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A Methodology for Ontology-based Knowledge-level Inoperability among Parliaments

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ABSTRACT

Most of the information systems (IS) interoperability research and practice in the e-government area has been focused on the operational level, aiming mainly at enabling the delivery of integrated electronic services involving several government agencies to citizens and enterprises based on the 'one-stop shop' model, and the support of co-operation among government agencies from the same or even different countries at the operational level. This paper is dealing with knowledge-level interoperability, which aims at the support of higher knowledge-intensive tasks of government, such as the formulation of legislation. In particular, it presents an ontology-based methodology for achieving knowledge-level interoperability among IS of Parliaments. It is based on the common use by Parliaments of the ontology of the 'Issue-Based Information Systems' (IBIS) framework for codifying the public policy related knowledge produced in the various stages of legislation formulation. Also, an application of the proposed methodology is presented for the case of the Law concerning 'Contracts of Voluntary Cohabitation' that has been recently passed by the Greek Parliament; its evaluation resulted in a proposal for a refinement of the above ontology that can be used for achieving a better codification of the knowledge that the main content (articles) of Laws contains.

Keywords (Required)

e-government, Parliament, knowledge, interoperability, ontology, issue-based information systems (IBIS).

INTRODUCTION

The achievement of information systems (IS) interoperability, defined as the ability of IS and of the business processes they support to exchange data and to enable the sharing of information and knowledge (European Commission, 2004), has attracted much interest by 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 objective has been i) to enable the delivery of complete integrated e-government services to citizens and enterprises, in which several public agencies are involved, based on the 'one-stop shop' model, ii) to support inter-organizational co-operation among government agencies at the operational level, and iii) to enable cross-border operational collaboration between government agencies of different countries, e.g. for the delivery of pan-european e-government services by European Union 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 a major objective of IS interoperability, as shown by its abovementioned definition adopted by the European Union. Government agencies realize more and more the need of systematically managing and exploiting their knowledge, as a means of formulating better policies and regulations for addressing social needs and problems, delivering better services to citizens and enterprise and finally achieving higher efficiency and effectiveness (Wiig, 2002; Sourouni et al, 2008). For this purpose it is necessary to use more intensively and strategically methods and practices from the knowledge management domain (e.g. Nonaka, 1994; Nonaka and Takeuchi, 1995; Cohendet and Steinmueller, 2000, Tiwana, 2002) with appropriate technological support. In particular, it is important through appropriate information and communication technologies (ICT) to support and facilitate the four basic knowledge creation and exploitation processes proposed by Nonaka and Takeuchi (1995): knowledge externalization, combination, internalization and socialization. Also, it is necessary to achieve higher levels interoperability between the IS of different government agencies, allowing them to exchange not only data but also knowledge as well. According to the model of interoperability maturity levels in digital government proposed by Gottschalk (2007) 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 achieving the higher levels of 'value interoperability' (level 4) and 'goals interoperability' (level 5).

Parliaments possess huge amounts of public policy related knowledge concerning social needs and problems, policies, measures and regulations for addressing them, and also their advantages and disadvantages. This knowledge resides in the justification reports of the various bills, and also in their content (articles), which include policies, measures and regulations for addressing the 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 and stakeholders' representatives and by 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. For these reasons knowledge-level interoperability among IS of Parliaments would be quite useful. Also, this knowledge is useful to the Ministries (for designing and formulating their future policies, measures and legislation) and to the lower layers of administration (for enforcing the legislation effectively and proposing improvements in the future), and also to researchers (for understanding better social needs and problems, alternative policies, measures and legislations for addressing them and also the advantages, disadvantages and positions of various stakeholders on them). However, this valuable public policy related knowledge of the Parliaments is in the form of numerous text files, which cannot be fully exploited by other Parliaments, Ministries and other Administrations and researchers, and cannot support the abovementioned four basic knowledge creation and exploitation processes and knowledge exchange. 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 exploit and disseminate better this valuable public policy related knowledge by codifying (modeling) it in a more structured form using an appropriate common ontology.

Most of the previous research and practice concerning the achievement of interoperability between Parliaments' IS, and also with IS of other public organizations (e.g. Ministries and other Administrations), focuses on the development of XML-based standards for storing textual legislative documents (Biasiotti et al, 2008; Boer et al 2008), aiming to provide open access to these documents (without relying on proprietary standards), enhanced search capabilities and various additional functionalities (such as 'point-in-time' legislation). The most widely cited of these standards is the MetaLex (Boer et al 2008), which has been based on the experience gained from a number of previous similar standards, such as the NORME-IN-RETE (an XML standard for Italian legislation), the AKOMA NTOSO (Architecture for Knowledge-Oriented Management of African Normative Texts using Open Standards and Ontology), etc., and has become a CEN Prenorm. However, much less research has been conducted on the codified representation of the knowledge contained in legislative documents; as explained in the third section, some legal ontologies have been developed in this direction, but they are characterized by a focus on the legal elements and details of legal texts, and not on the public policy related knowledge they contain.

In this direction this paper presents a methodology for filling the abovementioned gap and achieving knowledge-level interoperability among IS of Parliaments, enabling a user of a Parliament's IS to access in an appropriate and usable form the public policy related knowledge on a particular question (e.g. concerning a social need or problem, the policies, measures and regulations for addressing it, the advantages and disadvantages of them, etc.) stored on their IS, and also on other Parliaments' IS. The proposed methodology is based on the ontology of the 'Issue-Based Information Systems' (IBIS) framework (Conklin and Begeman, 1989; Conclin, 2003) for coding the public policy related knowledge produced in the various stages of legislation formulation in the Parliaments, which is contained in: i) the justification reports of the various bills, ii) the content (articles) of the bills, and iii) the discussions on them taking place during the sessions of the Parliamentary committees, and finally in the plenary sessions of Parliament. Furthermore, an application of the proposed methodology is presented for the Law concerning 'Contracts of Voluntary Cohabitation', which has been passed in 2008 by the Greek Parliament; its evaluation resulted in a proposal for a refinement of the above ontology for achieving a better codification of the knowledge that the main content (articles) of Laws contain.

The paper is structured in five sections. The next section analyses the main sources of knowledge in Parliaments, followed by a brief review of relevant ontologies that can be used for codifying this knowledge. Then the proposed methodology for achieving knowledge-level interoperability among IS of Parliaments is presented, followed by the description of its abovementioned application. The final section outlines conclusions.

SOURCES OF KNOWLEDGE IN PARLIAMENTS

In order to understand and analyze the process of legislation formulation and the main sources of knowledge in Parliaments 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 five Laws from five different ministries, which have been proposed to us by the above three officials of the Greek Parliament as representative ones, and are shown in the Appendix; 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 Laws were discussed. From the above interviews it was concluded that the Law formulation process in Greece consists mainly of five stages (Figure 1):

i) Initial formulation of the bill in the competent Ministry; the justification report and the content (articles) of the first version of the bill are formulated and then sent to the Parliament.

ii) 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 any problems from a legal viewpoint.

iii) The Ministry of Finance assesses the costs that the application of this Law will create for the government

iv) The bill is then discussed in the competent Parliamentary committee (usually in several sessions), in which representatives of the main stakeholders and experts are invited and express their positions and opinions.

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

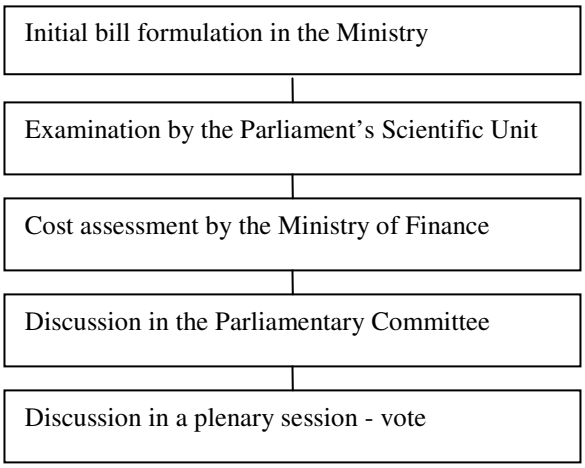

Figure 1. Stages of the Law formulation process

From our investigation it was concluded that the public policy related knowledge creation takes place mainly in stages i), iv) and v). In particular, in the first stage of the initial bill formulation in the competent Ministry participate experienced public servants mainly of higher hierarchical levels and also experts and representatives of the main stakeholders (e.g. trade unions, associations, municipalities, etc.), who contribute significant amounts of such knowledge 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 (see Appendix) a common structure has been identified. Initially, in the first paragraphs they include and clarify 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 from 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 topics, 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 these settlements.

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, 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 Laws, 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 existing settlements included in the bill; it should be noted that 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 this bill on behalf of the party, and then follow speeches of several 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.

RELEVANT ONTOLOGIES

Ontologies constitute abstract conceptual models of particular domains, which identify the kinds of entities existing in a particular domain and the kinds of relations among them, being acceptable a group of people dealing with this domain (Fensel, 2004; Visser and Bench-Capon, 1998). According to Uschold and Grunninger (1996), ontologies are of critical importance for knowledge acquisition, representation and exchange. For this reason we reviewed relevant literature in order to identify an ontology to be used as a basis for codifying the public policy related knowledge produced in the various stages of legislation formulation in the Parliaments, which has the form and characteristics analyzed in the previous section.

Previous research has been developed some legal ontologies. McCarty (1989) developed the 'Language for Legal Discourse' 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 behaviour), '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 in this direction they developed a legal domain ontology, which consists of i) a 'legal ontology' (with generic components usable in any legal sub-domain); it 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 ii) a 'statute-specific ontology' (with components that concern a particular legal sub-domain). Also, in the Estrella Project of the European Union (www.estrellaproject.org) has been developed the 'Legal Knowledge Interchange Format' (LKIF) legal ontology (Hoekstra et al, 2007; Boer et al 2008), 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 these ontologies we concluded that they are characterized by a purely legal perspective, focusing on the legal elements and details of legal texts, since they have been created mainly for supporting the development of legal knowledge systems and legal reasoning, in order to be used by persons with legal education; however, they lack public policy perspective (problems/solutions-oriented), so they are not suitable to be used for the representation and exchange of public policy related knowledge of Parliaments, e.g. concerning a social need or problem, the policies, measures and regulations for addressing it and also the advantages and disadvantages of them, which is the main target of this paper.

For this reason we also reviewed previous research that has been conducted concerning the representation of 'wicked' problems, which are characterised by high complexity and multiple dimensions, many stakeholders with different concerns and also different views and perceptions of the problem, lack of clear methods for finding the best solution and stopping rules, and only 'better' and 'worse' solutions, the former having more advantages and less disadvantages than the latter (Rittel and Weber, 1973). Considerable research has been conducted in the area of 'Issue-Based Information Systems' (IBIS) (Conklin and Begeman, 1989; Conklin, 2003; Gordon and Richter, G. 2002) for addressing wicked problems, which has resulted in the development of a framework for the representation of such high complexity wicked problems, potential solutions and arguments in favour and against them. This IBIS framework is based on a simple 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 (Kirschner et al, 2003; Karacapilidis et al, 2005; Loukis, 2007). This ontology is characterised by a public policy perspective and seems more appropriate to be used for codifying (modelling) the public policy related knowledge possessed by Parliaments.

A METHODOLOGY FOR KNOWLEDGE-LEVEL INTEROPERABILITY AMONG PARLIAMENTS

The proposed methodology for achieving knowledge-level interoperability among Parliaments is based on the codification (modeling) in each Parliament of the knowledge created for each bill it processes and discusses, which is recorded in the following four documents: i) the justification report of the bill, ii) the content of the bill (articles), iii) the minutes of the discussion on the bill in the competent Parliamentary committee, and iv) the minutes of the discussion on the bill in plenary sessions, in the form of one set (map) of interconnected questions (issues, problems), ideas (solutions, settlements) and arguments (positive-advantages, and negative-disadvantages) for each document. This can be done using one of the existing tools for representing knowledge on complex problems using the IBIS framework and ontology, such as the 'Compendium' tool we have used for the present study (http://compendium.open.ac.uk/institute/); this tool has been extensively used for various purposes (e.g. see Kirschner et al, 2003), is mature, and also offers the capability of easily creating such a map graphically, which is stored in a database as a set of records. The databases of all the cooperating Parliaments that store their knowledge can be interconnected (e.g. through Internet) in a 'star architecture' to central server (Figure 2), so that 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) can be sent not only to their own database, but also to the databases of all the other Parliaments, and then the results from all sent to the user who submitted the initial query. In the same way can registered authorized users from Ministries, Universities or Research Centers as well submit their queries and receive results from the databases of all cooperating Parliaments.

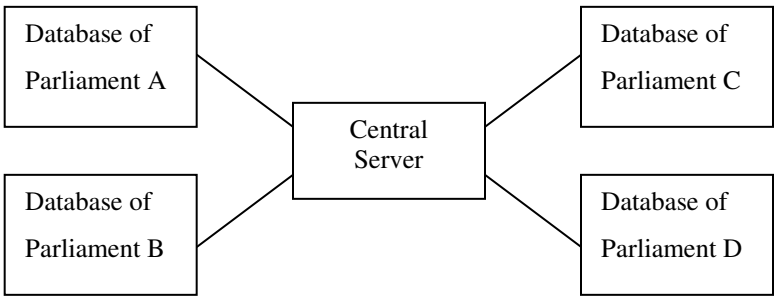

Figure 2. Architecture of interconnection of Parliaments' databases

The above methodology enables the exchange and better exploitation of the valuable knowledge that Parliaments possess (in comparison with keeping this knowledge in its initial textual documents' form). Also, it supports and facilitates the abovementioned four knowledge creation and exploitation processes (Nonaka and Takeuchi, 1995):

- knowledge externalization (enabling much higher extent of conversion of tacit knowledge into explicit, structured and directly usable knowledge),
- knowledge combination (having codified knowledge 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, etc.),
- and knowledge socialization (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).

The main preconditions for the application of the above methodology are: a) since in each Parliament all the above documents and discussions are in its national language, in order to achieve a substantial knowledge-level interoperability and exchange it is necessary the above knowledge codifications/representations to be both in the national language and in another language understandable by all (e.g. English), b) it is necessary that knowledge codifications/representations constructed by different Parliaments to have similar level of detail (i.e. if some Parliaments construct knowledge codifications/ representations of their bills with high level of detail, while some others include much less detail, then the benefits for the end

user will be lower); this might necessitate the establishment of rules that should be followed by all participating Parliaments.

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', which has been passed in 2008 by the Greek Parliament, having caused extensive debates with quite strong positions, both in favor and against it. Initially we codified the knowledge contained in the justification report of this Law based on the IBIS ontology using the Compendium tool; the corresponding codification/map 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 codification/map consists of three layers. The first layer includes, as clarification nodes, the seven basic reasons creating, according to the justification report, the need to legally regulate 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 broad particular 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 two clarification nodes in the fifth layer.

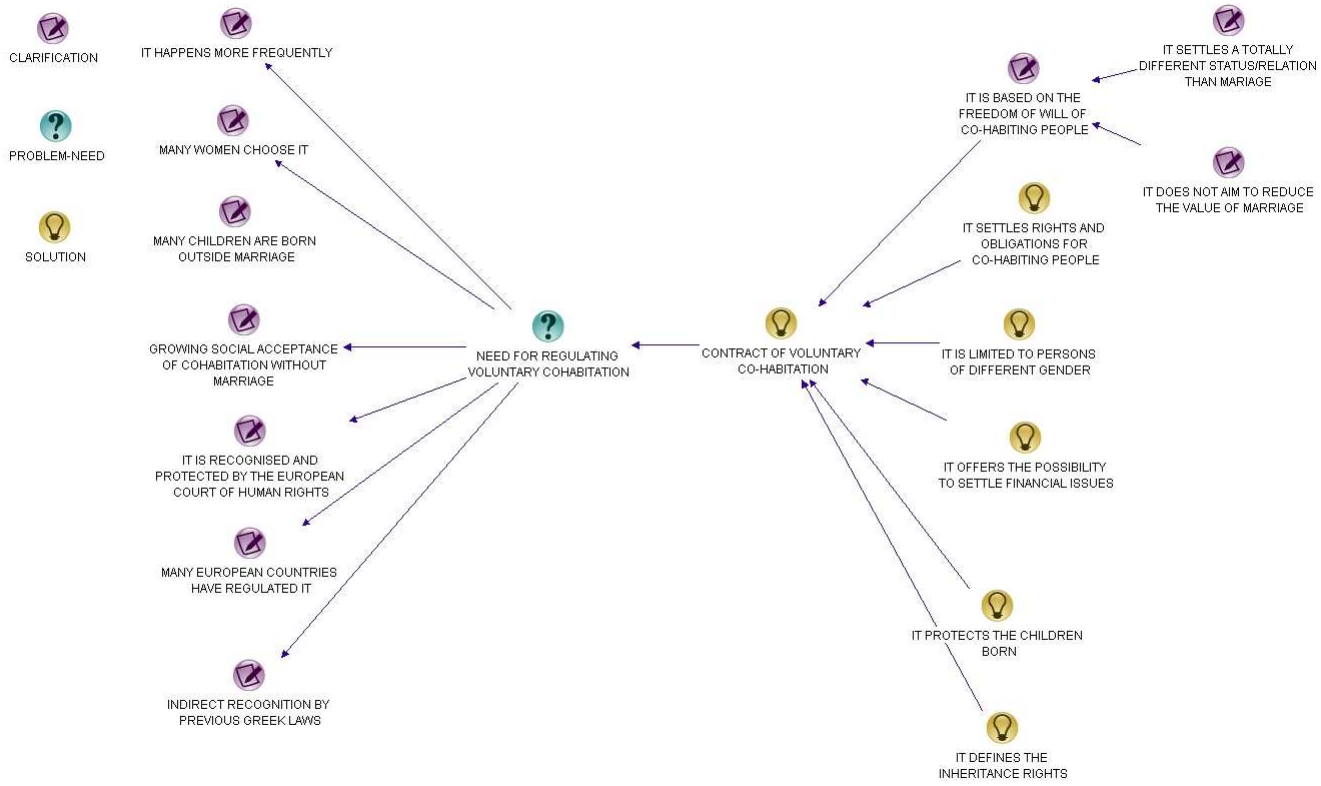

Figure 3. Codification/Map of the justification report

Then we codified in a similar manner the knowledge recorded in the content of the Law. The codification/map we constructed was quite lengthy, so we decided to break it into one high level codification/map for the content of the Law, shown in Figure 4, and also one lower level (detailed) codification/map for the content of each article; since the Law includes 13 articles, we constructed 13 corresponding codification/maps for them. In Figure 5 is shown the one for the content of article 4 that regulates the dissolvement of a contract of voluntary cohabitation. In these two codifications/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 codification/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, 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 codification/map in the third layer.

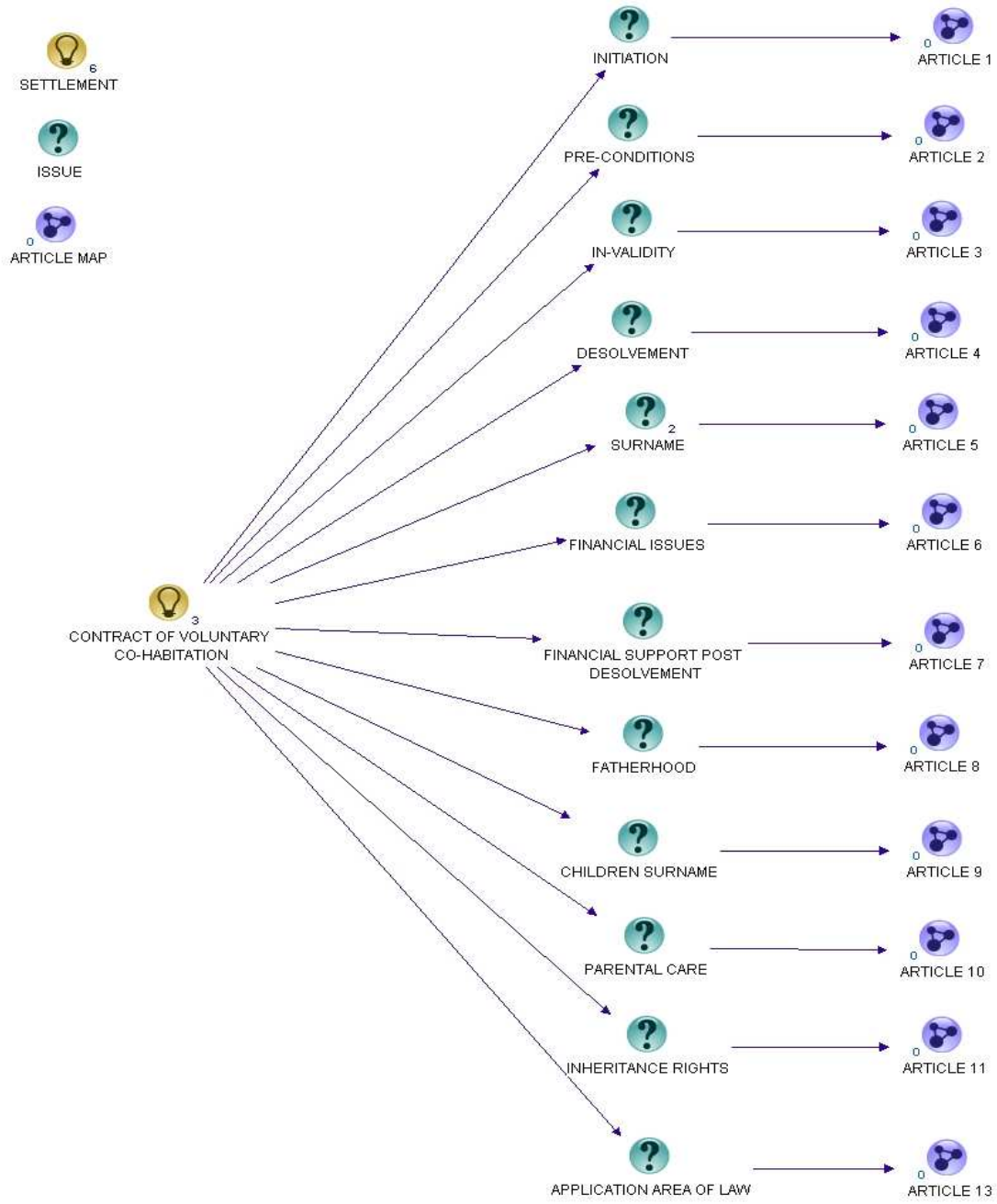

Figure 4. High level codification/map of the content of the Law

The codification/map of article 4 shown in Figure 5 is also structured in three layers: the first layer includes the main topic of the article, as an issue node, and a clarification on it; the second layer includes the three settlements that this article includes (corresponding to the three ways of dissolving a contract of voluntary cohabitation), connected with corresponding clarifications placed in the third layer.

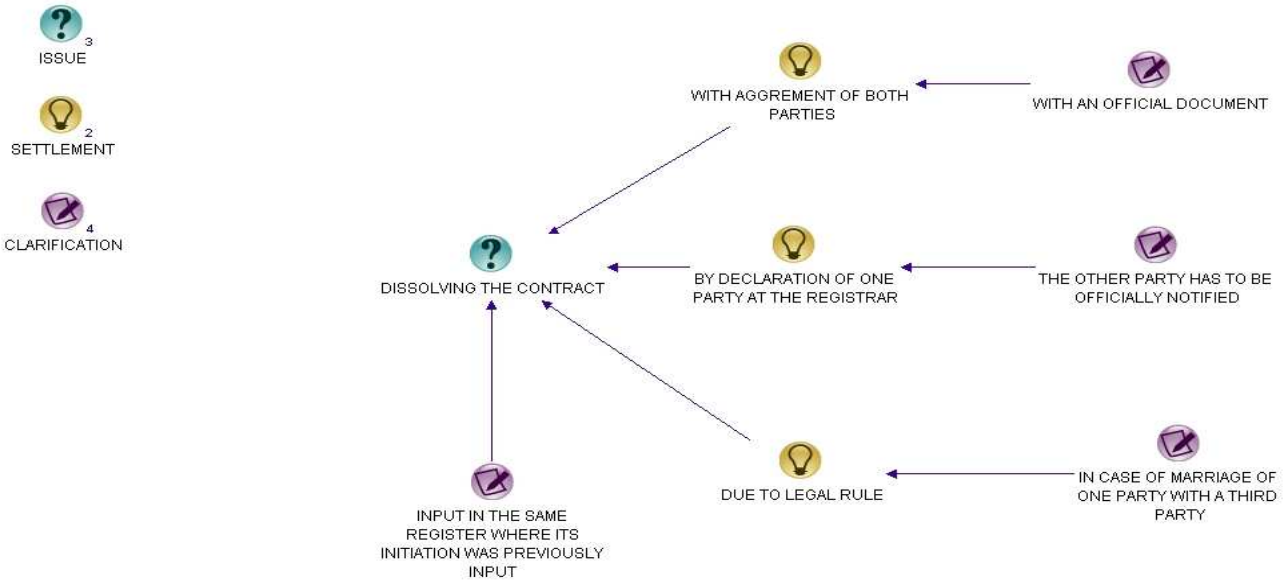

Figure 5. Codification/Map of the content of the fourth article of the Law

Finally we codified the knowledge contained in the minutes of the discussion that took place on this bill in the competent Parliamentary committee and then in Parliament plenary sessions. In Figure 6 we can see the codification/map for the opinions expressed by one of the experts invited in the competent Parliamentary committee, while in Figure 7 we can see the codification/map for the position of one party in the plenary session.

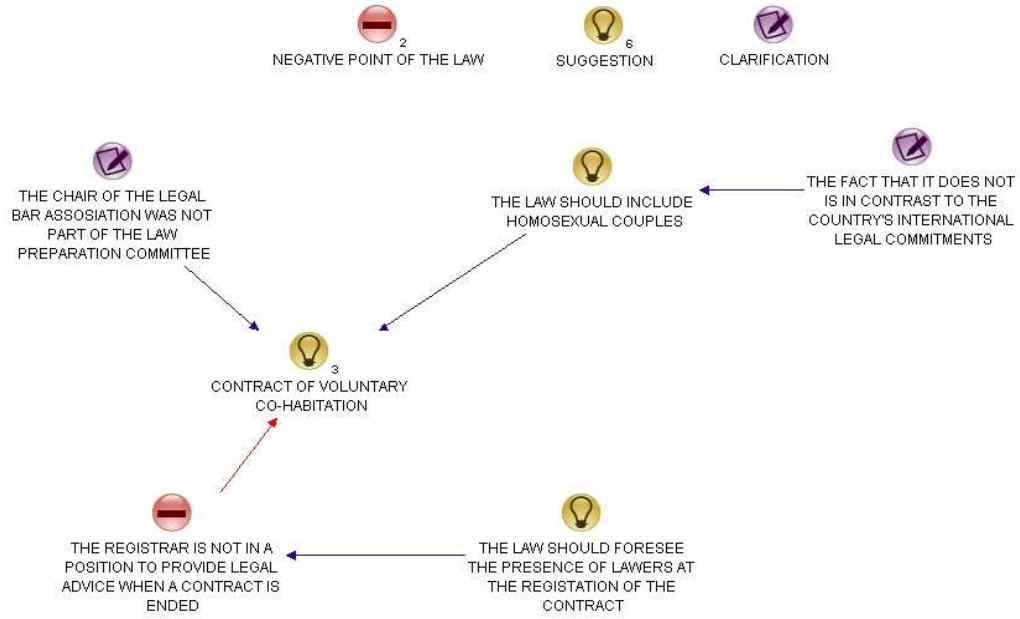

Figure 6. Codification/Map for the opinion expressed by one of the experts invited in the competent Parliamentary committee

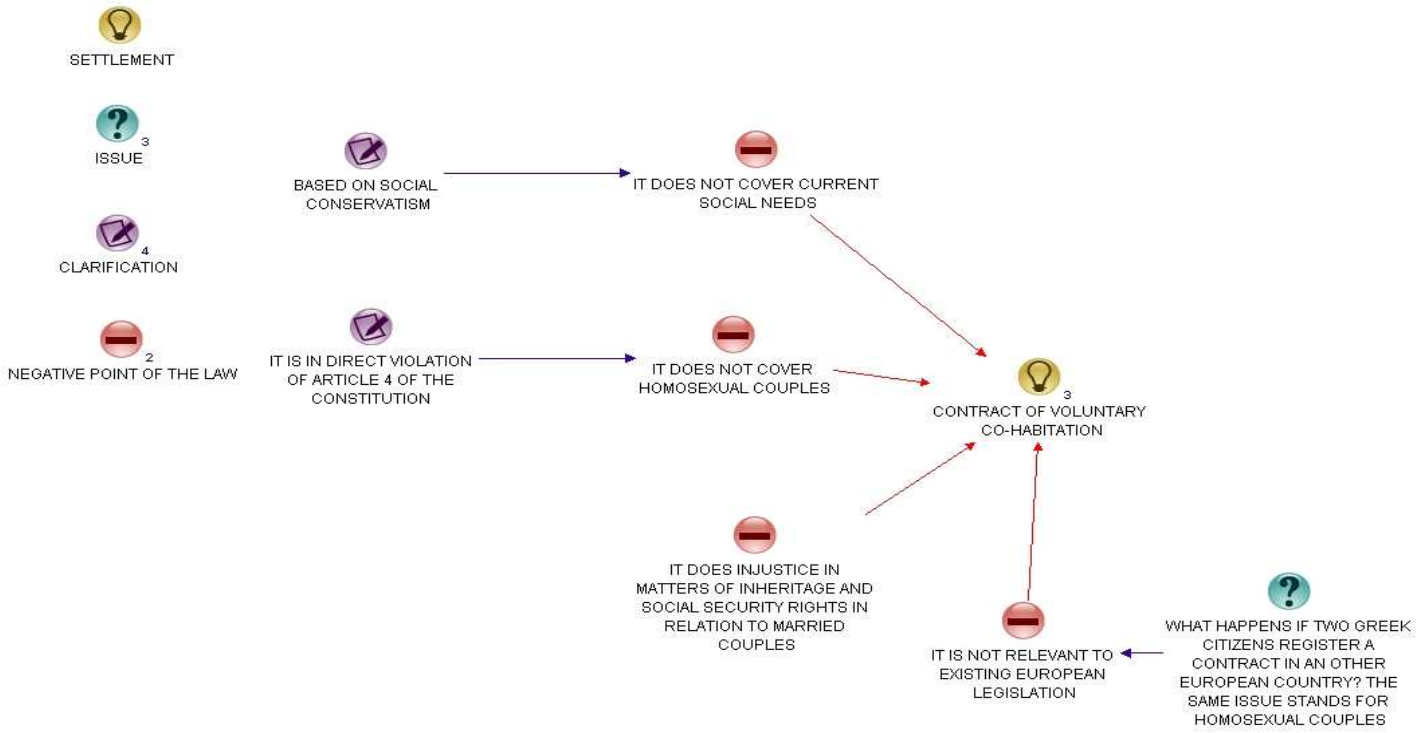

Figure 7. Codification/Map for the position of one party in the Parliament plenary session

CONCLUSION

In the previous sections of this paper has been presented an ontology-based methodology for achieving knowledge-level interoperability among IS of Parliaments, and in general better dissemination and exploitation of the knowledge that Parliaments possess, based on the ontology of the 'Issue-Based Information Systems' (IBIS) framework for coding the knowledge produced in the various stages of legislation formulation. The above proposed methodology has been applied for the Law concerning 'Contracts of Voluntary Cohabitation' and then evaluated by two lawyers of the Greek Parliament. They found that the codifications/mappings are understandable and include the substantial points of the corresponding documents and the knowledge they contain. They also remarked that the small number of types of elements/nodes provided by the IBIS framework and the Compendium tool respectively are to a satisfactory extent sufficient for expressing the knowledge that these documents contain concerning social needs and problems, policies, measures and regulations for addressing them and also advantages and disadvantages. The only exception they mentioned is that in the codifications/maps of the articles of the Law the 'settlement' type of node was too broad, and should be further refined into several types of nodes, which correspond to the different kinds of legal rules: prohibitive, imperative, permitting and presumptions (Georgiadis, 1997). Therefore in order to achieve a better codification of the knowledge that the main content (articles) of Laws contains it is necessary to refine the above IBIS ontology; in particular, the settlement type should be refined into the following types: i) prohibition, ii) obligation, iii) permission, iv) presumption and v) settlement (for elements not belonging to any of the above types). Also, they remarked that further similar research is required in Parliaments of other countries having different Law formulation processes (e.g. in federal ones) or/and different legal systems. The authors are conducting research in the above directions.

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APPENDIX: ANALYZED LAWS

- 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