

Government Information Centers: Digital Library Architecture for Depicting Public Sector's Hierarchy

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Abstract. The Public Sector produces and disseminates huge amounts of government information considered to be essential not only for its proper inner function (i.e. decision making processes), but also for citizen transactions and the internal market. However, the access to government information is limited and complicated due to the lack of advanced information systems based on international standards and formats. This paper presents a knowledge management framework for the functional improvement of Government Information Centres, which efficiently controls the flow and disposal of all types of government information in Regional Administration. In particular the implemented system: a) facilitates the flow of information within multifaceted administrative channels, b) ensures thematic homogeneity and interoperability for accurate and quality data/metadata exchange, and c) secures efficient information retrieval.

Keywords: Government Information, Thesauri, Ontologies, Knowledge Management

1. Introduction

The Public Sector produces vast amounts of information that need to be instantly disseminated among the appropriate Authorities of Regional and/or Local Administration. Such information defines and determines the required framework for the inner function of public services, as well as their external transactions with “customers”. Government information is significant for citizens, public servants and managers, as well as consumers and businessmen. Citizens interact with public services on a daily basis and need to be guided and informed promptly and efficiently. In addition, assisting citizen transactions respects the right to Freedom of Information. On the other hand, public servants and managers require operational, organizational and structural knowledge in order to perform their tasks and accomplish their objectives. Moreover, government information facilitates the decision-making process, as it maintains a collective memory of organizations’ dealings. Finally, consumers and businessmen require to be informed on the latest internal market legal and administrative operations, since the lack of reliable and valid information may influence the smooth conduct of trade procedures. Besides, no business activity may be performed without accurate information on the required domains (European Commission 1998).

In general, Government Information consists of:

- Legislation - all types of legal actions published in the Official Gazette of each nation.
- Information sheets - brochures that are published for assisting and guiding citizen-state transactions (e.g. a pamphlet regarding the issuance of a driving-license certificate).
- Public records: material that is “created, received, and maintained as evidence and information by public services in pursuance of legal obligations or in the transaction of business” (Healy 2001). Public records may yield public or personal interest. For example, the required procedure and deadline for the payment of taxes may have

official importance. However, the issuing of a license for a business operation has personal interest. Our focus is only on those public records with official interest.

In almost all European countries, Government information could be organized into the following thematic categories: a) regional planning and development; b) health and welfare; c) public works; d) supervision of public work construction; e) supervision of public work preservation; f) environment and land planning; g) forests; h) agricultural development; i) local government; j) personnel management. Such a categorization may be further adjusted according to the information needs of each state's Public Administration.

Information flow in the Public Sector is characterized by time-consuming and complicated procedures due to the lack of integrated information systems within public services that are based on international standards and formats for information management. Moreover, legislative and administrative diversity results in a lack of homogeneity regarding information organization and distribution. Furthermore, the existing systems of electronic registry for information management do not support information retrieval based on multiple indexes that may all be linked and accessed in unison. Hence, these factors hinder the smooth flow of government information within multi-faceted administrative channels, resulting in an inefficient and time-consuming identification and retrieval of information. Current initiatives are designed and arranged to meet the needs of the publisher and require the users to be familiar with the framework of the structured information and the administrative functions of the Public Sector. They have to recall various parameters in order to set a simple query and must also re-execute their search more than once in order to find the required information, as it may reside in different locations. In consequence, the existing systems result in a "lack of transparency for citizens, employees and administrations at all levels (European Commission 1998).

Recent technology advances are capable of dealing with these factors by establishing the basis for digital government and ensuring services are entirely automated, interlinked and accessible via web portals. This paper may yet contribute to improving the functionality of Government Information Centers (GIC), which reside in almost every prefecture of the European States. The main objective of our approach is the exploitation of digital library technology for the proper management of all Government Knowledge. In particular we present an architecture that ensures a) a mapping of the Public Administration, b) management of the available government information, according to international standards and formats, and c) the depiction of the public administrative hierarchy and the navigation of the citizen towards structured and useful information. The proposed architecture also ensures semantic homogeneity and interoperability while it provides a communication system between services of Regional Administration and secures access to government information both for citizens and public employees. In the next section we present the structure and functions of Government Information Centers, while in section 3 we analyze the proposed model and its architecture. In section 4, we discuss some related works and finally we present our conclusions.

2. Government Information Centers

As already mentioned, almost all European States have established Government Information Centers in their Regions and/or Prefectures. The main objective of these Centers is to intensify the number of citizen-state transactions by providing services that facilitate

administrative procedures. Government Information Centers mediate between public services and user needs for the issuing of any official paper or certificate (e.g. passport, driving license, birth certificate etc.). As such, these Centers may provide all the needed requirements for any administrative action (i.e. necessary certificates). Moreover, the users may address their requests to GICs, and the latter undertake the task of communicating with the appropriate public service(s) and acquiring the necessary document(s) on the user's behalf. Hence, these Centers aim to constitute a one-stop shop of government services for citizens. Their objective is not only to assist citizens with multiple administrative actions, but also to satisfy multiple information requests on official records and legal acts, from various areas of interest. However, such an objective requires advanced information systems for the efficient management and prompt flow of government information. Therefore, we propose the exploitation of GICs for the development of a digital library network ensuring the storage, management and disposal of government information. Specifically each GIC should aim to:

- Collect the required material.

Each GIC collects the raw information produced by regional/local authorities or disseminated by Central Government, in order to develop a digital library.

Each GIC undertakes the processing of one or more thematic areas, according to the predetermined thematic categorization and allocation of government information (e.g. regional planning and development, health and welfare, public works, environment and land planning, agricultural development, etc.) Local community interests and needs may determine the thematic category that a GIC may handle. For example, the GIC of a Prefecture with many manufacturers may opt to encode the documents referring to industry.

The document flow may be controlled by a Secretariat Office that resides in every Directorate of the Prefecture. This office: a) receives all the records and legal acts sent by the Central Administration, and b) distributes them to the final addresses. As such, the secretariat office may also handle the distribution of the documents received to the Centers responsible for processing those particular documents, according to the thematic allocation of government information. Hence, the GIC of one Prefecture may collect all the information regarding tourism, while another may collect all the documents that refer to forestry.

- Describe and encode the gathered information.

Each GIC produces metadata (i.e. data describing data) for the Government information collected, in order to describe it thematically and bibliographically (i.e. title, signed authorities, receivers, etc.). The production of metadata contributes to: a) efficient information search and retrieval, as it ensures multiple access to multiple indexes, b) reliability in bibliographic and thematic description, as long as the same standards and formats are adopted, c) interoperability of systems and standards, and d) policy compliance (Federal Geographic Data Committee 1998).

- Develop and update a digital library for the collection of the gathered documents. The main objectives of the digital libraries are:
 1. The implementation of international standards and formats for thematic description and metadata production.
 2. The semantic homogeneity and interoperability.
 3. The minimization of labor costs and the time spent processing the same information.

Finally, each GIC sets permission rights on its information content, in order to control access to it. Three types of access rights may be introduced, depending on the user category:

a) records accessed by all citizens, b) records accessed only by employees of a certain public service, and c) records accessed by public servants of other services.

3. The digital library

3.1 Metadata and Semantics

The proposed model produces two types of metadata: metadata for bibliographic description, which refers to all information needed to uniquely identify an item (e.g. title, statement of responsibility, publication and production data, section titles, associated records etc.), and metadata for thematic description (semantics). Regarding the latter, each digital library establishes an authority file (set of thematic terms), which is built according to a thesaurus standard for term interlinking and concept definition. The resulting authority file covers: a) names of Corporate Bodies as well as Public Authorities in Central, Regional or Local Administration, b) geospatial terms and also places of state that fulfill some form of administrative activity, and c) topical terms; ranks, posts (positions within Public Services), competences and functions. These terms depict the geospatial and thematic hierarchy of the Public Sector.

Knowledge management tools (i.e. thesauri, ontologies, knowledge bases) interlink the metadata and meet the need for descriptive and controlled interrelated terminology, as they: a) contribute to the thematic organization of information on specific scientific fields, b) ensure thematic accuracy and consistency, and c) guide the end user to an efficient and high quality information search and retrieval. Due to the above, our focus will be on the semantic tools that may be used for the processing of public records and legal acts.

Based on the fact that Public Sector is ad hoc hierarchical, government information calls for three different types of term interlinking and hierarchy structure: thematic, geospatial and administrative. Thematic associations link topical terms that are thematically/conceptually related, while the administrative relationships stand for terms that are linked according to functions of Public Administration. Finally, the geographic associations link each place of State with the public services that reside in it. According to Figure 1, *Posts* are connected with public services and ranks. *Ranks* are linked to the posts. *Competences* are interlinked with names of public authorities. Finally, *Corporate Bodies* are all authorities of the Public Sector, as already mentioned, and are associated with: a) geographical names (where they reside), b) posts, and c) competences of the public corporate bodies.

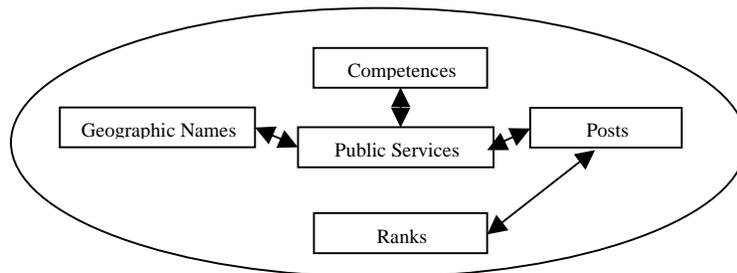


Fig. 1. The associations of the terms in the semantic network

However, as already mentioned, government information also calls for public service linking with supervisor/corporate authorities and administrative functions. Such a requirement represents the need of depicting the hierarchical structure of the Public Sector. A thesaurus of semantic schema may represent the conceptual and geospatial linking of administrative terminology but lacks the ability to present multiple hierarchical levels correlated with functions and structures in the Public Sector. As such, the administrative hierarchy may be depicted by an ontology semantic schema, capable of expressing multiple hierarchical levels. The selection of both semantic tools for the description of government information derives from the fact that the terms used to characterize conceptually public records and legal acts are also used to represent administrative functions.

Comparing thesauri with other knowledge representation models reveals their different nature. Thesauri are primarily designed and mainly used to organize concepts and thematic terms, in contrast to ontologies, which are primarily developed to express and organize entities. Thesauri cover the semantic relationships of:

- equivalence (synonymy) - by introducing the relationship indicators of “Use” and “Used for”
- hierarchy - by introducing the relationship indicators of “Broader Term” and “Narrower Term”, and finally
- association - by introducing the relationship indicator of “Related Term”.

Thus, thesaurus relationships may: a) thematically describe the government publications by establishing descriptive terminology and b) exemplify the thematic and geospatial hierarchy.

For example, Table 1 analyzes the relationships of the entry “Agricultural Products” based on a thesaurus and ontology schema respectively. As Table 1 indicates, an ontology is able to represent thematic hierarchy but unable to show the thematic association between terms. On the other side, thesauri can meet the semantic needs of government information, as the relationship indicators express the needed connections of thematic hierarchy and conceptual association.

Table 1. Thesaurus and Ontology cross-reference example

Thesaurus like Term Interlinking		Ontology like Term Interlinking	
<i>Lead Term:</i>	Agricultural Products	<i>Class:</i>	Agricultural Products
<i>Used for</i>	Rural Products Products of Earth		
<i>Broader Term:</i>	Products	<i>Super Class:</i>	Products
<i>Narrower Term:</i>	Cereals Fruits Cotton Grapes Legumes Tobacco	<i>Subclass:</i>	Cereals Fruits Cotton Grapes Legumes Tobacco
<i>Related Term:</i>	Agricultural Production Farming Indemnification Pricing Trade		

However, the hierarchy of Public Administration may be managed in an ontology framework. This semantic tool may meet the need of hierarchical representation, as it introduces the relationships “is a / type of” and “component/part of” that are strictly hierarchical (Noy & McGuinness 2001). Besides, the feature of inheritance that characterizes ontologies underscores the assumption that they are mainly designed to express and represent hierarchies of entities. On the other hand, thesauri cannot depict the organizational chart of authorities

(multiple hierarchical levels) along with their functions and corporative/supervisor organizations, due to a lack of indicators. For example, using “Related Term” indicator for administrative functions may create a conflict in the system and confuse the user, as this indicator is also used for stating the terms that are thematically/conceptually connected. In an ontology framework the names of public services are interlinked and correlated with their competences and supervisor/corporative authorities. The ontology is created by filtering the terms and associations of the thesaurus and then mapping the extracted information into an administrative hierarchical tree.

Therefore, two semantic tools may be developed in order to fulfil the information system requirements and describe, thematically and administratively, the government information in an electronic registry environment:

- A thesaurus, for: a) the establishment of descriptive and controlled, interrelated terminology. Here, the usage of common terms results in thematic consistency and therefore in thematic compatibility, b) guiding the end-user to efficient information retrieval by depicting the established thematic terms and representing the hierarchical relationships between concepts.
- An ontology, for: a) the encoding and representation of the administrative hierarchy of the Public Sector, and b) navigating the end-user through the encoded information, which represents the structure and functions of each hierarchical entity. Subsequently, the user may retrieve all the required information regardless where it resides.

3.2 The Architecture

The proposed architecture introduces a network for the interlinking of the resulting digital libraries in every GIC of a Prefecture and ensures efficient and prompt information retrieval via the usage of semantic tools (thesaurus and ontology). According to Figure 2, the end-user gains access to the network via a web portal. An integration agent handles the query by deciding: a) to which digital library the query must be executed, b) which semantic tool must be used, and c) which of the results must be integrated and returned. This agent proceeds with an integration of the given terms, hierarchies and administrative functions, as these reside in different locations. The agent accesses the digital libraries, retrieves the required information and integrates the results, in order to present them as a set. For example, in a query for the term “licences”, the agent may locate different kinds of licences (e.g. driving license, fishing licence, marriage licence, etc.) in the digital libraries of different GICs. In this situation, the integration agent organizes the results, in order to present them as a whole and provides the user with the option either to select the required type of licence for a further search, or to retrieve the documents for all the available types of licences.

Every Digital Library has the same structure. It consists of: a) the digitized data, b) the bibliographic metadata, c) an authority file with a thesaurus-like structure that represents the interlinking of conceptual and geographical terms, and d) an ontology that depicts the administrative hierarchy of the Public Sector and stands for the public services that are: a) either addressers or receivers of public records or b) signed authorities in legal acts, and/or c) a subject in the government documents.

The development of ontologies for the Public Sector’s administrative hierarchy may be realised by the Government Information Centres, due to their scientific know-how and technological infrastructure. Specifically, Central Administration may forward its

organizational charts and structure to the GICs. According to the thematic allocation of government information, each Centre may handle the creation of one or more organizational charts of Central Administration. For example, the Ministry of Agriculture may send its chart to the Centre that has undertaken the thematic domain of forests and/or agricultural development, while the Ministry of Health and Welfare may forward its structural framework to the GIC responsible for describing and encoding documents on health and welfare issues. Hence, every GIC would be able to develop an ontology for the organizations of the Central Administration. Within the same framework, the depiction of the hierarchical structure of Regional Administration may be realized by the GIC that resides in every Prefecture. The proposed architecture will ultimately accommodate the entire structure of the Public Sector, as all digital libraries will be connected and accessed via a network.

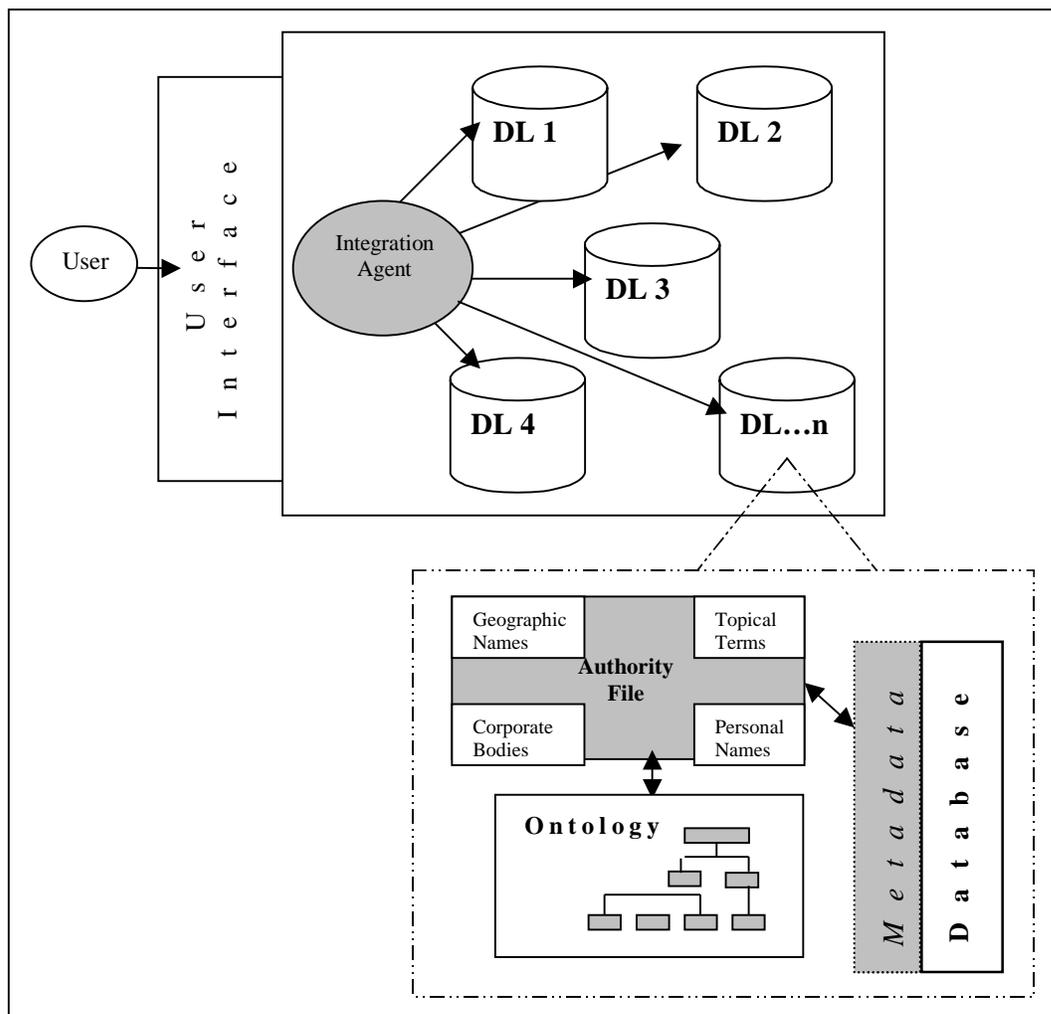


Fig. 2. The proposed architecture

The organizational charts of Central Administration need to be given once, since the update may be based on the text of the newly collected government information. Ontology update data may be derived from the authority file's content. More specifically, an algorithm may search the thesaurus like authority file for nodes indicating alterations or additions in Corporate Body Name entries. Public Authorities may have been entered either under place or jurisdiction (e.g. Athens. Internal Revenue Service, Corfu. Internal Revenue Service, etc.)

or under their proper name (e.g. Ministry of Economics, National Library of Greece). The detached nodes may be further organized into a hierarchical structure, according to ontology principles, based on their vertical associations (broader and narrower terms). The proposed algorithm may also search and detach the entries of the competences of public services. Within the scope of the ontology, these competences will be linked with the responsible hierarchical entity. Therefore, the GICs will update the developed ontologies with any additional or altered information that may appear in the authority file of the digital libraries.

Since the ontology derives from the authority file, clearly the two knowledge representation and management tools interact and complement each other, providing an integrated framework for the management of government information. The proposed ontology may also provide a classification scheme, necessary for efficient data exchange, high-quality and expertise information retrieval, as well as premium-quality prints of specialized catalogues. The hierarchical representation of Public Sector enables the allocation of classification number to each entity of the hierarchical level. Therefore, the Public Sector will be classified with an algorithm that provides for future safety, enrichment and extension. The current classification schemes are unable to represent the required administrative functions. For example, the Dewey classification system provides no accurate number for the concept of marriage license, but it appoints it to the category of religion.

The navigation through the nodes and edges of the authority file provides meaningful information concerning the Public Administration regulations, functions, transactions and its geographical distribution, while navigation through the ontology provides useful information on the Public Administration structure. For example, if a user sets a query for the phrase “marriage license” the system will provide:

- Conceptual interlinking of the phrase “Marriage License”.

Lead Term:	Marriage License
Broader Term:	Licenses
Related Term:	Churches
	Civil Registry
	Civil Status
	Family Law
	Town Halls

The retrieved results are presented by the thesaurus like authority file. The Integration agent searches all the available digital libraries, locates the required data in the authority files of the databases, retrieves the information and integrates the results, in order to present them as a set.

- The administrative functions that are correlated with the given query, i.e. the required procedure for issuing marriage license (all the needed certificates) and the section of the Public Sector that is responsible for its issuance.

Administrative Action:	Marriage License
Required Certificates:	Application Form (is supplied by the GIC and may be completed there)
	ID Card
	Church or Mayor Certificate indicating where the marriage will take place
Processing Time:	10 days
Issuing Authority:	The responsible municipality

The retrieved results are provided by the ontology. However, if the user also defines the place of his/her residence, the system will also define the municipality that is

responsible for issuing the license. For example, if the query is set as “marriage license” and “Athens”, the agent along with the aforementioned results will also search if “Athens” region has a municipality or, if it does not, which municipality is responsible for it.

4. Related Works

Many initiatives focus on methods and principles for ensuring better encoding, description and flow of government information. These initiatives refer either to the production of syntax metadata alone or to the development of both syntax and semantic metadata.

Initiatives representative of the first case are those that aim for electronic governance by 2004 and are oriented towards developing and adopting a common policy for record management and electronic record encoding. Such initiatives are: a) GILS – the US Government’s Information locator Service (US Federal Information Centre), b) e-GMS – the UK Government’s Metadata Standard (Cabinet Office 2003a) including e-GIF – the UK Government’s Interoperability Framework (Cabinet Office 2003), c) the AGLS Metadata Standard – the Australian Government’s Locator Service (National Archives of Australia 2000), and d) the NZGLS Metadata Standard – the New Zealand Government’s Locator Service (E-Government Unit State Services Commission 2001). These systems are based on an extension of the Dublin Core standard (an open forum engaged in the development of interoperable online metadata standards that support a broad range of purposes and business models, <http://dublincore.org/>) for the production of syntax metadata and are focused on public records and their transaction within central, regional and local administration. Our architecture is oriented to all published and disseminated government information and refers not only to syntax but also to semantic metadata production.

The importance of semantics for information retrieval and thematic homogeneity is emphasised by the fact that New Zealand’s E-Government Programme has included a specialized project named “Interim Report of the Portal Thesaurus Project” (E-Government Unit State Services Commission 2001) for the development and selection of thesauri, in order to describe government services and information resources. Two separate, built-up thesauri are created - the first for representing functions, and the latter for establishing subject terms. In our system, the proposed thesauri are used to represent geographic and thematic hierarchy, as well as establishing descriptive terminology, which is derived from the digitized texts by implementing a bottom-up procedure. The administrative hierarchy along with the functions of Public Authorities is represented via an ontology schema, which is produced by automatically parsing the semantic network and extracting the required semantics.

The production of semantic metadata for government information is mainly determined by the semantic tool(s) (i.e. thesaurus and/or ontology) to be used for establishing terms and interlinking. An initiative focused on the usage of ontology for semantic representation and encoding is the project named CITATION (Anagnostakis et al 2002), which proposes a software platform for access to administrative information resources. The application domain concerns the scientific field of Health. The project focuses on how end-users may ensure access to information sources on the Internet, as well as on how the retrieved information may be represented. Ontology is used to describe concepts in order to facilitate information retrieval. The main difference with our ontology is that it represents the administrative hierarchy and not the conceptual hierarchy, which in our model is organized in a thesaurus-

like semantic network. Moreover, our focus is on the primitive structure of data and metadata and not on tracing and organizing information on the Internet.

Within the same framework, the Energy Data Collection System (Hovy 2003) supports homogeneous access to multiple *energy* databases. The EDC system uses ontology to unify different databases' metadata and domain terms and therefore to create a coherent domain model. Domain-specific ontologies are integrated and mapped in a higher ontology. Therefore, ontology principles are only used to taxonomize sets of terms derived from different sources.

An initiative that proposes the usage of both thesaurus and ontology to encode government information is the Gaz-Guide Project (Liu et al 2001). It introduces a multi-agent system that assists information retrieval of the Official Gazette by mediating the user's information needs and the semantic structure of the data domain. This system embeds both ontology and thesauri to traverse different cognitive spaces. In the Gaz-Guide platform, the proposed thesaurus refers only to topical subjects, while the ontology represents: a) the types of legal acts as well as any kind of revision or reformation, and b) data on the issuing authority of each legal act (including contact information, URLs, functions, hierarchical relations). Our architecture refers to the description and encoding of all the available government information (legislation-Official Gazette and Public Records) and focuses not only on metadata structure and information retrieval, but also on information flow and distribution within Public Administration. Specifically, we deal with the representation of a) the geographic and thematic hierarchy, along with the established descriptive terminology on the scientific domain of the Public Sector, as well as b) the Public Sector hierarchy and its functions. Moreover, in our architecture all terms in the thesauri are interlinked, based on administrative functions, and operate within an authority file that resides in the same environment where metadata are structured and maintained. Furthermore, the type of legal act is represented in the bibliographic meta-tags, as such information refers to the bibliographic content of documents and not to semantics. We also suggest how the ontology may be developed and built automatically, by parsing the structured thesauri and extracting the required identities and concepts, which are being further processed and organized in the hierarchy of the Public Sector. Finally, we provide a method for efficient information flow, and we propose how Government Information Centers may contribute to it.

5. Conclusions

Government information constitutes the requirement for accurate citizen-state transactions and quality insight into Public Sector services. However, the access to published and/or disseminated information is limited, time-consuming and particularly complicated due to: a) the lack of organized systems within Public Services, based on international standards for their structure, and b) legislative and administrative diversity.

The proposed model innovates by developing an electronic registry for the management and flow of government information using: a) semantic tools, in order to ensure thematic and syntax homogeneity for data sharing, and b) a web portal interface, in order to provide efficient and prompt access to the available documents. The Government Information Centers, residing in every Prefecture of State, may implement the proposed architecture, since they are the responsible organizations for information rendering at a local level.

The suggested architecture secures: a) accurate and quality data and metadata exchange, b) advanced information retrieval, c) user navigation within the structure and functionality of Public Administration, and d) interoperability among legislative, administrative and geospatial information diversity.

The representation of geographic and thematic hierarchy via thesauri-like semantic schema, as well as the depiction of the administrative hierarchy via ontology, provide for greater transparency of public services, facilitate more informed decision-making, and take the citizen one step closer to a truly knowledge-based society.

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