UFO-L: A Core Ontology of Legal Concepts Built from a Legal Relations Perspective

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1 RESEARCH PROBLEM

Computer and Law is a transdisciplinary research field, which has received increasing attention from researchers in the past twenty-five years (Bench-Capon, T. et al, 2012). The problem of presenting the legal domain has been investigated in different perspectives by researchers, such as (Stamper, 1977), (Hafner, 1980), and (McCarty 1989), one of them is the ontological perspective. From NORMA proposed by (Stamper, 1991) to JudO ontology used in the Judiciary Framework proposed by (Ceci, 2013) and to LOTED2 proposed by (Distinto et al., 2014), ontologies have been used as a means of representing legal concepts. Specifically, there are some kind of ontologies called legal core ontologies (LCO), which represent generic legal concepts (*e.g. legal norm, legal fact,* and *legal relation),* usable in different legal domains. Some examples of legal core ontologies are: FBO proposed by (Kralingen, 1997), FOLaw proposed by (Valente, 1995), Core Legal Ontology (CLO) proposed by (Gangemi, 2007), and LRI-Core built by Leibiniz Centre for Law Research Group (Breuker and Hoekstra, 2004b).

Ontologies are a response for the paradigm shift, from static data storage in databases disconnected to Linked Data and Semantic Web (Isotani and Bittencourt, n.d), (Kuhn et al. 2014). Specifically, the use of core ontologies in complex domains, such as the legal domain, allows: 1) the reusability of generic concepts and semantic interoperability; 2) the expressiveness gain in languages based on ontologies, as well as clarity and correctness of the represented domain (Guizzardi, 2005).

Despite the efforts of researchers in the search for a computational solution that satisfactorily represent the legal domain, frequently research has not taken into account the use of legal theories, resulting in a gap between the conceptualizations that are typically considered in the areas of Computer Science and the study of the Law. In a preview systematic mapping of the literature on legal core ontologies, from 128 studies selected, in the time interval of 1995-2014, we have found out that only 35 (approx. 27%) used primary sources of legal theories; 44 studies (approx. 34%) used indirect sources (e.g. use a LCO based on a legal theory to build a domain ontology); and 49 studies (approx. 38%) did not use any legal theory as primary source (Griffo et al., 2015a).

This *gap* has been the subject of several papers, among them, the paper *Artificial Intelligence and Legal Theory at Law Schools* written by Gordon (Gordon, 2005), who suggested the introduction of an interdisciplinary subject in law schools. Also, in the paper *Ontologies: the Missing link between Legal Theory and AI & Law,* (Valente and Breuker, 1994) ontologies are presented as a *missing link* between AI & Law, emphasizing the importance of using legal theories as basis in Computer and Law research. Recently, Casanovas (Casanovas, 2012) wrote about the remaining *gap,* pointing out the nature of legal world and the computational reductionism as causes of this *gap.* In fact, to conduct research in a field composed by two distinct knowledge areas, it is necessary to have a consistent knowledge of both areas in order to produce suitable solutions.

If we assume the premise that the use of legal theories decreases the gap between Computing and Law, then the next question is: what particular legal theory should be considered by the ontologist? We defend, in this Ph.D. proposal, that the choice of a legal theory must take into account the needs of the contemporary juridical world. In this sense, the choice of a legal theory that does not take account the importance of principles as legal norms will result in a non-flexible computing solution, distant from the juridical reality. For this reason, we have chosen Alexy's Theory of Fundamental Rights (Alexy, 2010), (Alexy, 2003) as proposed in (Griffo et al., 2015b).

Alexy's theory of Constitutional Rights or Alexy's theory of Fundamental Rights addresses some problems of Legal Positivism by proposing the (1) *Structure of Constitutional Right Norms* and the

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(2) *Weighing and Balancing structure* (Alexy, 2010). The scope of this proposal is the first part of the Alexy's Theory, which creates a basis for the second part.

Under the computational perspective, (Guizzardi, 2005), (Guizzardi et al., 2008), have shown the consequences of building ontologies (core ontologies, domain ontologies, application ontologies) without the use of foundational ontologies, which are: inconsistency, incorrectness and incompleteness, denominated in the literature as quality characteristics (Kececi and Abran, 2001). In this context, the construction of the LCO proposed here is based on the Unified Foundational Ontology (UFO) and propose a new layer for UFO. This layer (called UFO-L) will represent the generic legal concepts extracted from selected legal theories as shown in Figure 1.

The generic concepts existing in UFO will provide a basis for legal concepts in UFO-L. For instance, the use of *relators,* an existing concept in UFO, will be used to represent legal relations. According to Guizzardi (Guarino and Guizzardi, 2015) a *relator* is an objectified relational property that is existentially dependent on more than one *individuals* (e.g. marriage, medical treatment, legal relation).

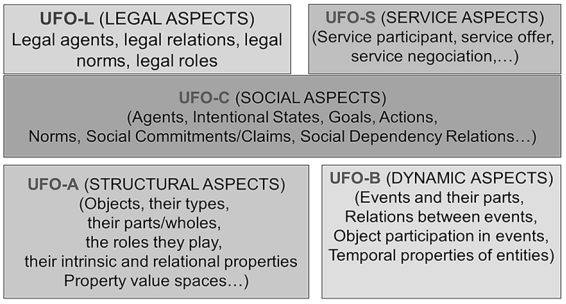

Figure 1: Unified Foundational Ontology - UFO (Guizzardi, 2005) (adapted).

Usually, legal ontologies are built under the Kelsen's Pure Theory of Law perspective rather than a subjective perspective that highlights legal relations (e.g. FBO, FOLaw, CLO). We propose removing the focus of legal norms and put it in legal relations (subjectivist view). As a result, we expect to achieve a legal core ontology that comes closer honor the current practice in the area of Law.

With this subjective perspective it is expected to achieve more flexibility, completeness, and consistency to model legal domains. Also, it is expected to decrease modeling costs with the reuse of generic concepts provided by LCO and decrease the effort to execute semantic interoperability between legal domains.

In addition, this research aims to answer the following questions: Is the use of ontologies effective to represent the contemporary legal world from the legal relations perspective? What benefits does the LCO provide for modeling legal domains?

For this work, we use some legal definitions as follows.

Norm: A *norm* is defined as "the meaning of a normative enunciation" (Alexy, 2010). *Norms* are classified as *deontological (or legal) norms* and *axiological norms*. By turn, the *deontological norms* are classified as *rules* and *principles*. *Principles* are optimization requirements, which have different degrees of satisfaction (degree of fulfillment) depending on both factual and legal aspects. On the other hand, *rules* are norms, which are or fulfilled or not. (Alexy, 2010).

Legal Relation: is a *bond* between subjects achieved by the existence of a *legal fact*. In other words, it is the *social relation* typified in a *legal norm.*

Legal Theory: In a simple definition, a legal theory is a body of systematically arranged fundamental principles in order to discuss and describe *the ontological problem of law* under a specific perspective.

2 OUTLINE OF OBJECTIVES

The main goal of this thesis proposal is summarized as follows: We aim to build a legal core ontology with a relational perspective based on a structural legal theory of fundamental rights. For this, we will use Alexy's Theory (Alexy 2010), (Alexy, 2003), a contemporary legal theory, to extract the essential legal concepts and relations in order to contribute for decreasing the gap between Computer and Law. It is out of the scope to develop an approach for legal argumentation (dynamic issues).

Also, to build a consistent ontology and obtain ontological quality, we will ground the legal core ontology in a foundational ontology - the Unified Foundational Ontology (UFO). To achieve this goal, the following subgoals are considered:

1. To develop a systematic mapping of the literature on legal core ontologies and a comparative analysis of the existing legal core ontologies;
2. To build the legal core ontology (UFO-L layer) based on UFO as shown in Figure 1;

3. To validate UFO-L through empirical experiments with participants from Computer Science and Law and case study.

3 STATE OF THE ART

The concept of ontology has its origins in Philosophy (as a field of study and as a system of categories and their ties). However, in the past 2-3 decades, it has been adapted to Computer and Information Science to mean frequently a formal representation of a particular system of categories and their ties (Guizzardi, 2005), (Guarino, 1998). From this convergence, Guarino (Guarino, 1998), Gruber (Gruber, 1995), and Staab (Staab et al., 2001) propose definitions, methodologies and classifications of ontologies.

According to Gangemi *apud* Oberle (Oberle, 2006), ontologies are classified either by their specificity or by their purpose. Related to specificity, ontologies are: 1) foundational ontology; 2) core ontology; and 3) domain ontology. Related to purpose, ontologies are: 1) reference ontology; and 2) application ontology. Figure 2 shows ontologies from more specific to more general level.

A *foundational ontology* defines a set of domain-independent ontological categories. In turn, a *core ontology* defines a set of fundamental concepts of a field of knowledge (e.g. services, collaboration, law, organizations, software) that are still general concepts that occur across multiple domains; *core ontologies* are middle-level ontologies often built by reusing and/or extending a foundational ontology (Nardi et al., 2013); finally, a *domain ontology* is meant to capture a set of concepts from a specific domain (e.g. Brazilian law). *Foundational ontologies*, such as UFO (Guizzardi, 2005) and DOLCE (Masolo et al., 2003) are useful in building LCO because they can help to bring both ontological consistency and completeness to the process. For instance, the OPJK ontology used concepts as *agent, role, document, process,* and *act* from DOLCE Lite + CLO, SUMO, and PROTON (*apud* Caralt, 2008).

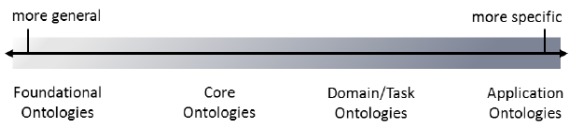

Figure 2: Generality level of ontology as a continuum (Falbo et al, 2013).

In the literature, the expression "*legal core ontology"* began to be used in middle 90' by Valente et al (Valente and Breuker 1996), and Breuker et al (Breuker et al. 1999). Among the most cited *legal core ontologies* in the literature are:

Frame-Based Ontology (FBO) proposed by (Kralingen, 1997), based on legal positivism (Hart, Kelsen, van Wright, and Ross theories) and written in Ontoligua. It is a mix of foundational categories and legal core concepts. The core of this ontology is the concept of norm and the related concepts of norm subject, legal modality, and description of the act.

Functional Ontology of Law (FOLaw) proposed by (Valente, 1995), written in Ontolingua, it is based on Kelsen, Hart and Bentham theories, and has a functional perspective and a knowledge-perspective (normative knowledge, responsibility knowledge, reactive knowledge, creative knowledge, and meta-level knowledge). As this ontology is based on Kelsen's theory, basically, norms are only rules, which are either observed or violated.

Hage and Verheij's Ontology. Proposed by (Hage and Verheij 1999), it was written in First-Order Logic and based on Dworkin and Alexy's theories of norms classification (norms are rules and principles). For them, a legal ontology is an interconnected dynamic system of state of affairs. The main categories of this ontology are individuals (state of affairs, events, and rules) and, similar to FBO's ontology, it mixes foundational concepts with legal core concepts.

Core Legal Ontology (CLO) proposed by (Gangemi, 2007) and written in OWL-DL, it is the first LCO that was constructed in a way that it is grounded in an explicitly defined foundational ontology (DOLCE).

LRI-core/LKIF-core was built by Leibniz Centre for Law Research Group (Breuker and Hoekstra, 2004), , and written in OWL+DL. It is grounded in different foundational ontologies (DOLCE, SUO, John Sowa's ontology). It has later evolved to **LKIF-CORE**, which has been built by the same group (Hoekstra et al., 2007), (Hoekstra et al., 2009).

PROTON+OPJK is a combination of ontologies built inside the SEKT European project. PROTON is a foundational ontology based on common sense concepts. OPJK (Caralt, 2008) is an ontology which contains relevant legal domain specific knowledge. Although, at first sight OPJK can be considered a legal domain ontology, it also contains several generic concepts that can be reuse in different legal domain ontologies (e.g. judicial

organization, judicial role), which gives it a flavor of a core ontology.

NM-L Ontology, coded in Prolog, is a ontology for legal reasoning proposed by (Shaheed et al., 2005). It was built as an extension of Naïve Metaphysics Ontology (NM Ontology) proposed by (Schneider, 2001), which is based on descriptive metaphysics of Strawson and Parson's roles. They developed a "naïve notion" on *ownership* using as basis the concepts *permitted, forbidden, obligatory and enabled* extracted from (Hohfeld, 1913), (Hohfeld, 1917) and (McCarty, 2002).

Ontology of Professional Judicial Knowledge (OPJK) proposed by (Casellas, 2011) is based on PROTON and other foundational ontologies, such DOLCE. Although OPJK is introduced as "a legal ontology developed to map questions of junior judges to a set of stored frequently asked questions", there are generic legal concepts in OPJK that put this ontology in the border between core and domain ontologies.

Ontological Model of Legal Acts proposed by (Gostojic and Milosavljevic, 2013), is a formal model of legal norms modeled in OWL. The purpose of this ontology is to support the retrieval and browsing of legislation. They represent legal relations as a social relation regulated by legal norm and relate rights and duties to this legal relation, but omit other existing legal positions (e.g. permissions, non-rights).

LOTED2 Core Ontology proposed by (Distinto et al., 2014) is a legal ontology of European public procurement notices, designed to support the creation of Semantic Web Applications. It was built by employing used concepts from LKIF-core ontology schema and it was coded in OWL.

The systematic mapping of the literature on legal core ontologies indicated the foundational and core ontologies more used to base on legal ontologies as shown Figure 3.

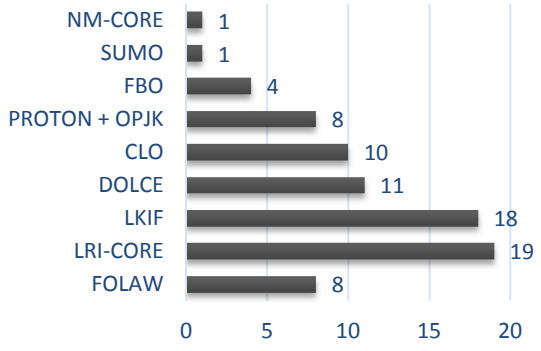

Figure 3: Use of foundational and core ontology in legal ontologies (Griffo et al., 2015b).

Other works related with legal domain representation cited in the literature, are: LEGOL, the seminal work, by Stamper (Stamper, 1977), NORMA (Stamper, 1991), Hafner's semantic work (Hafner, 1980), McCarty's language for legal discourse (LLD) (McCarty, 1989), Mommer's ontology (Mommers, 1999), Legal-RDF Ontology (McClure, 2007), LegalRuleML-core ontology (Athan et al., 2013), among others.

4 METHODOLOGY

The research will be primarily theoretical (bibliographical and documentary research methods), but also empirical (experiments).

The bibliographical method will be used to develop the systematic mapping study, which will map the state of the art on legal core ontologies. The guidelines proposed by (Petersen et al., 2008) and will be used for this method.

The documentary method is a systematic analysis of relevant documents (primary sources) with contents on the subject to be investigated (Mogalakwe, 2006). It will allow the analysis of laws, doctrines and jurisprudence in order to create a consistent theoretical legal basis. In this context, the representation of legal concepts, such as legal norm, legal relation, legal position, will be elicit from these sources. In addition, the experiments will evaluate the results of this research by criteria of legal correctness.

From the theoretical research, comparative studies on the main legal core ontologies (CLO, LRI-Core) will be produced to strengthen the importance of building a legal core ontology with a different legal perspective.

Regarding the method used for the development of ontology, the method will be iterative and incremental, starting with the representation of fundamental legal relations concepts, and then the study of other concepts, for instance, legal facts, legal agents, legal norms, and legal objects from documentary sources. Also, some methodologies applied to ontology development have been studied, for instance (Uschold and Gruninger, 1996), (Uschold and King, 1995).

Regarding the empirical research method, the purpose is to validate the hypothesis previously outlined and verify the model by ontological criteria of correctness, clarity, consistency, and coherence.

The experiments have the goals of, firstly, to know if the UFO-L legal concepts can be used to represent a legal domain, taking into account some

characteristics of modeling (rationality, facility, clarity, consistency, coherence and completeness). Secondly, to know if professionals in conceptual modeling, working in legal institutions, can use the UFO-L legal concepts to model legal domains and how the conceptual modeling background can influence the results. Finally, to know if legal experts can interpret adequately the models built by the beginners and professionals in conceptual modeling using UFO-L legal concepts. The expected result is that UFO-L be a bridge between computational technical end users and law end users, bringing expressivity, reusability and semantic interoperability for legal domains.

The experiments are the following:

Experiment 1:

Participants: undergraduate students with previous knowledge of UML and conceptual modeling.

Method: Legal scenarios will be provided to be modeled using UML and, also, using concepts of UFO-L. A form is presented at the end of the experiment to check characteristics of the concepts represented (e.g. clarity, consistency, completeness). An additional individual form will be filled to point out the difficulties and impressions faced by participants.

Hypothesis 1. The use of concepts of UFO-L, especially legal relators brings clarity and completeness to the model built since legal relators make explicit all existing elements in a legal relation.

Hypothesis 2. The legal concepts in UFO-L can improve the modeling ability of legal relations because the reuse of existing concepts in a generic level.

Experiment 2:

Participants: Professionals from Computer area with experience in conceptual modeling of legal domains and UML.

Method: The same legal scenarios provided in the experiment 1 will be provided to be modeled using UML and Concepts of UFO-L by these participants. In addition, the same forms submitted to Group 1 will be answer by participants in this experiment.

Since the modeling background can bring some bias to the experiment, the purpose of this experiment is compare the results of the Experiment 1 with Experiment 2 to analyze the influence of the modeling background.

Experiment 3:

Participants: Law experts (e.g. lawyers, judges, legal analysts), decision makers to implement technological solutions with or without experience in conceptual modeling (e.g. coordinator of TIC departments in Judicial Courts, Public Prosecutor's Offices, Attorney's Offices).

Method: The experiment will have two phases. In the first phase, legal concepts of UFO-L and a form to verify some characteristics (e.g. correctness and clarity) of these concepts will be presented. In the second phase, a model built with UFO-L will be provided to be interpreted by the participants. At the end, a form will be provided to evaluate the understanding of the participants (how clear and easy to understand is UFO-L? How close the legal concepts in UFO-L are to the real legal issues?). An additional form will be answered by the participants to point out the difficulties and the impressions each participant had on existing legal concepts in UFO-L.

Hypothesis 3. The use of concepts of UFO-L, especially legal relators, in legal domain modeling, permits law end users to understand the model built by ontologists and "speak" the same language used by them.

Hypothesis 4. The legal concepts in UFO-L can improve the modeling process, increasing the *understanding* between law experts and computer professionals.

5 EXPECTED OUTCOME

The main expected results are: 1) systematic mapping study on legal core ontologies and publication of results (Griffo et al, 2015b); 2) Experiments conducted in several research groups and legal institutions with the publication of results; 3) Legal core ontology (UFO-L) based on UFO with the publication of results. A part of the taxonomy of legal relations is shown in Figure 4; and 4) Defense of the thesis and publication. The time line is shown in Table 1 (year/semester).

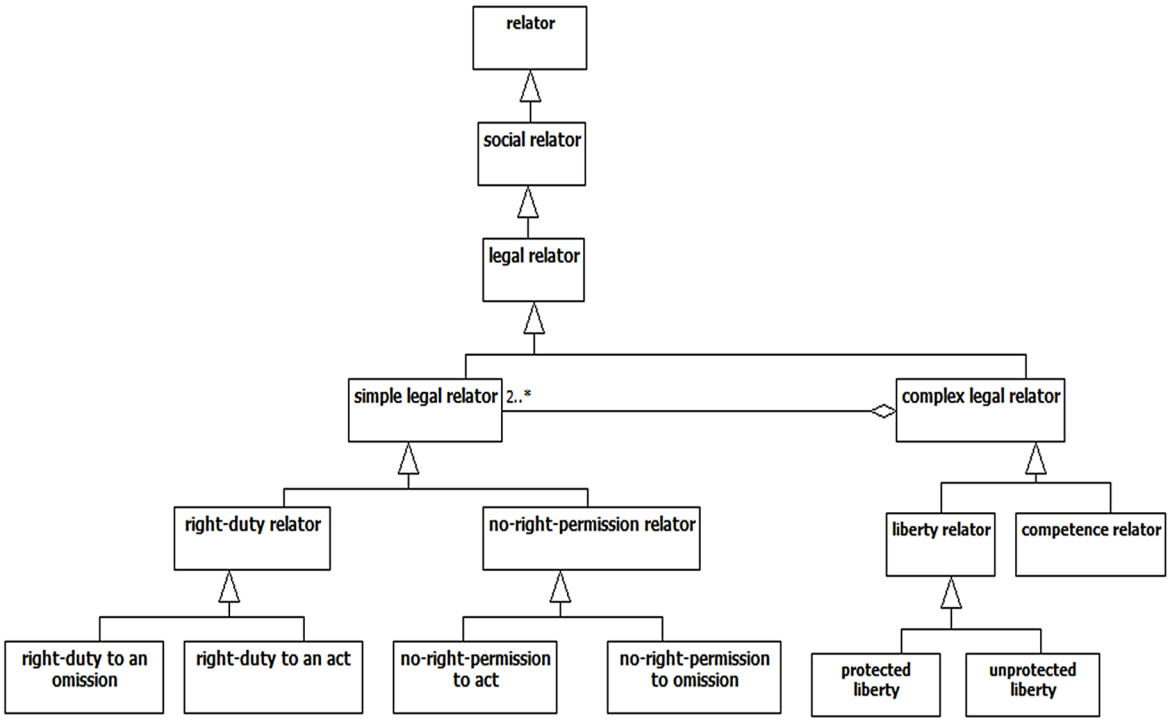

Figure 4: fragment of legal relators taxonomy (Griffo et al., 2015b).

Table 1: Schedule of activities.

	2015 1-2	2016 1	2016 2	2017 1	2017 2
Systematic Mapping	x				
Experiment 1	x				
Experiment 2		x			
Experiment 3		x			
Modeling – UFO-L	x	x	x	x	
Validation and verification	x	x	x	x	
Defense of Thesis Proposal			x		
Publishing results	x	x	x	x	x
Defense of the thesis					x
Publication of the thesis					x

6 CURRENT STAGE OF THE RESEARCH

The research concluded the systematic mapping study and the results (universe, sample, sources, research questions, exclusion and inclusion criteria, process used, analysis of results, list of selected papers, and biases) were published in Brazilian Conference on Ontologies 2015 (Ontobras'15) (Griffo et al., 2015a).

In addition, the first results of UFO-L (taxonomy of legal relators, computer and legal theoretical bases) were published in Workshop Multilingual on Artificial Intelligence and Law held on Artificial Intelligence and Law (MWAIL-ICAIL 2015) (Griffo et al., 2015b). A recent model of UFO-L has been developed and will be published next year.

The comparative analysis of existing legal core ontologies (CLO, LRI-Core, UFO-L) is under development, as well as a comparative analysis between existing legal concepts in computational approaches published in the literature and legal concepts represented in UFO-L.

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