A Comparison of Two Legal Ontologies

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Abstract[1]

In this paper we compare two different ontologies of the legal domain: Valente's functional ontology of law, and the ontology of Van Kralingen and Visser. We present criteria for a comparison of the ontologies and discuss their strengths and weaknesses.

1. Introduction

This article reports on a study into explicit conceptualisations of the legal domain, now widely referred to as (legal) ontologies. We compare two such ontologies, namely Valente's law functions and Van Kralingen and Visser's frame-based ontology. Both ontologies are intended to be (re)usable in the creation of legal knowledge systems. Our aim is to compare the ontologies, to assess their merits and thus, to contribute to future work on legal ontologies. We start by briefly discussing each ontology (section 2). Thereafter, we introduce a set of ontology-comparison criteria (section 3) and compare the ontologies using these criteria (section 4). Finally, we discuss the results, draw conclusions and provide suggestions for future research (section 5).

2. Legal Ontologies

In this section we briefly introduce the two ontologies of the legal domain. We use the abbreviations LFU for Valente's Functional Ontology of Law (Valente, 1995), and FBO for the Frame-Based Ontology of Van Kralingen and Visser (Van Kralingen, 1995; Visser, 1995; Visser and Bench-Capon, 1996a; 1996b).

2.1 Valente's Ontology of Law

Valente's ontology of law (1995) is based on a functional perspective of the legal system. The legal system is considered an instrument to change or influence society in specific directions, determined by social goals. Its main function is reacting to social behaviour. This main function is decomposed into six primitive functions, which, according to Valente each correspond to a category of primitive legal knowledge in LFU. Accordingly, LFU distinguishes six categories of legal knowledge: (a) normative knowledge, (b) world knowledge, (c) responsibility knowledge, (d) reactive knowledge, (e) meta-legal knowledge, and (f) creative knowledge. Below, we discuss each of these categories (an ONTOLINGUA specification of the ontology is given in Valente, (1995)).

(a) *Normative Knowledge*

Normative knowledge is characterised as knowledge that defines a standard of social behaviour. It thereby prescribes behaviour of the people in society. The standard is defined by issuing individual norms, expressing what ought to be the case. Because the norms contained in this category closely correspond to Hart's primary norms (Hart, 1961), Valente adopts this name for the norms in this category. It should be noted however, that not all legal norms are contained in this category, some legal norms - for instance Hart's secondary norms - are contained in the category of meta-legal knowledge (see below). Primary norms prescribe approved and disapproved behaviour by assigning a normative status to situations (acts are indirectly linked to norms since acts bring about situations). A primary norm either tags a situation according to the normative status allowed, and disallowed, or it does not give a normative status to the situation in which case the norm is said to be silent.

(b) *World Knowledge* (*Legal Abstract Model*)

In LFU world knowledge is legal knowledge that describes the world that is being regulated. It delineates the possible behaviour of (people, and institutions) in society, and thereby it provides a framework to define what behaviour ought (and ought not) to be performed. An example of world knowledge for traffic-law regulations is that a car, and a bicycle are driven by drivers, and that a bicycle is usually slower than a car. Because the legislation implicitly assumes a model of the world, World Knowledge is also referred to as the Legal Abstract Model (in the remainder we refer to World Knowledge as Legal Abstract Model - or LAM - to avoid confusion between legal and non-legal world knowledge). The LAM can be considered an interface between the commonsense knowledge of people in society (*cf.* consensus reality knowledge, Lenat and Guha, 1990) and

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[1] An extended version of this article ('A Comparison of Four Ontologies for the Design of Legal Knowledge Systems'; Visser and Bench-Capon, 1997) will appear in Artificial Intelligence and Law. In that article we compare - besides the two ontologies discussed here - also McCarty's LLD and Stamper's NORMA.

the normative knowledge. Within the LAM, two separate knowledge categories are distinguished: (b.1) definitional knowledge, and (b.2) causal knowledge. The definitional knowledge (b.1) is the static part, it consists of definitions of (b.1.1) legal concepts (e.g., agents, objects), (b.1.2) legal relations (e.g., legal qualifications of actions), (b.1.3) a case (*viz.* the problem case under investigation), (b.1.4) circumstances (*viz.* the grounded facts, or, building blocks of a case), (b.1.5) generic cases (*viz.* typical generic legal cases), and (b.1.6) conditions (*viz.* the building blocks of the generic legal cases). Together these constructs provide a vocabulary which can be used to describe the relevant aspects of the world under a specific perspective taken by the legislator. The causal knowledge (b2) is the dynamic part, describing the behaviour of people in society in terms of the definitional knowledge. This part of LFU has not been elaborated thus far.

(c) *Responsibility Knowledge*

Responsibility knowledge is legal knowledge that either extends (assigns), or restricts the responsibility of an agent for its behaviour. Its function is to provide the legal means to reject the common idea that someone is only responsible for what one causes. Restricting or assigning responsibility is done by (dis)establishing a link between the violation of a norm and an agent which is to be considered responsible for this violation.

(d) *Reactive Knowledge*

Reactive knowledge is legal knowledge that specifies which reaction should be taken (and how) if an agent violates a primary norm. Usually, this reaction is a sanction but it can be a reward as well.

(e) *Meta-Legal Knowledge*

Meta-legal knowledge is legal knowledge about legal knowledge, or, legal knowledge that refers to other legal knowledge. This category of legal knowledge is roughly equivalent to Hart's secondary rules; it includes norms that refer to primary norms. Two basic functions are supported by meta-legal knowledge. First, it regulates the dynamics of the legal system, for instance, by prescribing how to make amendments, and how to issue new primary norms). Second, it provides mechanisms to solve conflicts between instances of legal knowledge. These two functions lead to the distinction of four sub categories of meta-legal knowledge: (e1) norm data, (e2) ordering norms, (e3) normative default, and (e4) validity knowledge. Norm data (e1) includes information about norms, such as their scope of application, their type, their place in the norm hierarchy, their power origin, their promulgation, and the norm goal. Ordering norms (e2) are norms that determine how to solve conflicts. Examples are the well-known meta-norms: *Lex Specialis derogat Legi Generali, Lex Superiori derogat Legi Inferiori,* and *Lex Posteriori derogat Priori.* Normative default (e3) determines what the legal status is of behaviour in case all primary norms are silent (see: normative knowledge). Finally, validity knowledge (e4) determines whether legal knowledge is valid. It comprises two types of norms: empowering norms (determine conditions under which norms can be promulgated and considered valid), and derogating norms (determine conditions under which existing norms can be rendered invalid).

(f) *Creative knowledge*

Creative knowledge is legal knowledge that allows the creation of previously non-existent legal entities. It usually is stated in imperative terms, designating an entity (e.g. a governmental committee, or, a contract between two parties) that previously did not exist to come into being from a certain point of time.

2.2 Van Kralingen and Visser's Ontology

Van Kralingen (1995) and Visser (1995) have studied development techniques for legal knowledge systems. One of the ideas underlying their work is that robust (conceptual and formal) ontologies of the legal domain are necessities for reducing the task-dependency of legal knowledge specifications. Although there are some minor differences between the (conceptual) ontology as defined by Van Kralingen, and the (formal) ontology as defined by Visser, their similarities allow us to treat them as one ontology.

The main ontological distinction in FBO concerns the *legal ontology* and the *statute-specific ontology*. Below, we discuss these ontologies in turn, a more elaborate discussion can be found in Van Kralingen (1995) and Visser (1995). An ONTOLINGUA specification of the legal ontology is given by Visser and Bench-Capon (1996b).

Legal ontology

The legal ontology, in contrast to the statute-specific ontology, is the generic and reusable part of the ontology. It divides legal knowledge over three distinct entities: norms, acts and concept descriptions. For each of these entities the ontology defines a frame structure that lists all attributes relevant for the entity. Norm, act, and concepts are briefly discussed below.

(a) *Norms* are the general rules, standards and principles of behaviour that subjects of law are enjoined to comply with. In the ontology a norm comprises the following eight elements: (1) a norm identifier (used as a point of reference for the norm), (2) a norm type (either norm of conduct or norm of competence), (3) a promulgation (the source of the norm), (4) the scope (the range of application of the norm), (5) the conditions of application (the circumstances under which the norm is applicable), (6) the norm subject (the person or persons to whom the norm is addressed), (7) the legal modality (either ought, ought not, may or can), and (8) the act identifier (used as a reference to a separate act description).

(b) *Acts* represent the dynamic aspects which effect changes in the state of the world. Within the category of acts we make two distinctions. The first distinction is between *events* and *processes*. Events represent an instantaneous change between two states, while processes have duration. The second distinction is between *institutional acts* and *physical acts*. The former type of acts are considered legal (institutional) versions of the (physical) acts that occur in the real world (more precisely: an institutional act is a legal qualification of a physical act). We note that these two distinctions result in four different types of acts. All acts are assumed to have the following thirteen elements: (1) the act identifier (used as a point of reference for the act), (2) a promulgation (the source of the act description), (3) the scope (the range of application of the act description), (4) the agent (an individual, a set of individuals, an aggregate or a conglomerate), (5) the act type (both basic acts, and acts that have been specified elsewhere can be used), (6) the modality of means (material objects used in the act or sub acts; e.g., a gun), (7) the modality of manner (the way in which objects have been used or sub acts have been performed) (e.g., aggressively), (8) the temporal aspects (an absolute time specification; e.g., on the first of August, on Sundays, at night, etc, but not: during a fire, after the King dies, etc), (9) the spatial aspects (a specification of the location where the act takes place; e.g., in the Netherlands, in Leiden, on a train), (9) the circumstantial aspects (a description of the circumstances under which the act takes place; e.g., during a war), (10) the cause of the action (a specification of the reason(s) to perform the action, e.g., revenge), (11) the aim of the action (the goal visualised by the agent; e.g., with a view to unlawfully appropriate an object), (12) the intentionality of an action (the state of mind of the agent; e.g., voluntary), and (13) the final state (the results and consequences of an action; e.g., the death of the victim).

(c) *Concept descriptions* deal with the meanings of the concepts found in the domain. They may be definitions or deeming provisions and can be used to determine definitively the meaning of a notion, either by, as in the case of the former, providing necessary and sufficient conditions, or, as in the case of the latter, establishing a legal fiction. Another type of concept is the factor, which may either establish a sufficient condition, or indicate some contribution to the applicability of the concept, as discussed above. Finally there are meta concepts which are provisions governing the application of other provisions. Concept descriptions comprise the following seven elements: (1) the concept to be described, (2) the concept type (definition, deeming provision, factor, or meta), (3) the priority (the weight assigned to a factor), (4) the promulgation (the source of the concept description), (5) the scope (the range of application of the concept description), (6) the conditions under which a concept is applicable, and (7) an enumeration of instances of the concept.

Statute-specific ontology

The legal ontology of FBO contains constructs that are thought to be generic for the legal domain. That is, norms, acts and concept descriptions are considered to be present in any legal domain. However, modelling a legal sub domain also involves deciding upon numerous ontological questions. For instance, is it necessary to distinguish between male and female employers in the Unemployment Benefits Act? This motivates the distinction between the legal and the statute-specific ontology. Basically, the statute-specific ontology consists of predicate relations that are used to instantiate the frames for norms, acts and concept descriptions. Van Kralingen and Visser argue that the statute-specific ontology cannot be reused for other domain, and should always be created for each legal sub domain under consideration.

3. Criteria for Ontology Comparison

Ontologies are dependent on the purposes they are made for (Chandrasekaran and Josephson, 1997). For this reason we deem the comparison of ontologies to be fruitful only if they are designed (roughly) for the same purpose. We have to examine the purposes the ontologies under investigation are designed for. Assessing the adequacy of the ontologies has to be done in the context of this purpose.

Both ontologies have been proposed as a basis for the design of legal knowledge systems. The authors claim to cover what is to be distinguished as the building blocks of legal knowledge. So, clearly, they make several commitments to the legal domain. With respect to task and method commitments both ontologies are intended to make few such commitments. The LFU ontology of Valente is thought to be an instrument to make domain knowledge reusable for different tasks and methods (Valente, 1995, p.23-24). The FBO ontology of Van Kralingen and Visser is explicitly designed so as to make as few task and method commitments as possible (Visser, 1995; p.11, pp.102-103).

The discussion above suggests that we should compare the ontologies with respect to their suitability in the design of legal knowledge systems for different legal tasks, methods and legal sub domains. This purpose can be used to draw up a set of ontology-comparison criteria. We note that different authors tend to distinguish different ontology criteria (*cf.* Bench-Capon, 1990; Schreiber, 1992; Gruber, 1993; Valente, 1995; Visser, 1995, Van Kralingen, 1995; Uschold and Grunninger, 1996). After an analysis of the AI and AI-and-Law literature, we adopt the following set of criteria:

(1) *Epistemological adequacy*: The epistemological adequacy of an ontology refers to the degree to

which the ontology resembles the cognitive framework of the human problem solver (Schreiber, 1992, p.26). Thus, it is a measure of the extent to which lawyers use the concepts and relations distinguished in the ontology. The epistemological adequacy comprises five sub criteria. We illustrate these criteria by listing some relevant questions that can be used to apply them.

(a) *epistemological clarity*: Do all concepts and relations in the ontology have a clear and unequivocal meaning? Does the ontology effectively communicate the intended meaning of the defined concepts and relations (*cf.* clarity; Gruber, 1993, p.2)?;

(b) *epistemological intuitiveness*: Do the ontological concepts and relations provide a vocabulary that matches the intuition of the experts in the domain (*cf.* notational convenience; Bench-Capon, 1990, p.17; *cf.* conceptual distance, Falkenberg, 1989)?;

(c) *epistemological relevance*: Are all the concepts and relations in the ontology relevant for modelling legal tasks, methods, and domains (*cf.* relevance, Bench-Capon, 1990, p.17);

(d) *epistemological completeness*: Does the ontology cover all legal concepts and relations that may be relevant for any combination of legal task, method and subdomain? Are there entities that cannot be modelled with the entities distinguished in the ontology?;

(e) *discriminative power*: Does the ontology have enough discriminative power in that it provides distinctions at a sufficiently high granularity level (*viz.* sufficient detail)?

(2) *Operationality*: The operationality of an ontology refers to the effort required to implement the ontological concepts and relations in a representational language (*cf.* Schreiber, 1992, p.122; *cf.* practical validity, Valente, 1995, p.43). Therewith, the criterion is a measure for the ease with which the concepts and relations in the ontology can be used as a basis for an operational language given a legal task, method and domain. We distinguish three sub criteria and list some relevant questions to apply them.

(a) *encoding bias*: Does the ontology rely on symbol-level choices? An ontology should be specified at knowledge level, an encoding bias results when a representation choice is made purely for the convenience of notation or implementation (*cf.* encoding bias; Gruber, 1993, p.3);

(b) *coherence*: Is the ontology coherently defined in that it is internally consistent? An ontology is not coherently defined (incoherent) if a sentence can be inferred from the definitions that is inconsistent with another definition or (informally specified) example (*cf.* coherence; Gruber, 1993, p.3).

(c) *computationality*: Does the ontology provide a suitable basis for (computational) representation, and is this representation computationally adequate?

(3) *Reusability*: The reusability of an ontology refers to the degree in which the ontology can be reused to conceptualise new legal tasks, methods and subdomains (this includes the extendibility of the ontology, being the degree in which the ontology can be extended without revising existing elements of the ontology; Gruber 1993, p.3). In our comparison of the ontologies (see: section 5), we distinguish two sub criteria.

(a) *task-and-method reusability*: is the ontology dependent on certain (types of) tasks and methods, or alternatively, to what extend is the ontology reusable for various methods and tasks?;

(b) *domain reusability*: is the ontology dependent on certain (types of) legal subdomains, or alternatively, to what extend is the ontology reusable for various legal subdomains?

Any list of ontology criteria is open to discussion; arguably criteria can be removed from the list or new criteria can be added to the list. However, we believe the above list of criteria to cover most common ontology criteria mentioned in the AI (and Law) literature. It should be noted that criteria such as `how well does the ontology communicate ontological commitments between different research groups' can be derived from the list above. This criterion would, for instance, be covered by the (more primitive) criteria: *epistemological clarity*, *epistemological convenience*, and *coherence*. Similarly, the criterion `how well does the ontology support the knowledge acquisition phase?' would be covered by criteria such as: *epistemological clarity*, *epistemological relevance*, *epistemological completeness*, and *discriminative power*.

4. The Two Ontologies Compared

The set of criteria discussed in the previous section allows us to compare the ontologies described in section 2. We stress that the opinions given here are the personal and subjective opinions of the authors (when we phrase the opinion of other authors, this is stated explicitly). In section 4.1 through 4.3 we discuss the ontologies focussing on each of the three main criteria, in turn. Th