An Ontological Approach to Legal Literature for Improving Legal Knowledge Dissemination

Ioan Alfred LETIA[1], Sorina CORNOIU[2]
[1]*Department of Computer Science, Technical University of Cluj-Napoca*
Cluj-Napoca, Romania
letia@cs.utcluj.ro
[2]*Legislative Council*
Bucharest, Romania

***Abstract* – We present an ontological approach to the legal literature for translating sources of law into information accessible to people both with and without a legal education. To improve the quality of the legislative language and to facilitate legal experts and citizens in accessing the legislation we propose to use legal ontologies. In this sense we show the roles of two legal ontologies: the LKIF-core Ontology and the Lex-is Ontology in improving the dissemination of legal knowledge.**

***Index Terms* – computer science, information retrieval, knowledge based systems, knowledge representation, problem-solving**

I. INTRODUCTION

Access to legal information and, in particular, to the legal literature is a fundamental democratic right to be guaranteed to all citizens without a legal education. In this sense considerable attention has been given to the accessibility of legal documents, such as legislation and case law, both in legal information retrieval (query formulation, search algorithms) and legal information dissemination practice (numerous examples of on-line access to formal sources of law) [12].

There is a massive legal literature on-line, but these documents are often poorly accessible for the public without a legal education and specialized search engines. Dissemination of legal knowledge should take into account that current accessibility of sources of law does not suffice to serve legal and non legal professionals. Legal Knowledge are the three major views and interests [3].

the citizens - The largest population of users of law are citizens. The actions are planned by citizens under legal constraints, i.e. their understanding of the law limits or guides their options in acting. For the itizen, law is part of their daily (social) life, and their knowledge and understanding of law has a strong common-sense flavor).

the actors in the legal system (judges, lawyers, etc.). In this case law is what happens in court and to them law has the character of a permanent debate, even when they recognize that the debate should be ultimately grounded in legal sources.

the legal theoreticians (legal scholars and jurisprudence). This view of law as continuously evolving under changes in society and the legal debates is also the point of departure for most legal theoreticians. Jurisprudence works at a further level of abstraction, analyzing the law as a whole, critically evaluating doctrinal debates, considering the links between the law and other disciplines.

Legal literature consists of an abundant, high quality output of printed material and a certain amount of electronic contributions. Hereby some difficulties in accessing legal literature [6]: availability of documents inconsistency of descriptions, different user interfaces, identification of legal resources on the net and the quality of electronic resources. In this context, legal knowledge dissemination must purpose improving the quality and the readability of legislative texts and improving the accessibility of legislative texts for legal experts, decision-makers as well as citizens, thus promoting a democratic participation in the legislative process.

In the next sections, we want to show the roles of two legal ontologies LKIF-core ontology and Lex-is Ontology for improving the legal knowledge dissemination.

II. LKIF CORE ONTOLOGY

LKIF (Legal Knowledge Interchange Format) is developed as part of the ESTRELLA project to defines a knowledge representation language for arguments, rules, ontologism, and cases in XML [7].

LKIF is a knowledge representation formalism and enables the translation between legal knowledge bases written in different representation format and formalism.

The LKIF Core Ontology 1 is an OWL ontology, based on description logic (DL) of legal concepts allowing knowledge bases, encompassing specific terminologies, LKIF rules and normative statement to be represented in OWL and stored as OWL files. LKIF Core provides a vocabulary and a set of standard definitions of concepts common to all legal fields based on common sense [2]. LKIF Core Legal Ontology [8] consists of layers: the top level, the intentional level and the legal level. The top level contain fundamental module as top, location, time,

[1] The LKIF ontology is available online as separate but interdependent OWL-DL files at : http://www.estrellaproject.org/lkif-core

mereology and space-time. The intentional level include concepts and relations necessary for describing behavior agents , which are governed by law - action, expression, role, process. The process describes concepts related to change using time (duration) and energy as resource. The process is the basis for definitions of more concepts as actions, causation. The actions add an intentional view. Actions are intended process initiated by an agent. We distinguish physical actions from mental actions such as reasoning. Agents are held responsible for the effect of their actions. Legal reasoning. The legal level include ”norm” - defines norms as qualification, legal sources(legal documents customary law), ”legal-role” - defines legal concepts related to roles, ”legal-action” - defines public act, legal person, natural person, which allowed us to express normative statement (Ex. Norm, Qualification, Allowed, Disallowed). The norm is a statement that combining two meanings : deontic - in the sense that is a qualification of the (moral or legal) acceptability of some thing, and it is directive . A norm applies to a certain situation, allows a certain situation - the Obliged situation or Allowed situation and disallows a certain situation - the Prohibited or Disallowed situation. LKIF Core Ontology provides LKIF with a legal content that not only supports knowledge acquisition and knowledge interchange in legal domains, but provides framework for some basic legal inference, such as reasoning with deontic qualification over norms. LKIF Core Ontology can be used for reasoning as central knowledge component for knowledge systems. An ontology to support case-based reasoning is provided so as to represent the parts and relationship among cases in a case base. Norms, which are qualified in deontic terms, are used to assess cases. If there is no discrepancy between what is in the description of a case and what legal norms prescribe, the case is allowed [5]. If there are one or more discrepancies - violations - the case is a disallowed or illegal , and law may also prescribe a sanction. Processes, agents , actions and roles are concepts involved in reasoning about responsibility and causation in law, the notion of norm and propositional attitude enable reasoning about norms and norms violation. Exploration of expressive ontologies as LKIF

Core Ontology design patterns for the representation of social reality, change and causation, actions.

III. CAUSATION IN LAW

We try to modeling the representation of causation for automatic legal reasoning using LKIF Core Ontology. Representation of causal knowledge cannot be limited to the ontological elements of causal relations. Causal knowledge representation must be extended to the epistemological elements of our knowledge. Reasoning about causation in fact is an essential element of attributing legal responsibility [10]. Legal responsibility implies understanding of the relation between the legal concepts of responsibility and of causation in fact and, on the other hand, at the specification of an ontology of the concepts that are required for reasoning about causation in fact [9]. Legal responsibility attribution is a vital element of reasoning about legal cases. In the following legal case, we want to establish liability for a legal person using the LKIF Core ontology.

A minor collision occurred when a car negligently driven by person P1 turned into a main road and ran into a car driven by person P2. P1, by faulty driving, caused the damage for car’s P2.

Using the LKIF ontology, we can represents the actions A1, A2, A3, A4 (see the TABLE I) and the events (E1, E2) and then, we can establish liability. In this case we want to prove that person P1 which drove the car carP1 is liable for the damaged carP2 caused by collision between carP1 and carP2 . In this sense we take in consideration both physical causation (causal, factual links between events) and agent causation (i.e. with establishing which the agents are responsible one for a specific event (i.e. damage) reported in the case description). We can define liability in the following way: The subject is liable for the damage caused by the event if the subject has accomplished the event and the event which has caused the damage and the subject was at fault for the event.

We can formalize described scenarios as shown in the TABLE II:

TABLE I
CAR COLLISION

A_1 : $Driver(P_1) \wedge Time(t_1) \wedge Road(minor\_road) \wedge car(carP_1) \wedge drives(P_1, t_1, minor\_road; carP_1)$

A_2 : $Driver(P_1) \wedge Time(t_2) \wedge Road(main\_road) \wedge car(carP_1) \wedge switchto(P_1, t_2, main\_road, carP_1)$

A_3 : $Driver(P_2) \wedge Time(t_2) \wedge Road(main\_road) \wedge car(carP_2) \wedge drives(P_2, t_2, main\_road, carP_2)$

A_4 : $Driver(P_1) \wedge Road(main\_road) \wedge \neg assure(P_1, switchto(main\_road))$

E_1 : $(collide(carP_1, carP_2), t_3, main\_road)$

E_2 : $(damage(car(P_2, t_4))$

TABLE II
LIABILITY COLLISION

- $liability\ (P_1, damage, collide)$:
  $causes\ (P_1, collide\ (carP_1, carP_2), t3) \wedge$
  $causes\ (collide\ (P_1, collide\ (carP_1, carP_2), t3), damage\ (carP_2, t4))$
- $causes(P_1, collide(carP_1, carP_2)) =$
  $collide(carP_1, carP_2) \wedge$
  $has\_caused(\neg assure\ (P_1, collide))$

where:

causes (collide (carP1, carP2), switchto (P1, t2)
drives (P2, t2)) (1)

Represents the physical causation and can be inferred from TABLE III:

TABLE III
PHYSICAL CAUSATION 1

cause	A	B	C	D
effect				
A	-	N	N	N
B	N	-	N	N
C	N	N	-	N
D	N	Y	Y	-

Where:
A = drives (P_1, t_1),
B = switch to (P_1, t_2)
C = drives (P_2, t_2),
D = collide (($carP_1$, $carP2$), t_3)
and
has_caused ($\neg assure$ (P_1, switchto (main_road), collide)) (2)
represent agent causation and can be demonstrate using the fact that driver P_1 has violate the norm N (When drivers enter a main road they must be sure there is no oncoming traffic.)

N: Driver(X) ∧ MainRoad(Y) ∧ switchto(Y) ∧ assure(X, switchto(Y))

In our case, we have:

A_4: Driver (P_1) ∧ Road (main_road) ∧
¬ assure (P_1, switchto (main_road))

From (1) and (2) results that:

causes (P_1, collide ($carP_1$, $carP_2$)) =
causes (P_1, collide ($carP_1$, $carP_2$)) = collide (($carP_1$, carP2), t3) ∧ has_caused ($\neg assure$ (P_1, switchto (main_road), collide)) (3)

and

causes (collide ($carP_1$, carP2), t3),
damage ($carP_2$, t4)) (4)

represent physical causation and can be infers from TABLE IV:

TABLE IV
PHYSICAL CAUSATION 2

cause	A	B
effect		
A	-	N
B	Y	-

where:

A = collide (($carP_1$, $carP_2$), t_3), B = damage ($carP_2$, t_4)

From (3) and (4) results that:
liability (P_1, damage, collide):
causes (P_1, collide ($carP_1$, $carP_2$), t3)
∧ causes (collide (P_1, collide ($carP_1$, $carP_2$), t3)
, damage ($carP_2$, t4))

Finally, results that P_1 is liable for the damages $carP_2$ caused by collision between $carP_1$ and $carP_2$.

IV. NORMATIVE ASSESSMENT

LKIF Core Ontology defines deontic qualifiers in such a way that they can be used in normative assessment. Deontic reasoning is inherent to the domain of law. All the elements of the deontic vocabulary, including the operators are represented as OWL properties and classes in the module norm of the LKIF Core Ontology [5]. We presents the role of LKIF Core Ontology for reasoning using Pellet2 . Pellet API which provides functionalities to see the species validation, check consistency of ontologies, classify the taxonomy, check entailment and answer a subset of RDQL queries (known as ABox queries in DL terminology3 and SPARQL. SPARQL is a W3C Candidate Recommendation towards a standard query language for the Semantic Web. SPARQL can be used to query an RDF Schema or OWL model to filter out individuals with specific characteristics. SPARQL can be used to express queries across diverse data sources and the results of SPARQL queries can be results sets or RDF graphs4 In this sense, we perform case assessment, applying norms to individual cases describes by use [5] . For this, we consider the following two case:

1. Everybody is prohibited to cross the street without a pedestrian crossing.
2. Tom crossed the street wherever.

In the first step we try to reify the cases. We can link all the relevant individuals to the same instance representing the case. For this, we use the following axiom:

Domain-Of_Case ≡ ∃ part_of_case. {$case_i$} (5)

Each relevant individual is assigned to the class Domain-Of_Case1, and so, by the definition of (5), it is linked by property part of case, represented case as entity. For representation we use legal rule. A motivation for choice of rules is that OWL-DL is well suited to express taxonomical, terminological or generic knowledge, whereas rules may express configuration of concepts and properties that cannot be reduced to taxonomical classification. LKIF rules are more expressive than OWL, in particular with respect to use variables [2].

Using a rule formalism, one can obtain:

- ART1_Case (v):
Person(x) ∧ Street(y)
∧ Pedestrian_Crossing (z) ∧ cross(x, y)
∧ without(y, z) ∧ part_of_case(x, v)
∧ part_of_case(y, v) ∧ part_of_case (z, v) (6)
- ART2_Case (v):
Tom(x) ∧ Street(y) ∧ cross(x, y)
∧ part_of_case(x, v) ∧ part_of_case(y, v) (7)

From (6) and (7) we obtain that

[2] Pellet is an open-source Java based OWL DL reasoner
[3] Pellet Web Page: http://clarkparsia.com/pellet
[4] Protocol and RDF Query Language SPARQL Query Language for RDF : http://www.w3.org/TR/rdf-sparql- query/

ART2_Case (v) ⊑ ART1_Case (v)

The normative conflict resolution should be applied these individual cases which get classified as instances of LKIF Core Ontology ALLOWED and DISALLOWED. The core of normative assessment can be capture in the LKIF Core Ontology, by imposing the following axiom for each concept representing a generic case description.

$CASE_i$ ⊑ QUALIFICATION,

where QUALIFICATION should be one of the LKIF Core deontic concepts: ALLOWED, DISSALLOWED, OBLIGED. In this case, we can use SPARQL for query classifies as VIOLATIONS all instances of those generic cases that are Disallowed, but do not belong to any Allowed subclass of those generic cases.

```
CONSTRUCT {? case rdf: type: VIOLATION}
 WHERE (? case rdf: type? GCase
 ? GCase rdfs: subClassOf: DISALLOWED
 . OPTIONAL {(? case rdf: type? GCase2
 . ? GCase2 rdfs: subClassOf: ALLOWED
 . ? GCase2 rdfs: SubClassOf? GCase}
```

We show that SPARQL can be used to generating The hierarchy of generic cases descriptions, required for detecting exceptions in norms and resolving normative conflicts. We are demonstrate the roles of LKIF Core Ontology in organize and structure information. LKIF Core Ontology defines the legal concepts used as basic terminology for case description and norms and can be use for attribution of legal responsibility and can perform case assessment, applying norms to individual cases.

V. THE LEX-IS ONTOLOGY

Lex-is ontology is the part of LEX-IS (Enabling Participation of the Youth in the Public Debate of Legislation among Parliaments, Citizens and Businesses in the European Union) project5 , funded under the 2006 eParticipation Workprogramme.

The main objective of the LEX-IS Project is to improve the legislative process in National Parliaments through enhancing public participation in the preparatory stages with legislation proposal formation and debate an draft legislation.

To improve access and use of such information by non-specialist that are engaged in the legislative process has been used the Lex-is ontology6. Lex-is ontology will organize and structure legislative information in order to improve access and use of such information by non-specialist and at the same time to improve the level of communication and interaction between institutions of legislative nature and the society and defines: the structure, type and content of EU legislation, treaties, regulation, directives, decisions organized in thematic areas along with their interrelations, the structure, type and content of national legislation, constitutions, laws, along with their interrelation to EU legislation (for example a legal act that incorporates an EU directive in national law).

- Drive the content management system (show what to store, how to connect them). Les-is will enhance the participatory capabilities of its end users by proving them with information that will help them to understand and form opinions during the evolution of a particlar legislative process. The semantic ground of legal information is in Lex-is Ontology that show us what and how legal information are stored and how this legal information are interrelated.

- Drive the argumentation system (what are the states and processes of the argumentation and/or legislative process). In the argumentation system, the Lex-is ontology define aspects of the stored information (i.e. what are the stage/state of the legislative process, which documents belongs to which stage/state, etc.). In the Fig.1 we present Legal_Element Class of the Lex-is ontology, in the OWL 1.1 abstract format.

Using this ontology, we can obtain information about the legislative can be acquired through the ontology: how a legal element is decomposed into its basic elements (annexes, articles, paragraphs, phrases and keywords). For example, we consider the regulation with Celex number 32006R1052 from EurLex. Using the Lexis ontology we obtain the decomposition of this regulation into its basic elements in the Fig. 2:

Lex-is ontology can play the role of proving dictionaries for tagging, storage and retrieval of legislations and classification and interrelation of the legal documentation. We use SPARQL language for querying the LEX-is ontology. For example, if we want to find all Legal Element publisher in Official Journal OJ L 189, 12.7.2006, we use the following query in SPARQL in Fig. 3.

Using Lexis ontology, we show the role of this ontology for improving legal knowledge dissemination through proving dictionaries for tagging, storage and retrieval of legislations and classification and interrelation of the legal documentation.

```
SELECT ?Legal_Element
WHERE
{?Legal_Element  ?hasOfficialJournal
"OJ L 189, 12.7.2006"}
```

Figure 3. Query in SPARQL.

[5] Lex-is, Web page project : http://www.lex is.eu/default.aspx?page=home

[6] Lex-is" Project - D1.3 - Ontology for Legal Framework Modelling, 2007 : http://www.lex-is.eu/upload/deliverables/0402F10-LEXIS-OntologyforLegalFrameworkModelling.pdf

```
Class(Legal_Element partial Legal_Entity
annotation(rdfs:comment " The class Legal_Element
refers to laws, presidential decrees and constitutions
at national level and directives, recommendations,
regulations, decisions and agreements at pan-European
 context ")
DisjointClasses(Preparatory_Act Argument Activity Action
 Legal_Rule Event
Legal_Framework Legal_Structure_Decomposition)
restriction(hasDateValid (cardinality (1) xsd:int)
restriction(hasDate (cardinality (0) xsd:int)
restriction(hasDateEffect (cardinality (1) xsd:int)
restriction(hasDateIssued (cardinality (1) xsd:int)
restriction(hasDateOfSignature (minCardinality (0) xsd:int))
```

Figure 1. Legal_Element class of the Lex-is ontology.

```
Legal Element(32006R1052)
hasLegalForm(32006R1052, EU Regulation),
hasTitle(32006R1052,COMMISSION REGULATION (EC)
No 1052/2006
of 11 July 2006 amending Regulation (EC) No 2222/2000
laying down financial rules for the application of Council
Regulation (EC) No 1268/1999 on Community support for
pre-accession measures for agriculture and rural development
in the applicant countries of central and eastern Europe in the
pre-accession period (Sapard),
hasArticle(32006R1052, Art1), has Article(32006R1052,
Art2), hasOfficialJournalIdentifier(32006R1052, OJ L 189,
12.7.2006)
```

Figure 2. Decomposition of 32006R1052 regulation.

VI. RELATED WORK

Legal knowledge dissemination involve specialists for making explicit their knowledge and communication for translating that knowledge into understandable information. To improve the quality of legislative language and to facilitate legal experts and citizens in accessing legislation we propose using legal ontologies.

Many ontologies of law may be defined, their components depending mainly upon the task for which these ontologies are built for. We discuss some dimensions to distinguish types of legal ontologies, for example considering their level of structure [16].

- Organize and structure information - In theory, an ontology is a"formal, explicit specification of a shared conceptualization. The basic role of ontologies is to organize and structure information in the domain. Two examples of this use are the Jur-Wordnet ontology and CRIME.NL, an ontology of Dutch criminal law that was constructed with the specific aim to be re-used and adapted for Italian and Polish criminal law [4].
- Semantic indexing and search - The legal ontology here works as a semantic index of information, which enables semantic search for content. There is a key need to organize and be able to find these documents. Ontologies can be used to represent and search semantically the content of documents to go beyond word or keywords. In this sense, we present two ontologies: FAQ (Frequently Asked Questions) and CLIME [4].
- Semantics integration / interoperation - The basic role of ontologies in this case is to support applications to exchange information electronically. The ontology here works as an interlingua that defines a (narrow) vocabulary to be used to interchange information. An example of this type of ontology is LKIF Ontology.
- Understand a Domain - The ontology here works as a map that specifies what kinds of knowledge can be identified in the domain. These types of ontologies have been called core ontologies. Some notable examples are the Functional Ontology of Law (FOLaw) created by Valente and Breuker and LRI-Core.
- Reasoning and problem solving - The basic role of ontologies in this case is to represent the knowledge of the domain so that an automated reasoner can represent the problems and generate solutions for these problems. The ontology here works as the structure of the knowledge base.

VII. CONCLUSION

We have presented an ontological approach of legal literature for improving legal knowledge dissemination. Dissemination of legal knowledge should take into account that current accessibility of sources of law does not suffice to serve legal and non legal professionals. Considerable attention for improving legal knowledge dissemination has been given for design of legal argumentation management system. To be useful, such systems offer tools for legal evidence and proof that support lawyers in improving their formulation of arguments [13].

From a legal knowledge dissemination viewpoint we must mention work on a computer program called SMILE+IBP (Smart Index Learner Plus Issue-Based Prediction) bridges case-based reasoning and extracting information from texts. The role of this computer program is to extract information from textual description of the facts, based on ProPs (Propositional Patterns) to decided cases and apply that information to predict and explain the outcomes of new cases [1].

The same idea we must discuss about PADUA (Protocol for Argumentation Dialogue Using Association Rules) that models argument from experience. PADUA enable agents to engage in a persuasion dialogue regarding classification of a new example, and its application to examples in the legal domain [11].

In this sense we want to show the roles of two legal ontologies LKIF core Ontology and Lex-is Ontology for improving Legal Knowledge Dissemination. An ontological approach-based on the specifying the meaning of legal concepts and their relations contribute to our ability of understanding legal norms and the commitments we undertake when representing legal information and addressing legal issues [15].

The LKIF Core Ontology provides LKIF with a legal content that not only supports knowledge acquisition and knowledge interchange in legal domains, but provides framework for some basic legal inference, such as reasoning with deontic qualification over norms. Legal norms specify under what condition an intermediate legal concept applies to an entity. LKIF Core Ontology can be used for reasoning as central knowledge component for knowledge systems. An

ontology to support case-based reasoning is provided so as to represent the parts and relationship among cases in a case base. Norms which are qualified in deontic terms are used to assess cases. If there is no discrepancy between what is in the description of a case and what a legal norms prescribe, the case is allowed. If there is one or more discrepancies violations - the case is a disallowed or illegal, and law may also prescribe a sanction.

Processes, agents, actions and roles are concepts involved in reasoning about responsibility and causation in law, the notion of norm and propositional attitude enable reasoning about norms and norms violation. Exploration of expressive ontology as LKIF Core Ontology design patterns for the representation of social reality, change and causation, actions, which become parts of causal propagation.

Lex-is legal ontology enables structure the underlying legal domain with the objective to augment the participatory capabilities of simple stakeholders by supporting them in their need for understanding and interpreting legal information. To this end the LEX-IS ontology adds semantic grounds to legal information by decomposing it into basic classes (i.e. annex, articles, paragraphs, etc) and further interrelates this information with participation-related entities such as legal rules, arguments, opinions, participative activities, etc. . Lex-is ontology can play the role of proving dictionaries for tagging, storage and retrieval of legislations and classification and interrelation of the legal documentation. Lex-is ontology ensure efficient retrieval by enabling inferences based on domain knowledge to obtain a conceptualization share [14].

REFERENCES

[1] K. D. Ashley, S. Bruninghhaus, "Automatically classifying case texts and predicting outcomes", Artificial Intelligence and Law, 17:125–165, 2009.

[2] A. Boer, R. Winkels, F. Vitali. "Metalex and LKIF", In The Twentieth Annual Conference Annual Conference, pages 19–28, 2007.

[3] J. Breuker, R. Hoekstra, A. Boer, K. van der Berg, G. Sartor, R. Rubino, A. Wyner, T. Bench-Capon, "Owl ontology of basic legal concepts LKIF core", 2008.

[4] J. Breuker, A. Valente, R. Winkels, "Legal ontologies in knowledge engineering and information management", Artificial Intelligence and Law, 12:241–277, 2004.

[5] J. Breuker, van de Ven, S.El-Ali, M.Bron, R.Hoekstra, S.Klarman, U.Milosevic, L.Wortel, "D4.6. - Developing HARNESS Towards a hybrid architecture for LKIF", 2008: http://www.estrellaproject.org/doc/Estrella-D4.6.pdf.

[6] E. Francesconi, G. Peruginelli, "Integrated access to legal literature through automated semantic classification", Artificial Intelligence and Law, 17:31–49, 2009.

[7] T. F. Gordon, "Constructing legal arguments with rules in the legal knowledge interchange format (LKIF)", In P. Casanova and et al, editors, Computable Models of the Law, LNCS 4884, pages 162–184. Springer-Verlag, 2008.

[8] R. Hoekstra, J. Breuker, M. Di Bello, and A. Boer. "The lkif core ontology of basic legal concepts", Legal Ontologies and Artificial Intelligence Techniques, 2007.

[9] [9] J. Lehmann, J. Breuker, B. Brouwer, "Causation in AI and Law", Artificial Intelligence and Law, volume 12, Number 4, December 2004, pp.279-315(37).

[10] [10] J. Lehmann, J. Breuker, B. Brouwer, "CAUSATIONT: modeling causation in AI & Law", Law and the Semantic Web, page. 77-96, 2003.

[11] F. C. Maya Wardeh, Trevor Bench-Capon, "PADUA: A protocol for argumentation dialogue using association rules", Artificial Intelligence and Law, 17:183–215, 2009.

[12] L. Mommers, W. Voermans, W. Koelewijn, H. Kielman, "Understanding the law: improving legal knowledge dissemination by translating the contents of formal sources of law", Artificial Intelligence and Law, 17:51–78, 2009.

[13] H. Prakken. "Formalising ordinary legal disputes: a case study", Artificial Intelligence and Law, 16:333–359, 2008.

[14] M. Saravanan, B. Ravindran, S. Raman, "Improving legal information retrieval using an ontological framework", Artificial Intelligence and Law, 17:101–124, 2009.

[15] G. Sartor, "Legal concepts as inferential nodes and ontological categories", Artificial Intelligence and Law, 17:217–251, 2009.

[16] A. Valente, "Types and Roles of Legal", In Benjamins, V. R. et al. (eds.) Law and the Semantic Web. Springer: Berlin/Heidelberg, DE, 65-76.