Supporting Public Decision Making in Policy Deliberations: an Ontological Approach

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Abstract

Supporting public decision making in policy deliberations has been a key objective of eParticipation which is an emerging area of eGovernment. EParticipation aims to enhance citizen involvement in public governance activities through the use of Information and Communication Technologies (ICTs). An innovative approach towards this objective is exploiting the potentials of semantic web technologies centred on conceptual knowledge models in the form of ontologies. Ontologies are generally defined as explicit human and computer shared views on the world of particular domains. In this paper, the potentials and benefits of using ontologies for policy deliberation processes are discussed. Previous work is then extended and synthesised to develop a deliberation ontology. The ontology aims to define the necessary semantics in order to structure and interrelate the stages and various activities of deliberation processes with legal information, participant stakeholders and their associated arguments. The practical implications of the proposed framework are illustrated.

Keywords: eParticipation, Policy Deliberations, Decision Support, Ontology, Knowledge Modelling, Public Sector Information Systems.

1. Introduction

Carlsson and Turban (2002) predict a shift towards the adoption of intelligent decision support systems distributed over the Internet and intranets. They argue that their first target should be "the overwhelming flow of data, information and knowledge produced for the executives from an increasing number of sources" (p. 106). In fact, the synergies between artificial intelligent applications and decision support research have landmarked the eruption of business intelligence and semantic web technologies, such as data mining, web services and online analytical processing (Kalfoglou 2007; Phillips-Wren et al. 2009). Hence, these technologies provide new opportunities to complement the dominant mathematical approach and cultivate creative thinking in a more expanded interdisciplinary field of decision sciences (Matthews 2008).

Under this scope, decision support to human users requires developing appropriate interfaces and structures for communication, knowledge modelling, sharing and diffusion. During the last 15 years, the focus of a wide spectrum of knowledge management applications has been increasingly centred on the use of ontologies for semantically describing and structuring knowledge across and within particular domains. In general, ontologies are artefacts representing human knowledge (Brewster et al. 2004) or formal description of entities and their properties, relationships, constraints and behaviours (Grüninger and Fox 1995).

In the literature, there are various ontology application fields related to decision support; for example distance learning (Zaikin et al. 2006) or agricultural enterprise systems (Salampasis et al. 2005). According to Valente (2005), apart from building common understandings, ontologies can structure and organise information, enable semantic indexing and searching, foster interoperability, as well as facilitate reasoning and problem solving. Consequently, in addition to content annotation and efficient information retrieval, ontologies can further assist in allowing complex bureaucratic systems (e.g. European Union) to become more interoperable.

In this paper, the benefits of representing knowledge in the form of ontologies are recognised and exploited for the purpose of supporting public policy deliberations. Our study aims to contribute to the field of eParticipation (Saebo et al. 2008; Macintosh 2004). This emerging area of eGovernment concerns the use of ICTs for enabling citizen participation in public decision making activities. In particular, we develop an ontological framework which attempts to combine elements from current research and practice in the domains of governmental and legal knowledge. The main principle of this framework lies in the ability to connect people, arguments and information with policy making processes.

The rest of the paper is structured as follows. Section 2 explores the emerging area of eParticipation and the benefits of using ontologies for supporting policy deliberations. In Section 3, first previous work in the fields of eGovernment, eParticipation and the legal knowledge domain is reviewed. Based on this analysis, the design of the deliberation ontology is described. Section 4 discusses the practical implications of this study and provides some illustrating examples. Finally, Section 5 summarises and suggests issues for future research.

2. Background

2.1 Decision Support for Policy Making

Decision support for policy making is part of the broader concept of EDemocracy which is a rising multidisciplinary field. EDemocracy refers to the use of ICTs to support democratic processes and also incorporates accounts on how democracy itself should or ought to develop (Saebo et al. 2008). In practice, the eDemocracy idea includes different public sector initiatives, such as petitions, consultations, deliberations or panels (Demo Net 2006a). It also encompasses the use social media for political expression such as blogs, online political groups and common software applications such as social networks (e.g. Chadwick 2009).

Decision support systems for democratic processes have been examined. Grönlund (2003) discusses their role for encouraging broad participation by providing mediation in virtual groups and communication with the public. He emphasises that usability and openness of the policy making processes constitute the key factors and concludes that "the wise employment of DSS could serve to achieve something e-democracy so far has not - contributing to more widespread understanding of complex problems" (p.100). Blanning and Reinig (2005) propose a framework for conducting political event analysis in group decision support systems from a business perspective.

Providing analytical decision tools for supporting public involvement was explored in the special issue of the Journal of Multi-Criteria Decision Analysis (French 2003). Different approaches such as e-negotiations and multi-criteria frameworks for aspects of policy making were presented. The purpose was to examine how developments in multi-criteria decision support deployed via technologies can allow stakeholders to explore decision analysis and ultimately participate in decision making. Since then, to our knowledge, there are no major developments in this direction and the focus has shifted on matching the paradigm of DSS with public governance activities and eParticipation in particular.

The eParticipation concept was popularised from European Commission's (2008) eParticipation Preparatory Action. The term describes efforts to approach the eDemocracy research within the institutional settings of eGovernment. EParticipation aims to complement previous managerial agendas for achieving public sector digital reform and associated financial and administrative gains; see for example the analysis by Chadwick and May (2003).

EParticipation challenges centre on building the appropriate infrastructure and behaviour, integrating offline with online activities, providing meaningful feedback to citizens and developing evaluation mechanisms (Macintosh 2004). From a more technical perspective, eParticipation initiatives need to integrate in an innovative, yet interoperable manner a variety of modern tools, such as forums, search engines and argument visualization (Demo Net 2006a). More details on eParticipation research themes and open issues can be found in (Saebo et al. 2008).

In the rest of this paper, we broadly refer to eParticipation systems as ICT initiatives developed by public sector organisations to enable citizen participation in governance processes.

In the next section, we introduce deliberations as important eParticipation activities and argue for the benefits of using ontologies.

2.2 Deliberations and the Rationale for Using Ontologies

In political theory, public deliberations are believed to overcome the risk of elite-dominated representation by enhancing democratic governance and political expression (Kim 2006). Deliberations can be outlined as interpersonal goal-directed discourses where usually conflicting alternatives of public issues are discussed. Deliberations should not be confused with public consultations. Consultations are contributions of opinions from the public to authorities in an unstructured manner without the need to balance stakeholder arguments for reaching decisions.

In this paper, deliberations are approached as bureaucratic processes whose stages can be modelled as a sequence of activities with formalised input and output. Furthermore, their significance is emphasised since they can offer participation opportunities for various stakeholders such as individuals, citizen groups, domain experts, private organisations and others. The most typical example of public deliberations is the legislative process at local, national or transnational level.

In public deliberations, there is a constant interaction between participant stakeholders, the various stages and activities of the policy making lifecycle and the underlying legal framework. The latter includes all types of related legal documents such as directives, national laws and international treaties. In fact, recording the input and output of activities through the form of official legal documents is usually a basic perquisite for formal deliberations (Gionis et al. 2008). It is the basis upon which the process can be managed and monitored. Yet, legal documents in their original form constitute a very diverse field of knowledge since they act as containers of legal articles uniquely referenced within the legal system. Changes and interpretations on them are usually announced in separate documents.

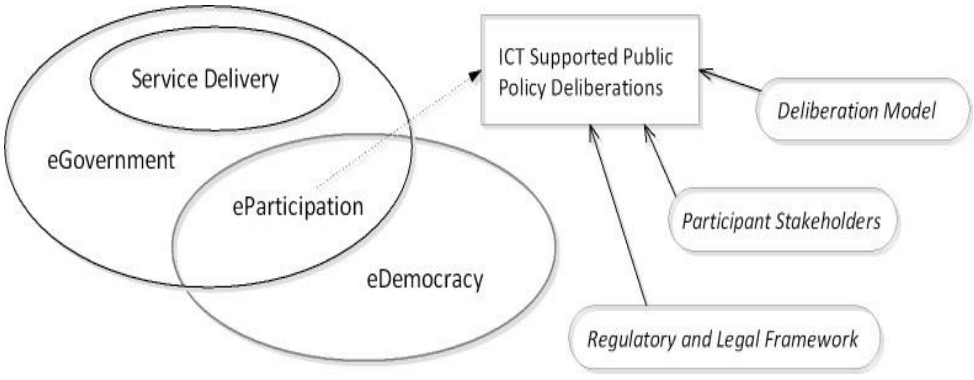

Fig.1 ICT supported public policy deliberations

Elliman et al. (2007) emphasise that the most fundamental barrier in public deliberations is the large amount of heterogeneous knowledge that needs to be made explicit in different formats at different stages. However, for non-expert participants, their ability to contribute to public decision making and produce quality informed opinions is vitally based on comprehending the necessary legal information, as well as the stages and the activities of the process itself.

In this context, ontologically supporting the process can have certain benefits wrapped upon the ability to interrelate stages and activities with information and participant stakeholders. During the design and implementation of systems, ontologies are used as vocabularies for tagging and retrieving information within the deliberative process while connecting it with people, processes and arguments. From the decision makers' perspective, this functionality allows to capture public sentiment while acting in control of and monitoring the process. From the citizens' perspective, it facilitates participation and enhances holistic understanding of the process.

Figure 1 summarises the above discussion and depicts the problem domain addressed in this paper. In the next section, after describing previous efforts of exploiting the benefits of ontologies in eGovernment, eParticipation and the legal knowledge domain, the design of the deliberation ontology is presented.

3. An ontology for Deliberating Public Policy

3.1 Previous Work

The benefits of knowledge engineering research have resulted in various ontology-driven applications for public sector information systems which offer decision support in a range of activities. In eGovernment research, we could distinguish between applications supporting service provision at the functional aspect and those intended to assist public policy making at the strategic aspect.

The first category includes standardisation efforts and certain European initiatives. These applications aim to foster service delivery by enabling semantic interoperability in terms of data and process integration. Two examples are the SmartGov and OntoGov projects. SmartGov develops a knowledge management platform focusing on the transaction and integration stage (Fraser 2003). OntoGov combines different ontologies to address the description and configuration of services (Tambouris et al. 2004). More information and examples on this category can be found in (Demo Net 2007, p. 125).

At the strategic aspect, public policy analysis has been a traditional problem also addressed by operational and applied systems' researchers. For example, Hermans and Thissen (2009) review and compare actor analysis methods and models used by analysts. Ontologies for governmental decision making support the combination of tools to structure and present information to the parties involved in the policy making process. Walker (2000) identifies this as a key decision support requirement. It sources from the fact that usually in real-world policy situations there is no way of ranking and identifying optimal solutions due to the great variety of possible alternatives, uncertainties, stakeholders and consequences of interest.

To address this gap, Loukis (2007) presents an ontology for supporting and structuring inter-governmental (G2G) collaborative policy implementation and evaluation. This effort includes concepts related to strategic analysis, alternative policy generation, evaluation and monitoring. From the Government to Citizen (G2C) perspective, Atkinson et al. (2006) present the

Parmenides system which allows deliberative structured argumentation over public policy decisions. Another relevant example is the Webocrat system (Paralic et al. 2003).

The use of ontologies in the legal domain is more complicated. It entails the dimension of structuring legal information but is mainly related to developing legal knowledge systems based on legal ontologies; a review is presented by Valente (2005). Such systems drive applications on assessing legal responsibility (e.g. Lehmann and Gangemi 2007) or modelling cases and legal argumentation (e.g. Mommers 2004).

For this study, the focus is on ontologically handling legal information; a key element of public deliberations as explained previously. In this direction, two emerging standards are the MetaLex and the LKIF. MetaLex is an open XML standard for legal document mark-up (Boer et al. 2008b). It provides a generic and easily extensible framework for encoding the structure and contents of legal regulatory documents and public decisions. It includes useful details such as version management.

The Legal Knowledge Interchangeable Format (LKIF) was developed complementary to MetaLex (Boer et al. 2008b; Hoekstra et al. 2007). It was part of a generic architecture facilitating communication between existing legal knowledge systems. Apart from describing legal information, LKIF intents to qualify agent actions according to normative law statements. In other words, assign legal responsibility and motivation over these actions.

Ontologies have also been exploited by European eParticipation initiatives. The Lex-Is Legislative Process Ontology is an important basis for our work (Lex-Is 2007b). It structures knowledge at the national legislative level and aims to enable stage and information awareness over deliberative processes in parliaments (Gionis et al. 2008). FEED (2009) is another ontologically supported initiative which targets issues related to energy and environment at the legislation proposal and formulation stages. Citizen participation in multilingual legislative drafting has also been examined in previous research (Boer et al. 2008a).

The eParticipation domain bears broad socio-technical dimensions which create complex characteristics for knowledge requirements. Demo Net is an important European support action for strengthening relevant research. It organised a workshop for exploring the benefits of knowledge management and semantic technologies for eParticipation (Demo Net 2006b). The workshop identified challenges for integrating heterogeneous knowledge in different eParticipation contexts. Some interesting issues raised tackled the granularity of knowledge concepts at different governmental levels (e.g. local, national) and issues of trust and shared knowledge ownership.

An ontology for describing eParticipation as a research domain was also developed by Demo Net researchers (Wimmer 2007). This ontology thematically classifies the domain knowledge such as the different eParticipation areas, tools, technologies, involved stakeholders and stages in policy making. Previous work provides a solid background for building the deliberation ontology at the next section.

3.2 The Deliberation Ontology

In ontology design, usually there is no optimal level of knowledge conceptualisation abstraction considered optimal across different settings (Al-Debei, Fitzgerald 2009). In fact, conceptualising knowledge is to a large extent a purpose-dependent activity grounded on sharing perspectives, simplifying and converging different and in many cases even conflicting world-views (Holsapple, Joshi 2002). Computational ontologies are formal models specified for ontology-driven systems and usually abide to feasibility constraints and formalisms which establish their modelling abilities (Kishore, Sharman 2004). For computational ontologies, the problem-solving dimension is the key factor in determining knowledge representation and their success is mostly measured towards concrete sets of requirements as in building database or interface components.

However, eParticipation systems usually address what is known as "wicked" or ill-structured problems and their implementation apart from highly fragmented has yet to achieve its practical potentials (Saebo et al. 2008). In many cases, such initiatives experiment with different tools and technologies aiming to attract and sustain stakeholder interaction. For such a domain, knowledge description maintains to some extent its philosophical origins in terms of orienting phenomena and their structures. Therefore, when supporting policy deliberations the objective is dual: (1) enable more informed and better quality decisions and (2) drive systems' architectures.

To these ends, our approach aims both at providing a generic customisable framework to address the problem domain, as well as a more domain specific case which is not however constraining for further developments. Consequently, the ontological foundations presented in this study could: (1) enable future research and practice to capture implementation details across different contexts and (2) promote further the synergies between decision support systems and eParticipation research (Grönlund 2003).

As explained in section 2.2, the basic requirement knowledge in the deliberation domain needs to fulfil is the connection between participant stakeholders, their arguments, the activities and stages of the process and the associated legal information. Furthermore, the information structure needs to achieve distinct levels of granularity allowing the manipulation of pieces of legal sources along with their container (the legal sources themselves) and their aggregation in topic-specific frameworks. Therefore, in our initial ontology design, the principle was to separate these concepts and define the basic relationships establishing their connection. This is shown in Figure 2 in the form of a UML diagram.

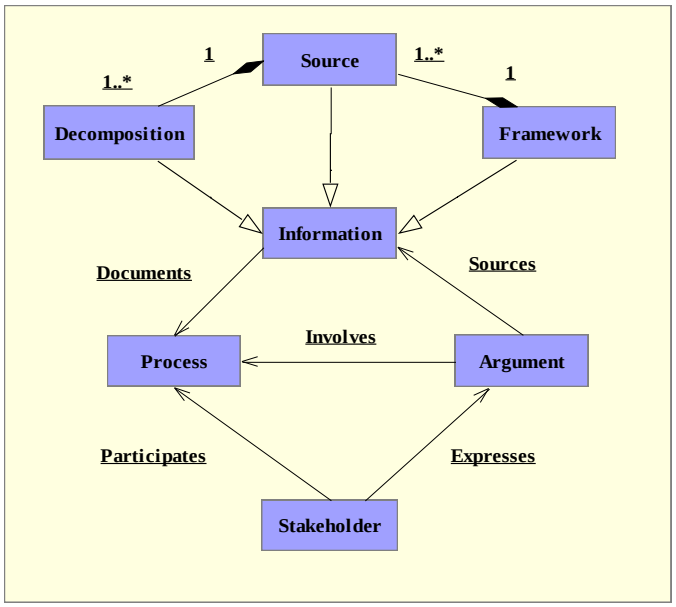

Fig.2 The principal domain of policy deliberations

At this step, a deductive approach was followed. According to the deliberation domain characteristics and the ontology objectives, general principles from a top-down strategy were applied. According to Holsapple and Joshi (2002), apart from deduction, other approaches to ontology design include inspiration (individual domain viewpoints), induction (empirical domain evidence), synthesis (reuse and composition of existing partial solutions) and collaboration (balancing multiple viewpoints).

Computational ontologies typically include classes (concepts), taxonomies to define class hierarchies, class relations, class attributes, instances (individuals), axioms and constraints (Kishore and Sharman 2004). Altogether, these elements define the ontology's modelling framework and inference abilities. There are different languages to express formal ontologies. For this application, the Ontology Web Language (OWL) was selected. OWL is a semantic web World Wide Web Consortium (W3C) standard family of XML languages for representing ontologies (Bechhofer 2004). It permits different expressivity formats based on description logic.

The ontology was created using the standard open source ontology editor and knowledge acquisition system Protégé-OWL (2009). Protégé was developed at Stanford University and benefits from a large international users' community. The ontology was verified using the semantic reasoner RacerPro (2009). Table 1 shows part of the ontology in OWL/XML.

The next step for designing the deliberation ontology was to specify the context of this initial domain view, first by deciding on deliberation models. The generic legislative process modelling framework developed under the scope of Lex-Is (2007a) was adopted. This framework combines an analysis of multi-facet workflow models sourcing from the description of formal policy deliberations conducted in the parliaments of Austria, Lithuania and Greece. Its purpose was to identify points of stakeholder engagement in the different activities of the policy making lifecycle and examine the formal stakeholders coordinating the process. Thus, it provides a generic deliberation model structure and also establishes the desired connection between activities, people, information and arguments.

```
.....
   <owl2xml:DataPropertyDomain>
      <owl2xml:DataProperty owl2xml:URI="&Ontology1211536131;hasVersionDate"/>
      <owl2xml:Class owl2xml:URI="&Ontology1211536131;Information"/>
   </owl2xml:DataPropertyDomain>
   <owl2xml:DataPropertyRange>
      <owl2xml:DataProperty owl2xml:URI="&Ontology1211536131;hasVersionDate"/>
      <owl2xml:Datatype owl2xml:URI="&xsd;date"/>
   </owl2xml:DataPropertyRange>
.....
```

Table 1. Part of the ontology implemented in OWL/XML.

In addition to the Lex-Is components for deliberation processes, the design priority was to introduce established concepts as foundations for the ontology's classes. Hence, a synthetic inductive approach was adopted and concepts and parts of different ontologies from previous work were used. In ontology design, synthesis is a well-respected principle fostering interoperability and modelling reuse (Kishore and Sharman 2004).

Figure 3 depicts the basic classes using Protégé's OWL Viz plug-in for graphical representation. An argument can be either a vote or an opinion allowing different levels of participation in activities according to the desired level of engagement. In terms of participant stakeholders, there is a need to distinguish between:

- *Formal Participants*: stakeholders institutionally coordinating aspects of the deliberation process. From the Lex-Is workflows, formal stakeholders include those responsible for drafting, approving, validating or receiving the legislation, e.g. in the Greek parliament appropriate committees are responsible for validating legislation.
- *Participants*: various actors participating in deliberation activities according to desired policies. In the eParticipation ontology developed by Demo Net (Wimmer 2007), such stakeholders typically include government officials, elected representatives, other policy-makers, businesses, trade unions, politicians and political parties, interest groups, individual citizens and other citizen organisations.

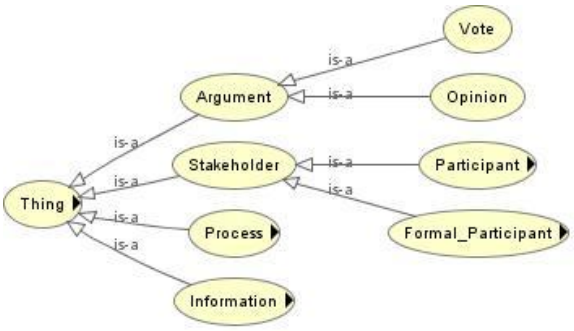

Fig.3 The basic classes of the deliberation ontology

For the information class, apart from the legal frameworks, the sources and their decomposition, concepts related to interpretations of the law and its simplified normative accounts need to be modelled. Although clarifying ambiguous parts of legal knowledge is not relevant, there is a need

to associate arguments and activities with different opinions on the law and its premises. The information class contains the following subclasses (figure 4):

- *Legal Source*: the LKIF framework for categorising legal sources was adopted. Sources include official documents acting as input or output of certain policy making stages or other types of supporting documents. Such examples are international agreements, treaties, regulations, directives, resolutions and others.
- *Legal Structure Decomposition*: for decomposing legal sources into their elements, the decomposition used in the Lex-Is (2007b) Legal Ontology was adopted. Legal parts include annexes, articles, paragraphs, phrases and keywords. Their hierarchy and connection is maintained through appropriate relations.
- *Legal Framework*: an aggregation of legal sources used to construct the valid law around specific deliberation topics. It usually includes pieces of a range of national or international laws, treaties and directives.
- *Legal Derivative*: legal sources are containers of normative accounts and they also bear different interpretations. In introducing another concept from LKIF, legal norms can be obligations, prohibitions or rights. E.g. "citizens under the age of 18 are not allowed to drive" is a normative prohibition.

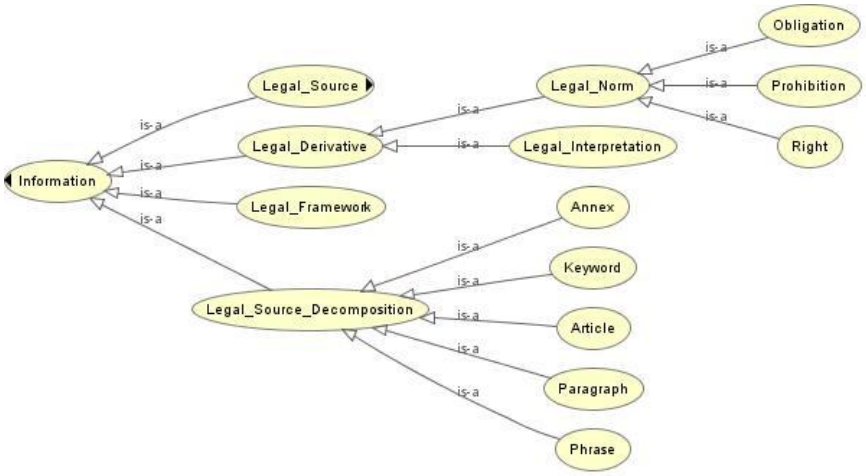

Fig.4 The Information class

For the process class, two main concepts were devised: stages acting as composite activities within the policy making lifecycle and activity components (figure 5):

- *Policy Stages*: the eParticipation ontology developed by Demo Net adopts the five main stages as agenda setting, policy formulation, decision making, policy implementation and policy evaluation. For this ontology, the decision making and the policy formulation stages were merged.
- *Activity Component*: apart from the need to introduce the basic workflow modelling components (initiation, termination activities and decision points), it is essential to distinguish between participatory and non-participatory activities. By making this distinction, it is possible to define the association of arguments and participants with the process through ontological properties. Participatory activities can be argument formulation, opinion declaration or voting.

The final step in the ontology design process was to define the main types of data and object properties associated with classes. This involves specifying necessary attributes, such as version and dates for the legal sources, as well as establishing desired conceptual connections among the classes so as to draw the ontology's functionalities. The competency questions approach introduced by Grüninger and Fox (1995) was used. It is a broad methodology for defining ontological requirements as well as assessing its desired functionalities. Properties modelled by the deliberation ontology in the form of competency questions include the following (relations are shown in italics, classes have their first letter capitalised):

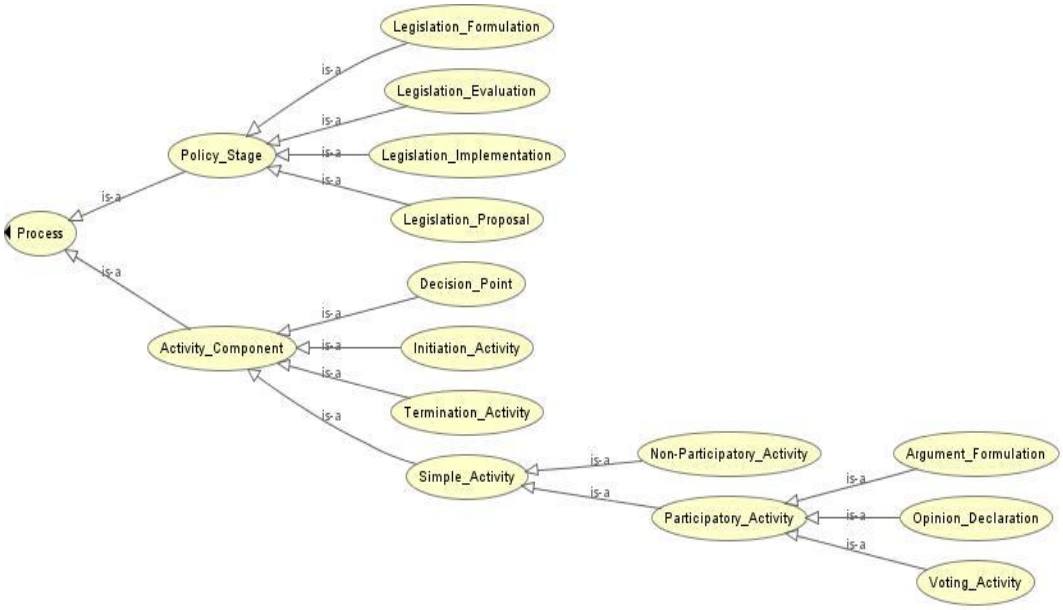

Fig.5 The Process class

- How are the activities of the process connected to the information - relations *hasInput* and *hasOutput* between the subclasses of Information and the Activity subclasses.
- How is a Legal Source decomposed to and reconstructed from its basic elements - relations is*AnnexOf, isArticleOf, isParagraphOf, isPhraseOf, isKeywordOf* among the concerned elements.
- Which are the application guidelines or official conclusions a Legal Source mandates - relation *hasLegalInterpretation* or *definesNorm* between the Legal Source and the Legal Interpretation or the Legal Norm respectively.
- How is the Legal Framework associated to a topic for a particular deliberation composed as an aggregation of Legal Sources - relation is*LegalElementOf* between the Legal Source and the Legal Framework.
- How is an Argument extracted from a Legal Source, an Article or a Phrase - relation *sources* between these classes and the Argument.
- An Opinion may *explain, support* or *oppose* another Opinion. It is the output of an Opinion Declaration Activity or it may *explain* a Vote.

- How is the sequence of activities modelled within a policy stage – relation *hasNext* between the activities. In case of a Decision Point the relations are *hasNextValid* and *hasNextInvalid* according to whether the decision question is valid or not.
- How are Stakeholders connected with different Activity Components - a Stakeholder may *trigger* an Initiation Activity or a Policy Stage, *receive* Information, *participate* in or be *responsible* for an Activity.
- How are important details concerning legal information managed – relevant attributes imported from the MetaLex mark-up standard, including versioning and dates, such as effect, efficacy, enactment and expiration.
- How is a Stakeholder associated with different levels of engagement in different activities – Stakeholder's property *hasLevelOfEngagement* or constrains through axioms for different Stakeholder levels.

In this section, the design of the ontological framework for describing public policy deliberations was presented. This framework, although classified as a domain ontology, is context neutral for different deliberation topics. This means that its use can be combined with other types of ontologies describing knowledge related to common sense (top level ontologies) and/or topic-specific domain ontologies. The next section elaborates on the ontology's practical implications and provides examples of its modelling abilities.

4. Discussion and Practical Implications

According to Brewster and O'Hara (2007), ontologies serve in practice both as mediums of efficient computation and as facilitators of human expression and communication. As mentioned in the previous section, the domain tackled in this paper requires the practical application of ontologies for both purposes. Table 2 provides an overview of the ontology's contributions according to the barriers related to public policy deliberations identified throughout this paper and mainly in section 2.

Policy Deliberation Barrier	**Ontological Contribution**
Policy alternatives and their anticipated impact are complex and not easy to understand and assess	The outcome of the deliberation process is summarised and can be visualised in appropriate forms
Arguments need to be associated with their background, their source and among each other	Modelling arguments, their associated relations and their interrelations
The legal information is incomprehensive by non-experts as grounded in the legal system's formalities	Enabled by legal source decomposition, legal norms and interpretations

The legal framework for a specific topic requires a combination of parts from different legal sources	Aggregation of sources or their needed parts to frameworks
The deliberation process is complex as a formal sequence of activities across the different policy making stages	The different activities and stages are modelled and associated with participant stakeholders, their inputs and outputs
The interaction among participants and their participatory rights in different activities and stages of the policy making lifecycle is not clear	Stakeholders acquire different levels of engagement during the deliberation stages and interact through arguments in corresponding activities

Table 2. An overview of the ontology's contributions.

From a stakeholder approach, using the ontology facilitates decision makers and participant stakeholders who are usually the ones affected by the deliberation outcomes. According to Geurts and Joldersma (2001), modelling participatory policy analysis requires consultation of the different sources of knowledge in order to integrate perceptions regarding the policy problem. This can be achieved by the ontology's abilities to model the interplay between stakeholders, arguments, legal information and the process itself.

Apart from facilitating the process, the latter also allows for its effective summarisation and visualisation in what has been described as a community's policy memory (Renton and Macintosh 2007). Deliberative policy memories can be combined with different technologies in more sophisticated functionalities. An example is natural language processing techniques for automatically identifying arguments from texts or normative accounts of the law.

Decision makers are enabled to overview and monitor the deliberation at different levels and design their participatory policies towards involved stakeholders. They are able to exploit different deliberation models by combining classes and relations from the Process class, as well as model their formal constrains and properties, e.g. legal sources are characterised by minimum one enactment date or a vote can be either negative or positive. Figure 6 presents such an example in terms of connecting the different activities in a legislation proposal stage. In this example, a drafted legislation receives financial approval before being submitted to the next stage.

Participant stakeholders, particularly citizens and citizen groups, can benefit from a more informed and holistic understanding of the process. They are enabled to overcome the complexities posed by the formalities of the legal system and produce more informed contributions leading to better quality decisions. Importantly, they are more qualified to assess the legislation's impact, view their interests towards wider societal problems and understand the complex trade-offs of actual policy making.

Additionally, both participant stakeholders and policy makers can benefit from ontological reasoning within and across different deliberations. Reasoning can answer questions such as: locate all instances of a concept (e.g. all negative votes or all opinions opposing a draft law) or identify all legal frameworks in which an article belongs.

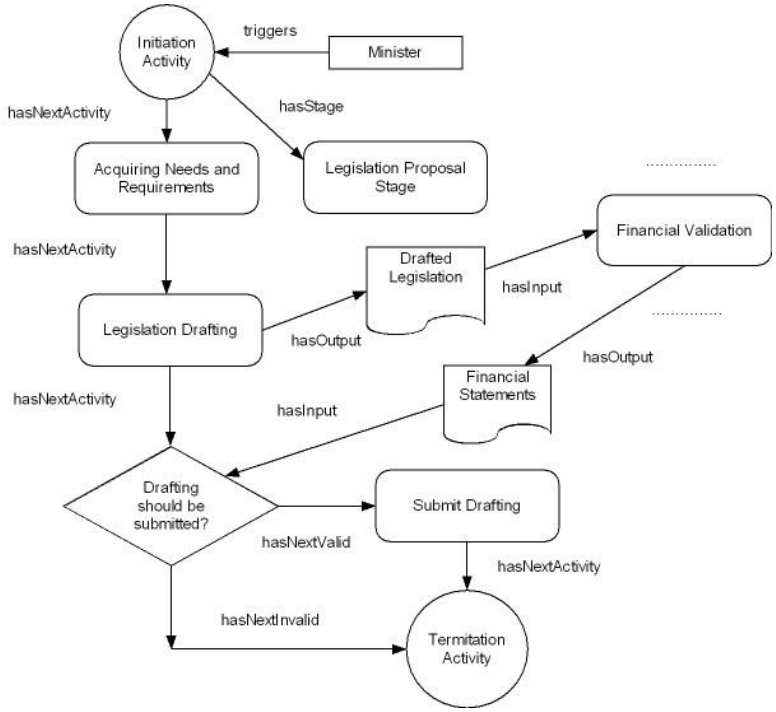

Fig.6 Some indicative parts of a deliberation model

Figure 7 presents an illustrative scenario concerning an argument formulation activity around a topic related to tourism using instances from the deliberation ontology's classes and relations. The example relates two opposing opinions around a proposed regulation with the interpretation of an article from a European Directive and a participant stakeholder's claim respectively. The activity is part of a proposal stage and the appropriate minister is responsible for drafting the legislation.

Another important practical implication concerns the ontology's connection with legal knowledge standards such as the MetaLex and the LKIF. This connection and its possible extensions allow the ontology to become interoperable with legal knowledge systems and benefit from the large amount of research conducted in the field of artificial intelligence and law (see the relevant part of section 3.1). For example, simulation scenarios could run in parallel to deliberations producing sample court decisions and different law interpretations. In this way, the legislation under deliberation can be connected with its real time forthcoming effects for societal stakeholders. In turn, they are enabled to see how their opinions can influence the legal system and comprehend decision effects. Figure 8 shows this relation between deliberations, the legal system and society.

Finally, as explained in the previous section, parts of the deliberation ontology source from the Legislative Process ontology developed by the project Lex-Is. These parts have been implemented in the Lex-Is platform which was tested in a series of pilot applications in the parliaments of participant countries (Austria and Greece). Specifically, the Lex-Is platform combined the decomposition of legal sources with an argumentation support system in order to build a structured forum able to visualise and summarise the argumentation flow of large discussions. For example, in the Greek case, the pilot deliberation was centred on a real-world

experimental discussion around the policy evaluation stage regarding a law on the status of civic partnerships beyond official marriage.

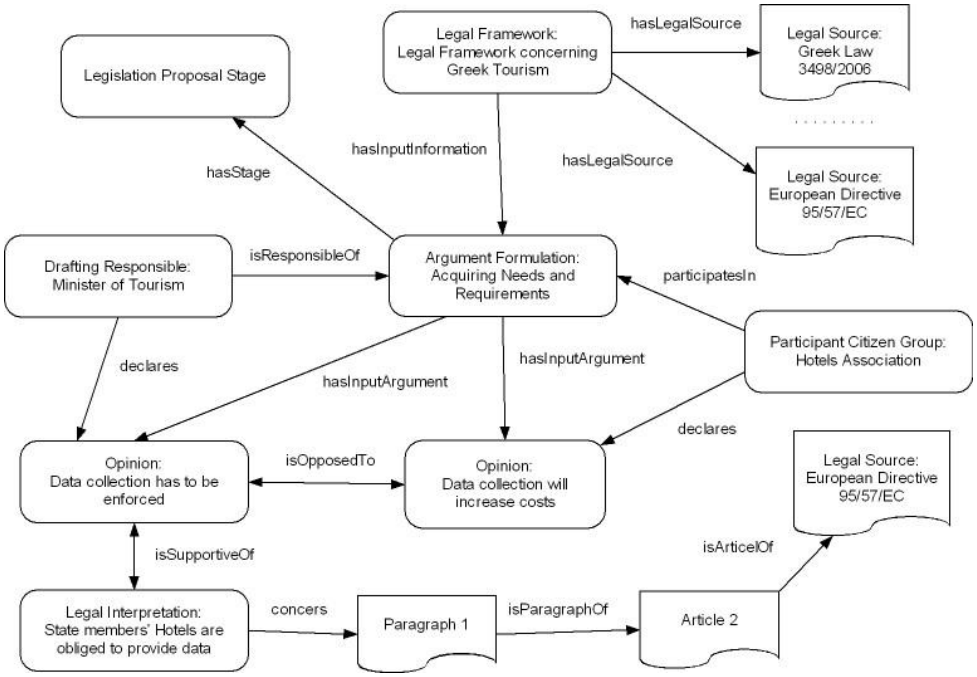

Fig.7 An argument formulation activity

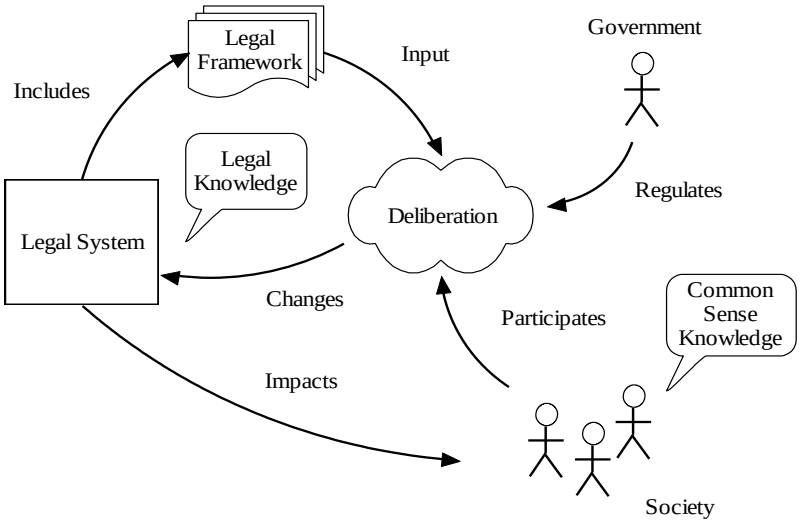

Fig.8 Connection between deliberations, the legal system and society

5. Conclusions

In this paper, first the benefits of using ontologies for supporting public decision making in policy deliberations were explored. The problem domain was presented as an interplay between the policy making process, the participant stakeholders and the associated legal information. After

reviewing previous theoretical and practical approaches from relevant fields, the design of a deliberation ontology was presented. The ontology's contributions were illustrated in terms of assisting different stakeholders to overview the process and the related arguments, interpret complex legal information and form better quality opinions.

Although our modelling framework focused on the case of national legislative processes, its generic top-down approach is easily extendible and customisable to other settings. Future research could integrate various contexts and further knowledge elements, such a time ontology dimension or a more advanced connection with legal knowledge systems. As it seems, automated policy making reasoning and analytical decision making is complicated and hardly possible. Nevertheless, an interesting direction could be to explore ways of combining the deliberation structures with more analytical tools aiding to formulate and assess the impact of policy making outcomes.

To conclude, it should be noted that efforts of collaborative public decision making do not necessary imply a shift towards direct models of participation or changes in existing well-established institutional practices. Instead, they stress the need to develop the appropriate decision support tools to overcome the barriers posed by the complexity of actual processes and empower wider societal input in the form of more informed contributions.

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