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A process-oriented ontology-based knowledge management system for facilitating operational procedures in public administration

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ABSTRACT

Public organizations produce daily a great volume of administrative documents, in order to fulfill their mission. This requires the use of a certain, unique for each procedure, legal framework. This article adopts a process oriented approach, through a web-based knowledge management system that provides this legal framework in an up-to-date and accurate manner. The system also supports the interpretation of the legal framework, supplying civil servants, citizens and businesses with precedents and opinions. The system employs an ontology in OWL for representing the public administration structure and any kind of document that flows among administrative units, during the execution of the procedures, which are mapped into OWL-S service models.

1. Introduction

The emergence of e-government as concept and practice is a significant development for public administration during the last decade. The main objective of e-Gov is the development of user-friendly and efficient services for citizens and business and semantic interoperability is a vital issue to solve within this domain. Currently the legal and e-Gov Semantic Web applications are still in an experimental phase, but their potential impact on social, economical and political issues is extremely significant. Web powered semantics could help the e-Gov by engineering inter-operable public administration procedures, facilitating *the performance of daily routine procedures* and helping inexperienced civil servants with new tasks, leading "knowledge based government, in a knowledge based economy and society".

Knowledge is now a major driving force for organizational change and wealth creation, and effective knowledge management is an increasingly important source of competitive advantage and a key to the success of modern organizations (Irma & Rajiv, 2001; Malhotra, 2002). As a result, companies are now implementing knowledge management processes and its supporting technologies. Knowledge management systems (KMS) are a class of IS developed to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer and application (Alavi & Leidner, 2001; Chang, Lee, & Kang, 2005).

Knowledge elicitation, acquisition and transfer are important sub-processes of knowledge management. Each deals with some phase of the process used by a manager when seeking out facts, advice, opinions or the expertise in order to make a decision or address an issue. Problem-solving usually involves both search and access to previously created knowledge (Newell & Simon, 1972). Especially knowledge transfer refers to the focused and intentional communication of knowledge from a source to a recipient to serve specific purposes (King, 2005).

A common feature in all democracies all along the world is the use of documental support for every operation undertaken by public administrations (Sabucedo & Rifon, 2006). We have worked in the development of a software system for the management of the preamble of administrative acts, which will allow the automatic retrieval and synthesis of the law in force and supportive material for the act's grounds for decision. Furthermore, all the legislation and supportive material would be available in an electronic text form, through the locally kept metadata that precisely define their content and context. In this way, certain Operational Procedures in Public Administration are facilitated acquiring homogeneity and becoming experience-independent, as inexperienced public servants have available the knowledge of the more experienced ones.

In this article we first specify the problem scope and parameters. Then, we briefly overview the various scientific fields that our problem belongs to and we review significant related work efforts that took place or still evolving. Finally, we propose a practical solution and we discuss possible benefits of its application.

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2. The problem

Each public organization produces a huge amount of public documents, both administrative acts (“performatives”) and informative ones. An administrative act is produced by an authorized body and it is directed to the external environment of public administration, i.e. it concerns citizens and businesses.

The problem is two fold. It concerns both the composition of an administrative act and its grounds for decision. It is based on the availability of an up to date legal framework and to the provision of the right knowledge to the right public servant, the right moment, for the right case.

Inaccuracies that lead to the production of unfavorable administrative acts are not usually on purpose. On the other hand, improper reasoning of administrative acts that illustrate public interest turns them to “collapse” in courts. In both cases acts have rest on insufficient knowledge, false understanding and interpretation of the legal framework. They contribute nevertheless to efficiency deficits and financial damages of the organization and public administration as a whole.

Recent researches (e.g. The Institute for Citizen Centred Service) (The Institute for Citizen Centred Service), show that an usual problem regarding citizen satisfaction from the e-government is the heterogeneity of the administrative acts i.e. the decision depends on civil servant’s personal knowledge and experience. Indeed in handling different cases civil servants have a certain discretion margin. Usually, if the analogy of a case and the applicable norm is not completely clear, they can assume that an analogy exists due to this discretion. This brings to surface the matter of transparency, which is an EU’s strategic objective of e-Gov beyond 2005.

Public documents are structured by following certain rules and forms. The distinction between elements that each public document must possess is as follows:

- before main text elements,
- main text’s elements, and
- after main text elements.

Especially concerning Decisions of Public Administration (acts), the main text has its own basic rules regarding structure and appearance. The basic characteristics of decision texts are explicitness, accurateness, briefness, rationalism and use of simple language. Decisions are legislative acts and they might be normative or personal/individual. They are divided in two parts: preamble and pronouncement (see Fig. 1).

In the **preamble**, which begins with the phrase “Having in mind”, all the valid legislation that provides the administration with the obligation or ability to produce the act, is presented. At the end of the preamble, the reason for which this act is produced is presented, in other words its grounds for decision, either because this is required by the regulation or because it is obligatory by the act’s nature.

Reasoning generally refers to the legislation that regulates the production of an administrative act and its interpretation. It also recognises the existence of the required real and legal conditions that allow or oblige the public organization to issue an administrative act. We refer to “special reasoning” when there is reference to the provision that is applied and full presentation of all the indications and elements that had been taken into consideration or had been related to the judgment.

Insufficient or vague reasoning is equivalent to inexistent reasoning and it implies – as in the case of non reasoning – invalidity of the act. The existence of reasoning provides citizens and judges with the ability to check whether the legal act is produced to satisfy public interest or to secure citizens and if it is in line with the relevant legislative framework. The Code of Administrative Procedures foresees that all (favorable or unfavorable) administrative individual acts have to provide reasoning on their main body. The lack of reasoning is fault and forms a reason for annulment cassation.

The operation of a system that would be in position to provide the proper legal framework for the production of an act, concerns both public servants who are responsible for that and citizens/businesses to which the act is addressed to. It promotes and supports the principle of the “proper function of public administration”. Finally the use of a knowledge base of precedents of acts, opinions and jurisprudence, adheres to the principles of “good administration”. These principles govern the management of public organizations.

3. Scientific framework

The Semantic Web (SW) has been in the focus of the AI community since 2001 and at this moment needs real-world use cases, in order to demonstrate its added (business) value (Abecker, Sheth, Mentzas, & Stojanovic, 2006). The Semantic Web provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries. SW is important for the development and use of the digital content in heterogeneous networks and transforms a pre-existing network to a knowledge- and service-sharing environment.

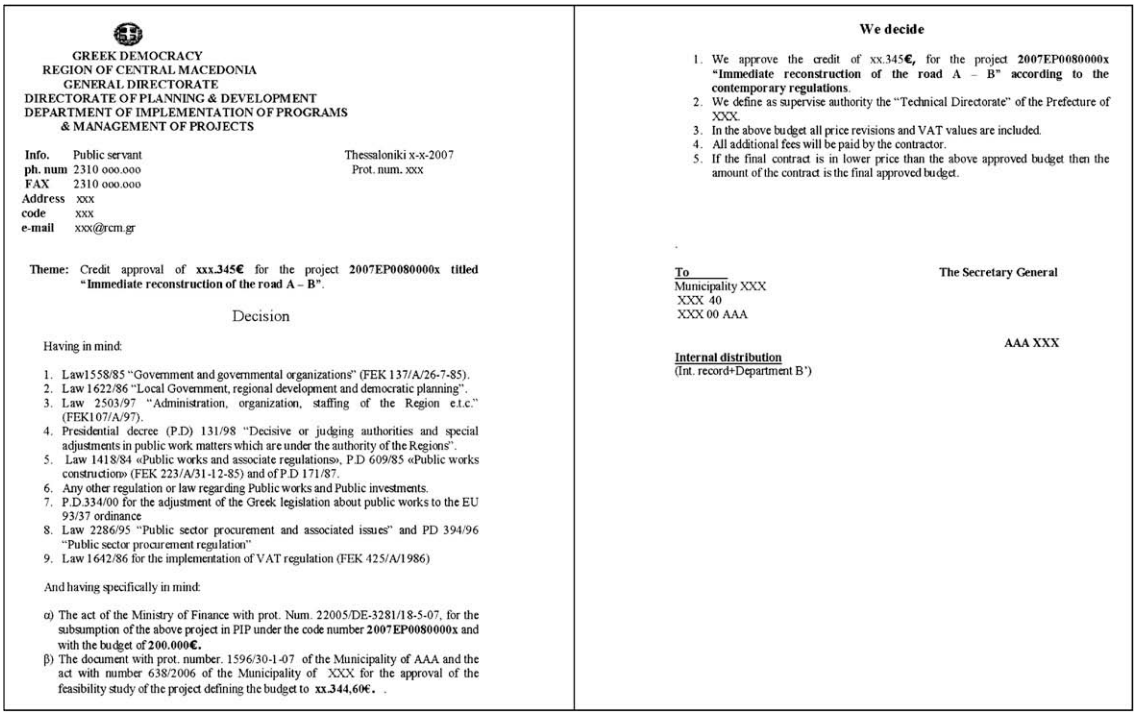
SW is a collaborative effort led by W3C with participation from a large number of researchers and industrial partners. It is based on the Resource Description Framework (RDF) and the OWL Web Ontology Language (OWL) as W3C recommendations, which are considered as basic knowledge technologies, i.e. semantic networks (RDF) and (description) logics (OWL). RDF is used to represent information and to exchange knowledge in the Web. OWL is used to publish and share sets of terms called ontologies, supporting advanced Web search, software agents and knowledge management.

On the other hand, the domain of e-government is unique because of its enormous challenge to achieve interoperability, given the manifold semantic differences of interpretation of, for example, law, regulations, citizen services, administrative processes, best-practices, and the many different languages to be taken into account within and across regions, nations and continents.

Interoperability is a critical issue for the development of modern e-government services. EC documents stress its role not as a simple technical matter concerning net linkage but as basic precondition of knowledge sharing and reuse among networks and reorganization of administrative procedure for better supporting services. There are three kinds of interoperability: technical, organizational and semantic. The first one concerns system linkage and defines standards, protocols and data forms. The second refers to information exchange in a comprehensive matter in and between administrations locally or internationally and between private and public sector. The third one concerns service enhancement by transforming internal function and interaction rules with citizens and use of ICTs (EIF European Interoperability Framework, 2004).

Therefore, the combination of these two domains seems to be quite natural: the e-government domain can provide an ideal test bed for existing SW research, and SW technologies can be an ideal platform to achieve the vision of a knowledge-based, user-centric, distributed and networked e-government. The SW is considered to be the infrastructure upon which all intelligent e-Gov applications will be built in the near future.

The use of the existing/available knowledge is important, but for a government that learns the critical point is the creation of



GREEK DEMOCRACY
REGION OF CENTRAL MACEDONIA
GENERAL DIRECTORATE
DIRECTORATE OF PLANNING & DEVELOPMENT
DEPARTMENT OF IMPLEMENTATION OF PROGRAMS
& MANAGEMENT OF PROJECTS

Info. Public servant
ph. num 2310 ooo.ooo
FAX 2310 ooo.ooo
Address xxx
code xxx
e-mail xxx@rcm.gr

Thessaloniki x-x-2007
Prot. num. xxx

Theme: Credit approval of xxx.345€ for the project 2007EP0080000x titled "Immediate reconstruction of the road A – B".

Decision

Having in mind:

1. Law1558/85 "Government and governmental organizations" (FEK 137/A/26-7-85).
2. Law 1622/86 "Local Government, regional development and democratic planning".
3. Law 2503/97 "Administration, organization, staffing of the Region e.t.c." (FEK107/A/97).
4. Presidential decree (P.D) 131/98 "Decisive or judging authorities and special adjustments in public work matters which are under the authority of the Regions".
5. Law 1418/84 «Public works and associate regulations», P.D 609/85 «Public works construction» (FEK 223/A/31-12-85) and of P.D 171/87.
6. Any other regulation or law regarding Public works and Public investments.
7. P.D.334/00 for the adjustment of the Greek legislation about public works to the EU 93/37 ordinance
8. Law 2286/95 "Public sector procurement and associated issues" and PD 394/96 "Public sector procurement regulation"
9. Law 1642/86 for the implementation of VAT regulation (FEK 425/A/1986)

And having specifically in mind:

α) The act of the Ministry of Finance with prot. Num. 22005/DE-3281/18-5-07, for the subsumption of the above project in PIP under the code number 2007EP0080000x and with the budget of 200.000€.
β) The document with prot. number. 1596/30-1-07 of the Municipality of AAA and the act with number 638/2006 of the Municipality of XXX for the approval of the feasibility study of the project defining the budget to xx.344,60€.

We decide

1. We approve the credit of xx.345€, for the project 2007EP0080000x "Immediate reconstruction of the road A – B" according to the contemporary regulations.
2. We define as supervise authority the "Technical Directorate" of the Prefecture of XXX.
3. In the above budget all price revisions and VAT values are included.
4. All additional fees will be paid by the contractor.
5. If the final contract is in lower price than the above approved budget then the amount of the contract is the final approved budget.

To
Municipality XXX
XXX 40
XXX 00 AAA

The Secretary General

AAA XXX

Internal distribution
(Int. record+Department B')

Fig. 1. A sample public administration act.

new knowledge. Since the key for the creation of new knowledge lies in the activation of the tacit knowledge (Nonaka & Takeuchi, 1995), organizational memory of e government has to focus from explicit to tacit knowledge. This means that generated documents must be enhanced with the knowledge that public servants posses from their experience.

Within the broad field of knowledge management, systems developers continue to struggle with the elicitation and codification of expertise (Nelson, Nadkarni, Narayanan, & Ghods, 2000). An expert is someone who is characterized by superior performance within a specific domain of activity (Johnson, Zualkernan, & Garber, 1987). The high value of tacit knowledge motivates the organization to attempt to capture it (Spiegler, 2000). An individual's knowledge cannot be useful to others unless it is expressed in such a manner as to be interpretable. Experts cannot not always fully explicate the tacit knowledge they use nor do they need to record it.

The suggested use of a knowledge-based portal in public administration will mainly benefit the routine tasks of back office procedures performed regularly or occasionally by civil servants. It is important though to have in mind the role of legislation and knowledge in the decision making process. To accomplish tasks that public administration carries, huge amount of information and knowledge is collected, created, stored and shared. Legal information has on the same time social and economical dimensions. It is vital for the democracy and citizen's every day life and his/her participation in the democratic procedures. Practical/technical solutions for accessing legal information/knowledge have a social dimension enhancing citizens in understanding them.

4. Related work

Related work concerns various aspects of the problem we address, namely use of semantic web technologies, like metadata, ontologies, web services, etc., for e-government legal knowledge. To the best of our knowledge there are no systems in the literature for performing semantic-based, goal-driven consultation and knowledge-sharing for administrative procedures and practical use and re-use of legal and administrative texts.

Concerning e-government ontologies, there are projects like the Smartgov project SmartGov Project or more recent ones like Ontogov OntoGov. In the former, an e-government service ontology about generic business activities is described, using the KAON modeling tool (Oberle, Volz, Motik, & Staab, 2004). The ontology comprehends four broad categories: activity, organization, strategy and marketing. In the latter, a platform which facilitates composition and evolution of e-Gov services is described.

Another initiative taken by the Essex County Council within the DIP project aims to develop a whole governmental Ontology, modelling a very wide range of concepts related to the British government and other important community agencies, their services and citizens.

Regarding metadata of legal or administrative texts many efforts are in progress, which aim at specifying strict metadata formats in XML/XML Schema for exchanging normative texts in a seamless, syntactically interoperable manner. Such examples are the NIR/PRIN project in Italy (PRIN Project, 2003), which concerns the European citizen in e-Governance, studying the legal–philosophical, legal, computer science and economical aspects, LexDania in Denmark, MetaLex in the Netherlands, CHLexML in Switzerland and e-Law in Austria. Special mention is made to CRONOLEX (de Rivero & Skarmeta, 2006), which is a system for dynamic representation of laws.

Legal ontologies aim at achieving semantic interoperability through the modelling of the legal domain with respect to legal concepts and law discipline. A number of projects, including e-Court, e-Power, FF Poirot, "Financial Fraud Prevention-Oriented Information Resources using Ontology Technology", CLIME, and SEKT (SEKT Project), aim at improving the access and understanding of large collections of legal information through the Internet, exploiting Semantic Web Technologies in the legal domain.

The most relative work with ours is the SEKT project, which provides support to newly recruited judges, based on ontologies of professional legal knowledge (Casanovas et al., 2005) rather than ontological models for theoretical legal knowledge, as most previous attempts. The ontology was built in OWL-Lite as a specialization of the Proton upper ontology and its structure resulted from the answers that judges gave to a questionnaire in order to reflect every day tasks.

Our system is differentiated from the works presented above since our ontology refers to administrative entities, procedures and documents rather than legal hierarchies. Public administration serves its own goals and objectives by producing acts that have their own rationale, which is quite different from the one of the courts. Acts use laws, as well as jurisprudence and administrative precedents. Additionally our system mainly aims to assist civil servants to compose a "performative" document using the right legal and institutional framework. Furthermore, our approach gives emphasis to the structure of the public administration in order to better represent the units that are pertinent to the production of documents as well as the workflow among them. Procedural aspects of the ontology are represented in a Semantic Web Service framework, namely OWL-S. The purpose for this is twofold: firstly, to allow easy sharing and re-use of the process models among different administration units and, secondly, to cater for future integration into e-government services.

Public administration's structure is specified by laws and it is not a result of the consensus of professionals. Laws, are usually needed, in specific circumstances described by a settled context. Organization of legal norms into legal areas that reflect scientific or professional fields or notions raise complexity for public administration since a legal field may refer to entirely different administration areas. Public administration and whoever interacts with it copes with procedures. These procedures may combine legal rules in a unique way. This might lead to a unique rationale, which is not the aggregation of a number of norms. Therefore, public administration procedures are the result of a combination between legal knowledge and administrative practice. This requires interpretation of the legal framework by the senior officers and the explication of the tacit knowledge of everyday practice.

5. Suggested solution

The suggested system has to serve the following functionalities:

- Support of the civil servants in composing administrative acts, with automatic updating of the legal framework, which is being taken into consideration for their production.
- Support of civil servants and citizens in reasoning and substantiating acts. Provision of access to the relevant laws (parts or whole) as well as to explanatory material concerning act's reasoning, such as precedent acts, opinions of the State Legal Council and decisions of Administrative Courts.

5.1. System architecture and functionality

The main component of the system is a Knowledge Portal which contains the procedures that each administrative unit performs. The architecture of the portal and its auxiliary modules are shown in Fig. 2. The main components of the portal are the *Public Administration Ontology* and the *RDF Metadata Repository* about the various documents needed to feed and guide the public administration procedures in order to produce certain acts, which are the actual products of the procedures. To this end, various auxiliary sub-components are employed, such as the *Administrative Procedure Wizards*, which guide a civil servant throughout the completion of a procedure by using pre-defined templates for the production of administrative documents through a well-defined work flow. These templates are actually part of the Public Administration Ontology. To design the templates, a knowledge engineer cooperated with experts in order to acquire their knowledge. The same process is followed for the depiction of procedures and the tasks that comprise them. Public Administration *Unit supervisors* can revise these templates when needed, based on new administrative practices or guidelines. Furthermore, a *document verifier* can facilitate citizens in verifying the validity of a decision made by the public administration.

The RDF Metadata Repository maintains metadata about legal and administrative documents that a civil servant should be aware

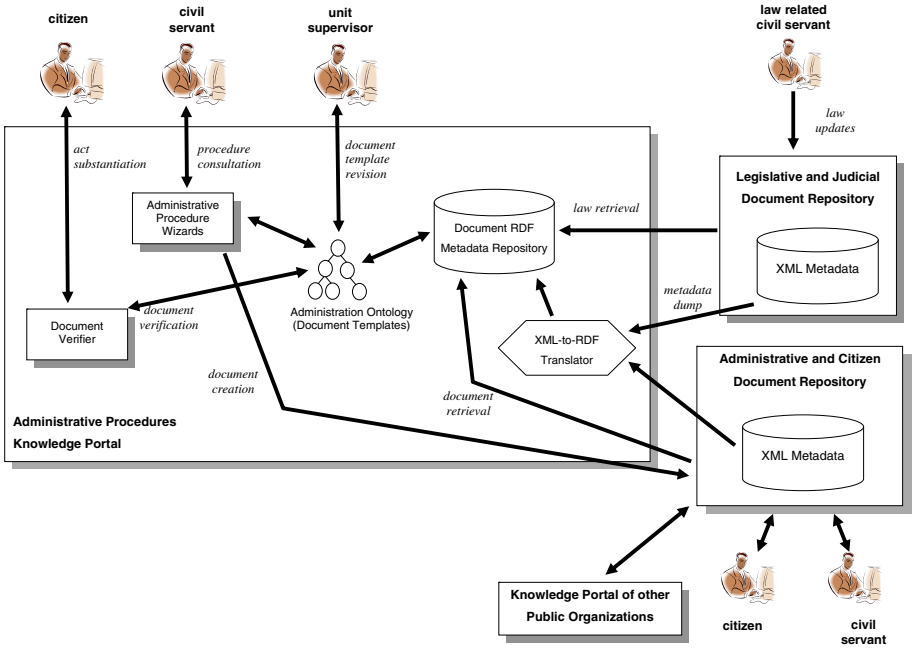


Fig. 2. Architecture of the Administrative Procedures Knowledge Portal.

of. Metadata are actually instantiations of the various document types defined in the administration ontology. The actual documents are stored in externally administrated document repositories, namely an administrative document repository and a legal document repository. More details on the legal metadata repository will be given in the next sub-section. The administrative documents produced by the system are regularly stored for future reference in some externally administrated document repository. Furthermore, the portal can also have access to such an external administrative document repository that can be populated by other public administration units. The metadata about these documents are synchronized using the mechanism explained in the next sub-section.

5.1.1. The legal metadata repository

It is important for every public servant to receive an up-to-date legal framework in order to accomplish every day tasks. This is possible with the use of XML-based data structure flexible enough to define all types of legal norms. The data structure has two parts: the metadata of the norm and the text of the norm. The metadata contain information for the identification and description of the legal norm. This information is not part of the text of the norm. It is the part that is updated when another norm modifies (revokes, replaces, cancels or includes) it.

The metadata used in our work are inspired by previous work done in this area, mainly from the PRIN Project de Rivero and Skarmeta (2006). More specifically, we use the following metadata for each norm:

- URN: Global identifier of the legal norm.
- Publication date.
- Take effect date (it can have several).
- Approbation date.
- Gazette where the norm was published.
- Unofficial name.
- Issued by.
- Links tags: links that the norm has with other norms, or with parts of other norms.

The data model was defined via an XML Schema document, where the structure of norms is defined by means of a contents–section–article–paragraph hierarchy. The model is equipped with a basic operator for the management of norm modifications. It is devoted to change the textual content of a norm portion and can be used for deletion of (a part of) the norm (abrogation), or the introduction of a new part of the norm (integration), or the replacement of (a part of) the norm (substitution) (Grandi et al., 2005; Mandreoli et al., 2006).

The XML metadata are regularly dumped onto the RDF metadata repository through an *XML-to-RDF translator*. When a norm is produced that modifies a pre-existing one, the user can realize the change through a notification on the screen. This is accomplished by checking at run-time the existence of links within the RDF norm metadata that replace or modify them with newer norms. Additionally, the previous preamble norms can be kept for comparison or even educational purposes.

Public administration's routines do not usually need temporal versioning of norms, as even in the case of an appeal the time lag is very short. If, in any case, the legal status has changed, the law in force when the act was produced can be found through its preamble.

5.1.2. The administration ontology

Knowledge is usually captured in ontologies. Building ontologies means entering in a process in which tacit knowledge is made conceptually explicit in a formal machine-readable language. The core element of this knowledge portal is the "ontology of Greek public administration procedures", which represents which types of *documents* are produced by which public administration *units* and how these documents *flow* among these units. The ontology consists of two parts: The first part represents, in OWL, the Greek public administration *structure* (i.e. administration units and their hierarchical relationships) and *documents*, which are either used by these units as a legal framework or they are produced by them. Thus, documents are further divided in Judicial/legislative and Administrative/citizen. In the second part, the *procedures* are represented in OWL-S service models. The ontology is updated continuously as new laws, administrative regulations and procedures are issued.

Public administration structure is specific and it is regulated by laws and decisions. On the "structural aspect" of the ontology, all agents (actors) of the administrative universe of discourse are included (Fig. 3), namely the three independent authorities (judicial, administrative and legislative), as well as citizens and businesses. In this paper, we consider in detail only the structure of the administrative authority.

Procedures of judicial and legislative authorities are beyond scope and objectives of this work. We consider only the products of these procedures, which are jurisprudence and laws, respectively (Fig. 4). These products may be used as supportive material in the reasoning phase or as inputs in public administration's procedures.

The structure of public administration is hierarchical. President of the Republic and Prime Minister are on the top, having discernible power and roles. They produce administrative acts, through certain procedures. Cabinet is also on the top. A hierarchy Ministry–General Secretariat–General Directorate–Directorate–Department follows, plus the Bureau, which may belong to one of the above entities. This hierarchical relationship is represented by "belongs to" and "supervised by" properties (Fig. 3 – top-left).

Concerning the public administration document type hierarchy (Fig. 4), we distinguish four major classes:

- Administrative documents, i.e. documents produced by public administration, which can be either *informative*, i.e. they do not have actual impact on the real world but they just inform a citizen or an administrative unit about something, or *acts*, i.e. the decisions have an impact for citizens or business (e.g. an approval for funding). Administrative documents also play the role of *products* of public administration procedures:
- Citizen documents, i.e. simple documents that are produced by the citizen and are used as input to the public administration, such as requests and declarations.
- Laws, i.e. documents that set the legal framework of the public administration and have a general validity, i.e. they are applied in any case.
- Case Law, i.e. decisions made by the Supreme Court or an administrative court in the past and are regularly used for decision making. Case Laws are usually made on individual cases and they are used as a guideline for new cases, but sometimes they refer not to individual citizens but to a broader category of people (regulatory acts).

The public administration procedure ontology is represented as an extension to OWL-S (Fig. 5). The key concepts of the ontology are procedures, full procedures, and tasks. Full procedures are composed by one or more procedures and procedures are composed by one or more tasks. Every procedure (and task) has a name which declares or indicates its objectives. The language used to depict this objective might not be strictly administrative. Thus, each procedure has a name, title and a short description providing the possibility to citizens and inexperienced civil servants to understand its aim. The title of an administrative act is used as a title for the procedure that produces this act.

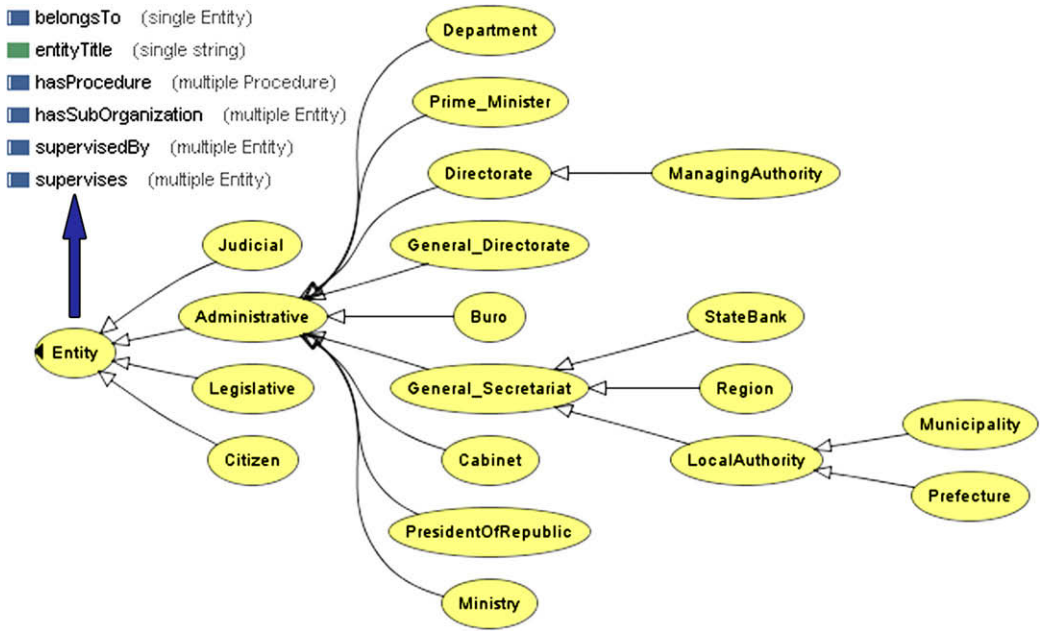


Fig. 3. The structural aspect of the ontology of public administration procedures.

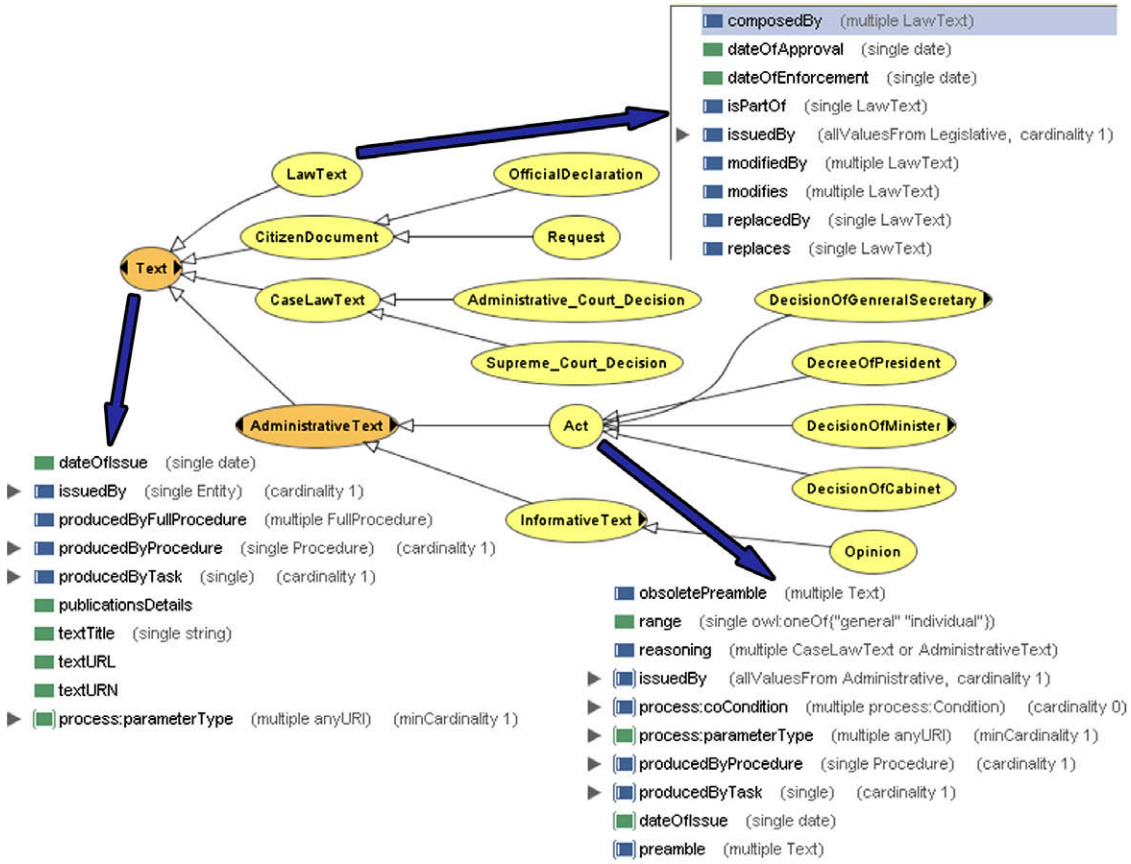


Fig. 4. The textual aspect of the ontology of public administration procedures.

Tasks are atomic activities that cannot be further cut down to smaller ones, performed by a single administration unit. Every task has just "title" as it is always used in the framework of a procedure. The title of the task is the same with the title of the administrative act or the informative document the task produces. Every task has as input any kind of text, namely administrative, legal, etc. The output of the task is the document that it produces.

We call *procedure* (Fig. 5) each integrated part (or step) of a *full procedure* (service), which includes at least one informative task (i.e. it tries to find or notify some information from/to another unit) and only one "performative" task (i.e. it produces a single act).

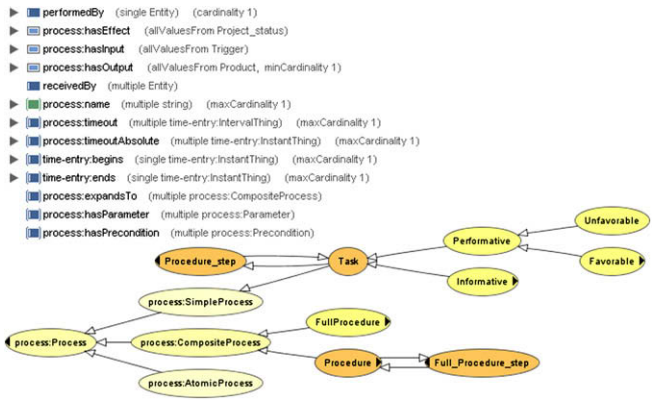


Fig. 5. The public administration procedure ontology as an extension of OWL-S.

"Performative" and informative tasks in the same procedure may not be performed by the same administrative entity. In certain circumstances, where only one act is produced by an administrative unit, the informative part may be included in the announcement/notification of the act. No further informative task is performed then.

Furthermore, in certain procedures and due to communicative barriers, set by the administration hierarchy, the unit which produces an act and the unit that communicates it to the interested parties may be different. The latter is the one that receives the act in the first place, as it affects its world.

We study public administration procedures whose products address to the organization's external environment. This environment includes citizens/businesses, other public organizations and public servants acting as citizens. Thus we are not interested in internal trivial, routine processes that produce no document for one of the previous actors/entities.

We call *Full procedure* a number of procedures intertwined. A full procedure may reflect to the provision of a service to one or several entities (property *provided To*). Fig. 6 shows the specializations of the OWL-S service, service profile and service process model classes. Procedures may be sequential or in an acyclic graph. In our ontology, we adopt the control constructs of OWL-S. Some examples of procedures that can be represented using our ontology are:

1. Hierarchical control that is anticipated by a law.
2. Hierarchical control that is performed due to objections/appeals.
3. Communication between public organizations due to joint responsibilities for the expression of agreement in order for a project to accomplish.
4. Sequential procedures that lead to the provision of a service.

Finally, Fig. 7 shows the input/output parameters for the public administration procedures and tasks, as specializations of the corresponding OWL-S constructs. Notice that input to a public administration procedure can be any document, which is called Text or Trigger, because it triggers a procedure, including also laws, etc., while outputs (or products) are only the administrative documents.

5.1.3. Functionality of the document templates

In this section, we briefly present how document templates are used, through the Administrative Procedure Wizards, to help the civil servant in producing administrative documents as a product of a well-defined procedure. The wizards are guided via the public administration ontology presented above. Each special document class of the ontology, such as the ones presented in the next section, defines a document type or a template which is produced by a certain full procedure type, which again is represented by a special full procedure class. The full procedure type is analyzed to a certain process model of multiple procedure types, which again are analyzed into a series of tasks types.

The user can select a full procedure type from the leaves of the procedure type hierarchy. Then, the system retrieves the corresponding document type from the constraints of the *process:has Output* property. The full procedure type also leads to the corresponding process model (through the *process:composed Of* property) and the component process types. Each procedure type then is implemented through a series of tasks types. So, selecting a full procedure type has as a result the appearance of the *tasks* (i.e. simple steps) that are required to complete a full procedure.

When the user selects a task type, a specific output document type (either informative or act) appears in the screen. It usually gives two fields: "preamble" and "reasoning" (or grounds). In certain procedures only the informative part may exist. The "performative" task leads then to the procedure templates of the department which produces this act.

Selecting the *preamble* a template of metadata appears. Some entries in the template regard laws and norms that are default, while other entries include possible document types about administrative texts that the preamble may refer to. Clicking on the default entries the user may retrieve the whole document. If the metadata refer to a paragraph or an article one can access only the certain part of the text. Clicking on the document types the user may select specific documents from a list.

Selecting *reasoning* one may find metadata of case law, opinions and related administrative acts, organized into corresponding categories. Clicking on these categories one can access the supportive material referring to this specific part of the procedure.

Furthermore our system provides support in the following circumstances:

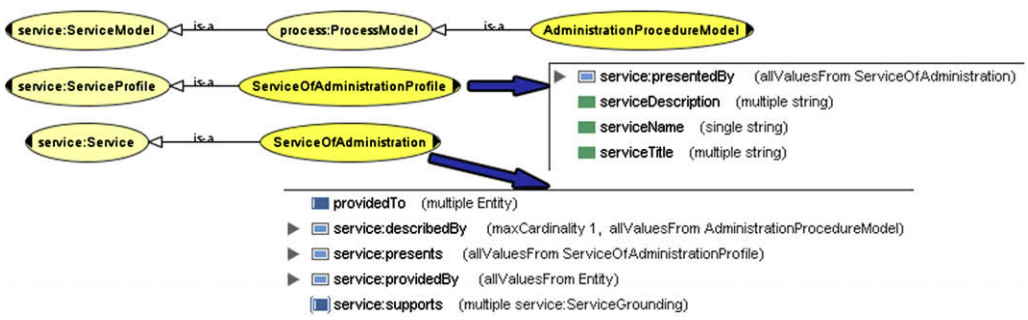


Fig. 6. Specializations of OWL-S service, Service Profile and Service Model.

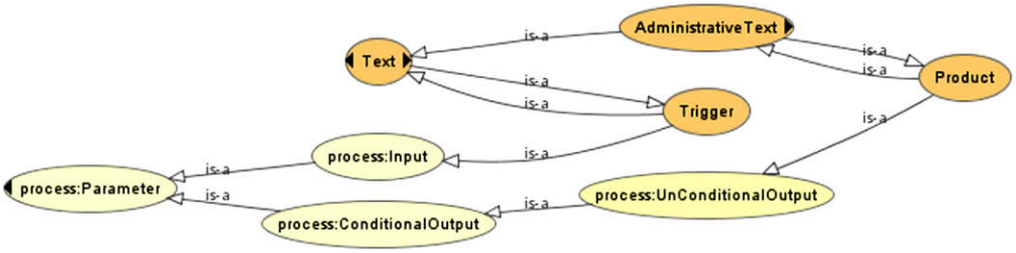


Fig. 7. Parameters of Public Administration Procedures.

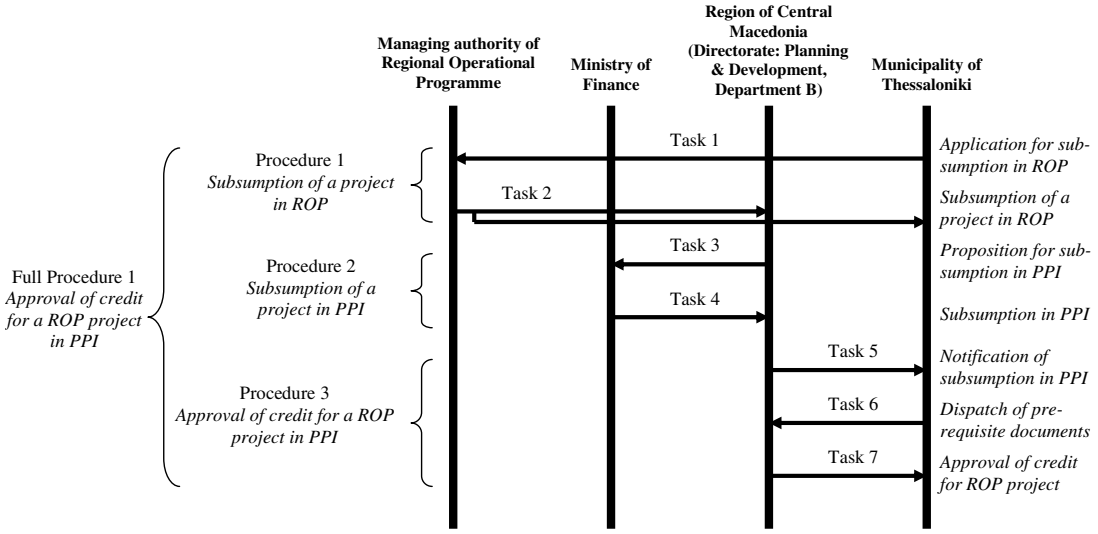


Fig. 8. Example of an administrative service (full procedure) and its environment.

- In the occasion of an administrative unit which has to accomplish a rare/special procedure, like a procurement or a responsibility that was transferred to it.
- To a citizen/business which received an administrative act and wants to verify its substantiation.

In both occasions there is a need to understand the legal framework which had been taken into consideration, other similar acts that were produced, and their status after an appeal.

To support this functionality one can search using the title of the administrative act that he/she is interested in. The system will lead him/her to the task that produces this act. There he/she may check the status of the act or monitor the total procedure.

An additional help is provided by guided dialogues, for users who have no certain information needs. One can navigate, answering questions, through the procedures of an organization. Dialogues lead from service goals (i.e. total procedures titles) to procedure and task goals (titles). Finally, he/she would be able to decide about the procedure or task that is interested in, reading their descriptions.

6. Case study

In order to better demonstrate the flexibility of the representation scheme achieved by the proposed ontology we study an example of a full public administration procedure (Fig. 8), concerning the approval of credit by the Public Investment Program (PIP) for a project implemented by a local authority that is going to be funded by a Regional Operational Program (ROP).

In order for an "approval of credit"[1] to be provided to a project, four public administration units are involved: the unit which implements the project (e.g. municipality of Thessaloniki), the Managing authority of the Operational Program (e.g. Regional Operational Program of Central Macedonia), the Greek Ministry of Finance and a Directorate of the Region (e.g. Directorate of Planning and Development of the Region of Central Macedonia).

The full procedure consists of three procedures: the first one is about the subsumption of the project in ROP. Triggering of this procedure is being made by the application of a public administration unit (e.g. municipality of Thessaloniki) for this reason (task 1). This application is addressed to the managing authority of the operational program (e.g. the Regional Operational Program of the Region of Central Macedonia). The managing authority is checking on some requirements of the project and when these are fulfilled it decides the subsumption of the project. In that case it informs both the applicant unit and the Region (e.g. Region of Central Macedonia) (task2).

At that time the second procedure takes place, the relevant Directorate (e.g. Directorate of Planning and Development) suggests the subsumption of the certain project to the PIP sending the appropriate suggestion to the Ministry of Finance (task 3). The ministry of Finance decides the subsumption of the project in the PIP and informs the above Directorate of the Region (task 4).

Then the third procedure is being triggered. The Directorate of the Region informs the applicant unit (municipality of Thessalo-

[1] Credit approval is the prerequisite for the payment of a project's activities.

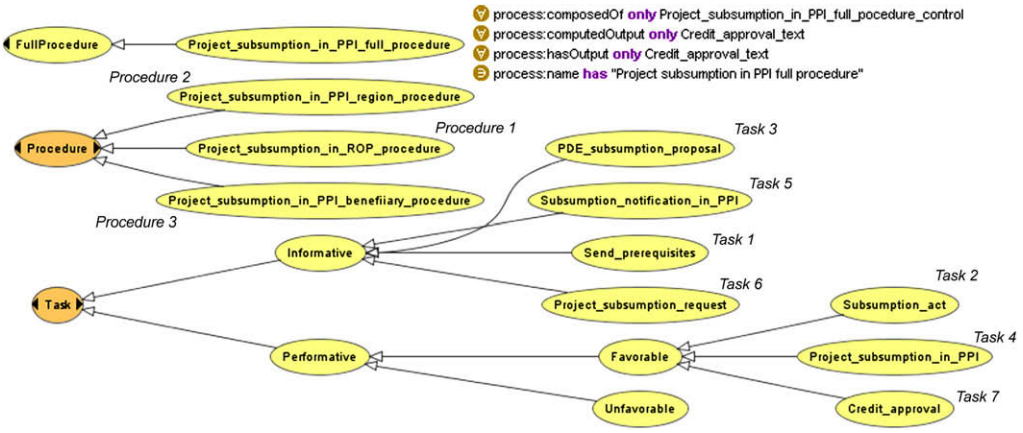


Fig. 9. Tasks, procedures and full procedures of the case study.

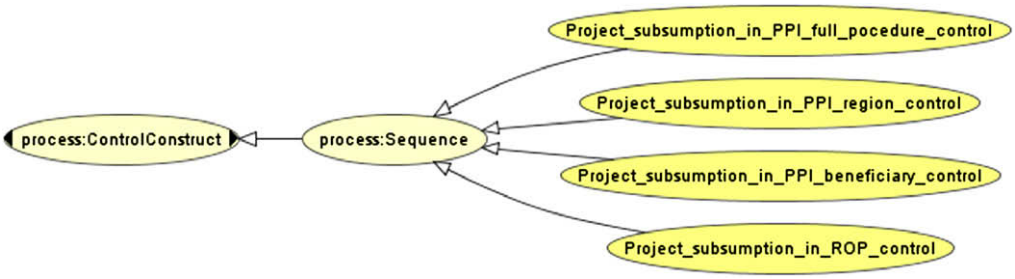


Fig. 10. Sequential process models of the case study.

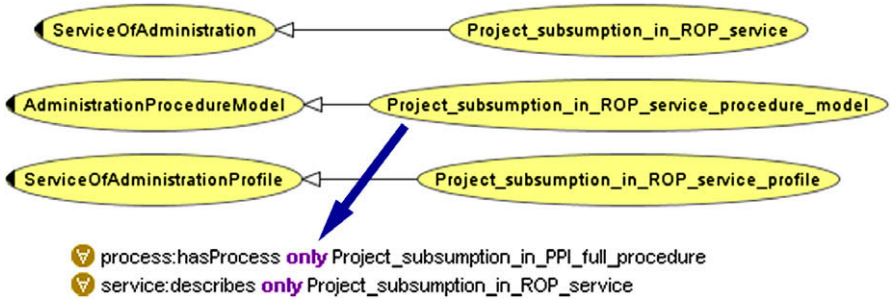


Fig. 11. Service, service profile and service model of the case study.

niki) about the subsumption of the project in PIP and guides it for the next steps, asking for certain documents and decisions that this unit is obliged to send in order for the third procedure (consequently for the full procedure) to be continued (task 5). When the dispatch of the prerequisite documents is being held (task 6), the Directorate of the Region decides for the "approval of credit" and informs the applicant unit (municipality) about it and for the following steps and requirements in order certain activities of the project to be paid (task 7).

In order this full procedure to be implemented a number of documents are circulated among the above four public administration units. Specifically, for the Directorate of Planning and Development, Department B of the Region (e.g. Region of Central Macedonia) these documents are (shown in Fig. 12):

- Notification about the subsumption of a project in ROP and **suggestion** to the Ministry of Finance for the subsumption of the project in PIP **(informative).**
- **Notification** to the applicant unit for the subsumption of the project in PIP and instructions for further actions **(informative).**
- **Approval** of credit for ROP/PIP project **(act)**.

These documents have certain structure and similar content and are repeated for thousands of projects. The system proposed is capable to facilitate these recurring tasks, using the ontology presented in Section 5, as shown in Subsection 6.1.

6.1. Implementation of the case study

In order to implement this case study in our ontology, we created several special classes, as specializations of the ontology classes we presented in Section 5. The full procedure of the case study is called *Project_subsumption_in_PPI_full_procedure* (Fig. 9). Notice that since this special type of full procedure should be re-usable in many special cases of approving credits for projects, it needs to be a class. Furthermore, the three procedure types that comprise

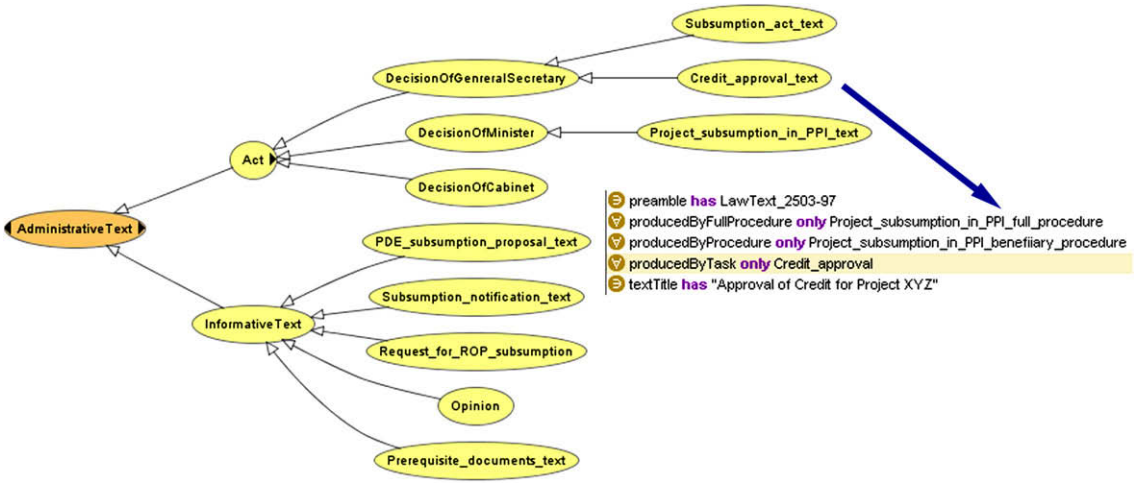


Fig. 12. Administrative Documents of the case study.

Table 1
Input/Output documents for the tasks of the case study

Task		Input documents	Output document
1	Project_subsumption_request		Request_for_ROP_subsumption
2	Subsumption_act	Request_for_ROP_subsumption	Subsumption_act_text
3	PPI_subsumption_proposal	Subsumption_act_text	PPI_subsumption_proposal_text
4	Project_subsumption_in_PPI	PPI_subsumption_proposal_text Subsumption_act_text	Project_subsumption_in_PPI_text
5	Subsumption_notification_in_PPI	Project_subsumption_in_PPI_text	Subsumption_notification_text
6	Send_prerequisites	Subsumption_notification_text	Prerequisite_documents_text
7	Credit_approval	Prerequisite_documents_text Project_subsumption_in_PPI_text Subsumption_act_text	Credit_approval_text

the full procedure and the seven tasks types identified in the case study above are also shown in Fig. 9.

Each procedure (or full procedure) type needs to be associated with a process model. This is done through restrictions on the *process:composed Of* property (see Fig. 9). In this case study, only the sequential process model is used, as shown in Fig. 10. The process model that corresponds to the full procedure of the case study is called *Project_subsumption_in_PPI_full_procedure_control*. Notice the convention that the name of the process model of each procedure is constructed by adding the "*_control*" suffix at the corresponding procedure name.

Furthermore, the full procedure of the case study is "wrapped" with a corresponding service and service profile, and the relevant process model is wrapped with a service model (Fig. 11). The connection between the service model and the full procedure is done through the restrictions of the *process:has Process* property.

Finally, the administrative document types used in the case study are shown in Fig. 12. Table 1 shows how these document

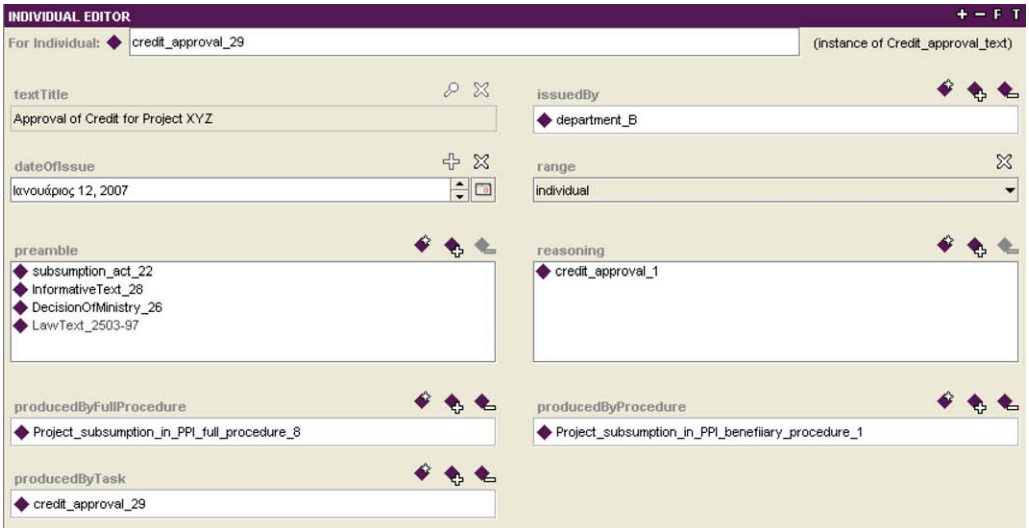


Fig. 13. A credit approval document instance.

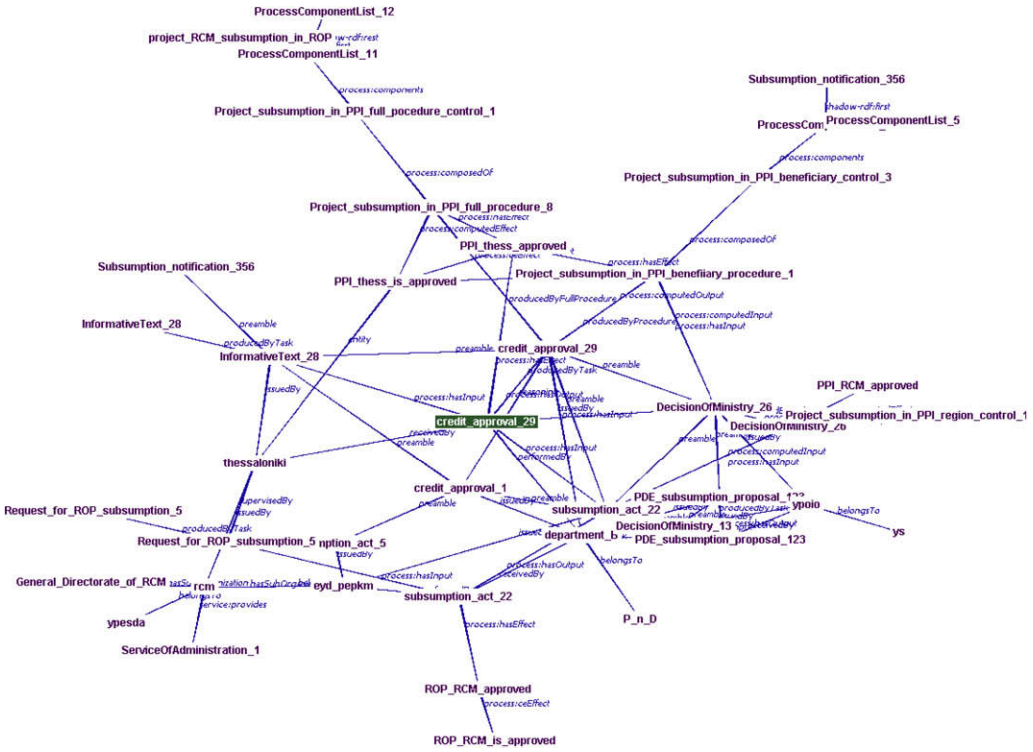


Fig. 14. Fragment of the instance graph of the case study.

types are related to the tasks of the case study (Fig. 9), i.e. which document types are input and output to each task type. Notice that the connection between each document type and the corresponding full procedure, procedure, and task type that produces it is established through restrictions on the *produced Full Procedure*, etc., properties. Furthermore, notice in Fig. 12 how a document type (namely a template) is constrained to use certain other documents, such as laws, through e.g. its *preamble*.

Concerning instances, in this case study we have implemented one such instance of a full procedure that produces one instance of a credit approval document, using all the procedure, task, document and administrative unit types presented above. Fig. 13 shows the sample credit approval document instance (*credit_approval_29*), whereas Fig. 14 shows a small fragment of the instance graph that is centered on this instance. In the instance graph, nodes are instances and links are the relationships between them, namely the object properties that link one instance to another. In total, there are 62 such instances.

7. Conclusions

The new challenge for public administration is the exploitation of its knowledge sources, in order to refine its internal processes and provide better services. This article describes a process oriented knowledge management system that provides specified knowledge for administrative procedures. It also gives the opportunity to citizens and civil servants to identify a decision's status concerning reasoning completeness. They can identify its validation in the real world after a potential judicial testing too.

Due to the great overload of legal norms that exist in Greece, there is a true need for help to civil servants who use legislation, in order to maintain an updated version. The aim is to get "knowledge-powered organizations", i.e. organizations where knowledge management happens in the background as part of the day-to-day job (Smith & Farquhar, 2000). In addition, the system links semantically public administration, as it leads through sharing of common practice and terminology to the adoption, not only of a common language but of a common rationale. When this rationale has to be revised, this could be done throughout the whole administration without finding other channels to communicate such a change. This facilitates present and future managerial shifts.

Public organizations may provide the same services that are differentiated on account of the importance (e.g. amount of the investment) or the spatial responsibility. Interconnecting full procedures or services we might lead to similar procedures and tasks which will lead to national operational and semantic standards. Thus the overall management of public administration is being promoted.

Both legal norms and administrative practices/procedures become accessible to citizens and businesses, which may easily raise arguments and objections. In parallel, public servants may provide services in an easy way having quick access to a complete and sound legal and administrative framework.

The creation of this knowledge management scheme is very important for knowledge storing right after its creation or transformation from tacit to explicit. It promotes and supports the principle of "good administration". During a production of an act or promulgation many organizations reinvent the wheel, sometimes in the wrong way. Furthermore, the maintenance of knowledge could be easily handled by the "experts" of the public administration units, which are the actual public servants, in a manner similar to (Lepouras, Vassilakis, Halatsis, & Georgiadis (2007)).

The advantage in comparison to existing systems of case law retrieval is that only jurisprudence that refers to a certain act is retrieved. This is facilitating, as a certain mixture of legal norms could produce a significantly different rationale than each norm separately. All supportive material concerning act's grounds is connected with the specific act and refers to its background. Still, in similar administrative cases, where the legal framework is the same, a similar decision has to be taken establishing semantic and linguistic unity.

Finally, the proposed system creates a strong managerial benefit for the public sector affecting both efficiency (speeding up recurring tasks) and effectiveness (assisting the production of sound decisions).

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