Improving Public Administrations via Law Modeling and BPR

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Abstract. *Semantic Web* technologies can be used to produce conceptual representations of legal documents and to perform reasoning on the information that they contain. At the same time, Business Process Reengineering is being applied more frequently to optimize the procedures of Public Administrations. While the existing literature on tools and methodologies to analyze, model and manipulate legal documents is extensive, there is a lack of a comprehensive tool that allows for a complete analysis of laws in all their aspect. In this paper we propose the design of a modeling framework to support the law-making process, facilitating the participation of people without a jurisprudence background to the editing of regulations.

1 Introduction

Semantic annotations and interchange formats for laws have raised significant interest. In fact, enriching legal documents with semantic information can greatly aid the reasoning on the statements contained in laws, as well as favor indexing and interchange of the document. In addition, XML has become the *de facto* standard for legal documents authored by the legislative bodies of several countries, including the House of Representatives of the United States of America, the African Union's Parliament and several European governments [5]. Moreover, a Legal Knowledge Interchange Format (LKIF) [6] is the indispensable tool to achieve interoperability among the members of transnational institutions such as the European Union. It is not surprising that the definition of such LKIF is one of the top priorities of the European Union to connect their member countries' Public Administrations [5]. See [1–4] for further details.

At the same time, the use of Business Process Re-engineering (BPR) has become one of the recent trends to support Public Administrations in redesigning their processes, reducing their costs and improving citizens' participation [7, 8]. There is however a need to link procedures to the regulations by which they are defined and directed. Any implementation of a re-engineered (or a new) process requires a parallel action on both the redesign of processes and on the introduction of law changes. This is to give analysts the ability to understand the impact on laws of a process redesign.

In this paper we propose a *law modeling framework* – called VLPM 2.0 – that leverages existing systems for legal knowledge representation and interchange in

order to provide a way to better understand legal documents. Our ultimate goal is that of supporting the law-making process by:

1. Facilitating the participation of people without a jurisprudence background to the editing of regulations.
2. Providing effective means to comprehend the law.
3. Provide a way to make changes to the law and keep track of the dependencies between textual resources (i.e. legal documents and other documentation of a PA procedure) and models.

Specifically, we focus on documents that define, regulate or in some way affect procedures (e.g. Public Administration procedures, company policies that need to comply with certain regulations). This category of legal documents is usually the one in which functional analysts are more interested.

Our framework addresses the needs of three potential users:

- CITIZENS, who want to understand laws, procedures and legal documents in general without any technical or legal expertise.
- FUNCTIONAL ANALYSTS, who analyze the processes in PAs or who need to understand the legal requirements for some (usually IT) system.
- JURISTS, who are in charge of designing and editing a piece of legislation. They need to be able to easily visualize and navigate the document as well as be able to track past changes and dependencies to other documents.

The approach that we present in this paper is of particular interest for the developed world as well as developing countries. As the Report of the 2009 World e-Parliament Conference [16] points out, the latter scenario represents an easier deployment environment for legal ICT-based services due to a usually less saturated body of laws. Moreover, the young democracies of the developing world could greatly benefit from an approach that takes into consideration ICTs in laws since the beginning.

2 Related Work

ICT-based services have become pervasive in modern societies and, as a result, parliaments are relying at different degrees on complex information systems to support their operations. Several works aim at improving and modernizing Parliaments and Public Administrations by providing solutions typical of ICT. These are mainly (usually XML-based) representation formats for legal documents and information systems.

The work presented in this paper uses AKOMA NTOSO XML [1] as format for the representation of input legal documents. AKOMA NTOSO is a project developed by UN/DESA for African parliaments and it includes a schema for the markup of legal texts. This format is designed to achieve interoperability between parliaments and is thus generic and pattern based in order to support different legal systems and document structures. Other markup formats and information systems are described in [5].

In the recent years, the interest towards linguistic and semantic technologies for the representation of legal knowledge has increased. The most notable endeavor in this direction is the Legal Knowledge Interchange Format (LKIF) and its related LKIF-core and LKIF-extended ontologies [6]. This is the main product of the European ESTRELLA Project [5] and it is intended to serve two purposes:

- Provide reusable ontologies for the development of legal knowledge management systems.
- Provide an interchange format for existing legal knowledge representation languages.

Visual modeling approaches have been applied to the legal field by other related projects. The most common reason to model legal information is compliance assessment of business processes. See for example jUCMNav [13], which is used to evaluate the compliance of processes to legal requirements and has a method to establish traceability links between elements such as goals and procedures [14].

While our focus is on the business processes of Public Administrations, legal documents do not usually contain only procedural information. High level principles and rules play a crucial role in regulating and motivating processes.

Our framework will be primarily based on the concepts of two approaches that are complementary in representing these two aspects of legal documents [11]:

- VLPM [10] uses UML to model the processes defined by a law, semi-automatically extracting them from a legal text marked with the *NormeInRete* XML tags [3]. The methodology it enforces strictly separates the actors, the entities and the activities defined in the document and organizes them in a hierarchical fashion. More notably, VLPM supports change management of a law by maintaining the traceability between the text and the model elements. VLPM has been used in the context of the introduction of e-Voting in the Italian autonomous region of Friuli Venezia Giulia in 2007.
- Nomos [9] is a goal-oriented approach to effectively capture high-level principles in terms of goal realization for requirements guided by satisfiability of normative propositions obtained from rules embedded in a law. This approach, based on the i* framework [12], aims at applying goal reasoning to legal knowledge in order to model the aspects of a legal document that do not represent procedures.

This paper presents a possible framework architecture to implement the integration of the two approaches presented above. The integration between of the two methodologies is justified by [18] as a way to achieve a legally correct representation of a procedure.

Although outside the scope of this work, formal verification of processes [15] is an aspect worthy of notice as it could be integrated into the law modeling process as future work.

3 VLPM 2.0

In this section we describe a law modeling framework – VLPM 2.0 – to support re-engineering of Public Administration procedures. We first introduce the issues of modeling information contained in laws. We then present an ontology for business process concepts that we use as interchange format for our modeling and finally we discuss the components of our framework. Although this chapter (and this paper) focus on the extraction of procedural information from legal documents, our approach supports any type of document from which information relevant to the domain being model can be found.

3.1 Modeling Processes and Other Aspects of Laws

For anyone without a jurisprudence background, laws are extremely difficult to understand, mainly due to the complexity of the legal language and the intricate system of dependencies in which they exist. Furthermore, the application of laws is subject to the *interpretation* of a set of documents and thus, to a certain degree, subjective. Despite the fact that processes are defined in laws usually written for that purpose, they always depend on a set of laws that define principles and rules to be followed. This requires a holistic approach to law modeling.

If the text of a norm is well formed[1], it organizes its statements by their type, generally using the following three classes (see [17] for a more detailed discussion):

- *Constitutive Rules*: rules that answer the question "what is X?". They define abstract and concrete entities such as concepts, actors, institutions, roles, competences, attributes, etc. that did not exist before the promulgation of the law.
- *Instructional Rules*: rules that answer the question "what to do?". They give prescriptions that fix duties with respect to given goals.
- *Procedural Rules*: rules that answer the question "how to do X?". They define formal obligations and model formal actions.

In general, a legal text is an unordered mix of rules of these three classes. An expert is needed to classify each paragraph, isolate the procedural statements from the others and determine the sequentiality of the described activities and events, as well as the involved actors. Deciding the degree of formality used to model legally defined processes is not an easy task. Laws are (or at least should be) formally written in order to avoid ambiguities and this should intuitively suggest that a formal modeling language is required. However, process models should be easily understandable and visualizable by users with non-technical backgrounds. We consider UML-AD (UML Activity Diagrams) and BPMN as two candidate languages that fit this description as they are both based on the semantics of Petri Nets, thus fulfilling the requirement of formality, and they are both visualizable and easily understandable.

[1] Usually this means following the national directives for the correct drafting of laws.

The categorization of laws presented above leads to the observation that business process models are not sufficient to represent all the aspects of a law. Legal documents, in fact, often define complex constraints that affect processes and that cannot be modeled as sequences of actions.

3.2 Data Representation and Traceability

Enriching the text of a law with semantic information has many advantages, among which that of allowing reasoning on the legal concepts in the text. The LKIF-core ontology [6] has been developed with this purpose in mind. However, since it has been designed as part of a generic architecture for legal knowledge systems, the support that it gives to process modeling is at a very high level, while the sub-ontology of legal entities is much more detailed.

In order to be able to add semantic information about the business processes described in legal texts, we developed an ontology that extends the concepts in LKIF-core with a business process meta-model that borrows several entities from the BPMN meta-model [19]. In this way, we added some concepts that partially overlap with LKIF-core entities but that more effectively address our needs. Our ontology is not a specification of the BPMN meta-model in OWL. We instead abstracted the core entities of a business process from the BPMN meta-model, obtaining a smaller but more generic ontology, in the sense that a set of instances of the classes in our ontology could be easily transformed to BPMN as well as UML-AD.

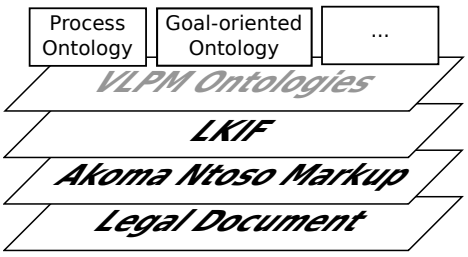

Fig. 1. VLPM 2.0 layered approach to legal knowledge representation.

For our framework, we envisaged a layered approach to knowledge representation, as depicted in Figure 1.

The first level above the raw document is represented by AKOMA NTOSO markup, that helps us structuring the text and adding references to external ontology elements. The layer above the markup consists of an RDF representation of the model (made of instances of LKIF and VLPM 2.0 ontologies). We use the referencing mechanism of the AKOMA NTOSO schema to tag fragments of texts so that they become linked – where relevant – to elements of this model. Notice that our framework aims at being general and, in fact, Figure 1 shows

that it is possible to have multiple ontologies to represent different aspects of a law.

Figure 2 depicts the core classes of our ontology that represent Business Process entities. The diagram includes (shaded) classes from the LKIF ontologies to highlight the connection between Business Process concepts and legal concepts.

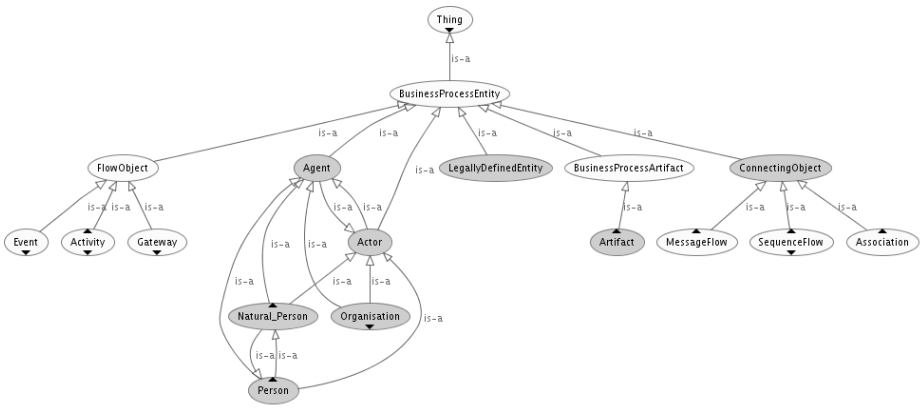

Fig. 2. VLPM 2.0 Ontology Business Process Entity classes

By using an intermediate representation in RDF of the model data, using instances of the classes of our ontology, we can achieve traceability between the text and the models. Figure 3 details how this traceability is maintained (the diagram refers to Business Process modeling). References to external resources are "declared" in the header of an AKOMA NTOSO document as Top Level Class (TLC) References. We make them point to instances of classes of our ontology (instances of Business Process Entities in the case of the figure). An inline reference points to a TLC reference using its local ID. Each TLC reference has a URI that points to an entity in the RDF store, thus allowing an inline reference to be connected to such entity. Backwards traceability is achieved by using the *defined_by* object relationship of the VLPM 2.0 ontology from the business process entity to a *Legal_Source* with the URI of the inline reference. In the same way, by making sure that the URI of the business process entity in the RDF Store is the same in the model (that is usually written in XML/XMI), we achieve RDF-model traceability. The *modeled_by* object property is provided to link entities to model elements that don't have the same URI. This is due to the fact that a model is the result of a transformation of (part of) the RDF store to another notation that can have an incompatible URI schema.

3.3 Framework Components

Law modeling with VLPM 2.0 is a process in four phases:

1. *Markup*: in this phase a legal document (or a set of legal documents) in AKOMA NTOSO XML format is marked with tags that identify business process entities, namely actors, activities, artifacts, events.
2. *Transformation*: in this phase the objects in the RDF store are transformed to a suitable representation in a modeling notation (e.g. BPMN for process modeling). This transformation must be performed in such a way that the already established links with text fragments are maintained.
3. *Modeling*: in this phase the analysts use conventional modeling tools to work with the model(s) obtained at the end of the transformation.
4. *Change Management*: this last phase involves identifying the changes made to the model(s) and comparing them with their original version in order to evaluate the impact of changes to the model on the laws. This can be used to generate skeletons of amendments (in AKOMA NTOSO XML) to be evaluated and edited by stakeholders with legal expertise.

We envisaged four components of our framework to support these four phases:

- *Editor*: this component is a customization of Bungeni Editor[2] that adds UI elements and functions to mark up part of the text and link them to instances of ontology classes. We designed a Model Element Editor to graphically manipulate elements in the RDF store from within the editor that is called when a portion of text is marked as relevant for the analyst.
- *RDF Store*: this component stores all the model information and the traceability links using a semantic notation.
- *Transformer*: this component is an extension of the Transformer Server of Bungeni Editor. Bungeni Editor relies on a XSLT engine that runs as a HTTP service and that is integrated via a REST API. An interface is provided to extend the transformer with new target formats. The role of the transformer is that of converting the document into an XML file and of translating the content of the RDF store to formats understandable by modeling tools. For this reason, extensions for this module must be implemented for each target modeling tool.
- *Change Manager*: this is the module of VLPM 2.0 that manages the changes in models and provide the means to evaluate the impact of such changes to the current law. It must be implemented as a plugin of a modeling tool or as a standalone application that takes as input the model. The Change Manager must be able to identify the changes the model has undergone and navigate the links between the modified model elements and the related text fragments. The module must then visually show the impact of such modifications and allow the creation of a template of a new amendment to the current law.

[2] The official editor for AKOMA NTOSO documents, available at `http://code.google.com/p/bungeni-editor/`.

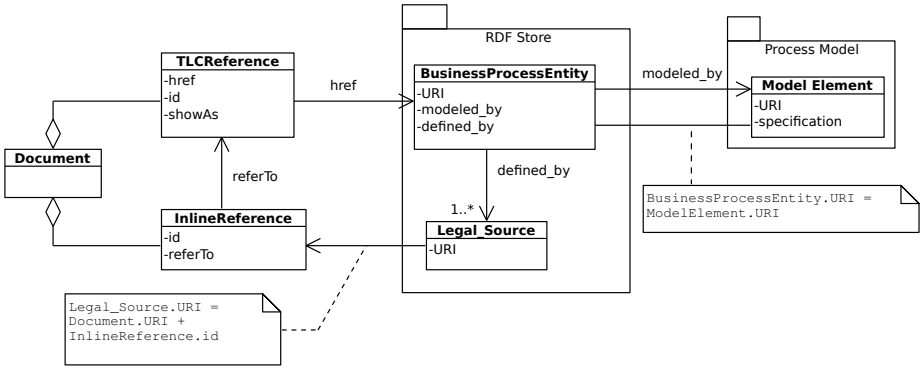

Fig. 3. VLPM 2.0 *Round-trip* Traceability Strategy

4 Conclusions and Future Work

In the last decade parliaments have put a signicant effort into the development of ICT solutions to facilitate the access to legal information. The definition of standards plays a key role in the delivery of services to the citizens but it also paves the way for the development of new tools. This is particularly evidenced by the Africa i-Parliaments Action Plan[3], in which the AKOMA NTOSO XML standard is designed not only to accomodate current users but also future developers of tools for the manipulation of legal documents.

A major issue faced by Public Administrations is the complexity of legislations, in which laws are continously added, amended and repealed, often causing inconsistencies that can go unnoticed even for several decades. This is further complicated by the overlapping of transnational legislation, such as that of the European Union. Besides "technical" challenges, a serious issue is represented by the fact that laws are mainly a product of political representatives, who might have an agenda that does not include facilitating understandability ("obscurity by design"). This would represent the main obstacle to the implementation of formal approaches to law design.

In this paper we have presented a framework that aims at addressing the needs of citizens, analysts (from Public Administrations or companies) and jurists. VLPM 2.0 is an approach based on (graphical) modeling of the contents of the legal documents that regulate a domain. The complete approach can be applied in developing countries and especially in young democracies. In a context in which the legal system is not as complex as in developed countries, designing laws in a formalized way (with the aid of visual modeling) could foster the consistency of the law system and the efficiency of Public Administration. Moreover, facilitating the access to parliamentary information by using semantically rich meta-data and simplified visualizations of laws can signicantly speed up development by increasing the participation of citizens to a true "*e*-"Democracy.

[3] `http://www.parliaments.info/`

Furthermore, this application of VLPM 2.0 could represent an opportunity for "reverse innovation". In fact, while VLPM 2.0 would have to deal with the relatively low complexity of the legal systems of developing countries, such deployment scenario would be a testbed to facilitate the subsequent deployment in more developed and complex environments.

However, in order for this framework to be deployable, several challenges have to be addressed:

- It is necessary to improve the support to different views of the same domain, without disregarding non-procedural information.
- We need to better understand the needs and expectations of jurists, in order to make the framework more usable in a real setting. There is thus a need to carefully design the User Experience of these stakeholders.
- Finally, while the framework aims at being generic, there is a need to formalize the methodology or a set of best practices for law modeling, in order to improve the quality of analysis and re-engineering of legally defined procedures.

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