses a structured vocabulary – an ontology – to describe the meaning of the content in terms of the business context that the content relates to. So when a user is in a complex situation, such as helping a widowed mother process a set of disability applications for two disabled children in a particular state, content that is relevant to that particular situation can more easily be retrieved, even when all the pieces are stored in different locations.

The figure shows the main functional components of the system.

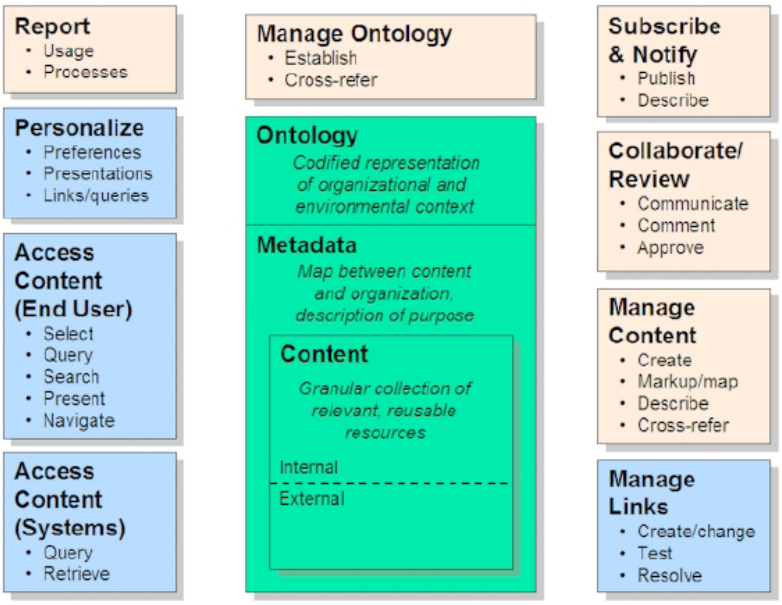


*Figure 5: Functional Overview (Hynes T. and Degler D. 2004)*

The next figure presents the technologies used to address the functional requirements.

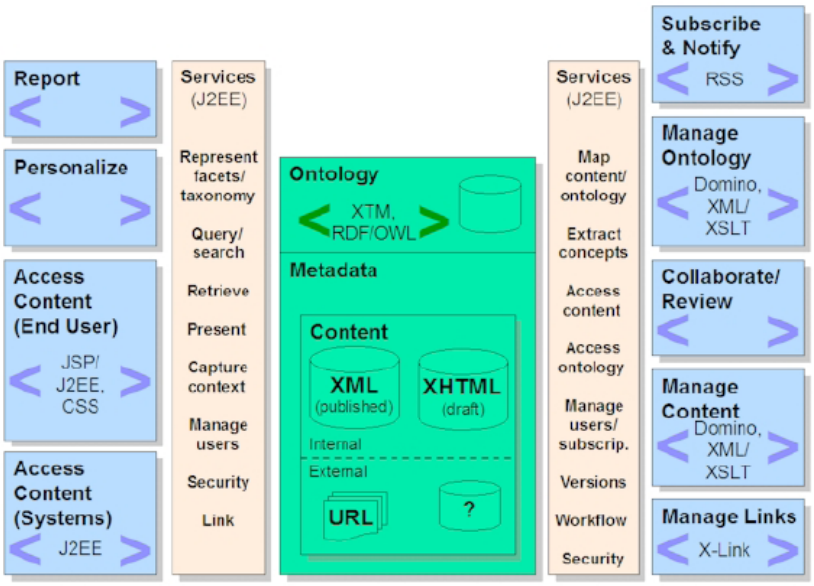


*Figure 6: Technical Overview (Hynes T. and Degler D. 2004)*

For the content data itself, currently a mixed environment of XML and HTML content operates, although the plan has been to use XML for the publishing repository and XHTML for draft content that can be shared through a review/collaboration viewer. For performance and compatibility in the current environment, a relational database is used for housing content metadata and for querying the end user faceted taxonomy – the underlying data has been modeled/designed using the Topic Maps Reference Model and will be able to be shared with other systems using semantic ontology standards such as XTM (an ISO standard) or the W3C's RDF/OWL.

J2EE and Cascading Style Sheet (CSS) have been used at the end user level and XML/XSLT in content administration to modularize the interface – in order to preserve the reusability of the granular content and allow some of the "granular interface components" to be also reusable by other applications, taking advantage of the same services for content retrieval currently used within the applications.

There are functional areas in the application where further research is still being done to see what technologies best suit SSA's needs, while there are also areas where it was chosen to

wait until emerging technologies mature further before making longer-term decisions on the direction.

#### 2.1.2.2 DiBIS, Hamburg

During 2002-3, the informatics department of Hamburg University ran an explorative project which focused on the application of Semantic Web technologies to enable the "contextualisation" of DiBIS, which is the Web-based citizen information service for the Hamburg area. For this purpose, an ontology of all informational resources (public and private) relevant to the administrative services related to the pilot life-event of 'changing residence' was developed. This ontology was further used to semantically mark-up the resources and to provide a machine readable "explanation" of how these resources were interrelated.

The ontology development was based on the RDF language and DAML. The Java based Jena Toolkit was employed for providing run-time components representing and manipulating the RDF models which also includes DAML+OIL functionality on top of the RDF models for handling ontologies (Klischewski 2003).

#### 2.1.2.3 Ontology of handicapped people

During 2003-4, the same department conducted more focused work on ontology development in the area of handicapped people. A domain ontology was developed based on a conceptual separation between physical (e.g. building) and informational objects with links between them. The tool SemTalk was used for the domain modeling and ontology design (Klischewski 2004). As the project was focused on the process of the ontology development, the results were related more to this task per se and less to the practical usage of this ontology by the information systems of the City of Hamburg.

#### 2.1.2.4 ICONS EWD-P System

Another interesting case refers to the implementation of an ontology using Topic Maps technologies by the ICONS IST funded project (IST-2001-32429). The project developed the European Exchange of Documents – Polish system (EWD-P), an application responsible for the elaboration and communication of the official Polish standpoint concerning the EU procedures and regulations (Grzegorz Blizniuk *et al.* 2005).

The business case for this work has been the following: the General Secretary of the Council of the European Union sends documents related to EU proposed procedures and regulations to all national administrations and asks for the standpoints of the member states within a certain timeframe. Each EU document is categorized along the predefined EU classification system. These categories determine receivers of the document in the Polish (and any national) administration. The problem is that the Polish and EU classification systems are not unified and vary both in the sense of language and in the sense of categorization logic and power. One EU category can be mapped to several Polish categories. Similarly, one Polish category can be mapped to several EU categories. To handle this inconsistency, the EWD-P ontology has been developed to act as the bridge between the two classifications systems. This ontology constitutes the logical heart of the EWD-P system, providing mapping between inconsistent sets of concepts and was implemented using Topic Map technologies. The EWD-P module responsible for the ontology management (called Concept Glossary Manager) fully implements the extremely flexible model of the Topic Maps standard and offers the possibility to import and export any ontology defined in the XML Topic Map format.

Although the main objective of the EWD-P ontology has been to manage the EU – Poland interoperability within the area of mapping of document categories, the ontology also proved its effectiveness in other knowledge tasks, e.g. representation of the organizational structure of central government units, experts and their competencies, hierarchical dictionaries.

In the figure that follows the basic part of the abstract EWD-P data model is presented.

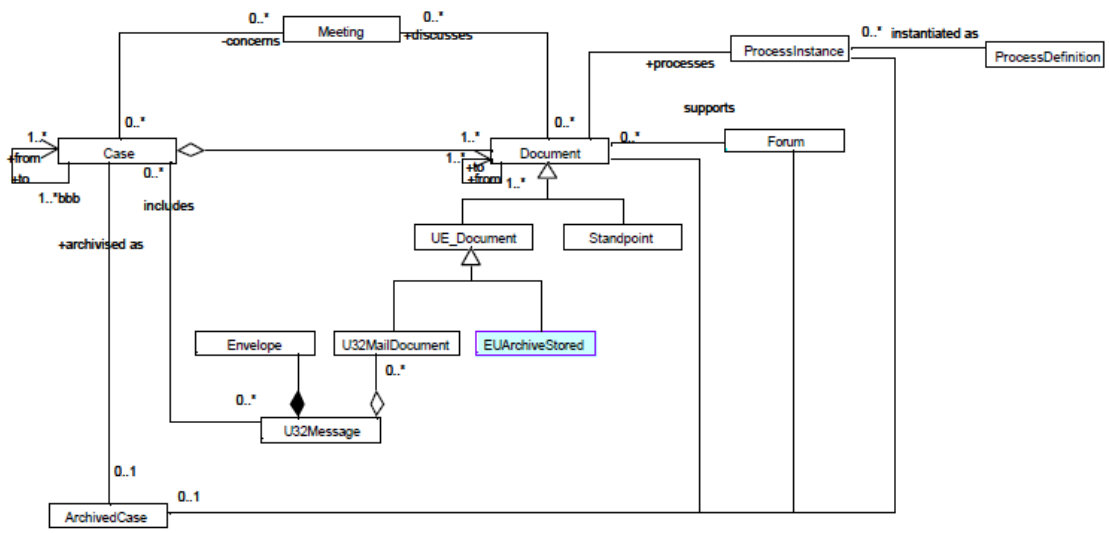


*Figure 7: The basic part of the abstract EWD-P data model (Grzegorz Blizniuk et al. 2005)*

### 2.1.2.5 MITRE: Network Centric Semantic Linking

In October 2004, MITRE published the "*Netcentric Semantic Linking Report: An Approach to Enterprise Semantic*" (MITRE 2004) where the experience of exploring the "Network Centric Semantic Linking[10]" as a potential solution for integration across the U.S. Military Enterprise was presented. Although the project focused on the military domain, the results are important enough to be included in this eGovernment survey.

In a nutshell, for the prototype system two independent domain ontologies were created and linked to databases storing domain specific data. Then mappings were provided to a third reference ontology in order to use and query combined data from the two domains.

As an example of the queries the system can handle and the ability to join concepts at different levels of aggregation, a new concept called *RestrictedOperationsArea* has been defined as the union of all members of the class *RestrictedTarget* from the Target ontology and all members of the class *RestrictedOperationsZone* from the Airspace ontology.

As *RestrictedOperationsZone* is an abstract class, it has no instances. However, it does have subclasses that have instance data mapped to them. This means that a query for all members of the class *RestrictedOperationsArea* will return all members of *RestrictedTarget* as well as all members of the classes *AirborneEarlyWarning*, *DropZone*, *UnmannedAerialVehicle* and *SpecialOperationsForces*.

The experience gained by the Netcentric prototype is important and may become a valuable asset to other domain data modeling efforts. From a technological perspective, a full set of innovative technologies were used (e.g. the OWL language) and several aspects were examined in depth (e.g. querying ontologies). At a conceptual design level, the approach is equally important as it demonstrates the advantages of using a reference ontology for linking (mapping) a set of domain ontologies.

More specifically, to achieve interoperability across domains the use of a reference ontology for linking (mapping) a set of domain models (e.g. ontologies) has been proven a powerful and extensible solution. This conclusion is of particular importance for the eGovernment domain. Taking into consideration the multiplicity and fragmentation of the administrative space even inside the same national administration, it is unreasonable to expect that a common domain model could be ever imposed to all different functional administrative

[10] The report authors acknowledge that the use of the word "Mapping" instead of "Linking" would have been more appropriate.

segments/domains (e.g. agriculture, education, health). By adapting a "linking" approach via a reference model/ontology, autonomy of each segment/domain is guaranteed, while a unified structure is set to allow interoperation across independent domains. The scalability, extensibility and reuse of this approach are critical features that in the long run cover the extra development and mapping costs. The same approach obtains particular interest, when the focus is on the interoperability problem between different countries administrations. The EU experience, mainly through the IDABC programme, proves that any attempt to enforce centrally issued standards in the European public administrations run the risk of being perceived as an intervention. Thus, the "linking" option seems to be a viable solution to this problem.

### 2.1.3 Generic Data Models

As explained above, these models represent the public administration domain taking a top-level, abstract view and are used as blueprints for the construction of more concrete and domain/case specific models. Reusability, creation of a common understanding/language and the anticipated cross-domain conformance to conceptual standardized descriptions are the main advantages introduced by the development of these models.

Generic data models have been proposed by various researchers for a variety of domains. The analysis and design "patterns" related literature (e.g. (Fowler 1997), (Hay 1996),(Gamma *et al.* 1995; Silverstone *et al.* 1997)) and the deontic models field (e.g. (Wieringa and Meyer 1993; Johannesson and Wohed 1998)) have already given a remarkable number of reusable and generic data representations. Similarly, reference, domain-specific representations have been proposed in particular areas of interest (e.g. (IBM 1993; Association for Retail Technology Standards 1995)). The same need has led IT vendors such as SAP and IDS Scheer to formulate ready-to-configure solutions (solution maps) covering specific industries and creating generic industry data models (IDS Scheer 1999; SAP 2000).

Despite this general interest, similar efforts in eGovernment are rather limited. In our understanding, this is due to the fact that the eGovernment domain constitutes an extended, complex and diverse domain. The process for reaching the abstraction needed for creating generic and global data models for this challenging domain is a highly multi-disciplinary and complex task, which requires in-depth knowledge scattered in various and not adequately cross-referenced fields of expertise (e.g. PA and public policy theory, organizational and business management theory, enterprise and information architectures, knowledge management, systems analysis and engineering).

Two initiatives in the UK, namely the UK Integrated Public Sector Vocabulary and the UK Government Common Information Model together with a growing number of national and international attempts to propose eGovernment metadata descriptions based on the Dublin Core Metadata Initiative are the efforts we found relevant to this category. Although, part of our work related to the proposed Governance Enterprise Architecture and, more specifically, three generic object models could be also placed here, we prefer to present it separately and together with the overall GEA approach and models in a later chapter of this work.

#### 2.1.3.1 The UK Integrated Public Sector Vocabulary (IPSV)

IPSV is an example of a rather rare and ambitious governmental initiative to create a global and centrally managed vocabulary to be used by the whole spectrum of public organizations. Although vocabularies as models are placed low regarding their expressive power, this effort is remarkable mainly due to its novelty, size and nationwide scope (UK LAWs Project 2005).

*Figure 8: First level categories*

**Business and industry**
**Economics and finance**
**Education and skills**
**Employment, jobs and careers**
**Environment**
**Government, politics and public administration**
**Health, well-being and care**
**Housing**
**Information and communication**
**International affairs and defence**
**Leisure and culture**
**Life in the community**
**People and organisations**
**Public order, justice and rights**
**Science, technology and innovation**
**Transport and infrastructure**

The overall project is managed by the UK Office of the Deputy Prime Minister. The IPSV has become available to all public bodies since April 2005. Before that, several controlled vocabularies had been proposed in the UK public sector. The Integrated Vocabulary has brought together and built on three vocabularies, namely:

- The Government Category List (GCL) – a high level category list owned by the Cabinet Office E-Government Unit for use across government.
- The Local Government Category List (LGCL) – a product for use in the Local Government Community.
- The seamlessUK Taxonomy – a product of the seamlessUK Project for broad use.

The expected benefits from this effort as expressed by its creators are anticipated to be:

- Consistent information indexing (tagging) and categorization.
- Interoperability across data sets from multiple organizations.
- Ability to offer the same information across a variety of delivery channels.
- Reduce the confusion for public sector organizations creating metadata schemas or indexing resources.
- Provide the 'encoding scheme' for populating metadata elements in the general UK E-Government Metadata Standards (e-GMS) initiative.

The first level of IPSV categorization is presented in fig. 8. Fig. 9 presents as an example a part of further analysis of the "International Affairs and Defence" concept.

**International affairs and defence**
. **Defence**
. . **Armed forces**
. . . **British Army**
. . . **Cadet forces**
. . . . **Air Training Corps**
. . . . **Army Cadet Corps**
. . . . **Sea Cadet Corps**
. . . **Royal Air Force**
. . . . **Air Sea Rescue Service**
. . . **Royal Navy**

*Figure 9: The "International Affairs and Defence" concept*

Despite the fact that the vocabulary has become available only recently, the first practical application took the form of a step-by-step guide to meta-tagging with the IPSV. Through this guide, agencies gain practical advice on adding and using IPSV terms to their metadata.

#### 2.1.3.2 The UK Government Common Information Model (GCIM)

The UK GCIM is perhaps the more relevant initiative to the generic data model category (fig. 10). The GCIM is a high-level information model for the sorts of activities undertaken by the public sector. It is part of the more general UK e-Service Development Framework (Office of e-Envoy UK 2002). The central GCIM concept is the Service Interaction, which embodies the aspects of the particular service instantiation.

Every PA service is different and the only way to enable reuse of components is to use an agreed reference structure. The GCIM framework provides such a structure, which ensures that analysts, system engineers and domain experts share a common view of the domain. While each e-service development project needs to develop its own domain model, the classes used in the various domain models should be categorised under the GCIM concepts.

Based on its purpose, the view of the GCIM model is focused on the transactional aspects of electronic service provision by public administration. According to the GCIM model, the operational level of the model consists of objects Subject, Identifier, Location, Evidence, Outcome, Rule, Service, Service Interaction and relationships amongst them modeling transactional aspects. *Service Interaction* is typically an exchange of information with a common set of identifiable participants (*Subjects*/*Identifiers*) in a certain *Location* and involves a type of a *Service*, governed by *Rule*s, requiring *Evidence* and generating *Outcome*s.

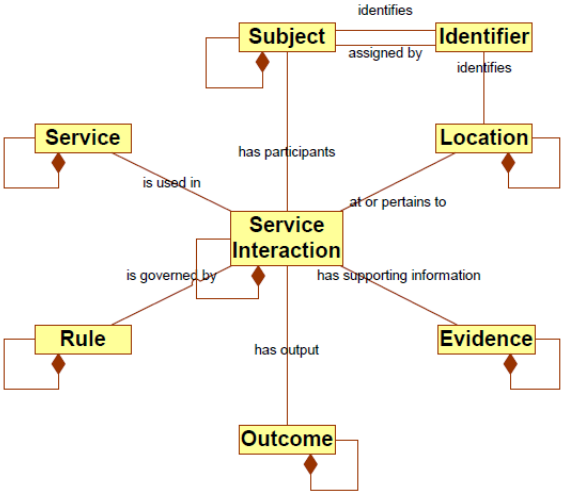


*Figure 10: The UK Government Common Information Model*

#### 2.1.3.3 Dublin Core related modeling efforts

The Dublin Core Metadata Initiative (DCMI) and the derived Dublin Core metadata element set (ISO 15863) is a standard for cross-domain information resource description. It is probably the most widely used and recommended metadata set. In addition, many Member States have either mandated the Dublin Core as the standard for metadata in their public administrations or have already developed their own national metadata sets or variations of the Dublin Core.

More generally, an increasing number of governments worldwide recognize the role of establishing metadata standards as an integral ingredient of their interoperability framework towards realizing their eGovernment strategy. As presented in (CEN 2003), the Dublin Core has been used as a basis from different national administrations in their efforts to establish a suitable metadata standard for their needs. The following initiatives and standard proposals are currently available and have been presented and compared in (Tambouris and Tarabanis 2005).

- UK e-Government Metadata Standard ver. 2.0, April 2003. From http://www.e-envoy.gov.uk/Resources/Guidelines/fs/en
- Irish Public Service Metadata Standard. ver. 1.0, August 2001. From http://www.gov.ie/webstandards/metastandards/index.html
- The Danish Government Metadata Standard (data derived from a study conducted by the MIReG project)
- The Finnish Government Metadata Standard (data derived from a study conducted by the MIReG project and the Web site http://www.intermin.fi/juhta/suositukset/jhs143.htm)
- The Iceland Government Metadata Standard (data derived from a study conducted by the MIReG project)

- The Australian Government Locater Service (AGLS). From http://www.naa.gov.au/recordkeeping/gov_online/agls/summary.html
- The New Zealand Government Locater Service (NZGLS). From http://www.e-government.govt.nz/nzgls/index.asp
- The Canadian Government On-Line Metadata Standard. From http://www.cio-dpi.gc.ca/im-gi/meta/clf-nsi-meta/clf-nsi-meta_e.asp

In this part, we briefly present four international initiatives proposing eGovernment metadata standards that were highly motivated and influenced by the DCMI and by the fact that many national administrations had started independent and uncoordinated efforts to use DCMI as a starting point in order to present their national metadata standards frameworks. These four initiatives share more or less the same drive and conclude in similar results regarding the proposed elements set. These are:

- DC-Government Working Group Application Profile. From http://dublincore.org/groups/government/profile-200202.shtml
- The CEN/ISSS Workshop on Metadata for Multimedia Information - Dublin Core (WS/MMI-DC)
- The MIReG project funded by the IDA initiative. From http://dublincore.org/groups/government/miregmetadata-20010828.shtml
- The element set proposed by the IST eGOV RTD project. From http://www.egov-project.org

As presented in (CEN 2003), an important consideration for establishing a European metadata model for e-government is its structure. There are two main approaches for developing a metadata model. The first implies a flat model whereby the type of all elements is "string" and thus is simple to understand and use. This is the prevailing approach in the DCMI and all the national metadata initiatives. The second approach models hierarchy between elements. This makes it more complex, but capable to exploit (and be exploited) by new technologies (e.g. RDF, OWL). Only the IDA MIReG initiative follows this latter perspective.

*The Dublin Core Government (DC-Gov)* initiative has been running since 2001, as a specialized Working Group under the DCMI auspices. DCMI Working groups are organized around specific problem domains.

The DC-Gov Working Group is a forum for individuals involved in implementing Dublin Core within and between government agencies and International Governmental Organizations. The working group identifies commonalities in current public administration metadata implementations and make recommendations for future DC terms and best practices. The working group cooperates with other international standardization initiatives as appropriate.

The work of the DC-Gov has been towards specifying a Metadata Element Set for eGovernment. At this point, it is not yet known when this process will finish and what the Element Set finally accepted by the Usage Board will be. In any case, the work seems to have been moving rather slowly since 2003, when a study for the current usage of the DCMI by governments was conducted and the DC-Gov interest has been shifted to the use of DC for describing services.

There has also been another interesting initiative run under the CEN/ISSS. In Nov. 2003 the "*A Dublin Core eGovernment profile and model*" report was drafted by the MMI-DC Workshop within the European Committee for Standardization (CEN).

In a quite similar - and in a way overlapping - effort to that previously presented, the production of this CEN Workshop Agreement (CWA 14860) was formally accepted as part of the CEN/ISSS Workshop on Metadata for Multimedia Information - Dublin Core (WS/MMI-DC).

The CWA presents a proposed metadata application profile based on Dublin Core for eGovernment in Europe. The proposed application profile is a synthesis of relevant national metadata standards in Denmark, Finland, Ireland, Iceland and the UK. The results of other

non-European national metadata standards as well as the MIReG project funded by the IDA initiative and the IST eGOV Research and Technological Development project co-funded by the European Commission were also taken into consideration.

This work is restricted to defining a common element set and element refinements; thus, encoding schemes are not discussed at this stage. The report aims at providing the basis for the work and a first version of the metadata application profile. In this respect this report has been considered by its creators a “live” document, as it should be regularly revised according to discussions between stakeholders in Member States.

The final document proposes an eGovernment Dublin Core Application Profile (DCAP). For this purpose, a set of rules is presented and a methodology towards specifying a European eGovernment DCAP is given. The main principle of the work is to protect the investment in Member States and at the same time propose a DCAP that is simple and small. For this purpose, the national standards have been analysed and compared. A set of harmonisation guidelines has then been applied and, as a result, the first version of a European eGovernment DCAP has been specified. Finally, the mapping between this DCAP and national standards has been presented. In summary, from the initial 18 elements in use in several DC metadata initiatives in Member States, 1 is currently eliminated, 7 are retained as elements, while the remaining 10 are either included as refinements or mapped to those retained. Thus, no new metadata term has been included in this AP. The work only involves adding all national metadata standards, comparing them and harmonising them towards a common European metadata standard.

*The IDABC MIReG project* (2001-2003) has been an IDA project focusing on developing extensions to the Dublin Core for government information. It is based primarily on the national metadata recommendations of the Member States' public administrations in order to bring national initiatives in the area together, a motivation and drive quite similar to the two above mentioned initiatives.

MIReG is also concerned with tools for the management of metadata through the storage and retrieval of XML schemata. The objective of this action is to produce a metadata framework for government information in pan-European applications with associated vocabulary control, ontologies and topic maps and best practice guidelines.

The main difference between MIReG and the other DCMI-triggered initiatives for Government metadata standards is that the latter assume a "flat" model of elements (i.e. no hierarchy) while MIReG assumes an object model where some elements are strings, whereas some other are objects.

The concrete results of the projects available through the MIReG web site are:

- The MIReG metadata model
- A generic tool for the management of metadata
- Supporting documentation

The MIReG metamodel is presented in the figure below in UML notation.

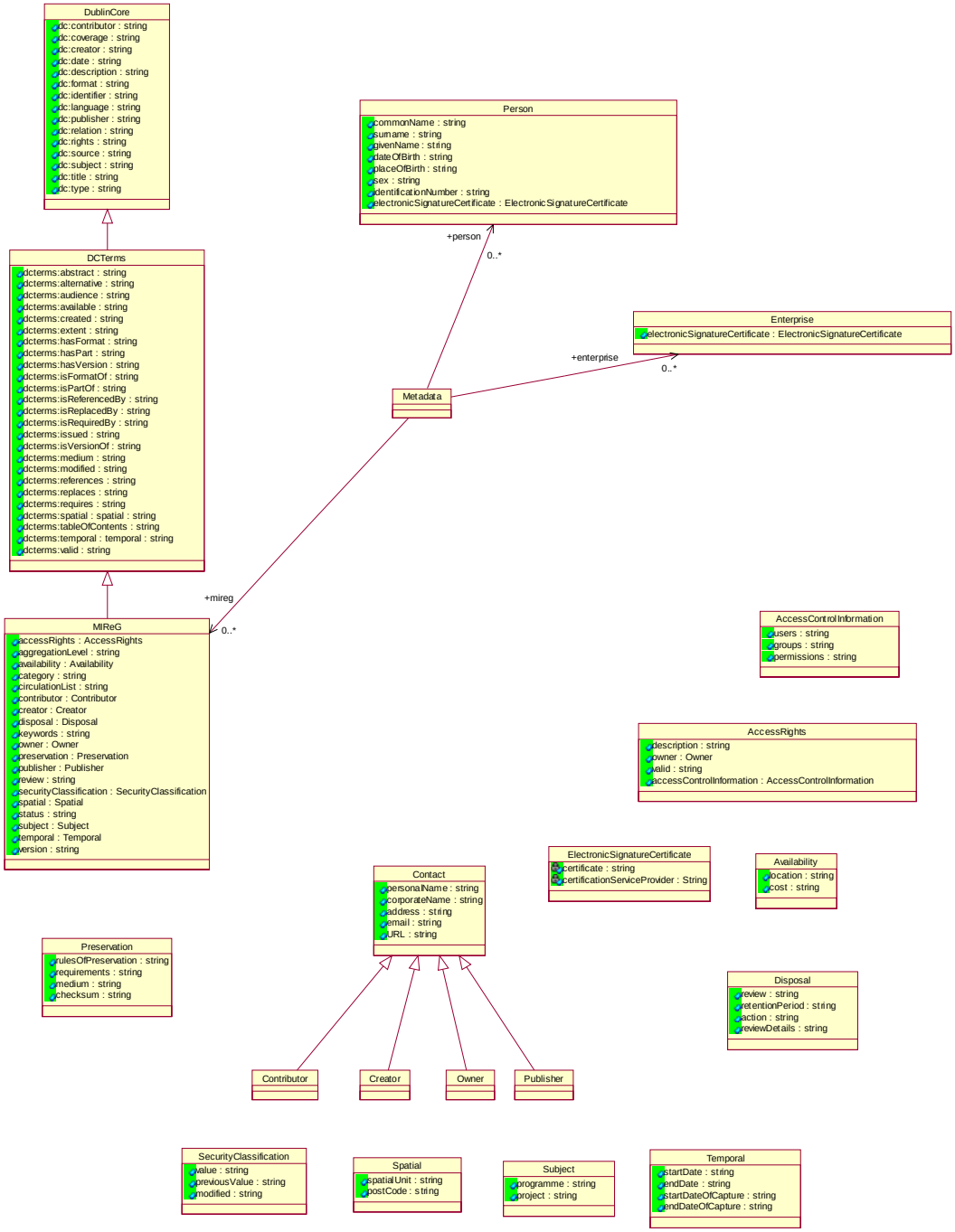


*Figure 11: The MIReG Metamodel*

*EGOV* has been a research project aiming amongst other things to specify a simple Application Profile for eGovernment in Europe (Tambouris E. 2001). At the time of its development (2001-02), the eGOV element set consisted of ten DC elements, one e-GMS element and one PRISM element (Tambouris and Tarabanis 2005). The eGOV element set is considered a "true" Application Profile in the sense that it does not propose any new element; it rather mixes elements from existing namespaces to address its own needs.

## 2.2 PROCESS/SERVICE MODELING

Process modeling has become a popular aspect of business modeling during the last fifteen years with the rise of the Process Reengineering and Innovation imperative and the subsequent process-oriented approach of contemporary organizational systems. Although object oriented analysis (mainly through the introduction of "object methods") and concurrent engineering (Taylor 1995) have tried to partly merge the data and process view of information systems using a unified language, the different substance and views of the two modeling stances are still prevailing. In this line, the Enterprise Architecture approach allows a loose coupling between organizational data and process models, recognizing on the one hand the autonomy and highlighting on the other the importance of cross-referencing between enterprise data and process models.

For developing the latter, the workflow community has had a substantial contribution during the previous decades, proposing models, patterns, techniques and formalisms for describing, documenting and studying business processes (e.g. the Workflow Reference Model from the Workflow Management Coalition (WFMC) (Peter Lawrence 1997). The main focus in this period has been on intra-organizational processes. During the late nineties, the shift of interest to cross-organizational interactions gave a boost to the inter-workflow literature (Hiramatsu *et al.* 1998), which tried to extend the scope of workflow management among various autonomous organizations. With this, the focus has been shifted to inter-organizational workflows.

During the same period, with the internet revolution and the popularization of Service Orientated Architectures (SOAs) there has been a shift from process orientation to service orientation. Actually, the service concept could be perceived as an adaptation of the process concept to environments and architectures that put the service at the centre of their interest. These architectures are specifically focused on issues related to advertise, discover, invoke, compose and monitor services available from multiple providers over the web. This shift of interest resulted in the development of the Web Service family of technologies at the implementation level, while more recently the Semantic Web research agenda provides models and methods that have led to the emergence of the Semantic Web Service technologies.

In the family of Web Service technologies, several attempts have been made to standardize the execution of complex processes, which consist of a number of autonomous Web Services. In this line, WSCI, WSCL and BPL4WS are three important initiatives. Sun/BEA/Intalio/SAP consortium's Web Services Choreography Interface (WSCI)[11] is an XML-based interface description language that describes flow of messages exchanged by a Web Service participating in choreographed interactions with other services. W3C's Web Services Conversation Language (WSCL)[12] is a submission by Hewlett-Packard to the W3C, which allows defining the abstract interfaces of Web services (that is, the business level conversations or public processes supported by a Web service), the XML documents being exchanged and the sequencing of those documents. The Business Process Execution Language for Web Services (BPEL4WS)[13] is the cooperative merging of WSFL[14] and XLANG[15] for Web services orchestration, workflow and composition.

Moreover, from the Semantic Web Services field, both the OWL-S and the WSMO service ontologies provide relevant process descriptions and models. Interestingly, there is a growing interest in instantiating these generic service ontologies to the eGovernment domain.

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[11] http://www.w3.org/TR/wsci/

[12] http://www.w3.org/TR/2002/NOTE-wscl10-20020314/

[13] BPEL4WS Position Paper available at http://www.bpmi.org/downloads/BPML-BPEL4WS.pdf

[14] http://www.ebpml.org/wsfl.htm

[15] http://www.ebpml.org/xlang.htm

The workflow versus SOA approaches are discussed in (Gortmaker *et al.* 2005), mainly through the presentation of two reference models: the Workflow Reference Model (Lawrence P. 1997) and the SOA reference model (M.P. Papazoglou and D. Georgakopoulos (eds.) 2003). The applicability of these models in implementing process orchestration in eGovernment is questioned and a deficit is identified. According to (Gortmaker *et al.* 2005), "… the workflow reference model is too much focussed on technology and therefore fails to address the non-technical coordination issues and although the SOA reference model does address many of the issues, the model remains rather descriptive, only pinpointing the required functionality, but not indicating how this should be filled in". Thus they conclude that a new domain specific reference process model is needed to facilitate process orchestration in eGovernment.

In general, there is a rather small number of process models specifically proposed for the eGovernment domain. On the contrary and due to the growing interest in applying Web Service and Semantic Web Service technologies in eGovernment, there is a vivid interest in proposing eGovernment domain specific service models. In the following, we present the most important efforts, starting from the more "traditional" process view and then presenting the eGovernment service models. Last, two proposals for eGovernment process modelling methodologies are also presented.

### 2.2.1 Process view

#### 2.2.1.1 Government Process Classification Framework

In 1996, the National Performance Review programme in USA and the Inter-Agency Benchmarking & Best Practices Council supported the development of a government process classification framework. A classification scheme consortium was formed to create a simple "Dewey decimal-like system". This consortium, comprised of representatives from numerous government agencies, reviewed numerous models of process classification and consulted with various industry experts to include specialists from MIT's Center for Coordination Science, Arthur Andersen's Global Best Practices team, the Brookings Institute and other representatives from state government.

The consortium built the Government Process Classification Scheme (GPCS) to be a simple information management tool to categorize common government processes. In the table, we present the two first levels of the GPCS. Third and fourth levels descriptions were also developed presenting a total number of more than 300 governmental processes.

| 1-Establish Direction | 2-Acquire Resources | 3-Provide Capabilities | 4-Execute the Mission |
|---|---|---|---|
| 11-Establish Policy | 21-Manage Acquisition | 31-Manage Resources and Capabilitites | 41-Designate the Office of Primary Responsibility |
| 12-Determine Requirements | 22-Conduct Research and Development | 32-Support Resources | 42-Provide Operational Information Support |
| 13-Develop Plans | 23-Produce Resources | 33-Provide Administrative Support | 43-Conduct Operations |
| 14-Budget Programs | | 34-Develop Resource Capabilities | 44-Sustain Field Operations |

*Table 3: Government Process Classification Framework*

It is important to mention that the GPCS provides no further analysis for the critical "43-Conduct Operations" (Inter-Agency Benchmarking & Best Practices Council 1996), which was left to be filled independently by each separate agency.

#### 2.2.1.2 The Federal Enterprise Architecture Business Reference Model

The USA CIO Council seeks to develop, maintain and facilitate the implementation of the top-level enterprise architecture for the Federal Enterprise. For this purpose, the Federal Enterprise Architecture Framework (FEAF) has been proposed (CIO Council 1999). FEAF consists of various approaches, models and definitions for communicating the overall organization and relationships of architecture components required for developing and maintaining a Federal Enterprise Architecture.

The Federal Enterprise Architecture is being constructed through a series of "reference models" designed to facilitate cross-agency analysis and improvement. The Business Reference Model (BRM) serves as the foundation for the other reference models – the Performance Reference Model, Data Reference Model, Application-Capability Reference Model and the Technical Reference Model (fig. 12).

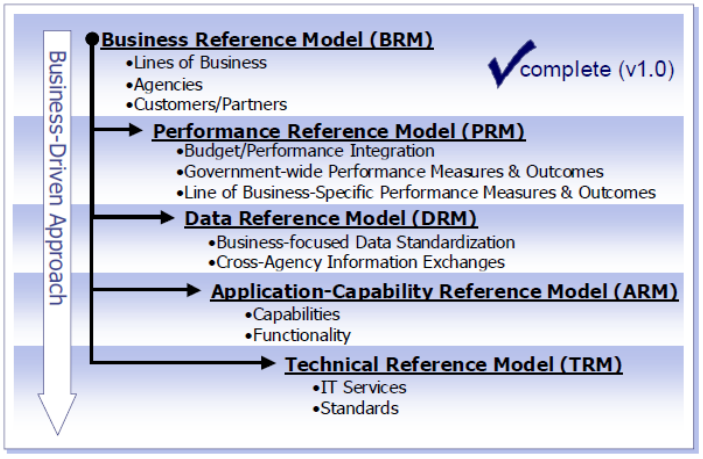


*Figure 12: The FEA Reference Models*

The BRM constitutes the foundational layer of the FEAF. The Model provides an integrated view of the Federal Government's business, detailing activities that agencies perform to achieve each mission and function. The BRM has been defined as "a function-driven framework for describing the business operations of the federal government independent of the agencies that perform them" (The Federal Enterprise Architecture Program Management Office 2003).

The BRM describes the Federal Government's Lines of Business and its services to the citizen – independent of the Agencies, bureaus and offices that perform these business operations and provide these services.

Following this similar to the previously presented Government Process Classification Scheme approach, the BRM identifies three *Business Areas* that provide a high-level view of the operations the Federal Government performs – Services to Citizens, Support Delivery of Services and Internal Operations/Infrastructure. The three Business Areas comprise a total of 35 external and internal *Lines of Business* – the services and products the Federal Government provides to its citizens; and 137 *Sub-Functions* – the lower level activities that Federal Agencies perform. In fig. 13 the three Business Areas and the 35 Lines of Business are presented.

The three Business Areas are each differentiated by the service being provided.

The ***Services to Citizens*** Business Area includes the delivery of citizen-focused, public and collective goods and/or benefits as a service and/or obligation of the Federal Government to the benefit and protection of the nation's general population. This Business Area includes 22 Lines of Business and 82 Sub-Functions.

The second Business Area, ***Support Delivery of Services***, aids the cause, policies and interests that facilitate the Federal Government's delivery of its services both to citizens and other federal agencies. This Business Area includes 9 Lines of Business and 32 Sub-Functions.


*Figure 13: The FEA Business Reference Model (version 1.0)*

*(The Federal Enterprise Architecture Program Management Office 2003)*

The final business area, ***Internal Operations*** and Infrastructure, refers to the "back office" support activities that must be performed in order for the Federal Government to operate. This Business Area includes 4 Lines of Business and 23 Sub-Functions. This business area is further divided into two sub-areas: Inter- and Intra-Agency Internal Operations. Whereas most agencies' back office activities support their citizen-focused Lines of Business (Intra-Agency), there are agencies that provide services for or leverage services from other federal agencies. These activities are distinguished within the Inter-Agency Internal Operations Business Area.

#### 2.2.1.3 Generic Administrative Procedures

In (Rosati *et al.* 2004) the authors follow a faceted classification analysis to model the overall eGovernment domain. This approach is interesting and is presented in more detail in our work in the part dealing with organizational modelling.

They introduce the Classification Research Group (CRG) theory16 and the CRG schema that defines the following generic facets:

- personality
- matter
- energy
- space
- time

Regarding the process modelling dimension, the primary and generic *energy* facet is identified to the administrative *process/procedures*. Three levels of abstraction are defined for the procedure facet: definition, promotion and control (fig. 14).

The class "*Defining procedures*" includes definition of principles, politics, normative and institutions. The sublevel of principles definition includes topics such as liberty, equality, right of access, etc. The political level includes strategies and politics. The normative frame

[16] Vickery B. 1961. Faceted classification: a guide to the construction and use of special schemes. London: Aslib, 1960.

includes legislative activity, juridical definition, codes of practice and standards. The institutional development frame includes the creation of public bodies and enterprises.

*"Promotion procedures"* comprise technology development and application; incentives to citizens, firms and non-governmental organizations; and education, training, information and assistance.

The last class groups procedures related to control. "*Control procedures*" can be exerted throughout different forms: judging and settling; certification; control and policing; punishing; and evaluation.

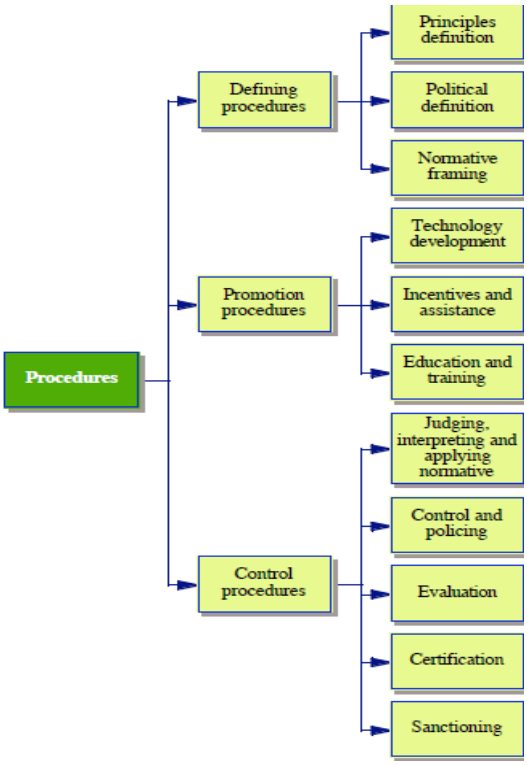


*Figure 14: Overview of Administrative Procedures (Rosati et al. 2004)*

#### 2.2.1.4 SAP Public Sector Solution Map

SAP has provided a series of generic process models, called "solution maps" covering various industries (e.g. banking, insurance, chemical). These models present, in a high, abstract and technology-independent level, the way the basic processes are executed in each industry. A solution map for the public sector was also developed. The model presents seven top-level governmental processes, namely:

- Organization Management
- Constituent Relationship Management
- Program & Project Management
- Human Resource Management
- Records Management
- Material & Services Support
- Business Support

These processes are further analyzed at a second level in the figure that follows:


*Figure 15: SAP Public Sector Solution Map*

These four initiatives are attempts to present generic process categories where all governmental processes could fit. Interestingly, the two first came from the public sector, the third is a research effort, while the fourth is a private company contribution. While the latter model has been used by SAP mainly as a blueprint and a reusable knowledge infrastructure for developing ERP systems for different kinds of governmental agencies, the first model didn't seem to influence a lot the USA agencies' process management practice, as no recent reference has been found for its usage. Almost surprisingly, no reference of this effort can be found even in the FEAF and the BRM related documents and literature. The FEAF-BRM representation is considered a key infrastructure that drives the overall Federal Enterprise Architecture development in the USA, thus its influence in eGovernment development in this country is expected to be of critical importance. Last, the procedures classification proposed in (Rosati *et al.* 2004) can be considered as research in progress, while its impact is still limited.

#### 2.2.1.5 A Model of Business Process Support System for E-Government

In a less generic and more project-based approach, in (Podgayetskaya and Stucky 2004), a model of a Business Process Support System (BPSS) for eGovernment is proposed. The proposed system consists of three main IT components: a workflow system for administration and control of information flows; Web Services enabling data transfer between computers; and a Web Server controlling all communications.

In the workflow system, the roles involved in eGovernment processes are defined to be external users, i.e. citizens, and internal users, i.e. the staff. Two kinds of internal users are identified: controlling and globally administering the overall process, i.e. the process owner; and observing and locally administering parts of the process, i.e. the process manager. Global administration signifies the overview of the complete business flow, making it a key function. In contrast, the local administration is limited to the overview of the processes managed by the respective staff member.

The external user is involved into the local processes only. All citizens are regarded as external users and only see the process offered by the customer unit. The administration

members are signified as staff with hierarchical structure: the department is lead by the administrator to whom the process manager reports.

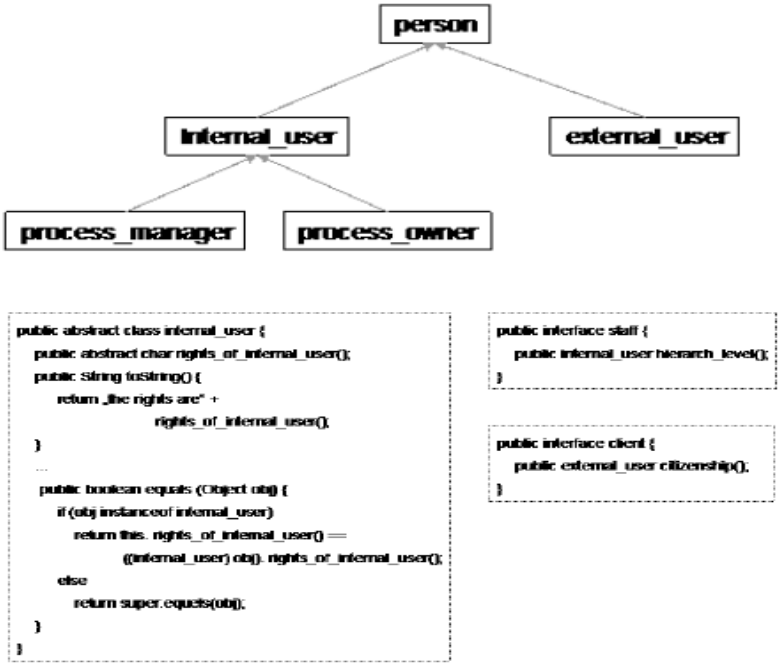


*Figure 16: Roles in an eGovernment process model*

The Web Server controlling all applications communication with all users in each organization is called the Workflow Enactment Server. It consists of two nodes: the Rule Based Collection and the Workflow Engine. The Rule Based Collection consists of a set of rules mapping to the public administration's hierarchical structure and permits a flexible and extensible process flow in case of ad hoc situations. Also exception rules are stored here. The workflow engine consists of two components A and B for process execution and control.

Component A is used for internal communication and controls all processes running in the organization. It is only visible for the process owner.

Component B is mainly responsible for external communication, enabling control and data flows with Web Services and web applications.

The proposed architecture was prototypically implemented using J2EE technologies. Communication between components of the Workflow Enactment Service was executed with RMI and the AXIS toolkit was used for Web Service implementation.

#### 2.2.1.6 Inter-workflow for eGovernment, India

In (Punia and Saxena 2004), three ways of structuring workflows in inter-organisational processes are introduced in the broad context of e-government services:

(a) Integrating sub-processes, which requires that various organisations involved in the process link together the sub-processes (which are internal to them) creating the new process that spans all the organisations. The sub-processes of all the participating organisations are treated as if they were simply parts of the larger inter-organisational process.

(b) Public processes. This approach relies on two or more organisations linking their internal sub-processes via a common public process that the organisations themselves develop or buy from a third party.

(c) E-marketplaces. This approach relies on a common market of service provider sub-processes that all the organisations can use. Organisations that want to use a service providing subprocess, make bids and organisations that want to sell a service sub-process respond to bids they can fulfill at a given price or some other reward. Someone, like a stock exchange authority, acts as intermediary, defines the rules and maintains the market.

In a public process workflow structure, two or more organisations come together and create new processes to be integrated with their existing processes. These new processes are common to all the partners and interface with each organisation's internal private processes. As stated above, these common processes are called public processes.

Private processes are internal and unique to each organisation and are managed independently, whereas public processes are common and standardised for everyone's use.

In order to explain the implementation of this concept, the case of passport application processing is presented. In this case, the Passport Office and Police Department (for verification of applicant's facts) need to cooperate with each other in order to issue a passport. Using the public process approach, the Police Department need not know how Passport Office processes work and vice versa. Currently, the main issues in the passport application processing are identified to be:

- Lack of process ownership and accountability
- Activity ownership – departmental focus
- Manual activity interfacing
- Lack of integration between the application processing system and the web-based information system

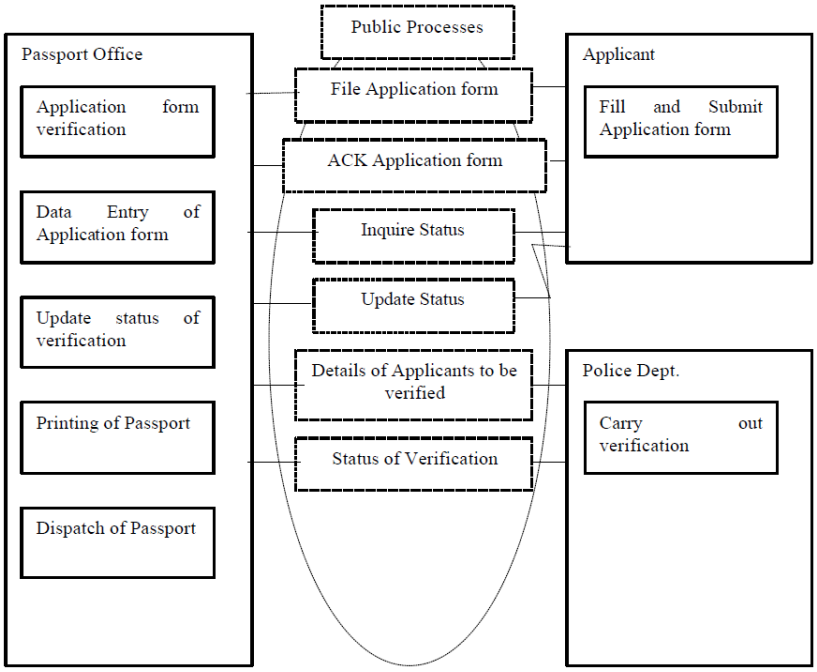


*Figure 17: Public-Private Process Modelling of Passport Application.*

By clearly separating the private from the public part of the workflow, the writers demonstrate the concept of a 'public process' as an effective workflow management tool for eGovernment implementations.

#### 2.2.1.7 The IMPULSE IST project

The IMPULSE IST project addresses public administration services based on processes spread over various information and workflow systems. This type of services (called "complex services") usually consists of several other available "simple" processes, which reside on the local (single agency managed) workflow systems.

The writers in (Aljosa Pasic *et al.* 2002) argue that the existing cooperative interworkflow models as described in WfMC-TC-2102 specifications17 and (Vassilis Christophides *et al.* 2001) are more suitable for virtual enterprises and similar applications, and less to public

[17] Interworkflow application model: WfMC-TC-2102 specification

administrations with hierarchical structures of streamlined procedures. The challenge is therefore, to create new models for interaction of heterogeneous PA systems where internal workflow process details are opaque to other organisations and where enactment of different workflows is performed in a co-ordinated way. This idea is similar to the "public process" concept presented in the previous case.

The IMPULSE proposes a supervising interworkflow hub, which acts as a control and co-ordination tier between citizens and agencies. The control layer of this hub takes care of connection, data translation and high level role mapping and is presented in the middle of the proposed architecture (fig. 18)

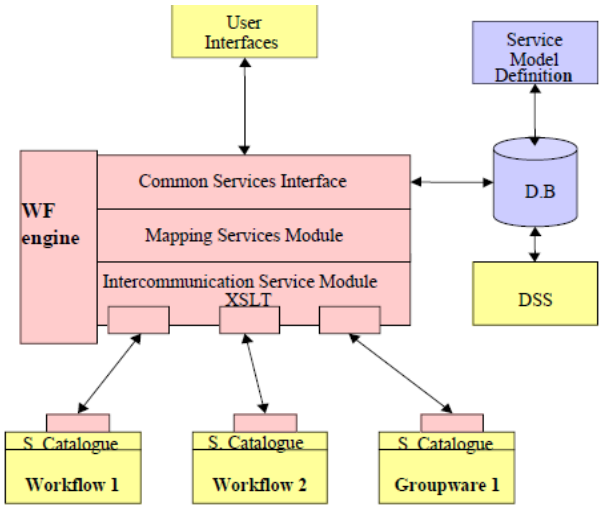


*Figure 18: IMPULSE model for interworkflow control and coordination in e-government applications*

IMPULSE accesses external applications for tasks and services execution via standardised software applications named connector agents. Each agency workflow must include a connector agent to support communication with the IMPULSE server. This requires co-ordination logic that copes with invocation across different platforms and network environments, together with a means of transferring workflow relevant data in a common format or transferring it to the case instances in the individual application environments.

Connector agents also negotiate the information needed by elements, specifying name and type of the information element (variable or document). Once the information required by the IMPULSE engine is known, the agent sends the information elements and invokes external enactment services. The basic protocol the agent follows is quite simple:

get_required_informationDef
set_input_information
need_moreInfo
get_returned_informationDef
get_output_information
release

Two limitations of the proposed IMPULSE system have been identified by the authors:

- Each possible interleaving of steps that might occur at execution time has to be predicted at process design time, which leads to extreme complexity of the design process.
- Further research on ontology in public administrations and work on distributed knowledge representation is needed in order to design more effectively these complex cross-agency services.

### 2.2.2 Service View

#### 2.2.2.1 Workflow versus Serviceflow

The shift of interest from traditional workflow to service-aware systems has been highlighted in (Wetzel and Klischewski 2004 ). The authors identified three main requirements for software support in inter-organizational services: flexibility, interoperability and customer/citizen orientation. They argue that these requirements are addressed better if we move from a Workflow to a Serviceflow approach. In Serviceflow Management the service nature of inter-organizational processes is put into the centre of modeling, design and architecture. The underlying conceptual distinction of the serviceflow approach is between the portion of the process where the customers concern is evaluated and cared for, versus the background processes (back-office).

The authors conclude that the serviceflow management asks for metaphors, concepts and architectures beyond traditional workflow management.

#### 2.2.2.2 Using Dublin Core for eGovernment service description

The recent service orientation has influenced not only the process and workflow communities but even the work conducted under the Dublin Core eGovernment Working Group. Following discussion at Working Group meetings in Florence (2002) and Seattle (2003), the DC-GOV workplan for 2003/04 included the development of "a set of best practice guidelines … for the use of DC to describe services." This direction has been based on the fact that "… e-government programmes that use Dublin Core have a common need to describe services as well as documentary resources".

The proposed elements for the DC eGov service description are the followings grouped into three categories:

- Content: Audience, Coverage, Description, Function, Language, Relation, Source, Subject, Title
- Manifestation: Availability, Date, Format, Type
- Ownership: Contributor, Creator, Mandate, Publisher, Rights

The WG has not yet finalized the proposed schema and relevant work seems to develop at a rather slow pace[18].

#### 2.2.2.3 The ONTOGOV Service Model

Following a Semantic Web Service approach, the ONTOGOV IST project has recently proposed an eGovernment domain specific service ontology, or a meta-ontology as it is called by the consortium. The proposed ontology is heavily based on the two major generic service ontologies, namely OWL-S and WSMO, but ONTOGOV does not reuse OWL-S or WSMO as such. The reason for developing a PA specific service ontology was claimed to be inefficiencies in the generic ontologies: Whereas the WSMO ontology did not contain the process model at the time of the development, the OWL-S ontology does not allow using the domain ontology entities as inputs/outputs of an activity in the process model and the formalism for expressing conditions is not defined. Moreover and although not mentioned explicitly, the proposed ONTOGOV meta-ontology specializes and instantiates in the eGovernment domain some features of the two generic frameworks. The work towards this task is considered of particular interest, thus we present it in details.

Similarly to the OWL-S ontology, the ONTOGOV Meta Ontology consists of two parts: the *profile* that is used for the service discovery and the *process model* that is used to describe the process flow (L. Stojanovic, A. Abecker, D. Apostolou, G. Mentzas, R. Studer, 2006).

To define the ONTOGOV meta-ontology profile, the OWL-S service profile ontology has been extended in the following ways (Ljiljana Stojanovic *et al.* 2004).

[18] http://dublincore.org/groups/government/

- The property "*hasReferencedBusinessRule*" was defined. This establishes a reference between the service description and the business knowledge that is represented in the form of an ontology. This ontology has been called *Business Rule* ontology and depends on the application domain. In the E-Government domain, this ontology is the *Legal Ontology*.
- The second extension comes from the business process modelling point of view. In order to model the resources involved in a business process, additional entities where introduced, such as the property "requires" and the concept "Resource". In this way, a bridge between the common language used by business people – in order to describe the business processes (i.e. web services) - and the ontology language used for describing web services was established.
- The third extension is achieved by taking into the consideration the standard metadata defined for the particular domain. For this, the CEN Application Profile v.1.0 metadata standard (CEN 2003) was used to describe the non-functional aspects of a PA service.

Regarding the process model, which interests us more here, the following differentiations to the OWL-S process ontology were introduced:

- As there are specific requirements concerning retraceability, realisation, security, cost etc. e-Government specific properties were added:
    - Each service is associated to the law it is based upon. It was perceived very important to document the laws and regulations not only for the whole process but also for specific activities.
    - Each service is associated with the software component that implements it.
    - It is necessary to assign security levels to each service.
    - Information about cost and time restrictions should be also specified.
- The concept "User-defined Input" is defined as a specialisation of the concept "Input".
- To establish the equality between two parameters the symmetric property "isEqualTo" was introduced.
- Since it is required that inputs/outputs are defined in the domain ontology, the additional concept "Reference" was introduced due to two reasons: (i) a property may be attached to several domain concepts; (ii) a concept defined in the domain ontology may have many properties and only a subset of them is used as an input. In order to specify the context of the usage of a property and to select a subset of them, the properties "hasConcept" and "hasProperty" were introduced respectively.
- While OWL-S uses preconditions and effects to refer to the changes in the state of resources, the ONTOGOV meta-ontology accepts the WSMO interpretation. Preconditions are used for defining what a service expects for enabling it to provide its service. Postconditions define what the service returns in response to its input.
- For a composite service, the following additional properties were added: the property "hasFirst" indicating the first service in the process flow and the transitive property "consistsOf" indicating all services that a service includes.
- A set of rules is specified. For example, if a part of a service (either an atomic or a composite service) is related to some part of the law, then the service itself is related to the same part of the law.
- The ONTOGOV meta-ontology process model provides the following control structures: Sequence, Split, Join and If-Then. While and repeat which are defined in the OWL-S process ontology have not been included, since none of the e-Government use-cases analysed by the project required them.
- To connect the services and the control constructs, the following properties were defined: (i) "hasNextControlConstruct" and "hasPreviousControlConstruct" whose domain is the concept "Service" and range is the concept "ControlConstruct"; (ii) "hasNextService" and "hasPreviousService" whose domain is the concept "ControlConstruct" and range is the concept "Service". The properties are inverse of each other.

- For the concept "if-then" several additional properties are defined in order to determine the next services based on the fulfilment of the condition.

The process part of the Meta Ontology is shown in fig. 19.

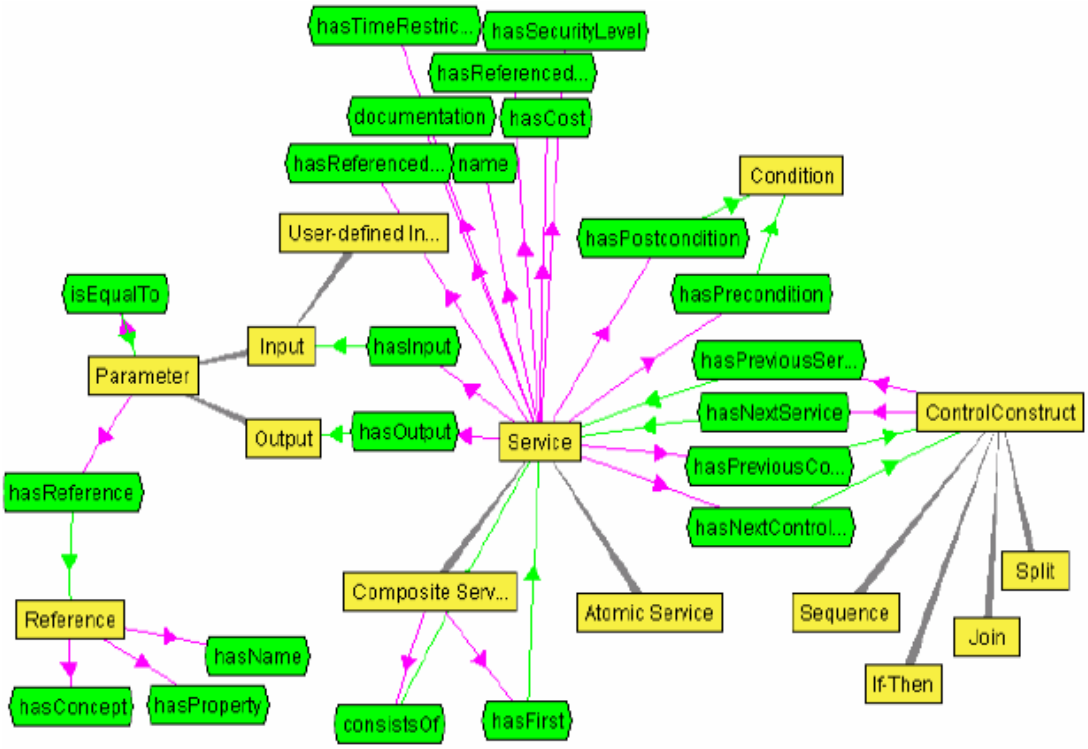


*Figure 19: The ONTOGOV Process Meta-Ontology*

As the project is still running, there are no currently available stable implementation prototypes, nor tools that could be used to mark-up PA services using the proposed meta-ontology.

#### 2.2.2.4 OWL-S Service Registry

Similar – though far less ambitious – work has been reported in (Sabucedo and Rifón 2005). In order to enhance the discovery capabilities of public administration services advertised in UDDI registries, an extension of OWL-S description is proposed in order to capture important PA service features. As presented in (Sabucedo and Rifón 2005), the main features for these enhancements include:

- Definition of a set of ObjectProperty to express features linked to services:
  - Support for requesting security services: encryption and electronic signature.
  - Making explicit the maximum data spread
  - Requesting signed acknowledgement of submitted questions.
- Definition of a set of Class to characterize actors involved in operations:
  - Characterization of citizens.
  - Characterization of PAs.

### 2.2.3 Methodologies

In this part, we present two proposals for developing process modeling methodologies specifically for the public administration domain. The first has been developed by the ICTE-PAN IST project, while the second has been developed by BOC GmbH Vienna together with the University of Linz under the ADOamt[19] Austrian national R&D project.

[19] www.adoamt.com

They both start from the finding that existing "general" process modelling methodologies cannot cover the specific process modelling requirements in the eGovernment domain, thus, there is a need to develop a PA specific methodology.

As both projects are still running, there are no concrete and detailed examples available of modeling PA processes using the specific methodologies, and thus no assessments of the actual modeling power and expressiveness and usability of the proposed methodologies and tools.

#### 2.2.3.1 Public Administration Operation Modeling Integrated Methodology

The ICTE-PAN IST project introduced the Public Administration Operation Modeling Integrated Methodology (PA-OMIM), a methodology that produces Business Process Models for PAs and focuses on the G2G collaboration processes[20].

The more general focus of the ICTE-PAN project is on creating collaborative environments for public administration. To this end, the project aims at developing an innovative methodology for modeling PA operations and tools for transforming these models into design specifications for e-Government environments automating and simulating complex processes. Such environments could model and simulate complex hierarchical processes, task allocations, etc. and interface with data repositories and other legacy systems or content created at different levels of the public administration hierarchy.

ICTE-PAN argues that none of the existing (off the shelf) Business Process Modelling methodologies could fulfil all eGovernment requirements and offer all the required features. Specifically, the general methodologies cannot fulfil some or all of the following features:

- Model collaborative complex processes.
- Combine "hard" and "soft" elements (adopting a socio -technical approach).
- Develop complicated Resource models (with knowledge bases, etc.)
- Develop an enhanced and interconnected top-level environment model with boundary definitions, stakeholders analysis, interests and concerns, business/legal constraints, etc.
- Support ontologies for modeling unstructured collaborative processes.

Therefore PA-OMIM was constructed. It combines elements from existing Business Process Modeling Methodologies with new elements and ideas from the area of Knowledge Management (e.g. ontologies).

The methodology consists of two components: the PA-OMIM Redesign Method and the PA-OMIM Modelling Language. The PA-OMIM Redesign Method consists of the following seven stages:

1. Definition.
2. Project Initiation.
3. Diagnosis.
4. Redesign.
5. Requirements Specification and Environment Design.
6. Implementation.
7. Evaluation.

The PA-OMIM Modeling Language is a graph-structured language. It is based on the XML Process Definition Language (XPDL)[21]. It has an intuitive format that enables model building and understanding by non-experts and also a simple and powerful notation that allows the modeling of PA collaborative processes. A multi-view approach has been adopted, in order to include in the models all the significant elements and associations among them. The PA-OMIM views are:

1) Environment View

[20] http://www.eurodyn.com/icte-pan/

[21] Workflow Management Coalition: Workflow Process Definition Interface – XML Process Definition Language, Document WFMC-TC-1025, 2002.

2) Process View
3) Organization View
4) Resource View
5) Information View

These views are self-contained and PA-OMIM implementers may choose to build models following a few or all of them; however, the views are complementary and direct connections exist that link the views together: an element of one view, e.g. an activity in the Process View, may be linked to an element of another view, e.g. an organization unit or a person in the Organization View, responsible for implementing (or participating in) the activity, therefore the implementation of all the views is strongly recommended.

#### 2.2.3.2 Processes in E-Government – A Holistic Framework

In a similar to the previous approach, the authors in (Palkovits and Wimmer 2003) argue that due to the high complexity of governmental processes and organisational structures, appropriate modelling methodologies and tools for eGovernment to cover all the additional requirements are not really available yet. Some of these requirements are reported to be:

- the identification of actors and their roles,
- the definition of possible communication channels,
- the transparency of the flows,
- the standardisation of terminologies for efficient and transparent communication,
- the integrated modeling from the portal to the back office and
- the integration of the citizen and company clerk as service consumers.

Therefore, the aim is to provide a holistic reference methodology and modeling functionalities within a tailor-made meta-modeling tool for the public sector. In this line, a Business Process Management methodology and a toolkit targeted for the public sector is proposed. The aim is at presenting a solution to support public administrations in the reorganisation and re-engineering of administrative processes towards online service provision.

In the course of a number of projects, BOC GmbH Vienna has developed a framework called EBPMS which integrates business-oriented modelling approaches and approaches for the modeling of information systems (IS) and IT infrastructures. In the ADOamt project, the approach is to develop a EBPMS compatible modeling tool, which realises the most important requirements to support the implementation of e-government solution from a business process management (BPM) and integrated service modeling perspective.

The E-PBMS Paradigm focuses on the requirements definition and the technical modelling of web applications. Basis for this framework is the modelling on four levels to control the complexity of web applications.

- On the strategic level the business model is depicted. Additionally decisions about objectives, the common organisational structure and the core business processes are made. This model gives a detailed overview of the services provided by public administration.
- On the business level the business processes as well as the working environment are modeled. The business level contains a number of different model types. The Process Map should give an overview of the different processes. To structure the working environment within an authority, a ministry or a city, two different model types are used in ADOamt. In the Organigram, the rough organisational structure is modeled to give an overview of the organisational units servicing the citizen. The Working Environment Model depicts the performers, roles, skills profiles and organisational units and connects them to the activities of a process.
- On the implementation level the organisational and technical realisation is executed.
- The aspects of runtime environment and the IT infrastructure are considered at the execution level.

In the figure that follows an overview of the framework is given.

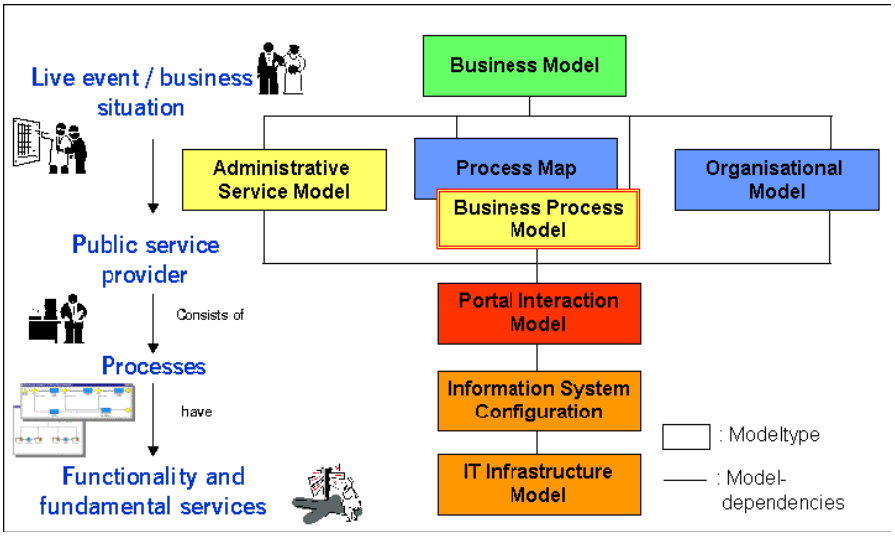


*Figure 20: Holistic Process Modelling Framework*

## 2.3 ORGANIZATIONAL MODELING AND INTEGRATION

While efforts to model data, processes and services in public administration as presented in the previous sections stem mainly from information systems and computer science disciplines, organizational theory provides some very interesting ideas and models that are closely related to the broader integration research. The different perspective introduced in the study of the field is demonstrated by the use of terms like "integration" or "information sharing" instead of the more technically oriented "interoperability". The difference between the two terms has been discussed in previous parts of this work. In this part, we do not intend to get in-depth in the organizational integration literature, as this would be out of scope regarding our research agenda. Though, we want to present some interesting approaches on organizational modeling and integration as we think that these may substantially influence and provide insights to work conducted in the field of IS interoperability.

Approaches such as "loosely coupled systems" (Weick and Goodman 1982), "interorganizational networks" (Gulati and Gargiulo) and the "governance theories" (Rhodes 1997) provide an interesting and novel view to contemporary organizations. What is common in all these approaches is the proposal of networking as the 'third way' and an alternative governing structure between the "anarchy of the market and the hierarchy of imperative coordination" (Jessop 2003). Whether proposing horizontal self-organization among mutually interdependent actors (Rhodes 1997), or loose coupling as a situation in which elements are responsive [to other network elements], but retain evidence of separateness and identity (Orton *et al.* 1990). These approaches introduce innovative organizational design as a means to overpass the administrative fragmentation caused by traditional bureaucratic structures. These ideas, models and approaches have not yet been adequately exploited by information systems' designers in eGovernment programmes and initiatives, mainly due to severe communication obstacles among the disciplines (e.g. different languages, self-reference).

From a really vast literature, we present here some attempts to present an innovative organizational modeling perspective for PAs. We have grouped these efforts in three categories:

- Government Taxonomies and Ontologies (Organizational Modeling)
- Government Inter-organizational Integration
- Government as Networks

### 2.3.1 Government Taxonomies/Ontologies

#### 2.3.1.1 Government functions taxonomy

McLean in (McLean 2000) highlights the problems involved in drawing up a taxonomy of government organisation by presenting attempts based on either structural or functional elements for classification purposes. The author argues that regarding classification "One Right Answer exists in biology, but not in human organisations" and demonstrates this by the phrase "Central Government is what the central Government says it is".

Despite these pessimistic findings the next three approaches try to present a basis for defining and classifying the eGovernment domain.

#### 2.3.1.2 Faceted Classification of Public Administration

In (Javier García Marco *et al.* 2005), the authors advocate the need for the development of an eGovernment domain ontology. In order to propose the dimensions of such an ontology and to address the complexity that has led McLean to the subjectiveness presented above, they depart from the theory of faceted classification as established by Ranganathan[22] and the Classification Research Group (CRG) theory[23] and they propose the facets for classifying all eGovernment resources to be the following:

- Services and practices (Entities)
- Life events (Kinds)
- Access mode (Properties)
- Stages (Processes)
- Citizens and companies (Patients)
- Public institutions (Agents)
- Geographic departments (Space)
- Dates (Time)

[22] S. R. Ranganathan, Prolegomena to library classification, Madras, Asia Publishing House, 1967.
[23] Vickery B. 1961. Faceted classification: a guide to the construction and use of special schemes. London: Aslib, 1960.

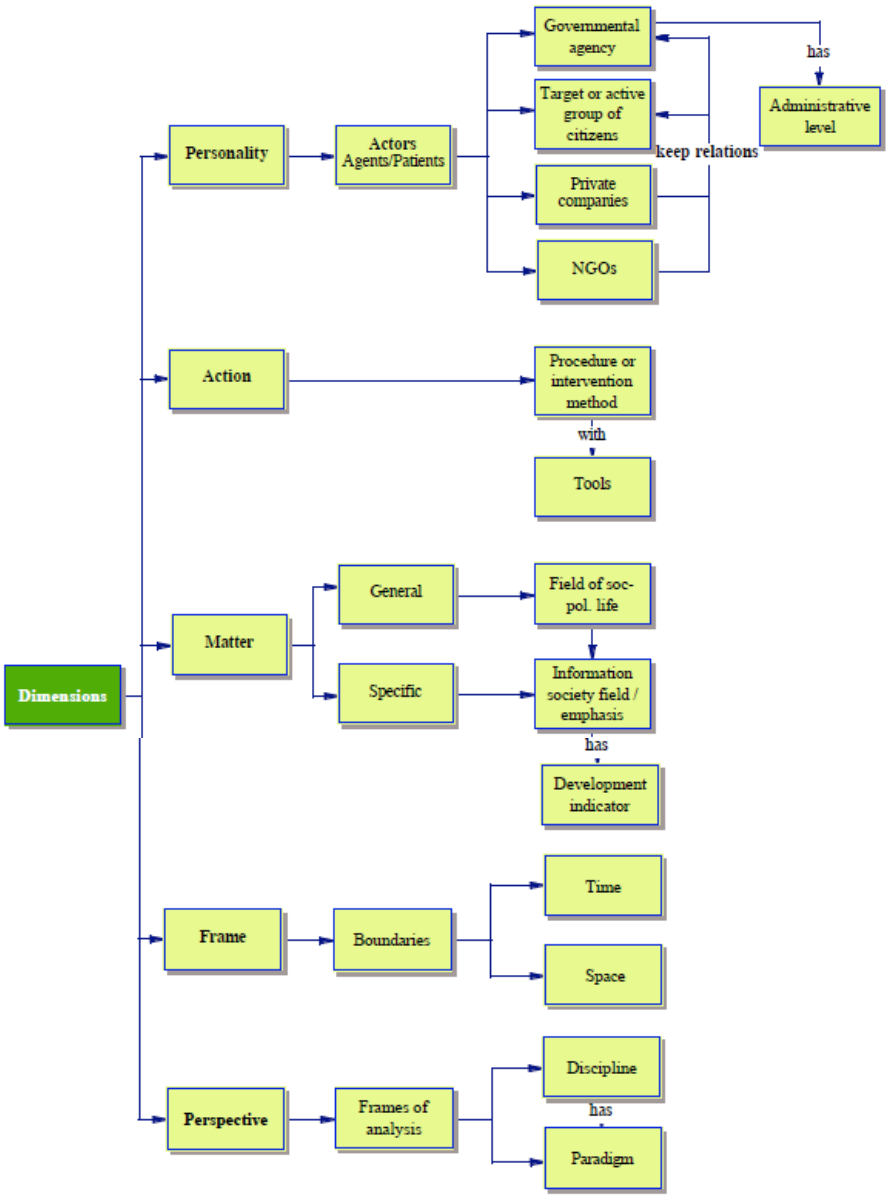


*Figure 21: eGovernment faceted classification*

From this extended set, in (Javier García Marco *et al.* 2005), they use a smaller facet set as proposed by the general CRG schema. These facets are:

- personality
- matter
- energy
- space
- time

They instantiate these general facets to public administration in the following way (fig. 1-25):

- The personality facet includes all the possible and actual actors – citizens, governmental agencies, companies and non governmental organizations – and their relations.
- Matter is the social fields of intervention.
- Energy is, in a more modern term, processes.
- The general facets of space and time are provided for spatial and temporal contextualization, filtering and navigation.

Finally, a facet has been added to the classic Ranganathan model to manage interdisciplinarity, which is called *perspective*. Its aim is to codify all that refers to different disciplines, paradigms and models.

#### 2.3.1.3 The three spheres in eGovernance

Grönlund (Gronlund 2005) adopts the proposed by Molin (Molin *et al.* 1975)[24] decomposition of the overall governance system in a democratic government system into three zones:

- Formal Politics
- Administration
- Civil Society

In fig. 22 arrows indicate influence, circles indicate domains of control and domain intersections indicate "transaction zones".

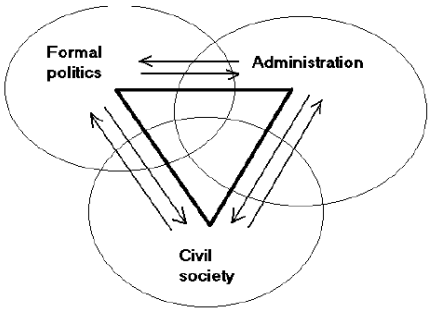


*Figure 22: Basic spheres and relations in a democratic government system.*

The table below summarizes important features of the three major spheres.

| | *Political sphere* | *Administrative sphere* | *Civil society* |
|---|---|---|---|
| *Motivation* | Representation<br>Balancing interests<br>Incompatibility management | Economic and legal rationality<br>Equality<br>Inspectability | Individual or community welfare and emancipation |
| *Focus unit* | Groups (representation) | Individual as social unit | Individual or group (as humans with interest) |
| *Interest* | Room to maneuver | Complete data<br>Universal/compre-hensive models<br>Value-freeness | Privacy<br>Expression |
| *Mode of operation* | Value (policy) based rhetoric<br>Negotiation | Engineering | Ad hoc, situational or issue-based, e g social movements |

*Table 4: A comparison of the spheres*

In (Gronlund 2003) these spheres are further discussed and candidate theories for studying them are presented.

#### 2.3.1.4 Gartner Government Performance Framework

Gartner proposed in 2003 the Gartner's Government Performance Framework (GPF) as a tool to assess the value IT can add in a public sector context[25]. Interestingly, the GPF groups all actionable activities for a public sector organization in three layers (Gartner 2003):

- Political Management: All activities involved with satisfying the political objectives of the government organization.

[24] As appeared in Goldkuhl, G. (1996). Generic business frameworks and action modeling. 1st International Workshop on Communications Modeling - The Language/Action Perspective, Springer Verlag.

[25] "Gartner Business Performance Framework v1.0" (http://www.gartnerg2.com/fw/fwbpf.asp).

- Service Supply Management: All activities involved with satisfying demand for services offered by the organization. "Service" includes emergency, healthcare, benefit payment services, as well as administrative obligations like tax filing and payment and license renewal.
- Support Services: All activities involved with supporting the organization.

## 2.3.2 Government Inter-organizational Integration

### 2.3.2.1 A Framework for Evaluating Information Sharing & Interoperability

Scholl in (Hans J. Scholl 2005) presents a multi-dimensional framework for planning and evaluating information sharing in government. EGovernment enhances the levels of information sharing among and between government levels and branches. For this sharing to become effective, interoperability at the technical level is not enough. In fact, the technology side may prove the least difficult to address, while the organizational, legal, political and social aspects may prove much more of a challenge. These "soft" aspects of integration complicate the development of collaborative schemes across PA agencies. Deploying wide schemas of information sharing among governmental bodies represents a far more difficult case than the deployment of a new information system in a single organization. For these reasons, a complete framework is needed in order to guide the planning and evaluation of information sharing in PAs.

The framework proposed by the author for this purpose is iterative in nature and takes into account aspects related to organizational integration and systems interoperability covering six levels:
(1) legal,
(2) policy,
(3) organizational,
(4) managerial,
(5) social process,
(6) technological.

The framework deliberately accounts for the flux and potential volatility in intra- and interorganizational relationships (fig. 1-27). It consists of the following stages:

- Identifying the Need for Information Sharing
- Identifying and Involving Salient Stakeholders and Their Leadership
- Identifying Needs, Wants, Benefits, Cost
- Analyze and Evaluate Organizational and Social Impacts
- Identifying Salient Stakeholders' Likely Stances
- Identifying the Pre-disposition for Collaboration
- Identifying and Facilitating Critical Success Processes
- Analyzing and Evaluating Technical Architecture Alternatives
- Experimenting with Prototypes and Components
- Evaluating Organizational and Social Acceptability
- Evaluating the Technical Robustness
- Incrementally Deploying Components
- Establishing the Level of Acceptance and Satisfaction

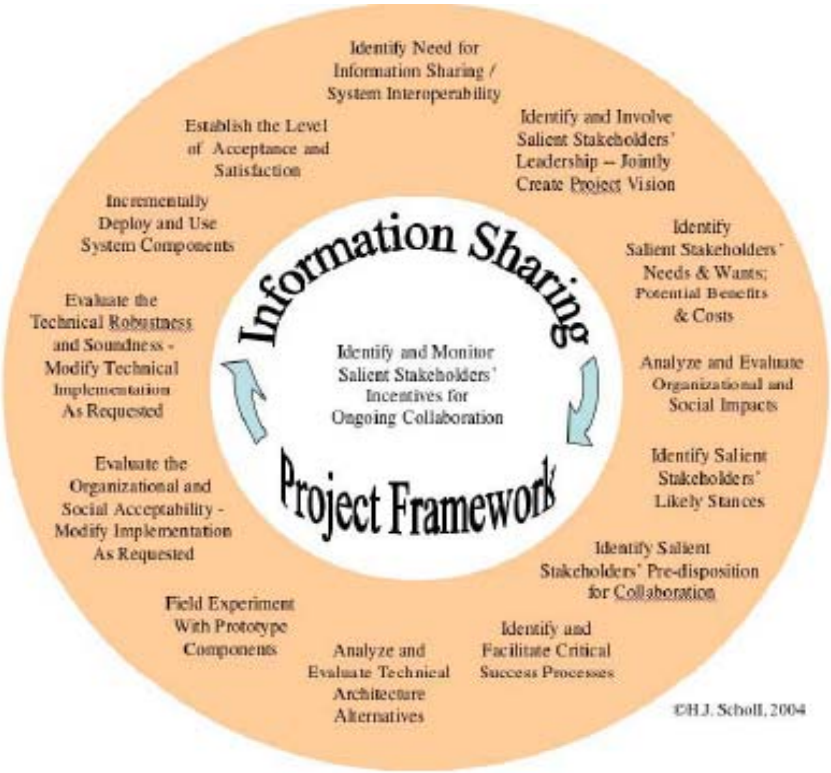


*Figure 23: The E-Gov Information-Sharing Project Framework*

#### 2.3.2.2 Modeling the Social & Technical Processes of Interorganizational Integration

Interorganizational information integration is the focus of a multi-disciplinary programme run by the Center for Technology in Government, University at Albany/SUNY and funded in part through a grant from the National Science Foundation (ITR-0205152).

In (Sharon Dawes et al 2004) the authors argue that sharing information in multi-organizational government settings involves complex interactions within social and technological contexts. Organizations must establish and maintain collaborative relationships in which knowledge sharing is critical to resolving numerous issues relating to data definitions and structures, diverse database designs, highly variable data quality and incompatible network infrastructure. Special attention is given to organizational and institutional factors that influence information integration and how those interact with characteristics of the technology.

In (Pardo *et al.* 2004) the first findings of the project to model the social and technical processes of interorganizational information integration in order to improve understanding of information system development and of interorganizational collaboration are presented. The research seeks to enhance both the conceptual and practical models of interorganizational information integration by building new understanding of the interaction among the social and technical processes in interorganizational information integration.

The authors depart from the existing efforts to understand the socio-technical interaction mainly through drafting enterprise architectures. They find that while an essential component of any intergovernmental integration effort, architecture frameworks have one major limitation: they are static. They depict technical and social factors as related but existing within separate environments. They don't explain or model how technical and social factors interact to influence the effectiveness of interorganizational information integration. Identification of these factors and processes in an integration strategy is very critical and perceived as a first step in helping government agencies establish and maintain collaborative

relationships in which knowledge sharing is critical to resolving issues such as data definitions and meaning.

To better understand these interactions, information integration must be viewed holistically, as embedded in four different but related contexts, as presented in fig. 24.

- Policy and Social Environment
- Organizational/Business Processes
- Interorganizational Setting
- Technology Solutions

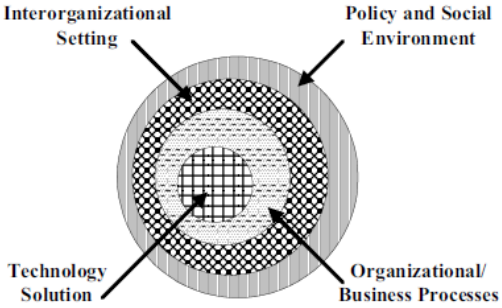


*Figure 24: Context of Information Integration*

Integration across distributed information sources and organizational boundaries constitutes a complex social process in which technological and organizational artifacts are developed and assembled for the purpose of information use. Integration components are organized into the groups shown in Table 5 below.

| Social Processes | Resources | Organizational Artifacts | Technology Artifacts |
|---|---|---|---|
| • information and knowledge sharing<br>• collaboration in work processes<br>• trust building<br>• negotiating<br>• decision making | • leadership and authority<br>• skills, materials, and facilities<br>• interorganiza-tional policies<br>• resource allocation mechanisms<br>• political will | • goal alignment<br>• policies<br>• management structures and decisions<br>• interpersonal relationships<br>• contracts and other agreements<br>• trust<br>• incentives<br>• norms<br>• social translation techniques<br>• shared understandings<br>• life-cycle/ budget-cycle alignment<br>• integrated work rules and procedures | • physical networks<br>• integrated system architecture<br>• interoperable hardware<br>• protocols<br>• standards and data definitions<br>• integrated applications<br>• process maps and models<br>• integrated databases and data warehouses<br>• analytical and decision support tools<br>• technical reports and analyses |

*Table 5: Components of Information Integration*

The social processes identified in the first column are generic ones expected to be involved in typical interorganizational relationships. The processes require resources, both tangible and intangible, to proceed (second column). The results of the social processes of developing integrated information systems and resources result in a potentially wide range of organizational and technological artifacts (columns three and four).

A preliminary model based on the material in Table 5 is shown in Fig. 25 below. The achievement of integration requires the development and use of IT artifacts, which are embedded in a social process. The artifacts are developed jointly through emerging social and technical processes. Thus, the full significance and effects of any technological artifact cannot be separated from the related processes and organizational artifacts. Artifacts thus embody

both technical and socially constructed attributes resulting from the interaction of social and technical actions and decisions along the development path.

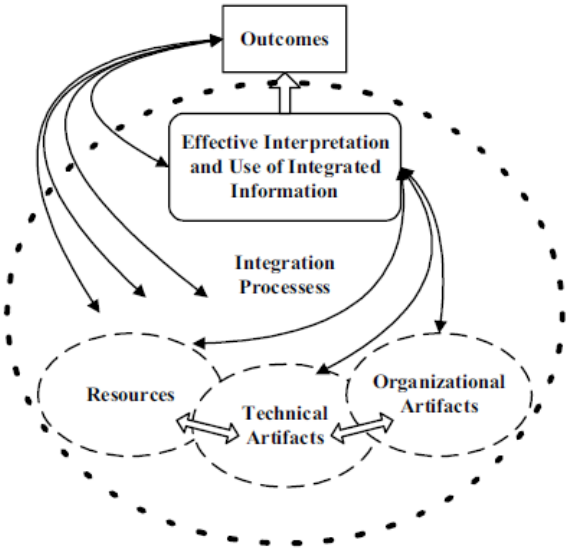


*Figure 25: Relationship of Integration Components*

The developed research framework suggests the dynamic nature of these interactions that are explored using system dynamics methods in order to explain how social processes generate or influence the nature of technical and social artifacts.

#### 2.3.2.3 New Models of Collaboration for Delivering Government Services

In (Dawes and Prefontaine 2003) a conceptual model of how organizations collaborate to deliver public services to citizens and businesses is presented. The study draws on the literature of interorganizational networks, management information systems, public management and organizational behaviour to devise a preliminary model of how such collaborations form and operate. The study has been a multinational investigation to document and compare the experiences of collaboration efforts in various countries. The model is derived from a comparative study of 12 collaborations in Canada, the US and Europe that involved various combinations of public, private and non-profit organizations pursuing a variety of service objectives[26]. The cases included in the research were selected based on the existence of a reciprocal and voluntary agreement between two or more distinct public sector agencies, or between public and private or non-profit entities, to deliver government services. The table below presents the main characteristics of the cases.

[26] http://www.ctg.albany.edu/projects/newmodels

| Case | Service Focus | Government sponsor | Predominant collaboration type | Service type |
|---|---|---|---|---|
| Access Indiana | Public access to state government information and transactions | State of Indiana | Public-private | Public access to multiple services and/or information sources |
| Ambassadeur | Citizen Internet exposure & training program in rural areas | Province of Quebec | Public-nonprofit | Public access to a single service type |
| Bremen on-line | Public access to city information and transactions | City of Bremen, Germany | Public-private | Public access to multiple services and/or information sources |
| Cadastre Reengineering | Real property tax mapping | Province of Quebec | Public-private | Support for governmental operations |
| First gov | Public access to federal government information | US federal government | Public-private | Public access to multiple services and/or information sources |
| Hotjob | Job offers portal | Belgian national government | Public-private | Public access to a single service type |
| Internal Revenue Service e-file | Filing of personal income tax returns | US Federal government | Public-private | Public access to a single service type |
| NYS Geographic Information System Coordination Program | Data sharing and development of data analysis expertise | State of New York | Public-public | Support for governmental operations |
| One-Stop Business Registration | Unique kiosk allowing electronic filling of all forms required to open a new business | Province of British Columbia | Public-nonprofit | Public access to a single service type |
| Ontario Business Connect | Unique kiosk of government services to businesses | Province of Ontario | Public-private | Public access to a single service type |
| Partners in Change | IT system to manage welfare benefits delivery | Province of New Brunswick | Public-private | Support for governmental operations |
| Service Canada Initiative | Online government information to citizens | Canadian federal government | Public-public | Public access to multiple services and/or information sources |

*Table 6: Case Characteristics*

Drawing on the research literature of several disciplines, a conceptual model was designed that covers macro, meso and micro levels of analysis of the collaboration projects to be studied. This model attempts to represent influential factors that operate at these three different levels. The model depicts six dimensions.

- The first dimension includes factors in the political, social, economic and cultural environment and is crucial because of the international character of the research project.
- The second dimension includes factors in the institutional, business and technological environment.

These first two dimensions constitute the macro environment.

- The third dimension includes the characteristics and objectives or motivations of the different participants in the projects.
- The fourth dimension includes factors related to the collaboration-building process per se, from inception to implementation.
- The fifth dimension includes factors related to collaboration methods, including the different governance schemes adopted, the nature of risks and benefits, the distribution of authority and control, resource sharing and the interorganizational management of the collaboration process.
- The sixth dimension includes collaboration and service performance factors.

In this model, the pervasive influence of the political, social, economic and cultural environments, as well as the institutional, business and technical environments on these initiatives are acknowledged by nesting these layers of environment and embedding the collaboration initiative within them. The model illustrates the importance of the dynamic influences among the dimensions. It suggests that the collaboration process influences and is influenced by the players and their expectations and by the modes and methods of collaboration they choose to use. The collaboration process leads to performance outcomes in terms of both the collaboration itself and the service goals it seeks to meet. These results further influence the players, what tools they choose and the way they interact. In addition, the feedback arrows represent the double-loop learning that took place – the participants not only learned better ways to manage these particular projects, they also learned how to

approach collaborative working relationships more generally. This iterative cycle of influences captures the full range of experiences documented in the case studies and suggests the key factors that shape new models of collaboration across programmatic and national boundaries.

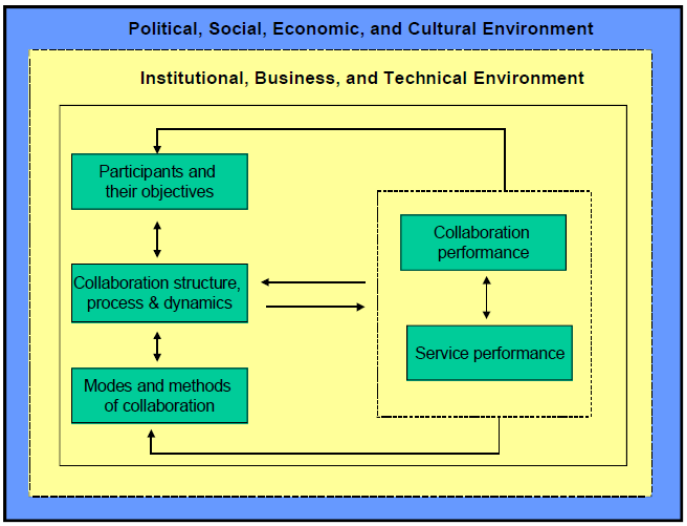


*Figure 26: model of service delivery collaborations*

#### 2.3.2.4 Organisational Interoperability Maturity Model for C2

Clark and Jones in (Clark and Jones 1999) take the Levels of Information Systems Interoperability (LISI) DARPA model (C4ISR Architectures Working Group 1998) and extend it to cover the organisational aspects of interoperability. The proposed Organisational Interoperability Maturity Model remains compatible with LISI and defines the levels of organisational maturity that describe the ability of organisations to interoperate at the organizational level. Five levels are identified in close relationship to the corresponding LISI levels:

| ***LISI Model*** | ***Organizational Interoperability Model*** |
|---|---|
| isolated/manual | independent |
| connected/peer-to-peer | ad hoc |
| functional/distributed | collaborative |
| domain/integrated | combined |
| enterprise/universal | unified |

*Table 7: LISI – Organizational Interoperability Models*

A short description of the five levels proposed follows:

*Unified*: a unified organisation is one in which the organisational goals, value systems, command structure/style and knowledge bases are shared across the system.
*Integrated*: The integrated level of organisational interoperability is one where there are shared value systems and shared goals, a common understanding and a preparedness to interoperate, for example, detailed doctrine is in place and there is significant experience in using it.
*Collaborative*: The collaborative organisational interoperability level is where recognised frameworks are in place to support interoperability and shared goals are recognised and roles and responsibilities are allocated as part of on-going responsibilities however the organisations are still distinct.
*Ad hoc*: At this level of interoperability only very limited organisational frameworks are in place which could support ad hoc arrangements.
*Independent*: This level describes the interaction between independent organisations.

### 2.3.3 Governments as Networks

#### 2.3.3.1 eGovernment Network: The Role of IT in Managing Networks

The research presented in (Yu-Che Chen 2003) is focusing on *e*Government networks. *e*Government networks are defined as networks of organizations that use information and communication technology for the provision of access and delivery of information and service to the public.

In (Yu-Che Chen 2003) Chen presents an analytical framework for the role of information technology in managing networks for public decision-making and services.

The framework has grouped factors affecting network performance into three categories: network structure, institutional forces and technology. Specifically:

- Network structure is considered important to study because a better understanding of structural characteristics is important for modeling how it responds to its surrounding environment.
- Institutional forces play an important role in deciding the adoption and use of technology.
- The independent category of technology monitors the current use of technology and tracks its influence on network performance over time.

Drawing from three bodies of literature (intergovernmental and network management literature, business organization literature, public management information systems), a list of hypothesized relationships to higher network performance is developed. Positively associated to this performance are thought to be the following:

Network Structure
H1: The level of core member contributions to the network.
H2: The level of professionalism and reciprocity.
H3: The perceived better match of costs and benefits by individual network members.
H4: The level of congruence in the interests of network actors.

Institutional Forces
H5: When a mandate fosters cooperation in a network.
H6: When its membership is mostly composed of those from a well-established organization.
H7: The maturity of a regulatory scheme surrounding network collaboration.

Technology
H8: An existing common technology standard or platform.
H9: The extensive use of collaborative information technology.
H10: The capability of network users in the use of information technology.
H11: The perceived ease of use for an information technology.

The proposed framework relies on two classification schemes to capture the coupling of management activities and information technology. The first classification scheme is about management activities. McGuire's[27] scheme has been adopted. This classification groups management activities into activating, framing, mobilizing and synthesizing.

- "Activating" identifies and involves stakeholders as network members and taps their skills, knowledge and resources.
- "Framing" refers to managing the perception of a network's individual members by shaping its norms and values.
- "Mobilizing" means garnering support from stakeholders, who could be current network members or a stakeholder individual or organization outside the network.
- "Synthesizing" activities are those that create a conducive environment for a productive interchange among network participants.

[27] McGuire, M. (2002). Managing Networks: Propositions on What Managers Do and Why They Do It. Public Administration Review, 62(5), 599-609.

The other classification refers to the information technology employed for enabling network management activities. This classification is not specific to a particular set of technologies. The focus is on functionalities on four levels with increasing levels of sophistication.

- Level 1 technology supports listserv functions and an e-mail directory of network actors. At this level, members can have one-to-one or one-to-many interaction with other members for information only exchange. Since e-mail is the primary means of communication, individual participants are responsible for saving information and keeping track of correspondence.
- Level 2 network information technology adds a central administrative function that supports central archiving and the management of correspondence and information. Central management of information can include a web site that has calendar information. However, the means of communication is still e-mail.
- Level 3 further adds collaborative information systems to facilitate the exchange of information. At this level, network members can take advantage of a group decision support system that supports real-time online conferencing and session archiving. Also, data linking is possible for one network member to access information housed by another network member. A web portal can be part of the group decision support system.
- Level 4 adds a fully developed information system to manage knowledge and resources for its network members. It allows network members to create, store, share and apply knowledge. It requires the ability to work with a central repository of information and resources. Network members can engage in interaction with the support of needed knowledge for real-time decision-making.

Last, the author discusses combinations of the four management activities and the levels of information technology use.

#### 2.3.3.2 eGovernment and the emergence of virtual organizations in the public sector

In (Bekkers 2003), Bekker studies the variety and complexity of virtual organizations in the public sector as they have emerged from the numerous e-government initiatives and proposes an explorative typology of virtual organizations. A virtual organization is defined as an informational space that facilitates the sharing of information and knowledge, as well as electronic communication in order to support collective action.

This typology is based on two dimensions: the degree of formalization and the openness of the inclusion and exclusion process of the virtual organization as an information space. Five types have been defined through this matrix structure:

*The federal virtual organization*: The autonomy and variety of the participating organizations is respected. They are responsible for the content and exploitation of their own information systems and related working processes. However, these organizations recognize the interdependencies between them. They acknowledge that they can improve the efficiency and efficacy of their task performance, if they share information. Through the introduction of a third party, a shared information space is created. This third party operates as an 'information broker' which coordinates the information exchange between the participating organizations.

*The virtual concentric organization:* The virtual organization as a concentric organization can be described as an information space which is created by the coupling of databases. Around these databases concentric circles of users can be identified, which are located within and outside the organization. Network technology facilitates real-time and online accessibility. These circles of user groups can process and share the information in the databases at the same time, parallel of each another. Through the intervention of a dominant actor, which plays an important role in the execution and monitoring of public rules and regulations, an informational space is created, which enables this central actor to control the information processing behaviour of groups within and outside the focal organization.

*The virtual platform organization:* In the platform organization a digital platform is created, which can be seen as a space for sharing of information and knowledge as well as a virtual meeting place for communication and interaction.

The communication and information exchange processes within the platform are not highly formalized. There is an open, unstructured communication, while the access to the platform is regulated. One has to be a member of a certain group to participate in the platform.

The participation in the platform is based on interdependency. Participants recognize that the sharing and exchange of information, knowledge and ideas could improve their own understanding. Moreover, it facilitates a process of mutual adjustment and shared understanding, which can stimulate collective action. Most platforms can be found in formulation and evaluation phase of the policy process.

*The portal organization:* In the portal organization information and other sources of knowledge are brought together as well as links which lead to other information sources. The architecture-model is based on the principle of linking, while also content management systems and models play an import role.

The interactions which take place within the portal organization are mostly structured and formalized, like the number and content of resources, the number and kind of links, the organization of the search functions and for instance the electronic form which could be used to order products or to ask for certain services. Access to the portal as information space is in most cases free. The establishment of these e-government portals is mostly based on the notion of interdependency. The notion of integrated, electronic public service delivery, which is at the heart of many e-government programs, is an important driver for organizations to share information in a portal.

*The virtual web organization:* The last type of virtual organization is the web organization. News and discussion groups on the internet as well as virtual communities are illustrations of the web organization. Discussion groups can be seen as loosely coupled interactions and relations between discussants, which created a shared information space. The internet can be seen as an infrastructure that enables people to organize themselves as a group, to explore the issues which appeal to common interests. Self-organization and goal searching, which takes places through communication and interaction, are two important characteristics of the web organization. The metaphor of a rhizome has been used to describe the form and functioning of this type of virtual organization. The rhizome result is a myriad of interrelated and isolated discussion and sub-discussion groups.

Bekker examines these types of governmental virtual organizations vis-à-vis three features:

- the coordination type used,
- the characteristics of the derived socio-organizational network,
- the characteristics of the supporting ICT-network .

Table 1-10 depicts the relationships between types of virtual organization and characteristics of the ICT-network.

| Virtual organization\ ICT-network | Federal | Concentric | Platform | Portal | Web |
|---|---|---|---|---|---|
| Nature ICT-network | Closed and formalized (mostly EDI-like) | Closed and formalized (intra- and extranet) | Closed (extranet) and open (internet) | Open (internet) | Open (internet) |
| Dominant information - architecture model | Information broker/referral index model | Database model | Platform | Linking and content management models | Rhizome |

*Table 8: Relationships between types of virtual organization and characteristics of the ICT-network (Bekkers 2003)*

# 3. APPROACHES BASED ON STATE-OF-THE-ART TECHNOLOGIES

Under this category, we have grouped efforts that have developed running systems demonstrating state-of-the-art technologies. These are:

- Running prototypes, demonstrators and proof-of-concept systems developed through projects usually with the participation of research organizations (e.g. universities), public authorities (e.g. ministries) and sometimes industrial partners. These projects explore state-of-the-art technologies in simulated environments and at a small scale in order to test the applicability, limitations and advantages of innovative technologies.
- Real production systems in full operation that exhibit and are based on new technologies. These are innovative systems that operate in real administrative environments.

For presentation purposes, we have grouped these systems based on the type of technologies use, in the following categories:

- Service Oriented Architectures, Web Services and Semantic Web Service technologies,
- Workflow and Process/Service Composition technologies,
- Content Management technologies.

In the following, we present each of the above categories separately.

## 3.1 SERVICE ORIENTED ARCHITECTURES, WEB SERVICES & SEMANTIC WEB SERVICE

In this part, we present systems that follow a Service Oriented Architecture (SOA) approach and implement this architectural paradigm using Web Service and Semantic Web Service technologies.

In the W3C's Web Service Glossary, SOA is defined as "a set of components which can be invoked, and whose interface descriptions can be published and discovered." The fundamental building block of a SOA is the service, and services are composed in specific ways to create applications. Services offer operations that clients (or other services) invoke. They can be rapidly deployed, easily reused, and are platform- and network-independent. In order to operate in a SOA environment, services must declaratively define their properties. This must be done in a standard and machine readable format. SOA offers native capabilities, such as publication, discovery, selection and binding[28].

A key concept in SOAs is the separation of the services from their implementation using the notion of an interface. The service interface must have sufficient information for a service to be identified (that is, found and understood) and used, without considering its internal design and content. The producer and the consumer of these services can be separated from one another, and the services can be registered so that a consumer or client can locate them in the registry.

SOAs provide a number of benefits for creating federations of services among disparate and loosely connected organizations, while allowing each organization to maintain its autonomy in terms of how it builds and designs services as well as their ownership. SOAs create a dynamically organized environment of networked services that are composable and interoperable. Multi-channel service distribution (e.g. cellular phones, PC, TV) and reuse of old and external applications to new user-facing transactions are some other important advantages for SOA (Brun and Nielsen 2004).

[28] http://devresource.hp.com/drc/columns/col0405a.jsp

SOAs may be implemented using different technologies. Earlier SOA development was based on CORBA Interface Definition Language (IDL), COM/DCOM Microsoft IDL (MIDL), Customer Information Control System (CICS) common area (COMMAREA) and other narrower-defined specifications (Natis and Schulte 2003). During the last years, Web Services technology has become the main implementation infrastructure for creating SOA environments.

Web Services extend the Web from a distributed source of information to a distributed source of services. In (Windley 2003), Web services are defined as self-contained pieces of code that have three distinguishing properties:

1. They communicate in an interoperable XML protocol, such as SOAP.
2. They describe themselves in an interoperable XML meta-format, such as WSDL.
3. They are able to federate globally through XML-based registry services, such as UDDI.

These three properties and the protocols that implement them achieve the bind, publish, and find functionality of an SOA (Windley 2003).

Recently, several initiatives try to introduce a semantic layer over the plain Web Service infrastructure. Semantic Web Services are Web Services, which have been formally described in a computer-interpretable way, through the use and sharing of widely accepted semantics. The main purpose for this is to enable the user to locate, select, invoke, compose, and monitor Web Services automatically and in an intelligent way. The core of a Semantic Web Service (SWS) remains the service: its description is a key concept. This description should be computer-interpretable, thus formal. There is a growing literature on formal service description. Currently, two major initiatives have proposed alternative formal service descriptions (ontologies): OWL-S e.g. (OWL Services Coalition 2004), and the Web Service Modeling Ontology (WSMO) e.g. (Roman *et al.* 2005). Based on these service ontologies, work has been already conducted in Web Service discovery (M. Paolucci et al. 2002) and composition (Hepp *et al.* 2005).

### 3.1.1 Drafting Service Oriented Architectures

In this part, we present the case of the Public Services Broker initiative run by the Irish Government. Although the effort is still at its first implementation stages, it constitutes an interesting national initiative to design a central SOA for public service delivery.

#### 3.1.1.1 Public Services Broker, a SOA for the Irish eGovernment

The Public Services Broker (PSB), currently under construction by the Irish Government agency Reach (http://www.reach.ie), is an integrated set of electronic processes, systems and procedures based on a service-oriented architecture (SOA) approach for eGovernment infrastructure. The PSB architecture is based on a decentralized, asynchronous XML messaging hub. The high level view of the architecture is presented in fig. 27.

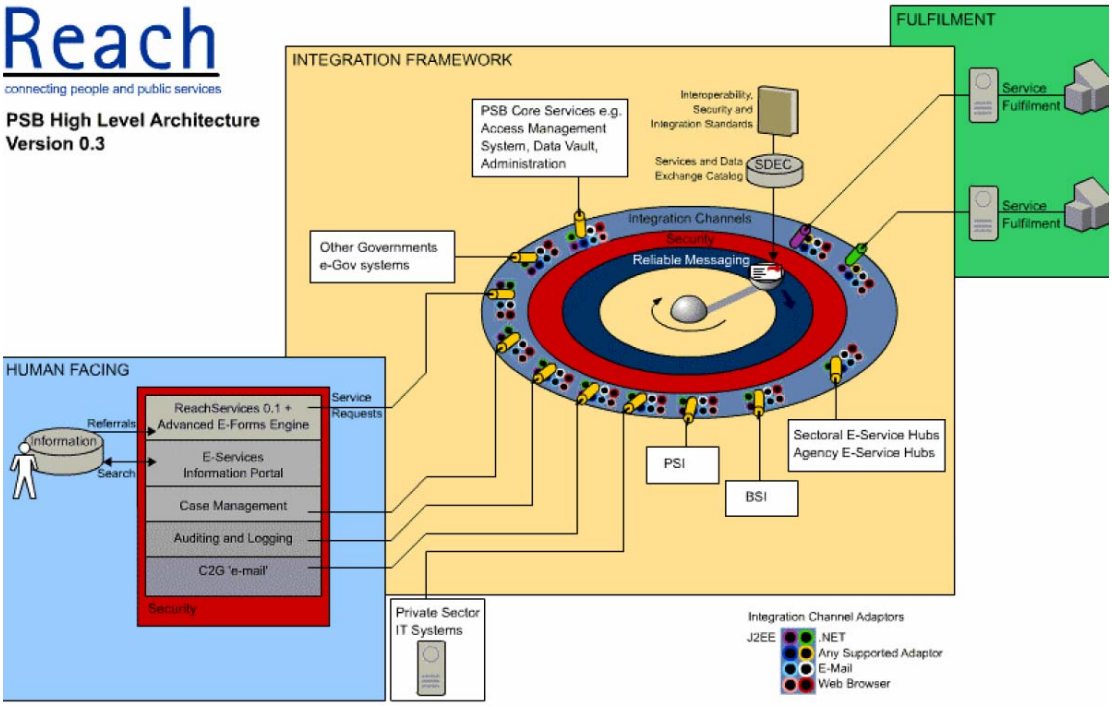


*Figure 27: High level view of the PSB architecture*

The PSB will provide a common access point for e-Government services, common interface standards, procedures and supporting services, together with the necessary infrastructure to make access to e-Government services as straightforward and secure as possible. In addition to supporting customer interaction, the PSB will also provide the standard mechanism for supporting government inter-agency collaboration.

The PSB in not a single application. It is:

- A Portal
- An Identity Management and Access Control System (IDMACS);
- A set of PSB user services (e.g. case management service, forms service;
- A set of PSB management services;
- An integration framework – a set of components and tools that will be used to integrate the above services and to PSB-enable Government services

In summary, the PSB will provide the capabilities to allow for:

- PSB users identities to be registered, authenticated and authorized to access resources under the control of the PSB;
- Authorized agency users to create downloadable forms, PSB online services and supporting information available to PSB users in a standard manner;
- Authorized agency users to use PSB services;
- Agencies to receive PSB Service Request Messages from the PSB Integration Framework in a secure, reliable and standardized manner;
- Agencies to publish and subscribe to events (e.g. agencies may subscribe to receive death notifications);
- Aggregation of PSB Online Services and development of new types of integrated services using the capabilities of the PSB;
- Customers to request downloadable forms, PSB Online Services and supporting information;
- Customers to track the progress of PSB Online Service requests;
- Customers to securely store personal information and sending this information when requesting Online Services;
- Customers to securely exchange messages with agencies;

- Administrative, Reporting and auditing services related to the above.

More specifically, and regarding the citizens and businesses the PSB will support the following services:

| Service |
|---|
| Register both online and via face to face mechanisms |
| Authenticate themselves using a variety of mechanisms including:<br>• Simple passwords over SSL;<br>• SSL client certificate;<br>• Secure ID and other token / Smart card;<br>• Biometrics. |
| Review their personal profile and request changes. |
| Personalise their interaction with the PSB. |
| Exchange "mail" messages with agencies. |
| Search and access content related to services. |
| Identify services with which to transact via a variety of mechanisms including a service taxonomy defined by Reach. |
| Delegate access for service request processing to intermediaries (e.g. an accountant). |
| Request (.pdf) forms for download and corresponding supporting information. |
| Complete service requests via a variety of mechanisms including:<br>• Online by themselves;<br>• In person in a walk-in centre;<br>• Over the telephone via a Call Centre Assistant. |
| Manage the data securely stored on their behalf in their Data Vault and use Data Vault data in service requests. |
| Save part completed forms. |
| Review their history of Online Service submissions. |
| Track the progress of Online Service submissions. |
| Terminate their account. |

*Figure 28: PSB services to citizens and businesses*

In addition to PSB Common Services, some additional Supporting Services will be developed. These services are necessary for the PSB, but will also be made available for agencies to use (under strictly managed circumstances). These supporting services include:

- Personal Service Identity Service – containing a directory of all personal customers;
- Business Service Identity Service – containing a directory of all business entities;
- Address Validation Service – containing a directory of all Irish addresses; and
- Electronic Payment (payment in and out) Service.

For fully deploying the PSB infrastructure, no existing products or software suites are expected to satisfy all of the PSB requirements. Thus, the PSB has to be assembled as a collection of services built from products and software. This is due to the fact that much of the technology needed is new and not fully specified and adopted in commercial products.

### 3.1.2 Web Services and Semantic Web Services based systems

#### 3.1.2.1 Transnational Information Sharing & Process Coordination

In (Su 2004) a prototype of a transnational information system is presented. Supported by a grant from the National Science Foundation of the United States, researchers at seven universities and experts from agencies in three countries, namely the United States, Belize and the Dominican Republic, are collaborating in order to develop a system that aims at

achieving information sharing, process coordination and enforcement of policies, constraints, regulations, and security and privacy rules.

Solving the complex problems that emerge in the transnational setting presents many new technological challenges. Some of them have been identified by the project to be:

- Data heterogeneity
- Language heterogeneity
- Heterogeneity in people and working environments
- Heterogeneity in government policies, regulations, constraints, and security and privacy rules
- Difficulties in inter-agency and inter-government communication and coordination
- Heterogeneity in computing platforms

The business case to test and demonstrate the developed technologies has been border control against illegal immigration and drug trafficking.

The architecture of the prototype system is shown in fig. 29. It consists of a host site and the sites of participating countries and their agencies. In the prototype implementation, two sites (one in Belize and the other in the Dominican Republic) were used to represent the countries' agencies. The data used to test and demonstrate the developed technologies have been artificial data, generated based on the port-of-entry and exit forms used by these two countries. No real data was used for privacy protection reasons.

The main system components are:

- A distributed query processing system that provides a form-based interface.
- A conversational interface, to allow users to query the distributed data. With this interface, users type natural language queries to the system in the same way that they would request the same information from another person.
- A language translation system.
- Event Registration and Subscription Facility to allow authorized users in the participating countries to define, register and get notifications for events of common interest.
- An event-trigger-rule server to trigger rules associated with the event.

A Web-services infrastructure has been jointly implemented by collaborating universities to achieve the interoperability of these component systems. Shareable operations provided by each system component are defined as Web-service operations. The invocation of these operations is achieved by message passing using SOAP.

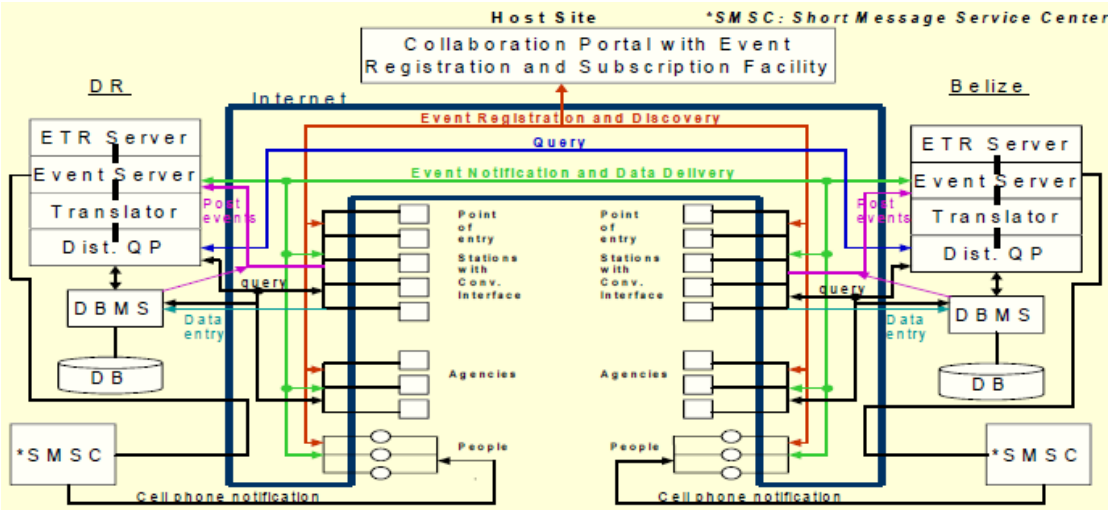


*Figure 29: Architecture of the Prototype System*

#### 3.1.2.2 DIP eGovernment

The Data, Information and Process Integration with Semantic Web Services (DIP) IST funded project (FP6-507483)[29] provides an interesting application of Semantic Web Service technologies in eGovernment. This work proposes an architecture for a life-event portal based on Semantic Web Services. The case study of "Disabled mother moves in to her daughter's home" has been reported to demonstrate relevant features of the proposed architecture.

The architecture includes three loosely-coupled layers: the Front-end, Middleware and Web Services. The modules are organized in layers (fig. 30):
– User Interaction: executes the user interface; supports the user to identify a life event; collects information for service execution.
– Middleware: allows the semantic description, identification, instantiation and invocation of services.
– Web Services: responsible for the execution of the services for a life event.

Each PA supplies services through the web service technology; each one is connected to the back-office and semantically described via the Internet Reasoning Service (IRS-III) module of the Middleware layer.

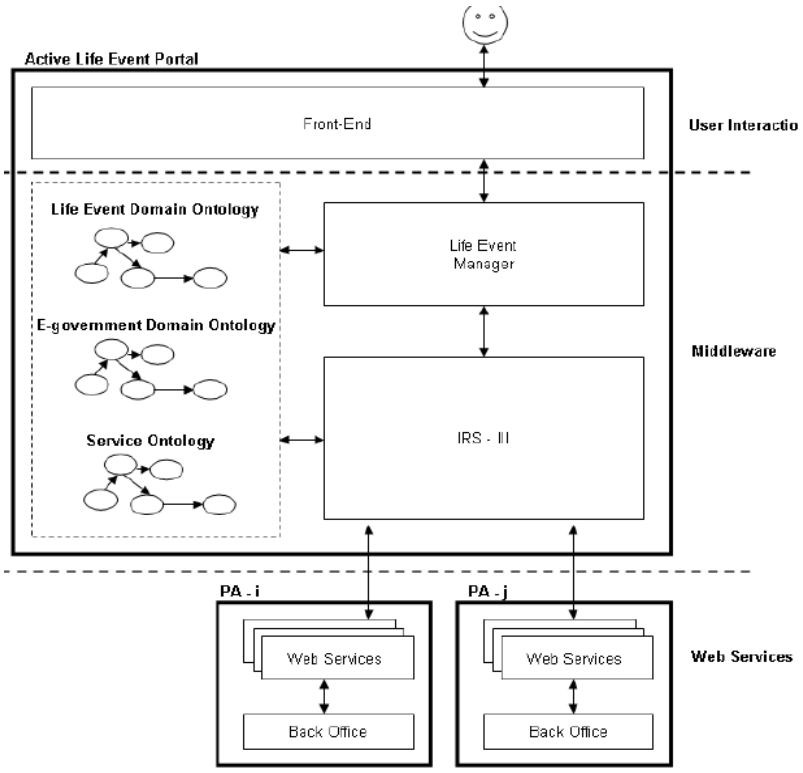


*Figure 30: The semantically-enhanced infrastructure of a portal.*

The system operation is described as follows (Gugliotta *et al.* 2005):

The end-user presents a request for a life event through the Front-end. The request is processed by the Life Event Manager; it also shows the hierarchy of topics, allowing the user to select the appropriate event. Information is described through the E-Government Domain Ontology, while the Goals are described via the Service Ontology. When the user invokes one of the goals, the Life Event Manager calls the IRS-III module, which retrieves the semantic description of the goal. Then, it creates an instance with specific data items; identifies and invokes the web services addressing the user needs by means of their semantic description. Finally, the web service is executed by the PA information system and the result is presented to the user.

[29] http://dip.semanticweb.org

Three ontologies have been described using the Operational Conceptual Modeling Language (OCML) (Motta 1999):

- The E-Government Domain Ontology.
- The Life Event Domain Ontology.
- The Service Ontology.

These ontologies have a central role in the proposed middleware system.

The E-Government Domain Ontology encodes concepts in the PA domain. The latter can be classified as follows (Bercic and Vintar 2003): Organizational, Legal, Economic and Business, Information Technology, End-user. The formal descriptions of the PA-related concepts are the building blocks for the descriptions of the two other ontologies. Part of this ontology is presented in Fig. 31.

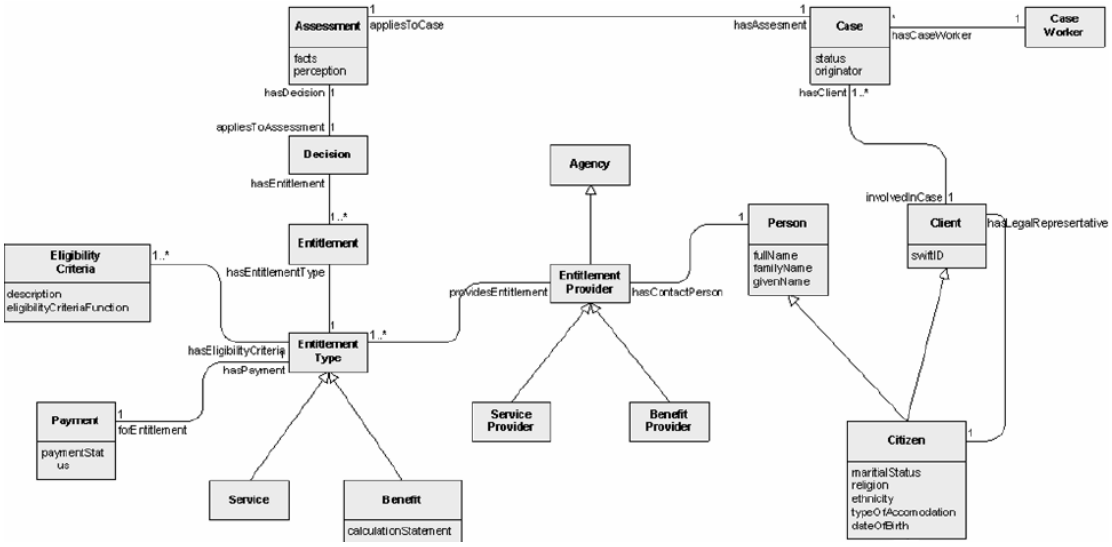


*Figure 31: The UML diagram showing part of the E-Government Domain Ontology with concepts connected with the 'Change of Circumstance' case study scenario*

The Life Event domain ontology defines a hierarchy of topics – a life event can branch to sub-life events – and describes them in terms of agents (citizen, business, organization,. . . ), involved actors, reference norms, reference information, parameters (date, locality,. . . ) and goals (Fig. 32). The Description & Situations (D&S) (Gangemi A. and Mika 2003) axiomatization is used, which constitutes a module of the DOLCE upper ontology (Oltramari A. *et al.* 2002). D&S is a theory to describe context elements – non-physical situations, plans, beliefs,. . . – as entities: it features a philosophically concise axiomatization.

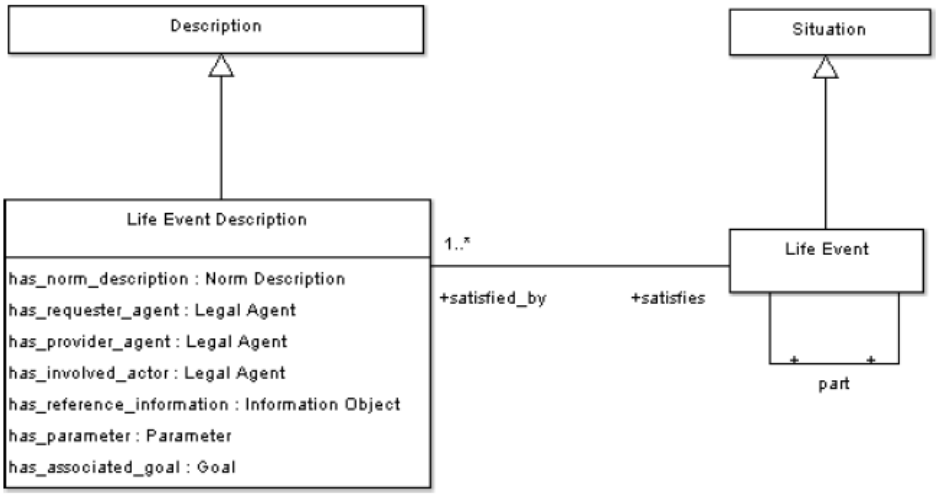


*Figure 32: The UML diagram showing the generic description of a life event.*

The Service ontology contains the SWS definitions. They correspond to instances of the goal, web service and mediator classes used in the IRS-III module. The following OCML code defines the notify-change-of-address-goal of the pilot business case, and the description of the county-council-provider-notify-change-of-address capability:

```
(def-class notify-change-of-address-goal (GOAL) ?goal
((has-input-role :value has-new-address
:value has-old-address
:value has-client-name
:value has-client-id
:value has-source-provider
:value has-target-provider)
(has-output-role :value has-confirmation)
(has-new-address :type string)
(has-old-address :type string)
(has-client-name :type string)
(has-client-id :type integer)
(has-source-provider :type service-provider)
(has-target-provider :type service-provider)
(has-confirmation :type string)))
(def-class county-council-provider-notify-change-of-address-ws-capability
(capability) ?capability
((used-mediator :value notify-change-of-address-mediator
has-assumption :value
(kappa (?psm)
(and (unit-of-organization (role-value ?psm 'has-target-provider)
?agency)
(county-council-organization ?agency)))))
```

In order to make easier the automated discovery and configuration of Web Services, semantic description of the services is supported by the IRS-III. The IRS-III module implements semantic interoperability, with the discovery and invocation of web services, by supporting the creation of semantic web services according to the Web Service Modeling Ontology (WSMO).

The WSMO main components are Ontologies, Goals, Web Services and Mediators. Goals represent the objectives that users would like to achieve via web services. One of the latter may be selected by a discovery process and executed. Mediators define mappings between components: for instance, a goal can be related to one or more web services through mediators.

The IRS-III architecture includes the following components: Server, Publisher and Client, which communicate through a SOAP-based protocol.

- The IRS-III Publisher entails associating a specific web service to a WSMO description. IRS-III contains platforms to support the publishing of web services as well as standalone Java and Lisp code.
- The IRS-III Server internally handles the Web applications accessible via HTTP GET methods.
- The IRS-III Client supports a goal-centric invocation mechanism. The user simply asks for a goal to be solved. Then, the IRS-III broker locates the appropriate semantic description, and then invokes the deployed service.

Although DIP is still a running project that ends in 2007, the findings so far are considered very interesting. In June 2005, the DIP project announced the submission of the Web Services Modelling Ontology (WSMO) to the W3C's Semantic Web activity committee.

#### 3.1.2.3 The OntoGov System

The service ontology proposed by the OntoGov project has been presented above.

More generally, the project investigates the application of ontologies in the eGovernment domain in order to achieve self-managing systems, i.e. systems that can continually update themselves (at least to a certain extent automatically) according to the changes in the domain. The goal of the project is to develop a framework and a system based on it that allows for

change propagation and traceability, contributing in this way to the bridging of political decision making with technical implementation. For example, when a passport issuance service has to be changed due to changes in national and European legalisation, the OntoGov system will enable change, while keeping the consistency of the whole system.

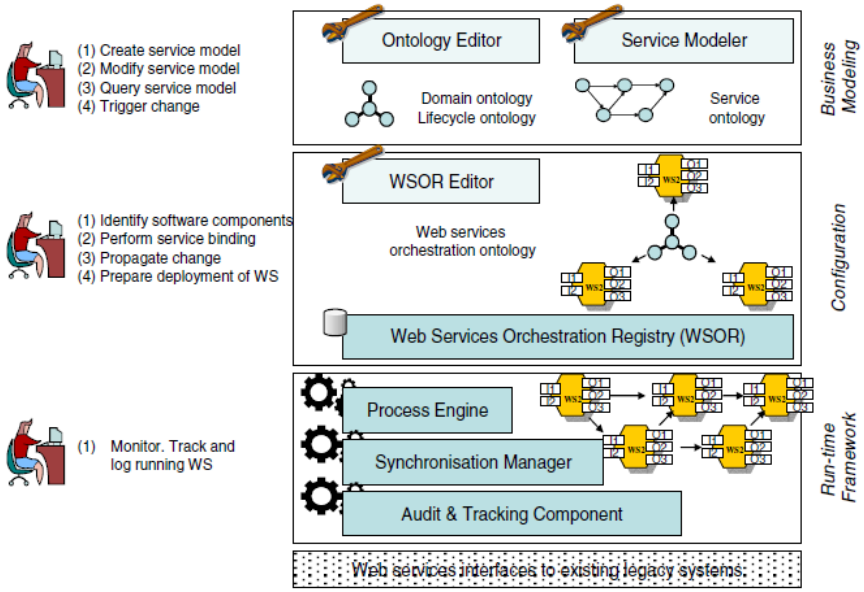


*Figure 33: ONTOGOV logical architecture*

The proposed architecture (shown in fig. 33) can be divided in three layers (D. Apostolou *et al.* 2005):

1. The Business Modelling layer is where a top level service model is drawn. Users of this layer will typically be PA domain experts that have sufficient knowledge of the domain. This knowledge includes the legislation that a service is based on, related directives, prerequisites etc.

2. The Configuration layer allows referencing the implementation of the business logic in actual software components. This task is carried out by the IT Consultant, who is responsible for the configuration and deployment of OntoGov services. The software implementation is achieved through Web Services interfaces.

3. The Runtime layer orchestrates and controls the execution of the atomic services by making the correct invocations of the Web Services configured in the Configuration layer.

In principal, the lifecycle of an eGovernment service starts when PA Managers trigger the generation or the change of a service. In order to accomplish this task, PA Managers need to have a high-level view of service models, links to related laws, resources involved and inter-relations with other services. Such a high-level view is provided by the service models developed in the Business Model layer.

The service ontology (or service model) becomes the main source of information for the Configuration layer. During configuration, the IT Consultant should identify the actual software components (Web Services) that enact the service model and, the policy and security level that their SOAP messages should accomplish. The WS Orchestration Registry is an ontology-based repository that stores the mappings between atomic services defined in the service model and Web services that carry out the task. According to the WSDL definition, these mappings comprise the selection of the WSDL operation (method) that should be called once the web service is invoked, and the linking of the WSDL parts (I/O attributes) to the atomic service inputs and outputs.

A Runtime Framework should be properly installed in a broker machine to allow the execution of Web services. A key component here is the Process Engine that acts as an orchestration machine extracting the service ontology from the ontologies and proceeding to deliver the request to the first atomic service described in the process model. The engine

relies on the use of a component called Synchronization Manager that hides the complexity of the synchronous or asynchronous behaviour of the Web services.

#### 3.1.2.4 WebDG, Virginia Tech

The work that has been done under the Web Digital Government (WebDG) project by the Computer Department of Virginia Tech is an interesting case of a comprehensive infrastructure for eGovernment Web Services.

WebDG's main contributions revolve around two features (Brahim Medjahed *et al.* 2003):

- Composing e-government services. The framework for automatically composing e-government services is based on a set of rules that check composability of services.
- Preserving privacy. To protect privacy, requests for services contain users' privacy credentials, which filtering mechanisms use to ensure that only authorized entities can access sensitive information.

For the purpose of this study the first feature is discussed in detail.

The Web DG system is built around three key concepts: distributed ontologies, Web Service technologies and service composability. The ontological approach was used to organize government information in order to make automatic composition feasible. Web services were used as wrappers that enable access to and interoperability amongst government services.

As presented in (Medjahed 2004), the number of Web services offered by government agencies can be large and continuously changing. This calls for techniques to organize government Web services in a way they can be efficiently discovered and "understood". For this purpose, the concept of community is introduced (Fig. 34). Communities provide means for an ontological organization of eGovernment space. Each community is specialized in a specific area of interest (e.g., disability, adoption). Organizing eGovernment services into communities aims at reducing the overhead of discovering these services. Communities are themselves services; they are created, advertised, discovered, and invoked as "regular" Web services. EGovernment service providers identify the community of interest and register their services with it.

Each community's definition includes three parts: *category*, *operations*, and *services*. The *category* contains three attributes: *domain*, *synonyms*, and *specialization*. *Domain* gives the area of interest of the community (e.g., "healthcare"). The *synonyms* attribute contains a set of alternative domains for the category (e.g., "medical" is a synonym of "healthcare"). *Specialization* is a set of characteristics of the current category (e.g., "insurance" and "children" are specializations of "healthcare"). Communities are invoked through their *operations*. The invocation of each community operation is translated into the invocation of an eGovernment service registered with the *community services* element.

Communities are accessible through a set of pre-defined operations called *generic* operations. Generic operations may be used "as is" by e-government services or *customized* to best fit the capabilities of those services. They are described at three levels: *syntactic*, *semantic*, and *operational*.

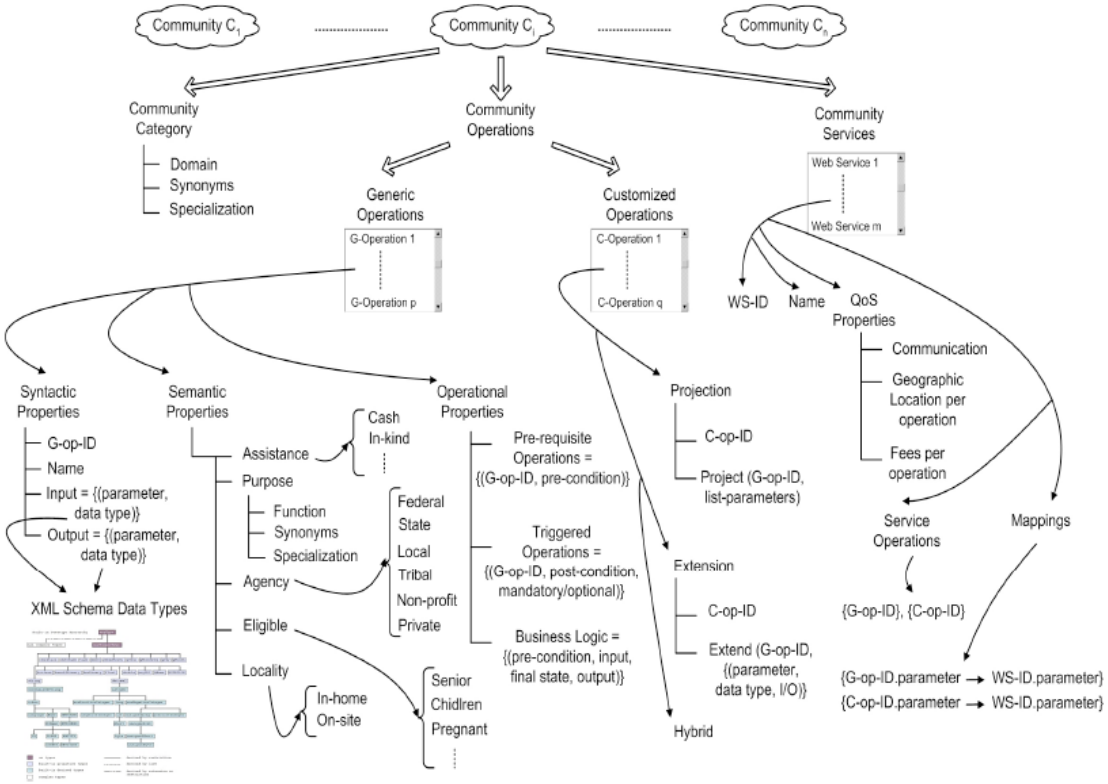


*Figure 34: Organizing E-Government Web Services on the Semantic Web*

The proposed model for composability contains a set of rules organized into five levels, as presented in fig. 35. Weights are assigned to each composability rule, and a set of algorithms taking into account the composability degree and threshold are used to decide each time the proper set of services and the feasibility of composition.

Three ways of combining Web service operations were identified: horizontal, vertical, and hybrid.

- Horizontal composition models a “supply chain"-like combination of operations.
- Vertical Composition models the “subcontracting" of an operation by another operation.
- A composite service CS may include operations that are horizontally composed and others that are vertically composed. This type of composition has been called hybrid composition.

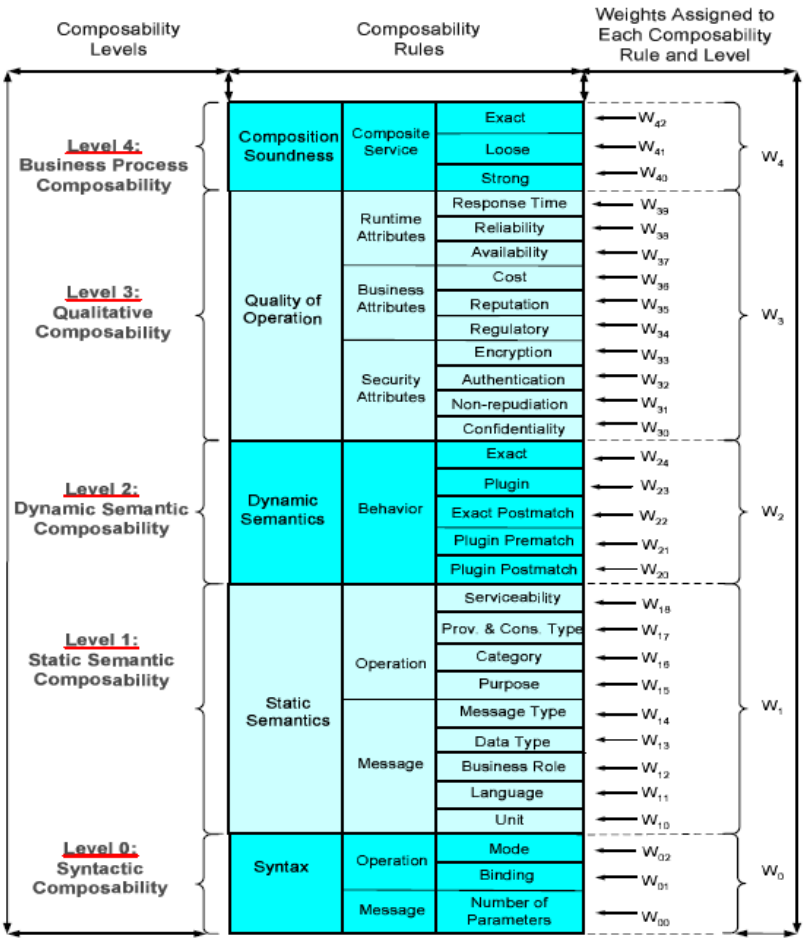


*Figure 35: Composability Stack*

Fig. 36 (next page) shows the WebDG system as implemented for a pilot in Indiana's Family and Social Services Administration (FSSA). The system is implemented across a network of Solaris workstations.

Citizens and case officers access the system via a graphical user interface implemented in HTML and Java servlets. WebDG currently includes seven FSSA applications implemented in Java (JDK 1.3). The Axis Java2WSDL utility in IBM's Web Services Toolkit automatically generates WSDL descriptions from Java class files, which WebDG publishes into a UDDI registry. WebDG uses the service management client within Apache SOAP 2.2 to deploy e-government services. Apache SOAP provides a server-side infrastructure for deploying and managing services, and a client-side API for invoking those services. Each service has a deployment descriptor that includes the unique identifier of the Java class to be invoked, the session scope of the class, and operations in the class available for the clients. WebDG deploys each service using its descriptor and the URL of the Apache SOAP servlet rpc router as input arguments.

The WebDG manager is at the system's core. The service locator (SL) looks up WSDL descriptions in the registry. Once the request handler discovers a service, it invokes the service's operations through a SOAP binding stub.

When service operations attempt to access the FSSA databases (implemented in Oracle 8.0.5 and Informix 7.0), a privacy-preserving processor intercepts the operation invocations and allows or disallows access based on privacy profiles, privacy credentials, and data filters.

The composite service manager uses the Java API for XML Processing (JAXP) to parse the XML-based composite service specifications. It then returns them to the matchmaker, which checks composability rules. The matchmaker then sends each composite service operation's category to the SL. The SL parses each located service's WSDL description and returns it to

the matchmaker. The SL retrieves only services whose category is compatible with the operation's category.

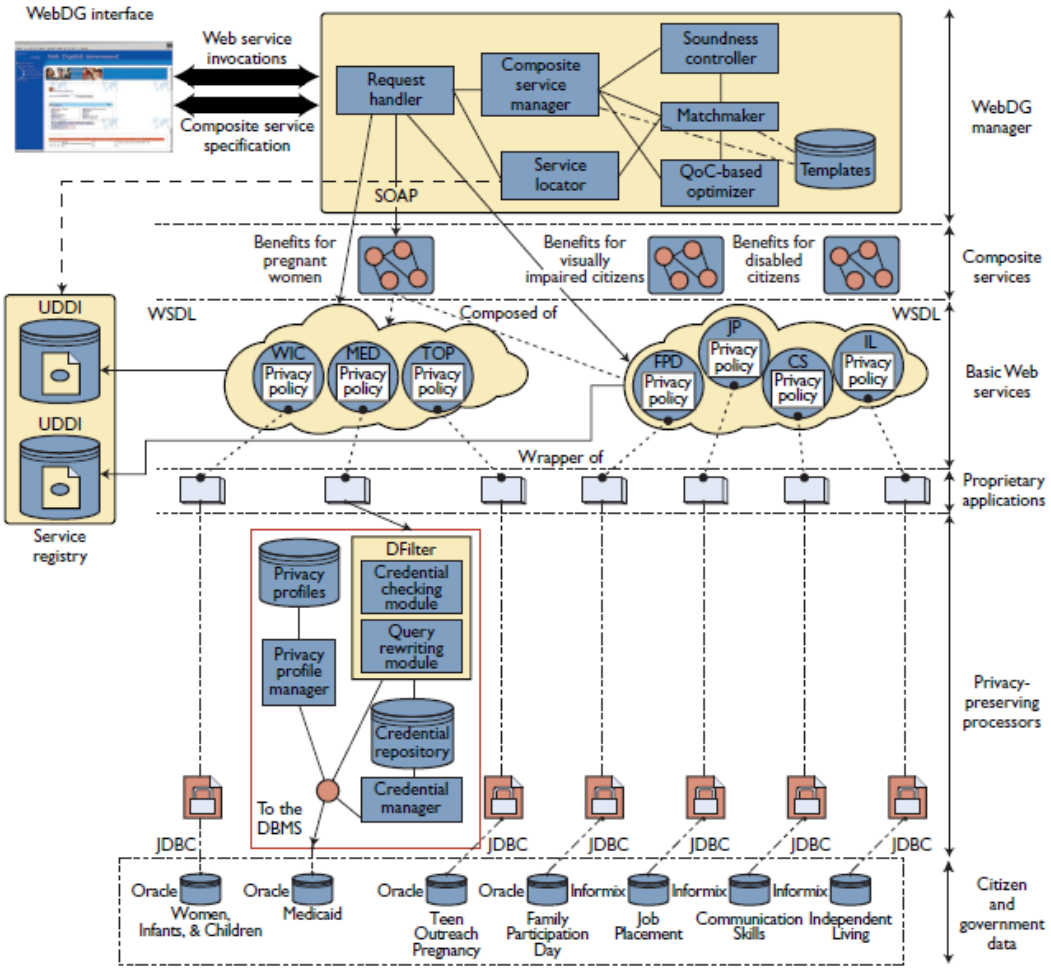


*Figure 36: The WebDG architecture*

After checking composability, the matchmaker generates composition plans and sends them to the optimizer, which selects plans based on quality of composition (QoC) parameters. Users define thresholds for such parameters as time, cost, and the plan's relevance to the user's specification. The optimizer returns plans to the matchmaker if the QoC parameter values are greater than the user's thresholds. The matchmaker forwards the selected plans to the soundness controller to check that the way they are combined provides added value. The controller then returns plans, along with their compatible stored templates (if any) to the composite service manager.

## 3.2 WORKFLOWS AND SERVICE COMPOSITION

*General description*

There is a growing and interest body of work regarding the technologies used for workflow and service composition. While workflow composition has been traditionally a field of research in the more general workflow literature, service composition initiatives are more related to the implementation of Service Oriented Architectures and particularly through the use of Web Service technology.

### 3.2.1 Workflow Systems

#### 3.2.1.1 Ontology-based workflow generation, Rutgers University - New Jersey

A collaborative effort between the State of New Jersey and the Rutgers University aims at designing and building a human-centred e-government portal to support small and medium sized enterprises to foster the establishment of new business (Chun *et al.* 2002; Chun 2003).

Registering a new business requires the collaboration and coordination of various state agencies as they execute their relevant tasks (inter-agency workflow). Although the core basic tasks of business registration remain the same, many tasks may diverge from this basic set, depending on the user's personal and business profiles (e.g. business types and varieties and its location may require different sets of permits and licenses). To guide entrepreneurs through the process of establishing their business, a workflow system was employed that is capable of (1) generating a customized workflow based on user parameters, requirements and constraints; (2) automatically executing the different processes involving the appropriate agencies in the appropriate sequence by authorized individuals, adhering to the business policies of those agencies; and (3) visually reporting the progression of the workflow to the entrepreneurs.

The system architecture is shown in fig. 37.

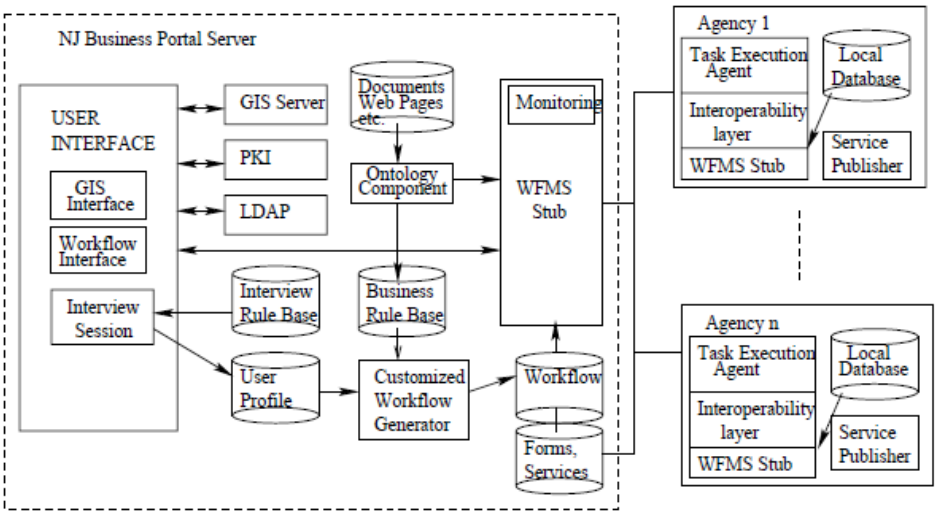


*Figure 37: New Jersey Business Portal Architecture*

The *Customized workflow Generation module* is responsible for the automatic generation of a customized workflow for each user, by taking into account the *services and tasks* and their *business rules* publicized by each State agency, and the *user profiles*. The user profiles are captured via a Web-based user interface using rule-based interview sessions.

A *decentralized dynamic workflow management system* (DDWFMS) is developed to eliminate the need for a centralized WFMS which has known problems such as limited scalability and performance bottlenecks. The DDWFMS relies on (1) on-the-fly construction of *self-describing workflows* and (2) their execution with the help of *WFMS stub* located at each agency. A self-describing workflow is a partition of the workflow that is associated with the tasks' definitions, the agencies responsible for their execution and the control flow information. When an agency receives a self-describing workflow, the WFMS stub extracts the tasks to be executed at that location, evaluates the control flow conditions upon their completion, constructs the new self-describing workflow(s) and forwards them to the appropriate agencies. The WFMS stub is also responsible for forwarding the dynamic changes that may occur during the execution of the workflow.

Rather than manually creating the appropriate workflows and entering constraints on data fields by hand, the system relies on a domain ontology that encapsulates the concepts in the small business initiation domain, the terms that are used to represent these concepts, and the relationships between them. The ontology is built semi-automatically based on automatic acquisition of ontological information from raw text. The system applies text mining techniques to discover important terms, organize the terms into concepts, and identify several types of relationships between concepts (e.g. fig. 38).

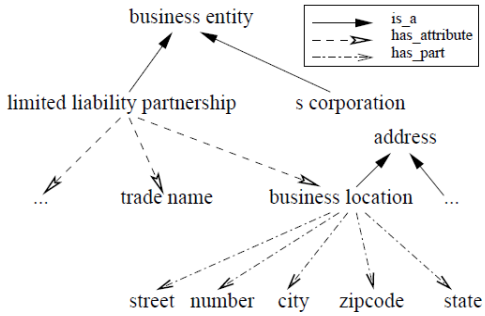


*Figure 38: A portion of the automatically extracted ontology*

Fig. 39 depicts component services to register a new business in the State of New Jersey, ranging from local, state and federal levels.

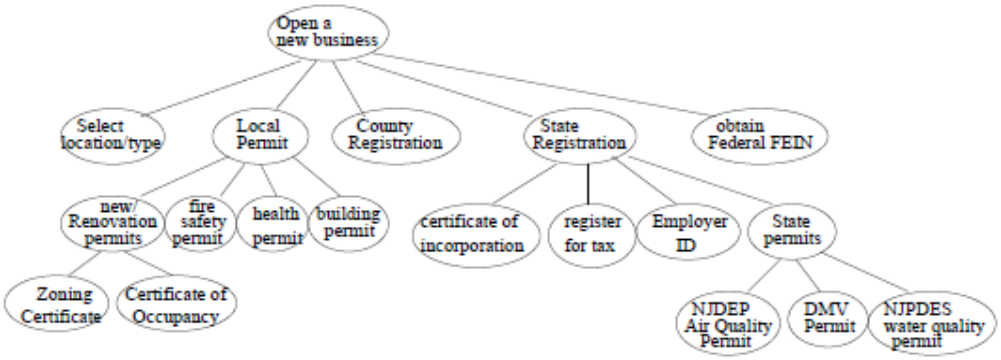


*Figure 39: Component Services for opening a new business*

Federal and state regulations may require a new business owner to obtain certain registrations, approvals, permits, and certificates from authorized agencies. Following are examples of different types of regulatory rules:

- Semantic Rules: These are the rules that affect the contents or activities involved in workflows and tasks. For example, an environmental protection regulation states that any business type that releases a certain level of spray paint into the air is required to obtain an air quality permit.
- Spatial Rules: These are concerned with the location and other geographic features of the business.
- Temporal Rules: Temporal rules state the absolute and relative deadlines associated with a task.
- Sequencing Rules: These rules specify the obligatory sequence among tasks.

Identification of appropriate services is based on these government regulations. We use an ontology to model concepts and relationships of these regulations. It is a conceptual hierarchy categorized into different topics (or types). Fig. 40 shows an example of land use related regulations, business related regulations and environment related regulations. At the leaf concept nodes, the regulatory rules are attached. These rules are represented as a set of Condition-Action rules as shown in fig. 41-42.

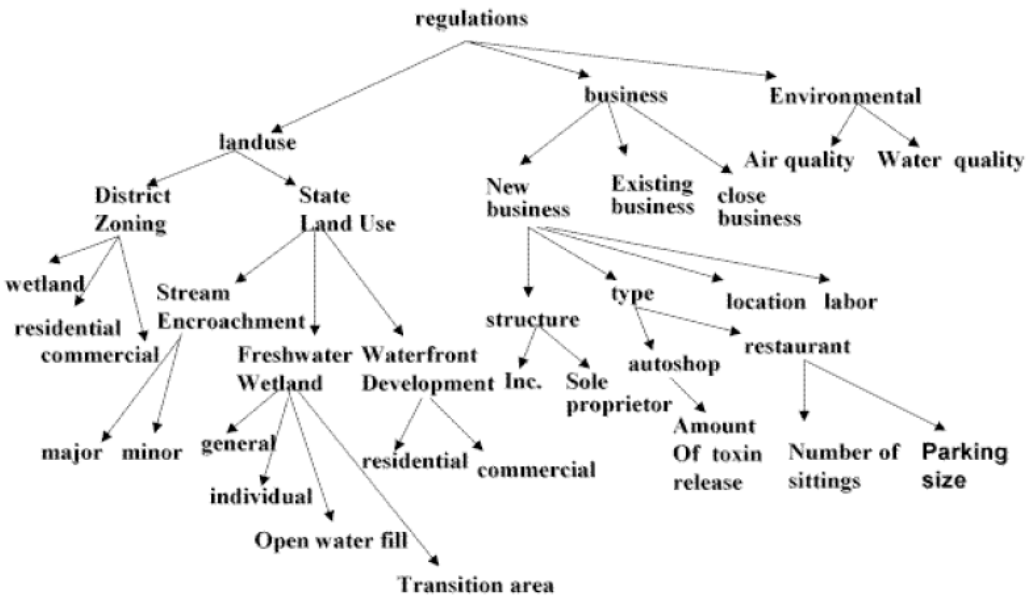


*Figure 40: Ontology of Government Regulations*

R1: $< struct = incorporated, insert(t1) \wedge insert(t2) >$
R2: $< struct = limited\ liabilitycompany, insert(t1) \wedge insert(t2) >$
R3: $< struct = limited\ partnership, insert(t1) \wedge insert(t2) >$
R4: $< struct = limited\ liability\ partnership, insert(t1) \wedge insert(t2) >$
R5: $< struct = sole\ proprietorship, insert(t3) >$
R6: $< struct = general\ partnership, insert(t3) >$
R7: $< register\ business, register\ business\ for\ tax >$
R8: $< register\ business, obtain\ federal\ employer\ id >$

*Figure 41: Selection Rules*

R9: $< register\ business, certificate\ of\ incorporation \prec register\ business\ for\ tax >$
R10: $< register\ business, fein \prec register\ business\ for\ tax >$
R11: $< register\ business, register\ business\ for\ tax \prec employee\ insurance >$

*Figure 42: Ordering Rules*

The set of user profile attributes are assumed to be hierarchically organized. The profile attribute data required for registering a new business in the State of New Jersey is shown in fig. 43, which includes business structure, location, name, type and employee information, such as payroll and number of employees.

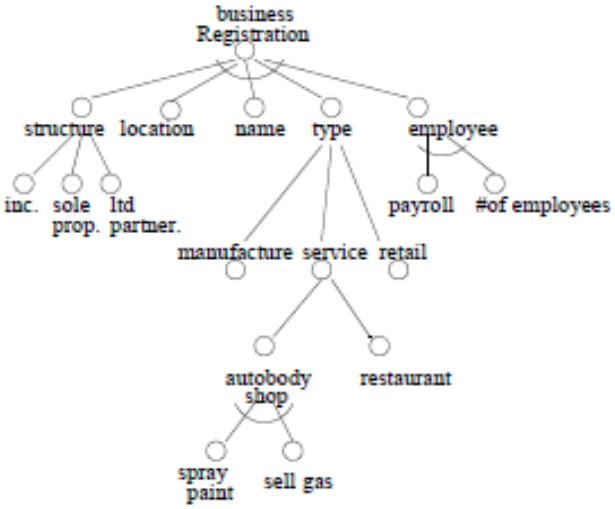


*Figure 43: Profile Attribute Hierarchy*

Given a set of customization rules and a user profile, the customization process generates an individualized workflow, selecting only relevant component services (i.e. tasks) following the selection rules and obeying other constraints such as the sequence imposed by the ordering rules.

### 3.2.2 Service Composition Systems

#### 3.2.2.1 The eGovernment Services Web portal, Quebec

In Quebec, a portal for eGovernment service is run by the local government. This portal uses an advanced keyword-based search service to allow users (citizens and businesses) to identify the services they need. In several occasions, in order to reach a service, a citizen must visit a constellation of Web pages and then read and understand information on several online services. In addition, the current architecture used by these Web sites does not allow simultaneous service provision like a change of address in several administrations. For doing such a change, a citizen must first find the online forms and fill them in according to the rules set by each administration. During all theses procedures, the citizen will be redirected to new Web sites. As a result of these long and cumbersome procedures, the level of interest of users decreases dramatically.

The proposed by the project eGovernment Services Web portal (eGOS) is based on Web Services and Semantic technologies and promises to facilitate service search and give the opportunity of building a one-stop service access.

In a nutshell, the system allows the user to identify "bundles of services" related to certain life-events and provides the client with the interface to interact with this "bundle" in a consistent and effective way. Web Service technologies and service life-event ontologies are used to this end. Fig. 44 below presents the 3-level system architecture of the eGOS platform.

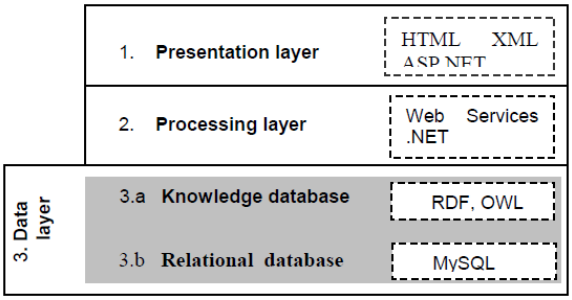


*Figure 44: The system architecture*

- The data layer defines the way to model the application domain, to create the knowledge base and to store it on a persistent medium.
- The processing layer defines the treatments which meet the functional needs of the system operators.
- The presentation layer defines the user interface, that is, the way citizens and business should interact with the system.

eGOS allows access to online government services according to one's profile. This portal plays the role of online middleware between services provided by government agencies and the consumers. In technical terms the UDDI protocol matches requests to appropriate Web services on its records. Once a Web service of interest which satisfies the request is found, a direct SOAP connection is transparently established between the service requester and the service provider. In addition, the eGOS component maintains a history of user operations carried out on its folder request services system.

The eGOS component is made up of the following elements:

1. The login system;

2. The profile access system; the eGOS identification system guaranties the confidentiality of transactions. The profile access system processes all personal data of the registered user such as physical address, phone number and e-mail contact.
3. The services request folder system; this system can be seen as similar to the idea of an electronic commerce shopping cart system.
4. The services search system; this system is accessible to all the users via a Web service and enables online search of all available government services.

For the latter, Protégé2000 was used to produce an RDF/S and OWL ontology description with a set of online government services.

The service search mechanism was designed and implemented using an ontology. The Service Search System manages a local online government services knowledge base. This knowledge base is described in RDF/OWL and can be used by an expert system to accomplish automatic reasoning. Each service in the knowledge base contains the description of the concepts used and the instances which describe the facts on the service. To conduct automatic reasoning on the user search requests, the OWLJessKB Java libraries were used. This way, the conversion of the semantics content into facts and rules usable by an expert system became possible. During this process, the RDF/XML domain model format is transformed into a first order logic representation by the Jess expert system to develop an inference engine. The Service Search System is accessible through a Web service (called RSW). It implements the searchServices() method which interacts with the knowledge base to extract concepts and properties from the ontology. The portal offers a user-friendly form to make requests. When the user defines the search criteria, a request is passed to the RSW Web service to extract data for a valid government on-line service.

#### 3.2.2.2 The Investors' Portal, Quebec

In Quebec again, several years ago, the government conceived a Web portal as a source of information and resources for businessmen willing to invest in Québec. In particular, this portal helps users find investment assistance programmes of interest offered by different government entities. These programmes may be financial assistance, tax or regulatory measures and various facilities to incite people in investing and creating jobs. In general, obtaining assistance is subject to the fulfillment of a number of conditions related to the profile of the investor and the nature of the intended investment project. Concretely, an assistance programme can be restricted to projects localized in some geographical region, some type of applicants, enterprises, length of project and type of field (e.g. information and communications technology).

In its current version, a user, upon selecting a particular programme, obtains a list of appropriate URLs. As the portal has been implanted in HTML, it does not allow automatic processing or any kind of reasoning because there is no semantics explicitly described for computer programs to handle. Thus, it takes the reading of the content of all these URLs to find a program, which matches one's profile. When a potential investor is interested in several projects or a group of investors collaborate on a project, it becomes clear that the traditional procedure turns into an energy and time-consuming burden with no guarantee of success.

To address this problem, a semantic Web services framework has been designed and implemented, as a meeting place between federal/provincial providers of investment assistance programmes and citizens/enterprises (Msaid and Tadiou 2004).

The system aims to help provider organizations publishing assistance programmes in an appropriate format and make them available to investors, who will be able to easily and quickly find suitable programs. A programme is considered suitable when its eligibility conditions are fulfilled by the search profile. The search profile is the combination of the profiles of the investor and his/her intended project. This search profile is described using terms selected from an ontology describing the domain knowledge of the assistance programmes. This ontology was built with the semantic Web Darpa Agent Modelling

Language (DAML), and a Web service infrastructure was created for government providers to publish their services. A Web portal with an integrated search and matching engine acts as the unique point of contact for governments partners.

A multi-layer approach was chosen for the semantic Web infrastructure. The architecture is displayed in fig. 45. The function of each layer follows.

| | |
|---|---|
| 1. Presentation Layer | HTML<br>Javascript<br>Java Applets |
| 2. Processing Layer | Java Servlet<br>JSP<br>Services Web |
| 3. Working Knowledge Base Layer | DAML<br>RDF/S<br>OWL |
| 4. Persistent Knowledge Base Layer | Relational Database |

*Figure 45: The Investors' Portal Architecture*

***4th Layer: Persistent Knowledge Base***. The knowledge base for assistance programmes is saved to ensure its integrity and availability for processing. The Jena environment contains a module, which saves a knowledge base written in RDF/XML format into a relational database. The Jena library was used to save the knowledge base of investment assistance programmes into a MySQL database.

***3rd Layer: Working Knowledge Base***. This describes how the knowledge base is created. The knowledge base for the investment domain is central for the system. For this purpose, an ontology of the domain in DAML was created in the following way:

- Identify the domain: here, the vocabulary used to express eligibility conditions of particular interest.
- Identify the scope of the ontology: an investor will be able to know if he/she is eligible for a given assistance program.
- Make an exhaustive list of terms as the vocabulary used in the context of investment assistance.
- Identify the classes and the hierarchical relationships between these classes.
- Identify interesting properties, which describe these classes and the hierarchical relationships between these properties.
- Identify the restrictions on these properties and classes. For example the cardinality, the type and range of accepted values or the kind of classes a property applies to.

The assistance programmes are then described as instances of the ontology built with Protégé. Each organization, which provides assistance programs, has its own vocabulary where concepts and properties are identified as Universal Resource Identifiers (URI). To avoid any ambiguity, an organization uses its own Internet domain name as a prefix in URIs (e.g. Investissement Québec is identified by URIs of the type: *http://www.demarrez-entreprise/vocabulary/<name of concept>*).

Each programme is presented as a file containing the description of concepts used and the instances describing facts of the program. A function helps extract the ontology (concepts and properties) from the ontological description of the programme. This description is then transferred and hosted by a Web service named SWPAI in French (Investment Assistance Programme Web Service). SWPAI services implement an operation for storing an assistance programme in a persistent container.

***2nd Layer: The Processing layer*** exhibits all the processing required by the system users. This layer processes the functional needs of the investors and organizations as actors of the system. A Web Services architecture was used for implementing this layer.

Processing is organized the following way:

- Saving the programme in relational data base.

- Maintaining and giving access to the knowledge base.
- Maintaining and opening the domain ontology to all.
- Setting the eligibility criteria to the program.

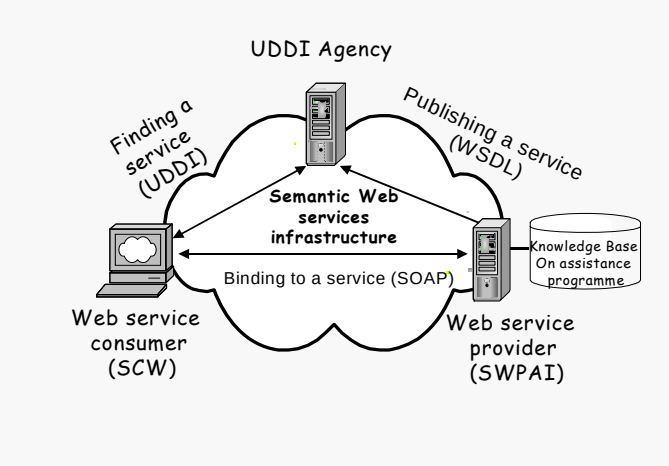


*Figure 46: The Processing layer*

The roles of the three components of this Web service architecture are:

- The Web service provider named SWPAI implements basic system processing and manages the knowledge base it hosts through three operations:
  - *EnregistrerProgramme* intended to providers; this operation is used when an organization decides to publish a new programme. The programme is first described in DAML+OIL and registered in a public location on the Internet or better, on the server of the organization itself.
  - *ObtenirOntologie* for the extraction of the domain vocabulary. A search profile is the description of an investor and his/her project as instances *investisseur* (investor) and *projet* (project) concepts in the knowledge base. To find a program, a user contacts an SCW service and specifies his/her current profiles. The SCW service queries the UDDI agency in order to retrieve SWPAI services compatible with the user request. Beforehand, the local vocabulary of the service requester must be updated by using the *ObtenirOntologie* operation which draws all the remote vocabularies from SWPAI.
  - *CalculerDegrePertinence* for the degree of pertinence to the given profile. This operation helps compare the RDF graphs representing the profiles of the investor and the project with parts of graphs of the assistance program, which give respective eligibility conditions. The *degree of pertinence* is computed by considering the average of *number of eligibility criteria fulfilled* by the profiles of the investor and project, and the *total number of these criteria* imposed by the assistance programme of interest in the SWPAI service. The algorithm for computing the degree of pertinence is presented below:

```
tcim = 0;
        for each instance "eligible project"
                nbcv = 0
                nbc = 0
                for each property
                        nbc++
                        if (property exists in profile) then
                                if (value(property) verify condition)  then
                                        nbcv++
                                endif
                        endif
```

- The Web service consumer, named SCW, is in fact a Web portal for accessing the system. It's an interface between consumers and providers of Web SWPAI. It allows the retrieval and invocation of operations implemented as servlets by SWPAI services. The SCW service has been implemented as a Java servlet deployed on the Tomcat

application server. This way, the system can be used from a lightweight client connected to the Internet and enabled with a Web browser. In addition, in this servlet, all the Java API, UDDI and SOAP protocols implement the functionalities of a Web service client.

- The public or private agency (UDDI) gives the location of SWPAI services registered within its database and their usage. The IBM WSDK 5.0 tool kit was used to conceive and implement all the SWPAI service providers. This tool integrates a UDDI agency for the publication of SWPAI services. Each SWPAI manages a knowledge base of a set of assistance programmes. This knowledge base is described in DAML and can be easily transformed into a resource and an input for automatic reasoning tools (e.g. expert systems). In addition, the SWPAI implements the obtenirOntologie operation for capturing the current domain knowledge to help users build their requests within the Web portal. The SWPAI service implements three basic operations: a new programme registration, querying the knowledge base and capturing the domain vocabulary

***1st Layer: The first (Presentation) layer*** defines the user interfaces and the way users interact with the system.

Summarizing, this case demonstrates a semantic matching between investors' profiles and governmental assistance programmes as registered in a registry, using a domain (programmes for investors) ontology and calculating the eligibility matching. The overall infrastructure is built with Web Service technologies.

# 4. OVERVIEW OF RELATED WORK

Concluding this section, we rate the initiatives that we think more relevant to our work based on the following five criteria:

- Their *relevance* to the public administration domain: Low (domain independent), Medium (partly PA domain specific), high (PA domain specific)
- The *depth* of analysis (e.g. number of concepts): Low, Medium-Low, Medium, Medium-High, High
- The part of the public administration *domain* modelled: Support Operations (S), Public Policy Formulation (P), Service Provision (O)
- *Perspective*: Technical, Conceptual/Business
- *View*: Holistic, Process, Object

| **Initiative** | **Relevance** | **Depth** | **Domain** | **Perspective** | **View** |
|---|---|---|---|---|---|
| The three spheres in eGovernance | High | Low | S, P, O | Conceptual | Holistic |
| Gartner Government Performance Framework | High | Medium-Low | S, P, O | Conceptual | Holistic |
| Faceted Classification of PA | High | Medium-Low | S, O | Conceptual | Holistic |
| SAP Public Sector Solution Map | Medium | Medium-Low | S | Conceptual | Process |
| Government Process Classification Framework | High | High | S, P | Conceptual | Process |
| ONTOGOV | Medium | Medium | O | Technical | Holistic |
| UK GCIM | High | Low | O | Conceptual | Object |
| WebDG Ontologies | Low | Medium-High | O | Technical | Holistic |
| DIP eGovernment Ontology | Low | High | S, O | Conceptual | Object |
| FEA Business Reference Model | High | Medium-High | S, O | Conceptual | Process |
| FEA other models | Low | Medium-High | S, O | Technical | Holistic |

*Table 9: Overview of the state-of-the-art*

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## REFERENCES


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