

Chapter 1

Introduction: Theory and Methodology in Legal Ontology Engineering: Experiences and Future Directions

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1.1 Legal Ontologies *Come of Age*

Paraphrasing Deborah McGuinness' expression for referring to the maturity of the field of ontology engineering we can say that today legal ontologies have *come of age* (McGuinness 2003). A considerable number of research projects aimed at the application of semantic-web technologies to the legal domain have indeed enabled the accumulation of considerable experience in the field of ontology engineering, which is the activity (and the technology) meant to construct conceptual structures or ontologies (model of concepts and their relationships). Legal ontologies have been proposed as conceptual models for the most diverse legal applications, such as information retrieval, interoperability frameworks and inference drawing, among others. This explains the current wide typology of legal ontologies in terms of granularity (domain-specific vs. core), degree of formality (highly axiomatised vs. lexical or language-oriented), methodologies of development (top-down vs. bottom-up and middle-out), and knowledge sources for concept and term extraction (official legal sources vs. legal expert interview and ethnographic work).

However, as a field of study becomes mature, difficulties and shortcomings of current choices become visible and require collective reflection. The diversity of methodological approaches and theoretical underpinnings in legal ontology engineering indicate both that it is a fertile field in which diverse research programs, rooted in different disciplines, are flourishing (Natural Language Processing, Knowledge Management, Knowledge Engineering, . . .), and that there is a risk of losing coherence among these diverse disciplines if dialogue is not enhanced, with regard to a set of open issues. Firstly, we need to consider the interface between language and ontology, namely how close conceptual models of the law

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and their linguistic expression are and consequently what role automated terminology extraction can play in the construction of formal models for the law. Secondly, we need to manage the multilevel complexity of legal knowledge and in particular we need to address the connection between core legal ontologies, domain models and their textual representation. Thirdly, we need to justify epistemological choices regarding the definition of legal knowledge and the selection of its representative sources, and in particular we need to establish whether content patterns specific for the legal domain can be envisaged and are desirable. Fourthly, we need to examine to which extent the formal constraints imposed by ontological structures imply limitations on the complete and faithful representation of legal knowledge, and what is the place of legal ontologies in a comprehensive view of legal knowledge management systems. Furthermore, we need to investigate whether fruitful synergies between legal theory and formal ontological analysis can be obtained, provided that a common ground for reflection is clearly defined.

1.1.1 Legal Ontologies in Legal Thinking

Legal ontologies, while resulting from the new ICT developments above described (and first of all, from the need to bring legal knowledge into the Semantic Web, making it searchable and usable), are connected to some traditional concerns of lawyers and legal academics. On the one hand languages and methods for ontological engineering provide a new way of expressing ideas that have been traditionally part of legal thinking (the idea that legal concepts have a structure and are linked one to another) and on the other hand they enable a critical reassessment of legal thinking and its embodiment in different legal practices.

As it is well known there has been a vast debate in ontological research concerning the object of ontologies and their connection with scientific and common-sense knowledge.

Some of the most known ontologists, such as in particular Barry Smith, have adopted a realistic–scientific approach. Ontologies must provide us with the structure of reality as it is discovered by science, and indeed ontology is understood as “the science of what is, of the kinds and structures of objects, properties, events, processes and relations in every area of reality” (Smith 2003). This rigorous approach is often contrasted with the view according to which ontologies are meant to provide the structures through which agents conceptualise (possibly wrongly) reality, rather than reality itself. These conceptualisations (regardless of how much there are scientific and objective characterisations of the reality to which they apply) have an interest on their own, especially when one wants to provide people with tools whose functioning reflects people’s understanding and categorising of the world. Thus we have seen in recent years the emergence of folksonomies out of people’s practice in using the Internet and tagging content. Ways of getting out of the extreme subjectivism to which the ontology-as-conceptualisation approach may lead can be identified in relying on people’s consent (or negotiation aimed at consent) on the one hand, and on relying on the nature of our abstract cognitive

competence (in the quasi-Kantian perspective developed by Nicola Guarino) or in the outcomes of experimental cognitive sciences (as suggested by Joost Breuker).

With regard to the law the contrast between realism and subjectivism takes a particular dimension. The law has indeed an ambiguous kind of existence: on the one hand it appears as an objective reality, which exists independently of individual desires and beliefs, and indeed constrains human actions; on the other hand it appears to emerge out of human commitments and beliefs, as a convention or an ideology (shared, in particular, among legal officers).

Often there is only a very partial convergence in assessing legal meanings: while on some points (e.g., on the idea that a contract is an agreement) there may indeed be convergence among most or all of the involved agents, with regard to other issues disagreement is ubiquitous (rather than a shared ideology the law appears as being constituted by a set of different views, sometimes overlapping, sometimes diverging, of different individuals and groups). The mixture of convergence and divergence is particularly clear in judicial law-making and in legal doctrine, where judges or authors mention precedents with which they agree but also those with which they disagree. And disagreement increases when one moves out of the legal professions, considering a broader pragmatic context (Casanovas 2009). A specific difficulty in dealing with the law consists indeed in the different perspectives through which the law is approached by people vesting different roles: a judge looks at concepts in order to understand what is the content of the law with regard to the case he is deciding (and to achieve the outcome he sees more legally just or equitable); an attorney tries to see whether such concepts can be given a meaning that supports her client's case; a citizen would like to anticipate the understanding of the judge or of his counterpart (to anticipate possible disputes), a company working in information retrieval focuses on the meaning that its intended users are likely to give to the terms they use in their searches, etc. It has been argued that the uncertainty about the content of legal concepts is only apparent, since it can be overcome by considering that the law itself constitutes its concepts, through its definitions and rules. However it is easy to see that this consideration does not solve the problems of constructing a legal ontology: first of all the law explicitly constitutes only some of its concepts and only in part (relying for the rest in common-sense and the knowledge of legal experts). Secondly, one needs to interpret the legal rules characterising legal concepts to establish how they determine the content of the regulated concepts: one needs concepts for understanding such concept-regulating norms.

It seems to us that the multi-level complexity and diversity involved in legal ontologies supports the main idea of this volume: there is no single approach to address the development of legal ontologies, but rather we have a cluster of problems, perspectives, instruments, and goals that require a plurality of approaches, motivated on theoretical but also on pragmatic grounds. Exploring the diversity of these approaches and how they complement one-another with regard to modelling and problematising legal concepts is indeed one of our fundamental objectives.

1.2 New Directions in Semantic Web Research: Rethinking Ontologies

The development of legal ontology engineering is not driven only by the curiosity of researchers, eager to use new tools to address the eternal problems of legal theory and legal practice. On the contrary, research on legal ontology engineering is mainly driven by the need to develop new computer applications, to better meet the demands of practitioners and citizens, in a framework characterised by an accelerated technological development. In the light of new trends in the broader landscape of semantic-web research the role and the utility of legal ontologies has indeed to be rethought. Research on the engineering of legal ontologies should in particular consider the recent developments questioning the need for a highly axiomatised and unified knowledge representation, and focusing instead on intelligence viewed as the ability to cope with heterogeneous and disperse data, based on different ontologies (Motta and Sabou 2006: 25; Fensel 2008: 3; d'Aquin et al. 2008: 22). This may lead to a new way of designing legal ontologies and of embedding them into architectures for legal information systems and other web services.

At present, more than sixty legal ontologies have been completed. The recent doctoral dissertations of Núria Casellas and Rinke Hoekstra focused on the field of legal knowledge representation and ontology building. More academic dissertations are under way, and several legal ontologies have been set within national and international EU Programs¹ (VI and VII Frameworks). Table 1.1 below reproduces the updating of thirty-three of them by Breuker et al. (2009: 12–14), based on the original André Valente's table (2005: 72).

This table certainly shows the strength and dynamicity of the domain. However, few of these ontologies have gone beyond the stage of advanced and refined prototypes, even scalable and ready for reusing. This is coherent with the industrial surveys on the Semantic Web (Cardoso et al. 2007) in which legal applications are almost invisible. Perhaps LKIF-core and the wide use of upper-top ontologies like DOLCE+ and SUMO in the legal domain are partial exceptions. We believe that this is going to change in the next future, but very likely, to be extensively applied, legal ontologies will have to be combined with other related techniques.

To develop ontologies into the next stage of the web, we have recently identified six challenges coming from the new generation of Semantic Web developers (Casanovas et al. 2010: 5–7): (i) the relationship between the Social Web (Web 2.0) and the Web of Data (Web 3.0); (ii) the construction of evolving and contextual legal ontologies (and their relationship with folksonomies); (iii) the construction of Semantic Legal Web Services (SLWS); (iv) bridging the gap between ITC law and ITC for lawyers; (v) grasping the changing and evolving nature of regulations through the convergence between Web 2.0 and Web 3.0; (vi) adding reasoning and applying dialectic systems to facilitate users' exchanges and legal operations through the web.

¹See a summary of ALIS, ARGUGRID, ASPIC, BEST, DALOS, ESTRELLA, OPENKNOWLEDGE.META-SEARCH, SEAL and SEKT, in Sartor et al. (2008: 8–16).

Table 1.1 Extension of André Valente's table of legal ontologies (Breuket et al. 2009)

Ontology or project	Application	Type	Role	Character	Const- ruction	Language
McCarty's language of legal discourse	General language for expressing legal knowledge	Knowledge representation, highly structured	Understand a domain	General	Manual	English
Valente and Breuker's functional ontology of law	General architecture for legal problem solving	Ontolingua, highly structured	Understand a domain, reasoning and problem solving	General	Manual	English
Van Kralingen and Visser's frame ontology	General language for expressing legal knowledge, legal KBSS	Knowledge representation, moderately structured (also as a knowledge base in Ontolingua)	Understand a domain	General	Manual	English
Mommer's knowledge-based model of law	General language for expressing legal knowledge	Knowledge base in English very highly structured	Understand a domain	General	Manual	English
Breuker and Hoekstra's LRI-core ontology	Support knowledge acquisition for legal domain ontologies	Knowledge base in DAML+OIL/RDF using Protégé (converted into OWL)	Understand a domain	General	Manual	English
Hoekstra and Breuker's LKIF-core ontology	Support knowledge acquisition for legal domain ontologies	Knowledge base in OWL, highly structured	Understand a domain	General	Manual	English
Gangemi, Sagri and Tiscornia's JurWordNet	Extension to the legal domain of WordNet	Lexical knowledge base in DOLCE (DAML), lightly structured	Organize and structure information	General	Manual	Italian
Benjamins, Casanovas et al. Ontology of professional legal knowledge (OPLK)	Intelligent FAQ system (information retrieval) for judges (luriservice)	RDF: Knowledge base in Protégé, highly structured (converted in OWL)	Semantic indexing and search	Domain	Semi-automated	Spanish

Table 1.1 (continued)

Ontology or project	Application	Type	Role	Character	Construction	Language
Casellas et al. Ontology of professional judicial knowledge (OPIK)	i-FAQ for judges (Juriservice, second version)	Last version in OWL. Knowledge base in Protégé, highly structured	Semantic indexing and search	Domain	Manual	Spanish
Lame's ontologies of French codes	Legal information retrieval	NLP oriented (lexical), knowledge base, lexical, lightly structured	Semantic indexing and search	Domain	Automated	French
Leary, Vanderveghe and Zeleznikow's financial fraud ontology	Ontology for representing financial fraud cases	Knowledge base (schema) in UML, lightly structured	Semantic indexing and search	Domain	Manual	English
Asaro et al. Italian crime ontology	Schema for representing crimes in Italian law	Knowledge base (schema) in UML, lightly structured	Organize and structure information	Domain	Manual	Italian
Boer, Hoekstra and Winkel's CLIME ontology	Legal advice system for maritime law	Knowledge base in Protégé and RDF, moderately structured	Reasoning and problem solving	Domain	Manual	English
Lehman, Breuker and Brouwer's legal causation ontology	Representation of causality in the legal domain	Knowledge base lightly structured	Understand a domain	Domain	Manual	English
Delgado et al. PROnto (Intellectual property rights ontology)	Integrating XML DTDs and schemas that define rights expression languages and rights data dictionaries	Knowledge base: first version in DAML+OIL (2001), current version OWL (2008)	Interoperability between digital rights management (DRM) systems	Domain	Manual	English

Table 1.1 (continued)

Ontology or project	Application	Type	Role	Character	Construction	Language
Teodoro, Binefa et al. e-Sentencias (Procedural ontology for multimedia in courts)	Ontology for representing procedural stages of Spanish civil hearings	RDF. Procedural knowledge within Spanish civil hearings (typology)	Diariation and content classification of the official video recordings (image and audio)	Domain	Manual	Spanish
J. Saias, P. Quaresma, Portuguese Attorney office ontology	Ontology to semantically enriching legal texts	OWL and logic programming (ISCO and EVOLP)	Organize and structure information	Domain	Automated	Portuguese
M. Klein, E. Uijtenbroek, A. Lodder, Laymen ontology	Ontology to represent laymen knowledge on liability cases	OWL and NLP. Knowledge base in laymen natural language	Understand a domain (tort law) and interoperability between NL and legal concepts	Domain	Semi- automated	Dutch
J. Breuker, A. Elhag's Crime.NL	Ontology of Dutch criminal law	OKBC	Main structure of (Dutch) criminal law; for comparing European CL	Domain/General	Manual	Dutch/ English
S Despres, S. Szulzman Micro-ontology	Ontology to represent concepts in European directives	OWL and NLP (TERMINAE method)	Understand a domain	Domain	Semi- automated	French/ English
UCC Ontology J. Shaheed, A. Yip, J. Cunningham	Ontology to represent top-level concepts (e.g. ownership)	NML top-level ontology based on NM	Organize and structure information	Domain (top-level)	Manual	English

Table 1.1 (continued)

Ontology or project	Application	Type	Role	Character	Construction	Language
E. Schweighofer, D. Liebwald's CLO (Comprehensive legal ontology)	Ontology for information management	Some frame representation		General	Manual with support of legal core ontolo- gies	English?
E. Melz and A. Valente's IRC ontology	Ontology of internal revenue code (USA)	OWL	Reasoning about tax cases	Domain	Manual	English

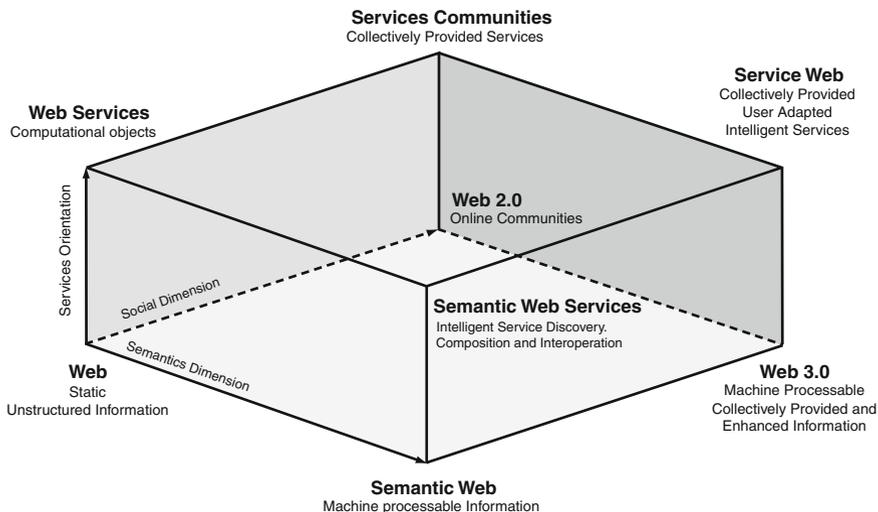


Fig. 1.1 Service web technological pillars. Source: Davies et al. (2009) (quoted with permission)

Especially point number three is interesting here. Web 3.0 is the product of the combination of semantic and social dimensions, and offering service communities is the product of the combination of semantic technology and web services. Figure 1.1 shows the vision of SWS, as recently plotted by SW developers (Davies et al. 2009). This would imply the transformation of Service-oriented Architectures (SOA) into an architecture comprised of billion of services, grounded into the worldwide sharing of content. Well, ontologies for IT law are playing a crucial role in this vision, because its technological features—reusability, autonomy, discoverability and composability—have to be mixed up with legal ontologies (on intellectual property principles, commerce, procedures, negotiation, mediation, security, contracting. . .) to be properly effective (ibid.). We think that the balance between services provided by humans and machines will be reached only if this new hybrid legal integration is provided.

1.3 Approaches to Legal Ontologies: Experience and Future Directions

Most of the chapters of this volume come from contributions to the workshop *Approaches to Legal Ontologies*, held in December 2008 at the European University Institute of Florence. The workshop gathered several research groups with experience in legal ontologies with the aim of setting up a space for presenting findings, sharing methodological concerns and exchanging ideas about the future of the field. The event was an occasion for bringing together different competences and backgrounds which play a role in legal ontology development. Thus the contributions collected in this book are a faithful representation of the diverse concerns that have

driven research on legal-ontology building in recent years. They address the connection between legal-ontology engineering and a diverse set of other disciplines: legal theory, legal sociology, legal pragmatics, comparative law, complex systems theory, computational linguistics, cognitive science, multimedia and other technologies. In the following a brief sketch of the different contributions is presented.

In [Chapter 2](#) Fernández-Barrera and Sartor analyse the value of legal doctrine and legal theory as an intellectual capital for ontology building. After acknowledging the fact that legal theory and legal doctrine represent just a part of legal knowledge, they proceed to analyse the characteristics of conceptual systems created and used by these disciplines. Some preliminary observations are made with regard to the utility of defining conceptual structures for legal contents despite the traditional criticisms based on contextual dependence and open-texture of legal concepts. Then, on the basis of an analysis of the historical works of several scholars different types of legal conceptual systems are identified, ranging from domain-specific to core conceptual structures, and from classical hierarchical organisations of concepts to more complex frame-based structures. The authors conclude that an important conceptual elaboration exists in doctrinal works which could be translated into formal ontological structures. However, due to the informal character of those conceptual systems, they should be carefully studied, problematised and specified before proceeding to their formalisation.

In [Chapter 3](#) Casanovas, Casellas and Vallbé present a methodology for tackling the knowledge-acquisition bottleneck in legal ontology engineering. The *socio-legal* approach proposed by them is based on an empirical approach to data gathering which involves different actors such as legal professionals, legal theorists, socio-legal researchers and engineers. The focus on contextually situated legal knowledge reveals an underlying theory based on legal pluralism and pragmatism which questions the completeness of traditional doctrinal approaches to the law. The approach is illustrated through the description of the design of the Iuriservice system and the construction of the OPJK ontology. The system was aimed at providing Spanish judges in their first appointment with semantically-enhanced access to a repository of practical questions with their answers.

In [Chapter 4](#) Joost Breuker and Rinke Hoekstra anchor the origins of ontology engineering in five disciplines which present different perspectives on the content and the use of ontologies: philosophical Ontology, information science, Artificial Intelligence, Knowledge Engineering, and Information Management. Different applications of ontologies and corresponding formalisms are envisaged by each one of those disciplines. However sometimes the chosen representation formalism is not suitable for the intended application and the authors adduce that this is due to an imprecise distinction between knowledge and semantics. Whereas the former refers to what people know about a term in general, the latter refers to the meaning a term acquires in a particular context. According to the authors, for understanding how terms acquire different meanings (which postulate different ontologies), we need to refer to cognitive science, i.e., to the basic architecture through which humans conceptualise the world according to their basic concerns. Cognitive science can

provide the foundation for the most abstract ontological concepts. Thus a common-sense and cognitive-science based core ontology is needed for the legal domain such as the LKIF-Core.

In [Chapter 5](#) Maurizio Ferraris presents a theoretical reflection on the nature of social objects which he conceives to be grounded on a theory of documents. The author starts by assuming that the existence of social objects is located in between physical objects and ideal objects. On the one hand, social objects do not fulfil the requirements for a mere physical existence, since they depend on men thinking about them. On the other hand, social objects, unlike ideal ones, occupy a portion of space and time. Thus Ferraris identifies two essential characteristics of social objects: firstly, their dependence on the existence on human minds; secondly, their dependence on their embedding in text. In this sense, the main conclusion is that social objects are *inscribed acts*

In [Chapter 6](#) Ashley considers the components that an ontology for case-based reasoning systems should have and presents the state-of-the-art of ontologies in such domain. More concretely, the paper identifies three main tasks case-based reasoning ontologies should support: case-based comparisons; distinction between deep and shallow analogies; proposal and test of hypothesis. The extent to which current ontologies can fulfil those tasks is assessed on the basis of an example consisting on a legal classroom discussion that an imagined case-based reasoning system should be able to simulate with the aid of the adequate ontology. The paper concludes that the first task can be already addressed by current state-of-the-art technologies. However further research is needed for meeting the requirements of the other two tasks and in this line the paper contributes to the definition of future research efforts.

In [Chapter 7](#) Mazzega, Bourcier, Bourguine, Nadah and Boulet introduce an innovative approach to legal ontologies inspired on complex systems theory. Their analysis starts from the observation that current legal ontologies are constrained by tree-like structures and thus offer a limited representation of the complexity present in any legal system. In this line, the paper presents a method for enriching a conventional ontological structure with further links between concepts independently of their a priori relations. This further links are based on the mutual information shared by the terms in the corpus, which is measured by information functions, having previously mapped the ontology to the corpus through a probabilistic measure of term occurrence. Furthermore, the analysis can be tailored to different scales, since these probabilistic measures can be applied to different levels of depth (from articles to the whole code or to the whole legal system).

In [Chapter 8](#) Boella and Rossi analyse in detail the crucial role of legal ontologies for ensuring the interoperability of contents stored in different knowledge bases. The authors propose a procedural model based on the multi-level structure of legal information. A modular model of legal knowledge is thus proposed, which relies on the following layers: lightweight ontologies at the first layer, service ontologies at the second layer, an intermediate layer converting service concepts into domain concepts, and finally the fourth layer constituted by the core ontology. The model is illustrated through the research undertaken in the framework of the ICT4LAW

project. Ontologies play a pivotal role in the project, since they enable the mapping between norms and the organisation's internal processes and regulations.

In [Chapter 9](#) Biasiotti and Tiscornia approach the linguistic dimension of legal ontologies and its interaction with formal models of legal concepts. The authors put a strong emphasis on the importance of textual sources of the law, which determines the relevance of bottom-up approaches for legal ontology engineering. Ontology learning techniques are considered to be the most effective approach for bridging the gap between dogmatic conceptual constructions and lexical structures in legal sources. Besides the distinction between lexical meaning and conceptual meaning the authors address the challenge of embedding both meanings into modular architectures for legal knowledge representation.

In [Chapter 10](#) Palmirani, Cervone and Vitali propose the enrichment of the CEN Metalex standard with LIDO (Legal Information Document Ontology), a legal-document ontology that enables the description of the legal meaning of textual components. This research is meant to bridge the gap between the mere representation of structural elements of legal text and the representation of their legal meaning. In particular, the LIDO ontology, based on the FRBR ontology, contains the following categories: legal actions affecting the document; legal temporal events; structure of the legal resource; semantic structure of the legal document.

In [Chapter 11](#) Sancho Ferrer, Fernández Hernández and Mateo Rivero discuss the role of ontologies in search technologies for legal databases. The authors highlight the current limitations of ontologies for managing large legal databases since search engines are still unable to exploit them completely. One crucial issue for improving searches is understanding how expert knowledge affects the formulation of search queries. In this sense the paper explores the search behaviour of legal experts and explains why the system performance when using ontologies is still not adequate. The development of a legal dictionary for semantic processing is presented as a possible solution and future research directions are proposed.

In [Chapter 12](#) Gangemi, Presutti and Blomqvist present two proposals for addressing design issues and supporting ontology engineering tasks: Ontology Design Patterns (ODPs) and the eXtreme ontology Design methods. Relying on the idea of design patterns originally developed in the domain of software engineering, ODPs provide solutions for types of problems that are frequently present in ontology design. The paper concentrates on CPs (content patterns), which are small ontologies to be used as basic building blocks in ontology engineering. The eXtreme ontology Design, a set of tools and methods that builds on ODPs for ontology development, is presented and applied in building an ontology for abusive discharges.

In [Chapter 13](#) Francesconi presents a machine learning approach to extracting legal rules from legislative texts for the support of legal ontology building, on the basis of a semantic model of legislation. The semantic model distinguishes Domain Independent Legal Knowledge (which provides a classification of legal rules) and Domain Knowledge (which presents a description on the entities of a particular domain and the relations holding among them). A double methodology is implemented for knowledge extraction, both top-down, illustrated by the definition of

a semantic model of legal rules, and bottom–up, consisting in the identification of rules instances in text. The goal of the paper is to strike a balance between consensus among legal knowledge engineers and authoritativeness in systems structured around legal rules by reducing human intervention in rule description.

In [Chapter 14](#) Ferrario, Guarino and Fernández-Barrera reflect on the value of formal ontology for service science and more concretely, for the clear understanding of the legal implications in service-oriented systems. This goal derives from the observation that current service science is lacking suitable semantic representations of business processes in a machine-processable way. In this line, the paper analyses the concept of *service* by using the analytical tools of formal ontology with a particular emphasis on the legal aspects of the notion. A *service* is understood as a complex event where different agents play different roles and assume different responsibilities, and is distinguished from a *good* in the sense that the former is not transferable while the latter, being an object, is.

In [Chapter 15](#) González-Conejero presents the potentialities of ontologies for managing, retrieving and searching multimedia legal files. Indeed, enhancing querying, management and storage capabilities of multimedia contents becomes a crucial issue in several institutional settings (for instance, in Spanish civil courts), when written files are substituted with electronic recordings. The MPEG-7 standard and multimedia ontologies are presented as possible solutions for managing multimedia contents even in the legal domain, provided that some particularities of the structure of judicial procedures are taken into account. The paper discusses the challenge of making explicit what is implicitly represented in images. It points to the role of pattern recognition and emotional speech analysis for tackling this challenge and bridging the semantic gap between concepts extracted from multimedia documents and their formalisation in an ontology.

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