

Interoperability in Digital Public Services and Administration: Bridging E-Government and E-Business

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Chapter 16

Knowledge Interoperability of Parliaments' and Government Agencies' Information Systems

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ABSTRACT

There is a growing awareness that the interoperability among Government Agencies' information systems (IS) is of critical importance for the development of e-government and the improvement of government efficiency and effectiveness. However, most of the IS interoperability research and practice in government has been focused on the operational level, aiming mainly to enable the delivery of integrated electronic services involving several Government Agencies, or to support the co-operation among Government Agencies from the same or even different countries. This chapter is dealing with knowledge-level interoperability, aiming to support higher knowledge-intensive tasks of government, such as the formulation of legislation and public policy. In particular, it presents an ontology-based methodology for achieving knowledge interoperability of IS of Parliaments and Government Agencies, so that they can exchange public policy related knowledge produced in the various stages of the legislation process. It is based on the common use by Parliaments of the ontology of the 'Issue-Based Information Systems' (IBIS) framework for constructing representations of this knowledge. An application of the proposed methodology is presented, followed by an evaluation, which results in an enrichment of the above ontology that enables a better representation of the public policy related knowledge produced in the legislation process, providing a 'higher quality' of knowledge interoperability. Finally a generalization of this methodology is formulated, which can be used for achieving knowledge interoperability among IS of other types of Government Agencies.

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INTRODUCTION

Government is divided in numerous Agencies of various layers (e.g. Central Government, Regional Government, Local Government, etc.), so that a better specialization and focus can be achieved; however, most social needs and problems cross the boundaries of several individual Government Agencies and necessitate close collaborations among them. These collaborations can be greatly supported and enhanced by achieving interoperability of the information and communication technologies (ICT) infrastructures of cooperating Government Agencies. For this reason there is a growing awareness that achieving interoperability among Government Agencies' information systems (IS) is of critical importance for government efficiency and effectiveness. The achievement of IS interoperability, which is defined in the European Interoperability Framework (European Commission, 2004) as the ability of IS and of the business processes they support to exchange data and to enable the sharing of information and knowledge, has attracted the interest of both researchers and practitioners. However, most of the IS interoperability research and practice in the e-government area has been focused on the operational level (Guijaro, 2007; Charalabidis et al, 2008; Sourouni et al, 2008; Charalabidis et al, 2009; European Commission, 2004); their main objectives have been:

1. to enable the delivery of complex integrated e-government services to citizens and enterprises, in which several Government Agencies are involved, based on the 'one-stop shop' model,
2. to support inter-organizational co-operation among Government Agencies at the operational level, and
3. to enable cross-border operational collaboration between Government Agencies of different countries, e.g. for the enforcement of European Union regulation and policies, or

the delivery of pan-European e-government services by its member states.

On the contrary, there has been much less research and practice concerning the 'knowledge-level' interoperability among IS of Government Agencies, even though the capability to share not only data, but also knowledge as well, has been recognized as a major objective of the IS interoperability concept, as shown by its abovementioned definition provided in the European Interoperability Framework (European Commission, 2004). Government Agencies realize more and more the need of systematically managing, exploiting and exchanging their knowledge, as a means of formulating better policies and regulations for addressing social needs and problems, delivering better services to citizens and enterprises and finally achieving higher efficiency and effectiveness (Wiig, 2002; Sourouni et al, 2008). For this purpose it is necessary that Government Agencies use more intensively and strategically methods and practices from the knowledge management domain (e.g. Nonaka, 1994; Nonaka & Takeuchi, 1995; Cohendet & Steinmueller, 2000, Tiwana, 2002) with appropriate technological support. In particular, it is important through appropriate ICT to support and facilitate both at the intra-organizational and the inter-organizational level the four basic knowledge creation and exploitation processes proposed by Nonaka and Takeuchi (1995): knowledge externalization, combination, internalization and socialization. This requires higher levels of knowledge-level interoperability between the IS of different Government Agencies, allowing them to exchange not only data but also knowledge as well. In the same direction the model of interoperability maturity levels in digital government proposed by Gottschalk (2007) suggests that the initial levels of 'computer interoperability' (level 1) and 'process interoperability' (process 2) should be followed by 'knowledge interoperability' (level 3), which is necessary for proceeding to

the higher levels of 'value interoperability' (level 4) and 'goals interoperability' (level 5).

The Parliament is the core institution of modern democracy that possesses huge amounts of such public policy related knowledge concerning social needs and problems, policies, measures and regulations for addressing them, and also their advantages and disadvantages. This extensive and valuable knowledge is of critical importance for government efficiency and effectiveness, and for the society in general. It resides in the justification reports of the various bills, and also in their content (articles), which include policies, measures and regulations for addressing the particular social need or/and problem addressed by the bill. Also during the discussions of them in the Parliament additional knowledge is contributed by the invited experts, the stakeholders' representatives and the Members of Parliament (MPs). All this huge public policy related knowledge of the Parliaments is quite useful to Parliaments of other countries in order to formulate their own policies, measures and regulations for various social needs and problems. The increasing globalization of the economy, resulting in much more extensive movement of people, goods, services and money among countries, necessitates that Parliaments when developing their legislation take into account the corresponding legislation that has been produced by Parliaments of other countries. In the same direction also pushes the increasing 'legal convergence' among the member states of the European Union. For these reasons achieving knowledge-level interoperability among IS of Parliaments would be quite useful. Furthermore, this knowledge is useful to numerous Government Agencies, such as Ministries for designing and formulating their future policies, measures and legislation, and to lower layers of Government (e.g. Regional and Local Government) for enforcing the legislation effectively and proposing future improvements of it. Also, this knowledge is useful to researchers, in order to help them analyze in depth the social needs and problems, the proposed

policies, measures and legislations for addressing them, and also their advantages, disadvantages and the positions of basic stakeholders on them. Therefore achieving knowledge-level interoperability among IS of Parliaments, Government Agencies, universities and research organizations is quite useful from several perspectives. This higher level of interoperability that focuses on public policy related knowledge would allow a unified public policy 'organizational memory' (Vouros, 2003) of government to be established.

However, this extensive and valuable public policy related knowledge of the Parliaments is in the form of numerous text files, which cannot be fully exploited by Parliaments, Ministries and other Government Agencies and researchers; also this form cannot support the effective exchange of knowledge and the abovementioned four basic knowledge creation and exploitation processes (knowledge externalization, combination, internalization and socialization). Most Parliaments make big investments for developing IS for creating, storing and managing electronically these valuable documents, and also for disseminating them through portals (Coleman, 2006; United Nations - Global Center for ICT in Parliament, 2008). In order to increase the effectiveness of these investments it is necessary to achieve 'knowledge-level' interoperability of these IS, which allows a better exploitation and dissemination of this valuable public policy related knowledge.

In this direction this chapter presents a methodology for filling the abovementioned gap and achieving knowledge-level interoperability among IS of Parliaments, and also with IS of Government Agencies and other interested organizations (e.g. universities, research centers), based on the representation (codification) of this knowledge in a more structured form using a common ontology. The proposed methodology enables a user of a Parliament's IS to search and access in an appropriate and usable form the public policy related knowledge on a particular topic (e.g. concerning a social need or problem, the policies, measures

and regulations for addressing it, the advantages and disadvantages of them, etc.) stored not only on their IS, and also on other Parliaments' IS. Also, it enables authorized users of Government Agencies' IS (or interested universities or research centers) to search and access the public policy related knowledge stored in IS of many different Parliaments. As explained later in more detail the 'quality' of this knowledge interoperability (i.e. the effectiveness of knowledge exchange) relies critically on the quality of the representation/codification of the knowledge contained in the initial legislative textual documents; if this knowledge representation/codification has weaknesses and deficiencies (i.e. omits substantial knowledge elements) then the 'quality' of knowledge interoperability will be poor. For this reason the knowledge interoperability problem is mainly a knowledge representation problem, so a large part of this chapter is dealing with formulating an appropriate approach and ontology for this problem. As explained in the following section it was finally decided to use the ontology of the 'Issue-Based Information Systems' (IBIS) framework (Conklin & Begeman, 1989; Conclin, 2003) as a basis for representing (codifying) the public policy related knowledge produced in the various stages of legislation formulation in the Parliaments. Furthermore, an application of the proposed methodology for knowledge-level interoperability is presented concerning the Law for the 'Contracts of Voluntary Cohabitation', which has been passed in 2008 by the Greek Parliament. Its evaluation resulted in an enrichment of the above ontology that enables a better representation of the public policy related knowledge produced in the legislation process, which finally results in a higher quality of knowledge interoperability.

The chapter is structured in eight sections. The next section presents the background to this research, while the third section analyses the main sources of knowledge in Parliaments. Then the proposed methodology is presented, followed by the description of its abovementioned application,

and its evaluation. The two final sections present a generalization of the proposed methodology and the conclusions.

BACKGROUND

Most of the previous research and practice concerning the interoperability between Parliaments' IS, and also with IS of other Government Agencies (e.g. Ministries), focuses on the development of XML-based standards for storing and exchanging the full text of legislative documents (Biasiotti et al, 2008; Boer et al., 2008); their main objective is to provide open access to these documents, without relying on proprietary standards, enhanced search and retrieval capabilities (using by metadata) and also some advanced functionalities, such as 'point-in-time' legislation. This research stream is influenced by the 'semantic web' vision (Fensel et al., 2003), being directed towards the gradual realization of the 'legal semantic web', and focusing on the addition of machine processable data in the main body of legislative documents (e.g. annotation indicating structure), and also of descriptive metadata (e.g. author, topic, etc.), during their production phase, based on predefined standards; this is expected to improve both the production workflows and the subsequent distribution and exploitation of legislative documents. One of the first XML standards for the representation of legal documents has been developed by the Italian Authority for Information Technology in the Public Administration in cooperation with the Italian Ministry of Justice, as part of the 'NormeinRete' Project (Lupo & Batini, 2003). Based on this standard, a federated system has been developed, providing access to all Italian legal documents; each Government Agency producing such documents has to structure them according to the above interoperability standard, store them in their own systems and make them accessible to a centralized retrieval facility. Another interesting project in this direction at the international level has been the

'AKOMA NTOSO' ('linked hearts' in English, while its full title is 'Architecture for Knowledge-Oriented Management of African Normative Texts using Open Standards and Ontology') (Vitali & Zeni, 2007), which has been implemented by the United Nations Department for Economic and Social Affairs; its basic objective was to create a 'lingua franca' for the interchange of parliamentary, legislative and judiciary documents between institutions of African countries. One of its main products has been an XML document schema, which provides advanced description capabilities for several Parliamentary document types (including bills, acts, parliamentary records, etc.), aiming to enable interoperability among Parliaments and Justice Courts of African countries. Based on the experienced gained from the previous efforts in this area, such as the abovementioned 'NormeinRete' and 'AKOMA NTOSO' projects, the MetaLex (Boer et al., 2008) XML has been developed and already become a CEN Prenorm. It is a generic and extensible framework for XML encoding the structure and metadata contained in documents that function as a source of law; it includes an abstract content model (its main elements are: container, hierarchical container, block, inline and milestone), a metadata model and a generic model for organizing metadata in RDF.

The above research stream has been focused on the full text of the legal documents, its main approach being enrichment of it with metadata and internal annotations for achieving the abovementioned benefits (e.g. interoperability, advanced search and retrieval capabilities), but is not dealing with the knowledge contained in them (which is the main target of the research reported in this chapter). However, the results of this research stream seem to find their way to practice: they have already started being adopted in the practices of some Parliaments, and they are seriously considered by some others. The recent 'World e-Parliament Report 2008' of the United Nations Global Center for ICT in Parliament (2008) emphasizes that it is necessary in the

document management systems of Parliaments to gradually introduce some method of advanced marking ('tagging') the elements of documents and analyses in detail the advantages that this approach can offer. In particular, it is noted that in the past such 'markup codes' ('tags') were used primarily in order to markup the typographical features of documents and control their format (e.g. specifying that a section of text should be indented, or bolded, or enclosed in quotes); however, today systems for tagging elements of documents have become increasingly sophisticated, and markup the structural element of a document as well, such as whether a particular text is a heading for a section, a paragraph of text, the title of the document, etc., and also (the more advanced systems) the parts of the text that are semantically relevant. These 'markup codes' ('tags') can be used by appropriate software applications not only to control the appearance of the document based on these structural tags, allowing the same content to be tailored for print, online, or some other presentation medium or format, but also to enable the development of high value information services based on the structural and semantic markup of the documents. For the above reasons this UN Report concludes that there is a concerted effort among some Parliaments to use XML-based open standards for legislation documents. These open standards, being non-proprietary offer the advantage of avoiding reliance on a single vendor, and enabling any ICT company to use them for developing software applications; also, the use of open standards results in higher interoperability, extending the accessibility of legislative documents, not only within the Parliament, but between the Legislature and the Government, between Parliaments and the Civil Society, and among Parliaments internationally. Furthermore, it increases competition among vendors and reduces on the long-term costs for Parliaments. For the above reasons, according to a survey conducted by the United Nations Global Center for ICT in Parliament and reported in this 'World

e-Parliament Report 2008' of (2008), among the 105 respondents, there are 13 Parliaments that have already XML-based systems for bills management and for recording and publishing plenary debate, while many others are planning to move in this direction. Therefore it can be finally concluded that most of research and practice concerning the interoperability of Parliaments' IS has been focused on the development of XML-based standards for storing and exchanging the full text of legislative documents, and not the knowledge they contain.

Another research stream is dealing with the representation, management and exchange of the legal knowledge contained in various sources of law, aiming to support legal practice and application of law, and also to support and improve legal reasoning and argumentation. This stream differs from the previous one in that it does not focus on the full text of legal documents, but on extracting and representing in a computer process able form their 'substance' from a legal perspective. A critical tool for achieving the above ambitious objectives of this research stream are legal ontologies, which are according to Visser & Bench-Capon (1998) highly important for legal knowledge acquisition and exchange, and for the design of interoperable legal knowledge management systems. An ontology constitutes an abstract conceptual model of a particular domain, which identifies the kinds of entities existing in this domain and the kinds of relations existing among them, and is acceptable the people working in this domain (Fensel, 2004; Visser & Bench-Capon, 1998). According to Uschold and Gruninger (1996), ontologies are of critical importance for knowledge acquisition, representation and exchange. Previous research has developed several legal ontologies, which aimed to be used as foundation for the representation of legal knowledge, so they could contribute to the interoperability of legal knowledge management systems. McCarty (1989) developed the 'Language for Legal Discourse' mainly in order to be used as a general representation language for legal knowledge; the basic components of this

language are 'atomic formulae' (predicate relations used to express factual assertions), 'rules' (connections of atomic formulae with logical connectives) and 'modalities' (time, events, actions and deontic expressions). A formalism for the representation of legal knowledge has been proposed by Stamper (1991, 1996), which includes three main ontological concepts: the 'agents' (organisms who gain knowledge, regulate and modify the world by means of actions), the 'behavioural invariants' (features remaining invariant over some time) and the 'realizations' (agents realise situations, which are denoted by behavioural invariants, by performing actions). Valente (1995) developed a 'Functional Ontology of Law', which distinguishes six types of legal knowledge necessary for legal reasoning: 'normative knowledge' (defining standards of social behavior), 'world knowledge' (describing the world being regulated), 'responsibility knowledge' (concerning extension or restriction of responsibilities of agents), 'reactive knowledge' (concerning sanctions for actions violating norms), 'meta-legal knowledge' (concerning legal knowledge) and 'creative knowledge' (concerning the creation of previously non-existent legal entities). Van Kralingen (1995) and Visser (1995) dealt with the use of legal ontologies for developing legal knowledge systems, and for this purpose they developed a legal domain ontology, which consists of (1) a 'legal ontology' (with generic components usable in any legal sub-domain), which includes three basic entities: 'norms' (general rules, standards and principles of behaviour that subjects of Law have to comply with), 'acts' (dynamic aspects which effect changes in the state of the world) and 'concept descriptions' (meanings of the concepts found in the domain), and (2) a 'statute-specific ontology' (with components that concern particular legal sub-domains). Also, in the ESTRELLA Project (its full title is 'European project for Standardized Transparent Representations in order to Extend Legal Accessibility' – for details see www.estrellaproject.org) co-financed

by the European Union has been developed the 'Legal Knowledge Interchange Format' (LKIF), which is a semantic web based language aiming to standardize the representation of legal knowledge and to support its exchange (Hoekstra et al., 2007; Boer et al., 2008). This language provides a direct support for representing three types of knowledge, which have been identified as most indispensable to law and legal reasoning: terminological knowledge, legal rules and normative statements. It is based on a legal 'core' ontology of basic legal concepts, which consists of a number of 'modules', each of them including a cluster of related concepts; its main modules are 'norm', 'expression', 'process', 'action', 'role', 'place', 'time' and 'mereology'. By examining the legal ontologies developed in this research stream we remark that they are characterized by a purely legal perspective, since they have been created mainly for supporting the development and interoperability of legal knowledge systems to be used by legal professionals, and do not have any public policy perspective (no problems/solutions orientation); these ontologies view only the 'legal substance', and not at all the 'public policy substance' of the legal documents. Therefore they are not suitable to be used for the representation and exchange of public policy related knowledge of Parliaments, i.e. knowledge about social needs and problems, policies, measures and regulations for addressing them and also their advantages and disadvantages, which is the main target of the research reported in this chapter.

For this reason we also reviewed previous research that has been conducted concerning the representation of highly complex problems. Considerable research has been conducted concerning the class of problems termed as 'wicked' (Rittel & Weber, 1973), which are characterised by high complexity, multiple dimensions/perspectives, many stakeholders who have different concerns and different views and perceptions of the problem; these problems are quite difficult to manage, since there are no clear methods for finding the

best solution and stopping rules, having only 'better' and 'worse' solutions, the former being characterised by more advantages and less disadvantages than the latter. Quite interesting research has been conducted in the area of 'Issue-Based Information Systems' (IBIS) (Conklin & Bege-man, 1989; Conklin, 2003; Gordon & Richter, G. 2002) for addressing wicked problems, which has resulted in the development of a framework for the representation of such problems, the potential solutions to them and the arguments in favour and against these potential solutions. This IBIS framework is based on a simple but powerful ontology for the representation of such problems, whose main elements are 'questions' (issues or problems to be addresses), 'ideas' (possible answers/solutions to questions/problems) and 'arguments' (evidence, facts or viewpoints that support or object to ideas). It has been successfully applied for the creation and representation of knowledge concerning complex problems in both the public and the private sector (e.g. Kirschner et al., 2003; Karacapilidis et al., 2005, Loukis, 2007, Renton & Macintosh, 2007) and has reached a high level of maturity. Also, there are electronic tools that support the use of the IBIS framework for these purposes, such as the 'Compendium' tool (<http://compendium.open.ac.uk/institute/>). This ontology is characterised by a policy (problems-solutions) orientation, so it seems more appropriate to be used for representing (codifying) and exchanging the public policy related knowledge possessed by Parliaments. However, it should be investigated whether such a simple ontology will be appropriate and sufficient for this particular purpose.

SOURCES OF KNOWLEDGE IN PARLIAMENTS

In order to design a methodology for achieving knowledge-level interoperability among IS of Parliaments it is necessary to understand and analyze the process of legislation formulation in the

Parliaments and the main sources of knowledge in this process. For this purpose initially we conducted interviews with three experienced officials of the Greek Parliament. Additionally we studied carefully and analyzed the justification reports and the main content (articles) of the following five Laws from five different Ministries, which have been proposed to us by the Greek Parliament as representative ones:

- Contracts of Voluntary Cohabitation
- Reinforcement of Security of Ships, Ports and Port Installations
- Measures for the Protection of Cultural Goods
- Consolidation and Licensing of Media Enterprises
- Regulation of Public Opinion Polls Issues

Furthermore, we studied carefully and analyzed the minutes of the sessions of the competent Parliamentary Committees and also of the plenary sessions in which these five Laws were discussed.

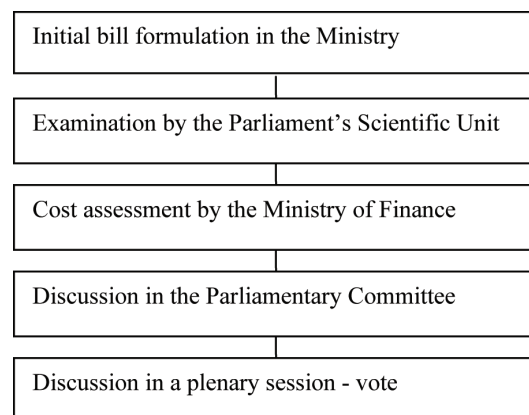
The above interviews and documents lead us to the conclusion that the legislation formation process is characterized by high complexity and a plethora of documents and stakeholders. It can be broadly divided into two basic phases: the initial draft legislation (bills) formation and the debate on draft legislation (bills). In each of them several meetings take place and numerous documents are produced. Also, in these meetings many types of stakeholders participate, such as experts from Ministries, independent experts, Members of Parliament (MPs), Parliamentary Committees, politicians, public servants, representatives of the affected socio-economic groups, non-governmental organizations, etc. Each of these stakeholders' groups has a different piece of information, experience and knowledge about the problem or issue addressed by the legislation under formation, so a 'synthesis' of these pieces is required. Also, these stakeholders' groups usually do not have the same views, needs, concerns, in-

terests and expectations concerning the legislation under formation, and very often there are conflicts among them. Therefore the social problems/needs addressed by most bills under discussion have all the above mentioned characteristics of the 'wicked' problems.

From a more detailed analysis we can distinguish five stages in the law formulation process in Greece (Figure 1):

- a. Initial formulation of the bill in the competent Ministry, where the justification report and the content (articles) of the bill are formulated and then sent to the Parliament.
- b. The Scientific Unit of the Parliament proceeds to an initial examination of the bill; it examines mainly whether it violates any of the articles of the constitutional law, and whether it has problems or weaknesses from a legal viewpoint.
- c. The Ministry of Finance assesses the costs that the application of this bill, after becoming a law, will create for the government
- d. The bill is then discussed in the competent Parliamentary Committee (usually in several sessions), in which MPs of all parties participate, and also representatives of the main stakeholders and experts are invited and express their positions and opinions.

Figure 1. Stages of the law formulation process



- e. Finally the bill is discussed in one or more plenary sessions of Parliament; at the end of this discussion the members of the Parliament vote whether the bill will be approved (passed) or rejected.

From our investigation it was concluded that the public policy related knowledge creation takes place mainly in stages (1), (4) and (5). In particular, in the first stage of the initial bill formulation in the competent Ministry participate experienced public servants, mainly of higher hierarchical levels, experts and also representatives of the main stakeholders (e.g. trade unions, associations, municipalities, etc.), who contribute significant amounts of the relevant knowledge that they possess on the theme of the bill. This knowledge is recorded in the justification report and in the content (articles) of the bill. From the analysis of the justification reports of the abovementioned five examined laws a common structure has been identified. Initially, in the first paragraphs they include a number of reasons (e.g. social problems and needs, new realities and trends at the national or/and international level, economic events, evolutions in the values and habits of society and in general various contextual factors) which necessitate the creation and application of the proposed law; then, in the following paragraphs are briefly mentioned the general directions of the Law and the solutions it provides concerning its basic theme (e.g. it settles rights and obligations to one or more groups, it protects the environment, it increases employment opportunities for some groups, etc.). Similarly the analysis of the content (articles) of these five Laws identified that they are also characterized by a common structure. They all consist of a number of articles, each of them settling a particular issue/dimension of the main theme of the bill; each article includes a number of settlements on the corresponding issue (i.e. solutions or ways of addressing it), and also further clarifications for some of them.

In the fourth stage of the discussion of the bill in the competent Parliamentary committee there is an extensive discussion between MPs of all parties appointed to participate in it, who have a good experience in the corresponding public policy domain; also, are invited representatives of the main stakeholders (e.g. trade unions, associations, municipalities, etc.), which are affected by the bill under discussion, and domain experts (e.g. University Professors), in order to express their opinions and positions on the bill. This knowledge is recorded in the minutes of the corresponding sessions of this Parliamentary committee. From the analysis of these minutes we remarked that though they have a much lower degree of structure than the justification reports and the content (articles) of the bills, some common structure can be identified. In particular, all participants mention mainly some disadvantages of the bill under discussion, or some advantages of it (to a smaller extent - mainly the MPs of the governing party). Additionally some participants make proposals for additional settlements or changes of the settlements included in the bill; some of these proposals are associated to disadvantages that the particular participant has previously mentioned.

Finally in the fifth stage of the discussion of the bill in a number of plenary sessions of the Parliament there is an extensive discussion between MPs of all parties. The position of each party is initially expressed by one MP, who is responsible for speaking about this bill on behalf of the party; then follow speeches of additional MPs from all parties on the bill. These speeches of the MPs in the plenary sessions have a similar structure with the ones in the Parliamentary committees: they include disadvantages and advantages of the bill, and proposals for additional settlements or changes of the included settlements.

Summarizing, from this analysis the of the legislation formulation process and documents it was concluded that extensive and valuable public policy related knowledge is generated concerning social needs and problems, policies/measures/

regulations for addressing them, and also their advantages and disadvantages. However, this knowledge is recorded in the form of lengthy texts in numerous documents, so it cannot be fully exploited by Parliaments, Ministries and other Government Agencies and researchers; this form cannot support the effective exchange of knowledge and the four basic knowledge creation and exploitation processes proposed by Nonaka and Takeuchi (1995) (knowledge externalization, combination, internalization and socialization). Taking into account that according to Vouros (2003) knowledge is information that has been appropriately transformed, so that it can directly assist people to get their tasks done successfully and efficiently, to learn and to innovate, it is necessary to transform these legislative documents, so that the knowledge they include is directly represented, in order to achieve effective knowledge (and not simply data) exchange and interoperability.

A METHODOLOGY FOR KNOWLEDGE LEVEL INTEROPERABILITY

Based on the findings of the above analysis of the sources of public policy related knowledge in the Greek Parliament, we designed a methodology for achieving knowledge-level interoperability among IS of Parliaments, and also with IS of Government Agencies, focused on public policy related knowledge. It is based on the representation/codification by all Parliaments, based on the IBIS ontology/framework (for the reasons explained in the 'Background section'), of the knowledge created for each bill, which is recorded in the following four documents:

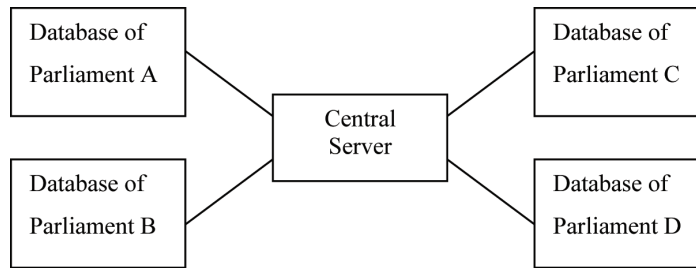
1. the justification report of the bill,
2. the content of the bill (articles),
3. the minutes of the discussion on the bill in the competent Parliamentary committee,

4. the minutes of the discussion on the bill in plenary sessions,

This representation/codification of the above documents will increase the effectiveness of knowledge exchange and interoperability. Each of these documents will be represented as a set of interconnected 'questions' (issues, problems, needs), 'ideas' (solutions, settlements) and 'arguments' (positive ones-advantages, and negative ones-disadvantages). This can be done using one of the existing tools for representing knowledge on complex problems based the IBIS framework/ontology, such as the 'Compendium' we have used for the present study (see <http://compendium.open.ac.uk/institute/>); it is a mature tool that has been extensively used for various purposes (e.g. see Kirschner et al, 2003), which offers the capability of easily creating such a set graphically in the form of a map consisting of interconnected nodes, which is stored in a database as a set of records. The databases of all the cooperating Parliaments, with the representations of their legislative documents can be interconnected (e.g. through secure Internet) in a 'star architecture' to central server; this knowledge interoperability architecture is shown in Figure 2. It allows a query submitted by a user in one of the Parliaments (e.g. concerning solutions for a particular social problem, such as policies, measures and regulations, or advantages and disadvantages of a particular solution) to be submitted not only to their own database, but also to the databases of all the other cooperating Parliaments, and then the results from all to be sent to the user. In the same way can authorized users from interested Government Agencies (e.g. Ministries), Universities or Research Centers submit their queries to the central server and then receive through it results from the databases of all cooperating Parliaments.

The above methodology/architecture enables a better exchange and exploitation of the valuable public policy related knowledge that Parliaments possess, in comparison to the current situation of

Figure 2. Knowledge interoperability architecture



keeping this knowledge in textual documents' form. It can support and facilitate the abovementioned four basic knowledge creation and exploitation processes (Nonaka & Takeuchi, 1995):

- knowledge externalization (by enabling much a higher extent of conversion of tacit knowledge into explicit, structured and directly usable knowledge),
- knowledge combination (by having the knowledge codified in this structured form it is much easier to combine knowledge from different sources and stages of the legislation formulation process, and also from different Parliaments),
- knowledge internalization (this codified form of knowledge is much easier to be embodied into the tacit knowledge of interested persons, such as MPs, employees of the Parliament and Ministries, researchers, or even 'simple' citizens),
- knowledge socialization (since tacit knowledge of different persons is converted in into explicit, structured and directly understandable form, so it is easier to become tacit knowledge of other persons).

AN APPLICATION OF THE METHODOLOGY

An application of the proposed methodology has been made for the case of the law concerning

'Contracts of Voluntary Cohabitation', in order to draw some first conclusions as to how appropriate and sufficient this methodology, and the IBIS ontology it is based on, is for this particular purpose. This law has been passed in 2008 by the Greek Parliament, having caused extensive discussions with quite strong positions, both in favor and against it. It consisted of the following 13 main articles:

1. Establishment
2. Pre-conditions
3. Invalidity
4. Dissolution
5. Surname
6. Possessions
7. Palimony
8. Fatherhood Presumption
9. Children Surname
10. Parental Care
11. Inheritance Rights
12. Suspension of Cancellation
13. Application Scope

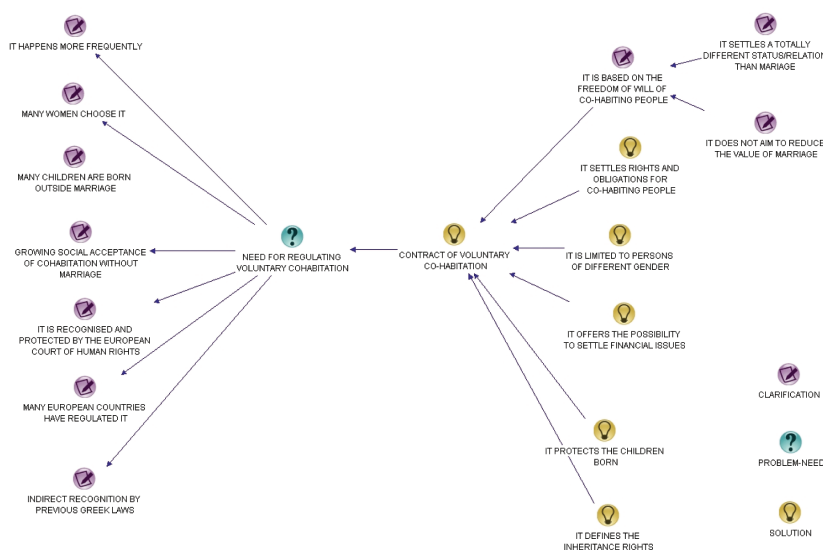
The application of the methodology included the following steps:

- The Greek Parliament provided all the documentation about the above law: (1) the justification report of the law, (2) the main text of the law (articles), (3) the minutes of the corresponding sessions of the competent Parliamentary Committee, and

- (4) the minutes of the corresponding plenary sessions.
- For each of these documents we constructed a representation (codification), based on the abovementioned IBIS ontology, of the public policy related knowledge they contain, concerning the ‘Contracts of Voluntary Cohabitation’ (problems/needs, solutions, etc.). For this purpose we used the ‘Compendium’ tool, which offers the capability of easily creating such representations graphically, as maps consisting of interconnected nodes, which are stored in a database as sets of records.
- These representations were given to two lawyers of the Greek Parliament, who had long experience in laws discussion, processing and formulation, in order to evaluate to what extent (a) they are understandable, and (b) they represent the content of the corresponding documents, i.e. they include the substantial points of the public policy related knowledge they contain.

In particular, initially we constructed a representation of the public policy related knowledge contained in the justification report of this law, in visual form (as a Compendium map), which is shown in Figure 3. We used three of the types of nodes supported by the tool with an adaptation of their meaning: note/information nodes (adapted as ‘clarification’ nodes), question nodes (adapted as ‘problem-need’ nodes) and idea nodes (adapted as ‘solution’ nodes). We remark that this representation/map consists of three layers. The first layer includes, as clarification nodes, the seven basic reasons mentioned in the justification report, which create the need for the legal regulation of the voluntary cohabitation, modeled through a problem-need node in the second layer, which is addressed by the law concerning the ‘Contract of Voluntary Cohabitation’, modeled as a solution node in the third layer. The fourth layer includes, as solution nodes, the five particular broad solutions this Law provides; furthermore, it includes, as a clarification node, the basic principle this Law is based on, while there are also two clarifications on it, modeled as clarification nodes in the fifth layer.

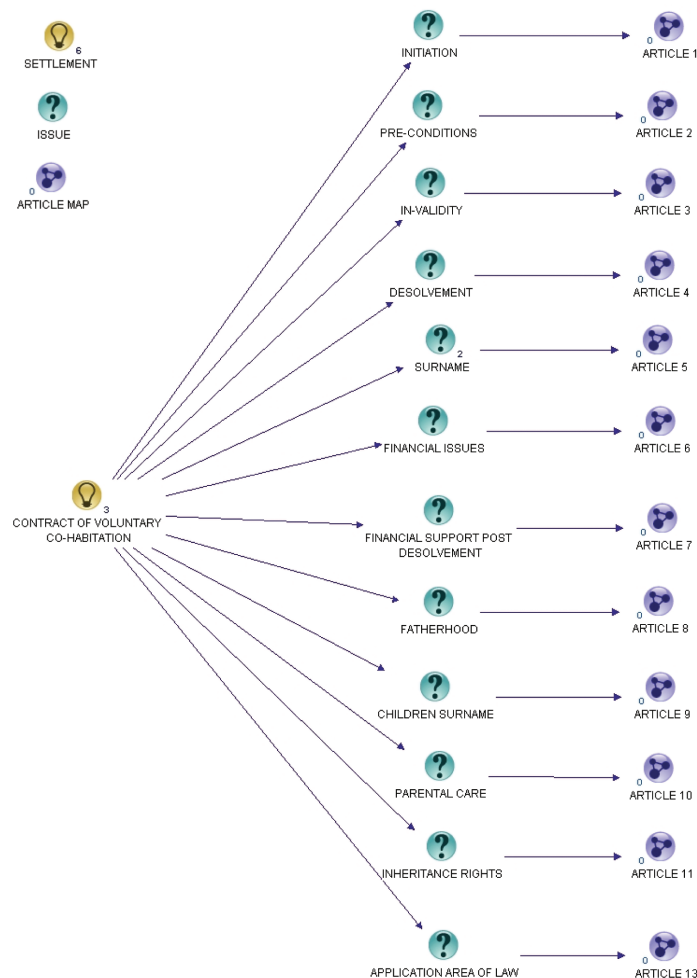
Figure 3. Representation/Map of the justification report



Then we constructed a representation of the public policy related knowledge recorded in the content of the law. Because this representation/map was quite lengthy, we decided to break it into one high level representation/map for the basic content of the law, shown in Figure 4, and also one lower level (detailed) representation/map for the content of each article; since the Law includes 13 articles, we constructed 13 corresponding representations/maps for them. In Figure 5 is shown the one for the content of article 5 that regulates the surnames of the persons entering a contract of voluntary cohabitation. In these two representations/maps of the content of the law

were used three of the types of nodes supported by the tool with an adaptation of their meaning: idea nodes (adapted as 'settlement' nodes), question nodes (adapted as 'issue' nodes) and note/information nodes (adapted as 'clarification' nodes). We remark that the high level representation/map of the content of the law in Figure 4 consists of three layers: in the first layer is represented, as a solution node, the law for the 'Contracts of Voluntary Cohabitation', while the second layer includes the 13 articles of the Law that regulate particular issues concerning the contracts of voluntary cohabitation, as issue nodes; each of them is connected with a link to its detailed rep-

Figure 4. High level representation /map of the content of the Law



resentation/map in the third layer. The representation/map of article 5 shown in Figure 5 is also structured in three layers: the first layer includes the main topic of the article, as an issue node; the second layer includes two settlements that this article includes; one of them is connected with a clarification placed in the third layer as clarification node.

Finally we constructed representations of the public policy related knowledge contained in the minutes of the discussions that took place on this bill in the competent Parliamentary Committee and then in plenary sessions. In Figure 6 we can

see the representation/map for the opinions expressed by one of the experts invited in the competent Parliamentary committee, while in Figure 7 we can see the representation/map for the position of one of the parties on this bill in the plenary session.

EVALUATION

In contrast to the operational level interoperability, in the knowledge level interoperability it is necessary to assess some more sophisticated

Figure 5. Representation /Map of the content of the fifth article of the Law

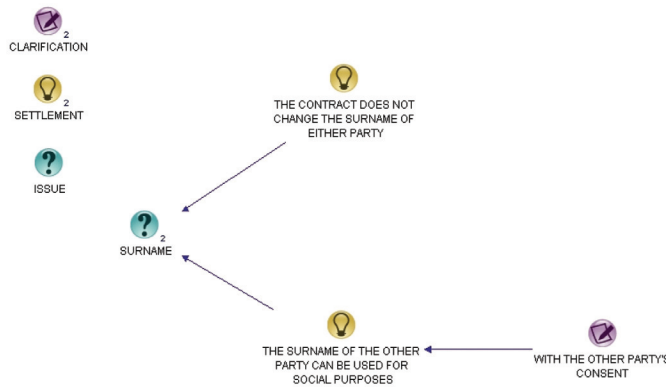


Figure 6. Representation/Map for the opinion expressed by one of the experts invited in the competent Parliamentary committee

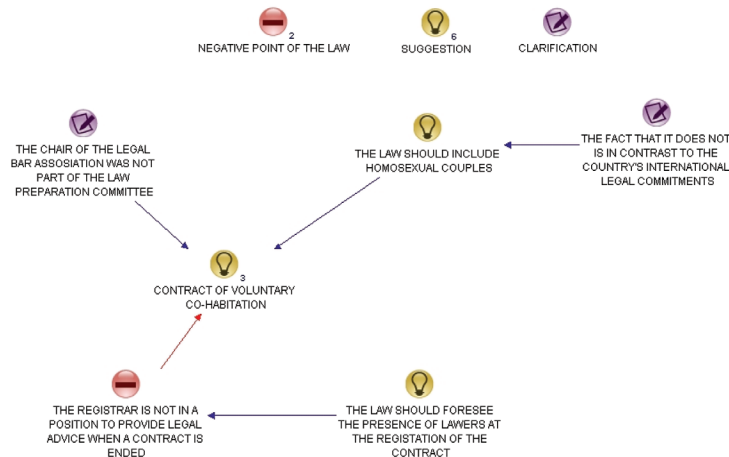
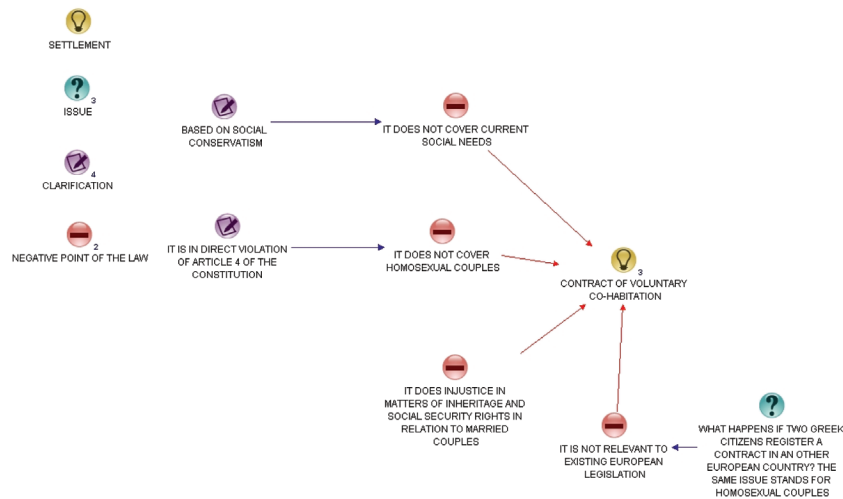


Figure 7. Representation/Map for the position of one party in the plenary session



aspects of its ‘quality’, which are associated with the degree to which the knowledge that the initial documents contain is transferred to the users of the remote interconnected IS. The basic determinant of this ‘quality of knowledge interoperability’ is the quality of the representation/codification of the knowledge contained in the initial documents: to what degree these representations/mappings include in an understandable (to remote persons who have not participated in the initial generation of the knowledge) manner the main substantial points of the public policy related knowledge contained in these documents? For this purpose the representations/mappings of the justification report and the main text (articles) of the law for the ‘Contracts of Voluntary Cohabitation’, and of the minutes of the discussions about it in the competent Parliamentary Committee and in plenary sessions, were given to two lawyers of the Greek Parliament, who had long experience in legislation formulation processing and discussion; they were asked to evaluate to what extent they represent in an understandable manner the main substantial points of the knowledge content of the corresponding documents.

Both evaluators found that the representations/mappings are understandable and include

the substantial points of the public policy related knowledge contained in the corresponding documents. They also remarked that the small number of types of elements/nodes provided by the IBIS framework and the Compendium tool are to a satisfactory extent sufficient for expressing the public policy related knowledge that these documents contain concerning social needs and problems, policies, measures and regulations for addressing them and also their advantages and disadvantages. However, they mentioned as an exception and important weakness that in the representations/maps of the articles of the law the ‘settlement’ type of node was too broad, and did not cover the classification of legal rules according to jurisprudence into particular types, such as prohibitive, imperative, permitting, presumptions, sanctions, etc., which is of particular importance for understanding and applying them. The categorization of the settlements included in the articles of a Law constitutes an important knowledge element, so its omission decreases – according to the above two experienced lawyers of the Greek Parliament – the quality of knowledge representation/codification and finally the quality of knowledge exchange and interoperability.

The above remarks lead us to the conclusion that the IBIS ontology we used as a basis for our representations was sufficient for the justification reports and the discussions (both in the Parliamentary Committee and the plenary sessions), but insufficient for the core content of the law (articles). For this reason we defined an enrichment of the IBIS ontology to be used only for the representations of the public policy related knowledge contained in the articles of law; in this enrichment we refined the 'settlement' type, taking into account the classification of rules defined by jurisprudence (Georgiadis, 1997; Lingeropoulos, 2002), into the following six types:

- a. **Prohibitive Rule:** They are rules through which it is imposed to abstain from a particular behavior or exclude a certain outcome, e.g. a minor is prohibited, without the consent of his guardian, to acknowledge the obligation or expropriation of his property.
- b. **Imperative Rule:** They are rules which impose a positive behaviour, e.g. the banks have to report to the Ministry of Finance some types of transactions, for which there is a suspicion of hiding fraudulent activities.
- c. **Permitting Rule:** They are rules which recognize to a person a certain authority or permit to it a certain action. e.g. a minor who has completed his 14th year of age can dispose, without the consent of his guardian, everything that he gains from his work or everything that he was given for his own use.
- d. **Legal Presumption:** They are outcomes, which the law defines that should be initially deduced as far as unknown incidents are concerned, in order to facilitate the judge to find out the truth or the untruth of litigants' pleas, for which finding evidence is impossible or very difficult, e.g. a child who took birth during the marriage of his parents is initially presumed that has got for father the

man to whom his mother is married to (except evidence for the opposite is presented).

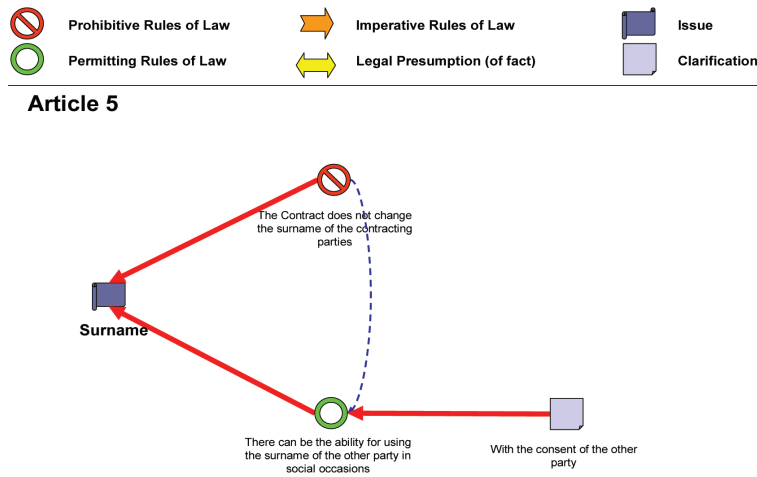
- e. **Sanction:** They define various types of sanctions (e.g. fine, imprisonment) for persons violating particular rules.
- f. **Settlement:** With this type will be modeled rules defined in bills' articles, which do not belong to any of the above five types.

In the following Figure 8 is shown the improved representation/map of article 5 of the law for the 'Contracts of Voluntary Cohabitation' using the above enrichment of IBIS ontology (it has been drawn using the Visio tool (<http://office.microsoft.com/en-us/visio/FX100487861033.aspx>), since Compendium in its current version does not allow the definition and use of new types of nodes); the initial representation of this article has been shown in Figure 5.

A GENERALIZATION

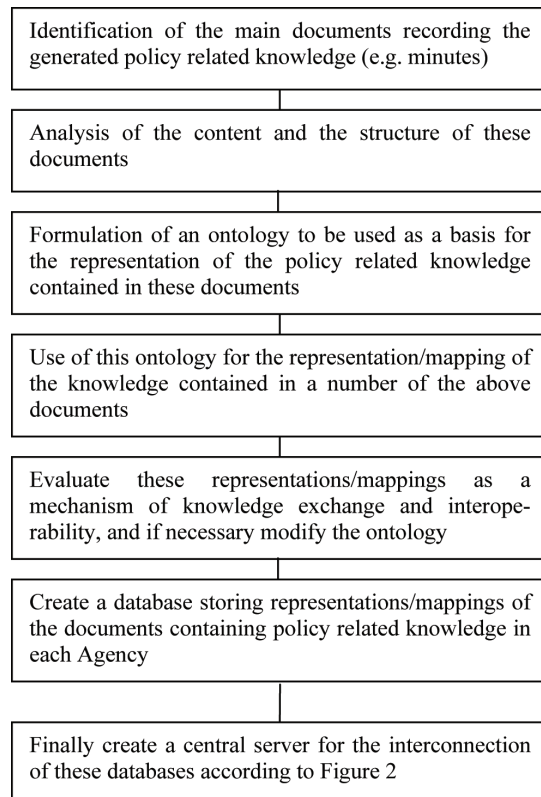
Finally a generalization of the proposed methodology has been formulated, which can be used for achieving knowledge interoperability among IS of 'similar' Government Agencies of various administration layers, e.g. Regional Government, Prefectural Government and Local Government. Each of these administration layers includes a big number of 'similar' Government Agencies, all of them having similar competencies and tasks, but for different geographical areas, e.g. Regional Authorities, Prefectures, and Municipalities. The basic decision making body of each of these Government Agencies (e.g. Regional Council, Prefectural Council, Municipal Council, etc.), which is a 'local Parliament' consisting of elected citizens' representatives from the corresponding geographical area, generates knowledge about policies that should be locally adopted, which would be very useful for other 'similar' Government Agencies. In particular, this valuable knowledge concerns local needs and problems, policies, measures and

Figure 8. Improved representation/map of article 5



regulations, advantages and disadvantages of them and positions of main local stakeholders. However, it is in the form of numerous text files, so it is not appropriate for knowledge exchange and interoperability (for the same reasons explained in the previous sections). Therefore a generalization of the proposed methodology, which is shown below in Figure 9, would enable the achievement of knowledge interoperability among the IS of such networks of similar Government Agencies, which would allow the effective exchange of this valuable policy related knowledge. It will result in the creation of an architecture of 'similar' (i.e. based on the same ontology) databases storing the knowledge representations/mappings of the Government Agencies of the network, which are interconnected through a central server according to Figure 2. This architecture enables a user of the IS of one Government Agency (e.g. a Municipality) to search and access in an appropriate and usable form the policy related knowledge on a particular topic (e.g. concerning a need or problem, the policies, measures and regulations for addressing it, the advantages and disadvantages of them, etc.) stored not only on their IS, and also on the IS of the other Government Agencies (e.g. the other Municipalities) of the network.

Figure 9. A generalization of the proposed methodology for knowledge interoperability among IS of networks of similar Government Agencies



CONCLUSION

In the previous sections of this chapter has been presented a methodology for achieving knowledge-level interoperability among IS of Parliaments, and also with IS of Government Agencies (or even interested universities and research centers). It enables a better exchange and exploitation of the huge public policy related knowledge that Parliaments possess; this knowledge is highly important for the efficiency and effectiveness of government, and for the society in general, as it concerns social needs and problems, policies, measures and regulations for addressing them, and also their advantages and disadvantages and the positions of main stakeholders on them. The 'quality' of this higher level knowledge interoperability relies critically on the quality of the representation/codification of the knowledge contained in the initial legislative textual documents; if this knowledge representation/codification has weaknesses (i.e. omits substantial knowledge elements), then the quality of knowledge interoperability will be poor. For this reason the knowledge interoperability problem is mainly a knowledge representation problem, so a large part of this chapter has dealt with the formulation of an appropriate approach and ontology for the representation problem. For the reasons explained in the second 'Background' section the proposed knowledge interoperability methodology has been based on the common use by all Parliaments of the ontology of the 'Issue-Based Information Systems' (IBIS) framework for the representation/codification of the public policy related knowledge produced in the various stages of legislation formulation.

From a first application and evaluation of this methodology encouraging conclusions have been drawn as to the appropriateness and sufficiency of the methodology and the IBIS ontology for the representation/codification of knowledge, which is the main determinant of the quality of knowledge interoperability. The only exception/weakness identified was that the IBIS ontology was

not sufficient for the representation/codification of the typology of settlements that the articles of a law include; taking into account that this is an important knowledge element, in order to achieve a better representation/codification and exchange of the knowledge that the core content (articles) of laws contain it is necessary to enrich the above IBIS ontology; in particular, the settlement type should be refined, based on the classification of rules proposed by jurisprudence, into the following six types: (1) prohibition, (2) obligation, (3) permission, (4) presumption, (5) sanction and (6) settlement. This provides a higher quality of knowledge representation and exchange, resulting in higher quality of knowledge interoperability.

Finally a generalization of proposed methodology has been formulated, which can be used for achieving knowledge interoperability among IS of networks of 'similar' Government Agencies of various administration layers (e.g. Municipalities, Prefectures, etc.). It results in the creation of an architecture of interconnected databases (all based on the same ontology) that store the knowledge representations/mappings of the main policy documents of the Government Agencies belonging to the network,

Further research work for evaluating and improving the proposed methodology is required in cooperation with Parliaments of other countries having different law formulation processes (e.g. in federal ones) or/and different legal systems. This research should focus on the following issues, which seem to be very important for the international application of this methodology:

- a. There are differences in the legislation formation processes and their main documents among countries, so a mapping between these different processes and documents is required in order to achieve the targeted knowledge-level interoperability.
- b. It is necessary that knowledge representations constructed by different Parliaments have similar level of detail: if some Parliaments

construct knowledge representations with high level of detail, while some others include much less detail, then this knowledge exchange will be less 'exchangeable'. This might necessitate the establishment of rules concerning the construction of these representations of the public policy related knowledge contained in the legislation process documents, which should be followed by all participating Parliaments.

- c. Since in each Parliament all the above documents and discussions concerning the various bills are in its national language, in order to achieve an effective knowledge exchange and interoperability, it is necessary the above knowledge representations to be both in the national language and in another language understandable by all (e.g. English).

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